A Review of UK Patent Activity for Genetic Resources and associated Traditional Knowledge

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Briefing Note

This report presents the results of research on UK patent activity involving genetic resources and associated traditional knowledge. The aim of the research was to assess the potential impacts of the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization* upon UK companies and research organisations who are active in the patent system. The Nagoya Protocol was adopted by the United Nations Convention on Biological Diversity in 2010 with the aim of realising the third objective of the Convention on the "fair and equitable sharing of the benefits arising out of the utilization of genetic resources."

The Nagoya Protocol was adopted in response to concerns expressed by biodiversity rich developing countries that valuable genetic resources and traditional knowledge are being appropriated for commercial gain without their knowledge, consent or a share of resulting benefits. The patent system is a central focus of these concerns and is associated with allegations of biopiracy or misappropriation of genetic resources and traditional knowledge. Because traditional knowledge of the uses of plants and other organisms is generally held by indigenous and local communities, patent activity also raises human rights and ethical concerns about the exploitation of vulnerable communities in developing countries. The Nagoya Protocol responds to these concerns by requiring users of genetic resources and traditional knowledge to:

- Secure prior informed consent from countries of origin to access genetic resources and prior informed consent of relevant indigenous and local communities for access to traditional knowledge associated with genetic resources;
- Establish benefit-sharing agreements on mutually agreed terms with countries of origin and relevant indigenous and local communities.

The Nagoya Protocol does not directly address intellectual property. However, the Protocol encourages increased transparency about the utilization of genetic resources and traditional knowledge as part of compliance measures. In parallel, debates on biopiracy or misappropriation are continuing at the World Intellectual Property Organization (WIPO) and under the Council of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Council). Debates at WIPO focus on a possible new instrument on genetic resources, traditional knowledge and traditional cultural expressions. A key focus of these debates is a requirement for patent applicants to clearly disclose the origin or source of genetic material and associated traditional knowledge.

The Nagoya Protocol and related debates at WIPO may have significant implications for UK applicants. We set out to answer four questions: 1) What are UK applicants actually doing with genetic resources and associated traditional knowledge in the patent system? 2) Where do the genetic resources and any associated traditional knowledge come from? 3) How important are UK patents involving genetic resources and associated traditional knowledge? 4) What steps might be considered to assist UK applicants with adjusting to the requirements of the Nagoya Protocol if it is ratified by the UK?

The research focused on international patent activity by UK applicants between 1976 and 2010. The focus on international activity captures the most important UK patents by focusing on inventions where protection is sought in multiple markets.

As a proxy for genetic resources we identified Latin species names in patent data and conducted additional work on traditional knowledge. We identified 13,874 species in 19,762 first filings of patent applications linked to 34,912 publications at the major offices and 260,349 follow on applications and grants in 91 countries. UK patent activity involving genetic resources and associated traditional knowledge constituted approximately 7% of total UK patent activity at the three main patent offices between 1976 and 2010. Between 2006 and 2010 activity levelled off at approximately 9% of overall UK activity at the major offices.

Viewed in terms of approximately 1.9 million taxonomically described species, UK activity is narrowly focused on approximately 0.7% of known species. UK activity by area of technology is concentrated on pharmaceuticals, biotechnology, and biocides and pesticides. Other areas of activity such as plant agriculture, cosmetics and foodstuffs appear lower in the rankings. Consistent with this profile, many species appear in UK patent activity because they are a target of a claimed invention (e.g. because they cause diseases or are a pest). We therefore set out to identify and review cases where a species is the source of, or material to, a claimed invention.

We approached this task by reviewing a total of 4,618 documents constituting 23% of UK first filings and 13% of publications at the major offices. We reviewed economically important UK patents involving species using citation counts and patent family size. We conducted detailed reviews of patent activity for species of relevance to India, Brazil and China and additional research on the potential origins of genetic resources in patents referencing 72 additional countries. Finally, we conducted exploratory thematic reviews of UK data on traditional knowledge, marine genetic resources and Antarctic species. The results are discussed in the report and compiled in Annex 1.

We find that patent documents are frequently unclear on the precise origin or source of genetic resources and associated traditional knowledge. However, a clear hierarchy emerges in references to sources consisting of: a) commercial suppliers; b) Type Culture Collections, public collections and databases, and; c) direct field collection of samples. A total of 227 examples are provided as supporting evidence in Annex 1 of the report. We found very limited evidence of direct field collection of samples. On the balance of the available evidence we conclude that the Nagoya Protocol will have limited direct impacts on patent activity by UK companies and research organisations. However, there will be exceptions for some companies and universities. The Nagoya Protocol will have indirect impacts on companies and research organisations seeking to operate in Contracting Parties to the Protocol in future.

We propose that UK organisations may wish to prepare for the Nagoya Protocol by reviewing existing patent portfolios and identifying appropriate adjustments to meet its principles. In planning future patent portfolios we propose that UK applicants and patent attorneys adjust their patent practices to comply with the Nagoya Protocol and relevant national legislation and consider constructive uses of existing options in the patent system to advance the purposes of the Protocol.

We provide a series of specific suggestions for consideration by the UK IPO including on disclosure of origin and the possibility of developing positive incentives to promote compliance with the Protocol by UK applicants. We propose that DEFRA considers using patent information as an engagement tool with UK companies and research organisations and uses increased transparency to promote research partnerships with other Contracting Parties to the Protocol.

1. Background & Options

This report examines international patent activity by UK applicants for genetic resources and traditional knowledge. The aim of the report is to assess the potential impacts of the 2010 Nagoya Protocol on UK companies and research organisations in the field of intellectual property.

The 2010 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) is a supplementary agreement to the 1992 United Nations Convention on Biological Diversity. The aim of the Nagoya Protocol is to implement the third objective of the Convention for the "fair and equitable sharing of the benefits arising out of the utilization of genetic resources...".

The Nagoya Protocol covers all genetic resources, with the exception of human genetic resources, and extends to the associated traditional knowledge of indigenous and local communities.[1] The Protocol will operate in a manner that is mutually supportive with other international instruments to which the UK is a Party such as the International Treaty on Plant Genetic Resources for Food and Agriculture under the Food and Agriculture Organization.[2]

The Nagoya Protocol addresses the terms of access to genetic resources and the terms of benefit-sharing arising from the utilization of genetic resources and traditional knowledge. Countries will be required to introduce national access and benefit-sharing legislation or regulations to implement and enable the Protocol. The main focus of the Nagoya Protocol is upon requirements to seek prior informed consent from competent national authorities prior to accessing genetic resources and to establish benefit-sharing agreements on mutually agreed terms.

Utilization of genetic resources under the Nagoya Protocol means "to conduct research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology...". As such, the Protocol does not apply to commodities in trade. Instead the Protocol focuses on the terms and conditions of access to genetic resources utilized in research and development for commercial or non-commercial purposes and benefit-sharing.

The main advantage of the Nagoya Protocol will be to improve legal certainty, clarity and transparency for countries, companies, researchers and indigenous and local communities involved in exchanges of genetic resources and associated traditional knowledge across frontiers. By clarifying the ground rules for these exchanges it is hoped that the Nagoya Protocol will establish a foundation for longer term partnerships and collaborations that will generate monetary and non-monetary benefits that can be directed to the conservation and sustainable use of biodiversity and internationally agreed development objectives such as the Millennium Development Goals. The UK has signalled that it intends to ratify the Nagoya Protocol. The Protocol will enter into force following ratification by 50 countries. At the time of writing 25 countries have ratified the Protocol and 92 countries have indicated their intention to ratify by signing the Protocol.[3]

Patent activity is a primary indicator of investments in research and development directed to the creation of new and useful commercial products. During the negotiation of the Nagoya Protocol developing countries expressed concerns that potentially valuable genetic resources and traditional knowledge were being taken from their countries without

their knowledge or consent and subjected to patent protection en route to the creation of new and useful products that generated financial benefits for patent holders. This is commonly described as biopiracy or the misappropriation of genetic resources and traditional knowledge. Developing countries argued that these practices violated the principle of state sovereignty over genetic resources under Article 15.1 of the Convention and the principle of benefit-sharing established in the third objective of the Convention.[4]

The Nagoya Protocol will require UK companies and research organisations who utilize genetic resources and traditional knowledge in research and development to obtain prior informed consent and establish benefit sharing agreements with the Contracting Party from whom the resources and associated traditional knowledge are obtained. The terms of national legislation and regulations to enable the Nagoya Protocol and access and benefit-sharing agreements are likely to address intellectual property issues. UK companies and research organisations will therefore need to adapt to these new rules.

Intellectual property issues are also being discussed in two international arenas. The Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore at the World Intellectual Property Organization (WIPO) is negotiating a draft treaty on genetic resources, traditional knowledge and folklore. A major focus of debate in these negotiations is the idea that patent applicants should disclose the origin or source of the genetic resources and traditional knowledge in patent applications. Proposals in this area range from voluntary disclosure of origin to mandatory disclosure with consequences ranging from no action to revocation of patent rights and other penalties. The European Union has accepted the principle of disclosure of origin but with limitations on its effects in the patent system.[5]

The second area of debate focuses on the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) under the World Trade Organization. This agreement expanded the availability of patent protection to all areas of innovation with limited exceptions in relation to *ordre public*, morality, health and the environment. The TRIPS agreement introduced minimum standards for intellectual property among member states of the WTO. The TRIPS Agreement is monitored by the Council on Trade-Related Aspects of Intellectual Property Rights (TRIPS Council). Developing countries have proposed a number of amendments to the TRIPS Agreement with the aim of "establishing a mutually supportive relationship" with the Convention on Biological Diversity.[6] The most recent of these proposals in 2011 include requirements for disclosure of the country of origin of genetic resources and/or associated traditional knowledge and the source of the genetic resources and traditional knowledge within that country. Furthermore, developing countries propose that applicants provide a copy of an Internationally Recognized Certificate of Compliance (IRCC) for the materials as envisaged in the Nagoya Protocol. In the absence of compliance with disclosure requirements the proposals advance a range of sanctions up to and including revocation of patent rights.[7] No progress has been reported at the TRIPS Council on these proposals at the time of writing.

A number of countries have adopted disclosure of origin or source requirements into their national legislation. These countries include Brazil, India, China and South Africa among others along with a smaller number of developed countries including Switzerland and Norway. These measures are confined to national legislation and are presented as supporting the implementation of the Convention on Biological Diversity and its Nagoya Protocol.[8] In our view, this is a growing trend and implies that UK companies and research organisations will increasingly encounter disclosure of origin requirements in important emerging markets.

For the UK one of the major uncertainties involved in these developments and ongoing debates are their impacts on UK companies and research organisations. The requirements of the Nagoya Protocol for prior informed consent and access and benefit-sharing agreements will take time to be established and require adjustments by UK companies and research organisations including identifying appropriate benefit-sharing options.[9] The key concerns on disclosure of origin or source in patent applications are: a) the exposure of companies and research organisations to claims to monetary benefit-sharing, and; b) potential sanctions and revocation of patent rights. Projected to the UK as a whole, this would involve rent transfers arising from UK investments in research and development to third countries that are the sources of genetic resources and/or associated traditional knowledge. Levels of UK exposure to such rent transfers are presently unknown.

Balanced against potential exposure to rent transfers are the potential medium to long terms benefits that could accrue to the UK from full participation in the Nagoya Protocol and adjustments to the patent system to promote greater transparency in the utilization of genetic resources and traditional knowledge. These benefits could be expressed in terms of partnerships in research and development with third countries that are also important markets for the UK (i.e. India, China, Brazil and South Africa among others). Furthermore the UK could also more easily advance common objectives with respect to biodiversity conservation and development goals in collaboration with partner countries.

It is important to recognise that it is not possible to fully estimate the potential costs of these developments to the UK i.e. potential costs from rent transfers. In the case of the patent system the reason for this is that it is not presently possible to link patent activity with economic data on licensing and the value of patent protected products. What it is possible to do is to examine existing UK patent activity for genetic resources and associated traditional knowledge to assess the implications of patent activity involving genetic resources for the UK. On this basis it is possible to identify potential steps to adapt to the provisions of the Nagoya Protocol and address proposals for adjustments in the intellectual property system.

There are three main challenges involved in identifying the implications of the Nagoya Protocol for patent activity from the UK. The first is identifying genetic resources and associated traditional knowledge. The second is limiting the analysis to patent activity for UK applicants. The third challenge is identifying disclosures of the origin or sources of genetic resources in UK patent documents. The first challenge was addressed using Latin species names as a proxy for genetic resources. We searched 11 million patent documents for Latin species names using species names from the Global Names Index.[10] The searches covered patent documents published between 1976 and 2010 at the European Patent Office, the United States Patent and Trademark Office and the international Patent Cooperation Treaty. The second challenge was addressed by limiting the data to UK patent applicants and UK inventors. The third challenge was addressed by searching UK patent documents for species known to occur in other countries of interest and interrogating the documents for references to those countries or species believed only to exist in those countries. These documents were then targeted for manual review. We illustrate this approach in the sections of the report on India, Brazil, and China and in Annex 1 for a selection of countries.

This report reveals that genetic resources are an important subset of UK patent activity. UK patent activity involving genetic resources and associated traditional knowledge represented approximately 7% of all UK patent activity at the three main offices between 1976 and 2010 rising to 9% between 2006 and 2010. Following the exclusion of common

model organisms, we identified 13,874 species in 19,762 first filings of patent applications linked to 34,912 publications in the three major patent offices and 260,349 follow on applications and grants in 91 countries around the world. Patent activity by UK applicants ranges from pharmaceuticals, biotechnology, personal care products, agriculture, biocides and pesticides, to emerging fields such as bionanotechnology and synthetic biology.

We reviewed a total of 4,618 patent documents constituting 23% of UK first filings and 13% of publications at the major offices. We reviewed economically important UK patents involving species using citation counts and patent family size. We conducted detailed reviews of patent activity for species of relevance to India, Brazil and China and additional research on the potential origins of genetic resources in patents referencing 72 additional countries. Finally, we conducted exploratory thematic reviews of UK data on traditional knowledge, marine genetic resources and Antarctic species. The results are discussed in the report and compiled in Annex 1.

We found that patent documents are frequently unclear in disclosing the precise origin or source of genetic resources and associated traditional knowledge. However, a clear hierarchy emerged in references to actual sources of material in the UK documents that we reviewed. These sources, in order of importance, are dominated by references to: a) commercial suppliers; b) Type Culture Collections, public collections and databases, and; c) direct field collection of samples. We found very little evidence of direct field collection of samples by UK companies and organisations. We therefore conclude that:

> *On balance, the provisions of the Nagoya Protocol will have a limited direct impact on patent activity by UK companies and research organisations. However, there will be important exceptions. The Nagoya Protocol will also have indirect impacts on companies and research organisations operating in Contracting Parties to the Protocol.*

Adjustments will be needed to patent practices by UK applicants to meet the requirements of the Nagoya Protocol. UK companies and research organisations should take active measures to prepare for entry into force of the Nagoya Protocol and identify opportunities to strengthen UK research and development through partnerships with Contracting Parties to the Protocol.

We suggest that the emphasis should shift from a defensive approach to the Nagoya Protocol to an active role in shaping implementation and pursuing opportunities for partnerships in research and development with other Contracting Parties to the Nagoya Protocol. This will involve significant challenges and unforeseen difficulties for UK organisations. To address these challenges, we suggest that guidance and support should be provided to UK organisations to successfully adjust to the requirements of the Nagoya Protocol. This guidance should provide a platform for the identification of best practice to inform engagement between UK organisations and potential partners in other countries under the Nagoya Protocol.

The report provides a series of options on steps that could be considered by UK government agencies and UK companies and research organisations in preparing for ratification and implementation of the Nagoya Protocol. We approach these issues from the bottom up by focusing on UK companies and research organisations first. Given the diversity of organisations and range of sectors involved in patent activity the emphasis in these suggestions is placed on identifying practical measures that UK organisations and

government agencies may wish to pursue in preparing for and implementing the Nagoya Protocol.

The key suggestions arising in this report are directed to four audiences: UK companies and research organisations; patent attorneys; and government agencies responsible for intellectual property, biodiversity and trade. We address each of these in turn.

UK Companies and Research Organisations:

UK companies and research organisations could prepare for the ratification of the Nagoya Protocol in a two stage process involving existing patent portfolios and future portfolios.

Existing Portfolios:

The provisions of the Nagoya Protocol will only apply to genetic resources and traditional knowledge obtained after the entry into force of the Protocol. However, companies and research organisations could prepare for the Protocol through a series of measures.

1. Reviewing existing patent portfolios for patents involving genetic resources and/or traditional knowledge and identifying the returns generated to the company or research organisation.
2. Assessing whether existing portfolios have any negative consequences for the conservation and sustainable use of biodiversity or for indigenous and local communities. Examples of negative consequences could include the use of endangered or threatened species in products linked to patent activity.
3. Assess patent activity in the *supply chain* for negative consequences for conservation and sustainable use and respect for the principles of the Nagoya Protocol.
4. Identify options for adjusting patent practice to respect the principles of the Nagoya Protocol.
5. Identify appropriate measures to adjust existing portfolios to the principles of the Nagoya Protocol when it enters into force. There will be no legal obligation to comply with the Protocol prior to its entry into force. However, the aim of such measures would focus on signalling a willingness to respect the principles behind the Protocol. Examples of potential measures are included under Future Portfolios below.
6. Patent activity involving plant genetic resources for food and agriculture can involve plant germplasm from many different sources. The bilateral nature of the Nagoya Protocol could lead to significant complexity for applicants pursuing patent rights. Companies and research organisations in the agriculture sectors may wish to evaluate the benefits of increased use of the Standard Material Transfer Agreement (SMTA) under the International Treaty on Plant Genetic Resources for Food and Agriculture. Increased use of the SMTA in agriculture could simplify consent and benefit-sharing within this sector when compared with the bilateral nature of the Nagoya Protocol.
7. UK research organisations, notably universities, are the most likely UK legal entities to engage in direct collection and transfer of genetic resources and associated traditional knowledge. UK research organisations may need to adopt a number of measures to adapt to the Nagoya Protocol. These measures might involve:
   (a) Including questions on whether genetic resources or associated traditional knowledge will be collected and transferred to the UK into project approval checklists;
   (b) Establishing whether access and benefit-sharing legislation or regulations exist in the relevant country where collections are proposed;

(c) Taking steps to ensure that all requirements for prior informed consent and benefit-sharing agreements are met by researchers and the University;
(d) Ensuring that staff responsible for entering into legal agreements on behalf of the University, including Technology Transfer Offices, understand the nature of the obligations under Access and Benefit-Sharing Agreements and consider the options on intellectual property provided below;
(e) Ensuring that staff engaging in research with indigenous and local communities are aware of responsibilities towards indigenous and local communities and appropriate standards of ethical conduct in research with vulnerable populations.

8. In preparing for the ratification of the Nagoya Protocol organisations in specific sectors will benefit from a review of existing guidelines and tools addressing Access and Benefit-Sharing as provided through the Information Portal of the Nagoya Protocol.[11]

Future Portfolios:

UK organisations could adjust their patent practices to meet the expectations of the Nagoya Protocol. The objective of these measures is to make creative use of existing possibilities of intellectual property to promote active compliance and support for the principles of the Nagoya Protocol.[12]

1. Consider carefully whether patent protection is required, why it is being sought, and its implications for respecting the principles of the Nagoya Protocol;
2. Develop a clear and easily explained rationale for seeking patent protection involving genetic resources and associated traditional knowledge. Make this rationale public and be willing to respond to requests for information on the organisation's policy in this area.
3. Ensure that patent claims do not cover traditional uses of the material or unreasonably limit opportunities for product development by traditional users such as indigenous peoples and local communities in countries of origin;
4. Consider joint ownership of intellectual property of any foreground generated through an access and benefit-sharing agreement with the partners to the agreement.[13] This may also include royalty free licensing of any intellectual property generated during the partnership between partners to the agreement;
5. Consider accessible licensing, including royalty free licensing, of intellectual property to businesses in developing countries where a species and any associated traditional knowledge is known to originate;
6. Consider low cost licensing models similar to the Stanford University Licensing Program for Cohen-Boyer patents to promote wide dissemination and uptake of intellectual property;[14]
7. Consider the use of a UK Licence of Right under Section 46 of the 1977 UK Patent Act;[15]
8. Consider the use of the 2013 UK Patent Box relief on Corporation Tax for income derived from patents to contribute to benefit-sharing directed to conservation and sustainable use in developing countries;[16]
9. Identify appropriate partners for delivering benefits to promote conservation and sustainable use in developing countries including appropriate monitoring and reporting;
10. Contribute patents to patent pools in appropriate technology areas. An example of a patent pool is the World Intellectual Property Organization *WIPO Re:Search* initiative on *Sharing Innovation in the Fight Against Neglected Diseases* to which GlaxoSmithKline and the University of Dundee already contribute;
11. Where utilizing a genetic resources in a claimed composition, method or process conduct checks on the conservation status of the species in the country of origin and whether the species is CITES listed or appears on the IUCN Red List of species. Take

appropriate action to avoid negative environmental impacts upon species involved in the claimed invention and comply with international law on trade in endangered species;

Patent Attorneys:

Patent Attorneys and patent agents are responsible for drafting patent applications. Patent attorneys typically seek to maximise the scope of protection to serve their clients interests in a particular technology sector or market. Under the Nagoya Protocol this expansive approach may not serve a clients interests where they are seeking to build and maintain relationships with countries providing genetic resources that are also major markets for end products (i.e. Brazil, India, China). Patent drafting strategies should also consider the wider context of a client's business and objectives.

In preparing patent applications involving genetic resources and traditional knowledge patent attorneys or agents should consider:

1. Clearly specifying the origin of genetic resources and associated traditional knowledge that form part of the subject matter of the claimed invention;[17]
2. Provide reference numbers for the relevant contract, permit and/or international certificate of compliance from a competent national authority and, where relevant, a reference to prior informed consent and a benefit-sharing agreement with indigenous and local communities;[18]
3. Consider including the information in 1 & 2 in a Declaration or Statement on Access and Benefit Sharing at the opening of the description using the model provided by the United States Bayh-Dole Act for the Federally Sponsored Research.[19] Draft proposals for a Regulation on access and benefit-sharing in the European Union suggest that patent applicants may be required to submit a declaration to competent authorities.[20] Transparency would be improved by including details of any such declaration in the description section of relevant patent applications;
4. Refrain from incorporating large numbers of species, genera or families of organisms that potentially contain claimed components into the scope of patent claims through references in the description;
5. Refrain from constructing patent claims to compounds, extracts or other components by listing all members of a genus, the genus itself, multiple genera or families of organisms;
6. Refrain from claiming similar DNA or amino acid sequences based purely on percentages of sequence identity to the reference sequence;
7. Limit the scope of patent claims to products, methods or processes utilizing genetic resources that are directed to markets;
8. Avoid constructing patent claims in a way that seeks to capture *any* potential use of claimed materials and thus giving the impression that the application seeks to restrict traditional uses or future research and development.

UK Intellectual Property Office:

Article 17.1 of the Nagoya Protocol calls upon Contracting Parties to take measures, as appropriate, to support compliance to "monitor and enhance transparency about the utilization of genetic resources". In considering the transparency of existing UK patent activity we make the following observations:

1. A species may appear in a patent document for a range of reasons i.e. because it is either the source of an invention or the target of an invention;
2. UK patent documents that make reference to a species or genetic resource normally make reference to other organisms. This can make it difficult to determine whether a species is material to the subject matter of the claimed invention, or put another way, that the invention depends on the genetic resource;
3. In the absence of enhanced disclosure of genetic resources material to the invention it can be difficult to determine the source or origin of the genetic resource and any associated traditional knowledge;
4. The appearance of a species in the title, abstract or claims of a patent records provides a decent guide to species that are a focus of the invention. However, this approach will not readily capture cases where patent claims focus purely on chemical compounds from a species;
5. Patent applicants may make reference to large numbers of species, genera or families of organism in the description or claims. In some cases the aim of these references is to *incorporate* a claimed component from *any* of the listed species, genera or families into the scope of the patent claims. However, no evidence is presented for the collection of these organisms or experimentation to establish that claimed components may exist in the organism. We call this *essential incorporation*. We believe that this practice is detrimental to the purposes and quality of the patent system and detrimental to the purposes of the Nagoya Protocol. We suggest further research on this issue and possible action to limit the practice of essential incorporation in patent applications;
6. With respect to debates on disclosure of origin in patent applications:

    (a) In the absence of disclosure of the country or origin or source of resources material to the invention it is not possible to gain a *fully transparent* view of levels of access to genetic resources and associated traditional knowledge in patent documents. This could generate uncertainty and mistrust among Contracting Parties to the Nagoya Protocol;
    (b) Users of the patent system are likely to fear the consequences of disclosure *vis a vis* demands for benefit-sharing or revocation of rights, in the absence of clear and unambiguous rules;
    (c) The international patent landscape for disclosure of origin is changing as a growing number of countries introduce unilateral requirements for disclosure of origin of genetic resources and associated traditional knowledge. UK companies and research organisations seeking to operate in these markets will inevitably be affected by these requirements;
    (d) Increasing unilateral adoption of disclosure requirements will have the cumulative effect of increasing transparency on disclosure of origin. The global nature of the patent information system means that this information will increasingly become available and opportunities to avoid disclosing the origins of material will decrease;
    (e) It is important that any rules on disclosure of origin focus on subject matter that is material to the claimed invention;

(f) Patent applicants frequently make reference to accessions from International Depositary Authorities under the Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure;

(g) The UK is home to seven International Depositary Authorities covering different types of microorganisms and other relevant materials. The depositary authorities cover nematode worms, fungi, yeasts bacteria, bacteriophages, algae, protozoa, animal cells lines, genetically modified cell lines, hybridiomas, and plant seed along with other materials;

(h) Patent disclosure under the terms of the Budapest Treaty appears to be uncontroversial. This could provide a possible model for enhanced disclosure of origin to improve transparency on the utilization of genetic resources in the patent system. Specifically, Budapest Treaty style disclosure could improve transparency with respect to the specification of the origin or source of genetic resources that are material to the claimed invention;

(i) Transparency on the utilization of genetic resources in patent applications in support of the Nagoya Protocol could be improved through the use of a *statement or declaration on access and benefit sharing* in the description section of patent applications. The statement or declaration could include basic information on access and benefit sharing modelled on the well established *Statement Regarding Federally Sponsored Research or Development* under the 1980 Bayh Dole Act in United States patent applications. This approach could potentially be harmonised with the proposed declaration of due diligence in European Union level proposals for a Regulation on Access to Genetic Resources and Benefit Sharing.

7. UK patent applicants could benefit from guidance on issues to be considered around the Nagoya Protocol when preparing the submission of patent applications. Patent Attorneys are a logical focus for the dissemination of guidance. However, UK companies and research organisations would benefit from guidance on issues to be considered and available options when considering applications for intellectual property rights;
8. With respect to compliance with the terms of the Nagoya Protocol we note that in the case of multinational companies it may be possible for a company to seek to circumvent the purposes of the Nagoya Protocol by filing in a non-Contracting Party through a non-UK registered subsidiary of the parent company. We assume that this behaviour should be discouraged in order to preserve the integrity of the Nagoya Protocol;
9. Cost effective long term monitoring of UK patent activity can be achieved by relying on patent information systems and indexing of patent documents for genetic resources. It remains important that any measures that are taken should not impose additional burdens on patent examiners. In practice, this could be achieved by combining taxonomic information and patent data to index patent documents and make the results available electronically;
10. The UK IPO could consider providing positive incentives for companies and research organisations to pursue partnerships on research and development involving genetic resources and associated traditional knowledge. Positive incentives could include a Patent Box style approach of tax reduction that encourages companies and research organisations to invest in pursuing partnerships. The Patent Box provides an example of creative use of flexibilities in the patent system that could be adapted and developed for the purposes of the Nagoya Protocol.

Department for Environment, Food and Rural Affairs:

The Department for Environment, Food and Rural Affairs is the lead UK agency for the Nagoya Protocol. The present research suggests that:

1. Patent data provides a valuable window into UK companies and organisations engaged in research and development utilizing genetic resources and associated traditional knowledge. We suggest that patent data on UK applicants could be used to develop an index of UK companies and research organisations involved in R&D on genetic resources and traditional knowledge. The index could then be used for a number of purposes:
    (a) As a tool for engaging with companies and research organisations active in research on genetic resources and associated traditional knowledge about the Nagoya Protocol. Specifically, the index can be used to target relevant organisations with information and form a basis for wider consultations with UK stakeholders;
    (b) As a medium to long term tool for promoting partnerships between UK companies and organisations and organisations in other Contracting Parties to the Nagoya Protocol;
    (c) In conjunction with the IPO the index could be used to target relevant UK companies and research organisations with relevant guidance on intellectual property issues and news on developments in this field under WIPO and related policy arenas.
2. It is important to recognise that UK companies may change ownership over time, merge with other companies or demerger. In addition, patent portfolios may be licensed or sold to third parties. This will raise issues about compliance with access and benefit-sharing agreements over time and will also raise challenges for the purposes of monitoring. These issues could be addressed through the use of public or commercial services that regularly track changes in ownership. Within the patent system changes of ownership (reassignments) of intellectual property are recorded in legal status data. However, this data can be difficult to access;
3. Patent data provides valuable information on partnerships involving research and development on genetic resources and traditional knowledge between likely Contracting Parties to the Nagoya Protocol. We identified partnerships with India, China, South Africa, Brazil and a range of other countries. This information could potentially form a basis for reviewing existing lessons learned from such arrangements, adjustments that may be needed to implement the Nagoya Protocol, and best practice;
4. The need for sectoral approaches to the Nagoya Protocol that recognise the specific circumstances of particular sectors has been raised at various times. In the case of patent activity the only sector that stands out as distinctive is new varieties of plants for food and agriculture that involve germplasm from multiple sources. As discussed below, the Nagoya Protocol could create complications for applicants for patent rights in this field because of the diversity of sources of germplasm that inform a specific claimed invention. We therefore suggest that greater use of the Standard Material Transfer Agreement under the International Treaty on Plant Genetic Resources for Food and Agriculture may present a way forward in managing complexity for companies and research organisations in this sector;
5. International Depositary Authorities (IDAs) under the Budapest Treaty have an important potential role to play in implementation of the Nagoya Protocol as it links in with patent activity. Specifically, the UK IDAs cover a large spectrum of genetic resources that fall within the Nagoya Protocol. Patent applicants do not display any apparent difficulties in

recording Budapest Treaty style disclosures (i.e. ATCC accession number, country: India);

6. The Global Biodiversity Information Facility is the key international taxonomic resource for the identification of species in patent data. However, its role as a tool in monitoring access and benefit-sharing could be improved through a range of measures:
   (a) More targeted inclusion of species data that is known to possess some form of economic or human use;
   (b) Greater attention to improving data on species distribution across the database but with particular reference to developing countries;
   (c) Greater attention to clarifying whether a species is endemic to a given country. This is important because identifying relevant sources of authoritative information on endemism is extremely difficult when dealing with thousands of species;
   (d) Integration of information on the known conservation status of an organism within GBIF would be very valuable in assessing whether innovations that use a species are likely to raise conservation issues. The availability of the IUCN red list within GBIF data fields could address this issue;
   (e) Are species in GBIF listed as endangered by CITES? At present it is difficult, without resorting to the CITES annexes, to identify whether a species is covered by CITES;
   (f) Marine species are important to the UK and an important source of genetic resources for use in innovation. However, GBIF data is not presently integrated with marine species databases. It would be helpful if marine species could be identified in the GBIF index and appropriate links identified to data sources;
7. Whether the emphasis is placed on utilization of a genetic resource or access to a genetic resource is a key tension in interpreting the Nagoya Protocol and the practical significance of the Nagoya Protocol for UK companies and research organisations;
8. In seeking to develop relationships with partner countries in implementing the Nagoya Protocol it may be logical to focus on countries that already have access and benefit-sharing regulations in place and where there are strong research and development relationships. Unilever UK and Hindustan Unilever in India provide the most striking example of patent activity involving genetic resources and traditional knowledge and joint ownership of intellectual property. Additional examples could be found in South Africa;
9. Much of UK patent activity is directed towards pharmaceutical developments that target pathogens or other diseases. A significant, if presently unclear, proportion of this activity is directed to, or relevant to, neglected diseases in developing countries. In promoting partnerships with developing countries greater emphasis could perhaps be placed on partnerships that target development needs in developing countries in conjunction with conservation and sustainable use. UK companies may be willing to contribute wider intellectual assets to such endeavours as in the release of malaria data by GSK in 2010;[21]
10. The emphasis on due diligence, and subsequent guidance on due diligence, within EU level proposals for access and benefit-sharing could be expanded to encompass the framework for Human Rights Impact Assessments as advanced by the UN Special Representative for Human Rights and Business and endorsed by the Human Rights Council in resolution 17/4 on the 16 June 2011.[22] When combined with information on the 2007 United Nations Declaration on the Rights of Indigenous Peoples, this information could form a useful basis for practical measures by UK companies to address issues relating to indigenous and local communities;
11. As noted above, in the case of multinational companies it may be possible for a company to seek to circumvent the purposes of the Protocol by filing in a non-Contracting Party through a non-UK registered subsidiary of the parent company. We

assume that this behaviour should be discouraged in order to preserve the integrity of the Nagoya Protocol;

12. As noted above for the UK IPO, consideration could be given to developing positive incentives for companies and research organisations to pursue research and development partnerships under the Nagoya Protocol. Examples of positive incentives include the Patent Box scheme that reduces corporation tax on profits from patents.

Trade:

This report reveals that UK companies pursue intellectual property protection in 91 countries. The majority of this activity is directed towards major markets including the United States, Japan, other European countries, and Australia. However, China, South Africa, and Brazil followed by Mexico are becoming increasingly prominent in UK activity. In addition, while access to patent data in India is poor, there is clear evidence of collaboration between UK companies and companies in India.

As discussed above, the majority of emerging markets have adopted disclosure of origin requirements within their national legislation. This could have negative consequences for UK companies and research organisations where they do not comply with access and benefit sharing legislation. Details of any sanctions for failure to comply with access and benefit-sharing legislation require further investigation and monitoring.

Further Work:

The research in this report was jointly funded by the UK intellectual Property Office and the Department for Environment, Food and Rural Affairs. The following suggestions focus on potential future work.

1. A major outcome of the existing research is the realisation that patent data provides a window into companies and research organisations engaged in research and development on genetic resources and traditional knowledge. In our view this data could be further developed as a tool for engagement with UK companies and research organisations and, over the medium term, as a tool for promoting partnerships between the UK and other countries in implementing the Nagoya Protocol.
2. Methods for assessing the realised economic value of patents are limited. Furthermore, the link between patent protection and products that reach the market is often unclear. Advances in economic valuation could be made using a web spider to identify internet sites selling products that can be linked back to patent data or through text mining in databases of company reports etc. Experimental work in this area would provide a fuller picture of utilizations of genetic resources and traditional knowledge in and beyond the UK.
3. The present research makes use of and contributes to the Access and Benefit Sharing Patent Index (ABSPAT). ABSPAT was conceived as an independent and cost-effective tool for monitoring genetic resources and traditional knowledge within the patent system by exploiting the availability of electronic patent data and taxonomic data to index species appearing in patents. Large scale indexing of patent data is cost effective because the data is available free of charge or at cost price. In the context of ratification of the Nagoya Protocol a growing number of countries have become interested in empirical data on the presence of genetic resources and traditional knowledge in patent data (i.e. Australia and India). As such, ABSPAT could potentially be developed as a cost effective monitoring tool under the Nagoya Protocol. The benefit of this work to the UK would be to make a practical contribution to the development and implementation of

the Nagoya Protocol and enhance the UK's reputation for providing high quality independent information to service policy needs.

4. As noted above, plant genetic resources for food and agriculture represent a distinctive sector of activity in patent data. It is possible that similar issues may arise with animal genetic resources. The World Intellectual Property Organization and the Food and Agriculture Organization will be commissioning analysis of patent activity for animal genetic resources. The outcomes of this research could, as appropriate, inform development of further guidance and measures on sectoral approaches.
5. In the course of this research and wider research on genetic resources in the patent system we have become increasingly concerned about the problem of essential incorporation involving the use of long lists of species, genera or families of organism to capture potential components of organisms in patent claims. We propose that more research is warranted to quantify this problem as a basis for potential future measures.
6. Marine genetic resources beyond national jurisdiction are a focus of debate under the United Nations Convention on the Law of the Sea. Research on marine genetic resources conducted in the framework of the present research reveals that marine genetic resources frequently occur both inside and outside national jurisdictions. Further research in this area may be desirable.
7. Over the longer term a fuller set of methods is required to understand and promote appreciation of the role of biodiversity in innovation inside and outside the patent system. The economics of ecosystem services has contributed to advancing methods in this area on the ecosystem level. However, a fuller appreciation is required of the longer term realised values of biodiversity. Methodological development is required in this area along with partnerships with organisations such as Kew Gardens in their established work on economic botany.

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[1] Article 8(j) of the Convention states that: "(j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices;"

[2] See Article 4.3 and 4.4 of the Nagoya Protocol.

[3] Nagoya Protocol, Status on the 05/10/2013. http://www.cbd.int/abs/nagoya-protocol/signatories/default.shtml

[4] Article 5.1. of the Convention states that: "Recognizing the sovereign rights of States over their natural resources, the authority to determine access to genetic resources rests with the national governments and is subject to national legislation."

[5] See WIPO/GRTKF/IC/8/11

[6] TN/C/W/59 and see also TN/C/W/52.

[7] TN/C/W/59

[8] UNEP/CBD/COP/10/INF/44

[9] The Annex to the Nagoya Protocol lists a range of Monetary and Non-Monetary Benefits as a guide for benefit-sharing arrangements. http://www.cbd.int/abs/text/articles/default.shtml?sec=abs-37

[10] See the Methodology Section in the main report for full details on the methodology.

[11] http://www.cbd.int/abs/instruments/

[12] This section incorporates and expands on the 2010 Untion for Ethical Biotrade UEBT Principles on Patents and Biodiversity. POL14. http://www.ethicalbiotrade.org/dl/UEBT_principles_on_patents_biodiversity_EN.pdf

[13] In the negotitation of intellectual property agreements 'background' refers to intellectual assets and know how that a party brings to the agreement and over which they retain rights. 'Foreground' refers to intellectual assets or know how generated in the joint work of the parties to an agreement.

[14] See for example, Hughes, S. (2001) Making dollars out of DNA - The first major patent in biotechnology and the commercialization of molecular biology, 1974-1980. *ISIS* 92**,** 541-575.

[15] http://www.ipo.gov.uk/types/patent/p-manage/p-useenforce/p-licence/p-licence-right.htm

[16] For further details of the UK Patent Box see the UK IPO website at: http://www.ipo.gov.uk/types/patent/p-patentbox.htm

[17] Subject matter means genetic resources and/or associated traditional knowledge that are material to the claimed invention.

[18] Applicants should be prepared to provide evidence of prior informed consent and an access and benefit-sharing agreement to the Competent National Authority where the applicant holds legal personality.

[19] See the USPTO website at: http://www.uspto.gov/web/offices/pac/mpep/s310.html and http://www.uspto.gov/patents/resources/types/utility.jsp . See also UNEP/CBD/COP/10/INF/44.

[20] European Parliament document 2012/0278(COD).

[21] http://www.nature.com/news/2010/100120/full/news.2010.20.html

[22] A/HRC/17/31

2. Executive Summary

Introduction:

This report examines UK patent activity for genetic resources and traditional knowledge. The report focuses on patent activity involving genetic resources and associated traditional knowledge at the European Patent Office, the United States Patent and Trademark Office and the international Patent Cooperation Treaty for the period 1976-2010.

The report aims to inform debates on the UK ratification and implementation of the 2010 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization.

The Nagoya Protocol aims to implement the third objective of the Convention on Biological Diversity directed to the fair and equitable sharing of benefits arising from the utilization of genetic resources. The report is also relevant to debates on intellectual property and genetic resources at the World Intellectual Property Organization and in international debates on trade, notably at the Council on Trade-Related Aspects of Intellectual Property Rights (TRIPS Council) under the World Trade Organization.

The research had five main objectives:

1. To identify UK patent activity involving genetic resources and traditional knowledge in the global patent system;
2. To identify the geographical distribution of species appearing in UK patent activity;
3. To identify the specific origin of genetic resources and traditional knowledge in UK patent activity using Brazil and India as test cases;
4. To identify economically important patents;
5. To map global UK patent activity.

The report is directed to four main audiences and three areas of UK policy:

1. UK companies and research organisations;
2. Biodiversity;
3. Intellectual Property;
4. Trade.

Methodology

The research objectives were realised by combining large scale text mining of patent data with taxonomic data, manual review of patent data and the use of visualization tools (see Section 3 on Methodology). Latin species names were used as a proxy for identifying genetic resources and associated traditional knowledge in the patent system. Species names were drawn from the Global Names Index (GNI) established by the Global Biodiversity Information Facility (GBIF) and the Encyclopedia of Life (EOL). 11 million patent documents from the European Patent Office, the international Patent Cooperation Treaty and the United States Patent and Trademark Office for the period 1976-2010 were searched for 6 million species names from the Global Names Index. Additional research mapped species name abbreviations. Wherever possible the results were harmonized with accepted scientific names from GBIF. The results were then federated with the EPO World

Patent Statistical Database (PATSTAT, October 2011 edition). Data on the global geographical distribution of species was obtained from GBIF.

The combined results of these approaches forms an index of species that appear in patent data known as the *Access and Benefit-Sharing Patent Index* (ABSPAT). The index consists of 767,955 patent documents containing 76,274 full Latin species names from 23,882 genera. We used the ABSPAT index to identify patent activity originating from the UK.

UK patent data was defined as a patent document containing a UK applicant in the assignee (applicant) field. This was combined with data for UK inventors from the inventor field with the additional condition that the first filing of an application was recorded in the UK. This additional condition focuses on UK inventors who are resident in the UK. A full explanation of this approach is provided in Section 3. Because we focus on patent activity by UK applicants, we do not discuss patent activity entering the UK from third countries.

Data processing was conducted in Vantage Point software from Search Technology Inc. and visualized using Tableau. Whole patent texts containing references to India and Brazil were reviewed and tagged in MaxQDA qualitative data analysis software. Additional patent data and data fields were obtained using Thomson Innovation. Patent family and citation analysis is based on Thomson Innovation data. The research is limited to the major collections listed above and focuses on international patent activity by UK applicants.

Scope & Limitations

The research covers UK patent activity involving species in the period 1976-2010 at the European Patent Office, the Patent Cooperation Treaty and the United States Patent and Trademark Office. The research therefore focuses on international patent activity by UK patent applicants. In economic terms, international activity is the most important because it targets international markets by pursuing protection in multiple countries. Applicants must also pay fees to secure protection in multiple countries. This provides an indicator of the importance of inventions involving genetic resources and associated traditional knowledge to the applicants. The report does not consider purely domestic filings for patent protection in the UK.

The main assumption informing the research is that patent applicants will typically use Latin species names in submitting patent applications when claiming rights over a genetic resource. There are four main caveats for this approach.

First, taxonomic information is incomplete relative to global biodiversity. Approximately 1.9 million species have been taxonomically described with estimates of overall species numbers in the region of 8.7 million (± 1.3 million).[23] The present research used 6 million species names, including all known variants of species names, and mapped all known abbreviations of species names. However, it will only capture taxonomically recorded species names and common names in a restricted area of agriculture (see below).

Second, in the case of plant agriculture, research by the authors for the Food and Agriculture Organisation demonstrated that patent applicants use common names for major crop species (maize, wheat, rice etc.). In response, the underlying data for this report includes validated data on common names for major food crops and forages appearing in the title, abstract or claims of patent documents. Future work will address this

issue for animal breeds and animal genetic resources. Third, the taxonomic nomenclature for viruses is complex. We believe that viruses are likely to be under-represented in the data.

Four, references to species as the sources of compounds for use in pharmaceutical patents may progressively disappear from view when a compound is fully synthesised. The reason for this is that follow on applications will name the compound rather than the species. We found limited evidence for the loss of species names in the case of anti-cancer compounds from *Camptotheca acuminata* as the source of topotecan marketed as Hycamtin by GlaxoSmithKline (GSK). Nevertheless, it is sensible to assume that species names will progressively decline in use as applicants focus on modification of compounds and other components. In practice, the patent system provides a ready means of tracking linkages between documents using patent families and citations. In our view this will permit the identification of follow on innovations linked to a species over time. This approach is likely to prove time consuming in terms of long term monitoring and requires further testing.

The research is confined UK patent activity where there is an identifiable UK country code in the applicant or inventor field in patent documents at the three major offices. The standard country code for the UK in the patent system is GB (Great Britain).

Key findings:

An Overview of UK Activity:

In the period between 1976 and 2010 a total of 13,874 species were listed in 19,762 UK patent filings at the three major patent offices.[24] The modern patent system is global in scope and UK patent filings resulted in 260,349 follow on applications and grants in 91 countries around the world.

UK patent activity involving genetic resources and associated traditional knowledge represented approximately 7% of all UK patent documents at the three main offices between 1976-2010. UK activity involving genetic resources and associated traditional knowledge measured on publication counts displayed a rising trend across the period but levelled off at 9% of all UK activity between 2006 and 2010.[25] Figure 2.1 displays trends in overall UK activity at the major offices and trends involving genetic resources and associated traditional knowledge.

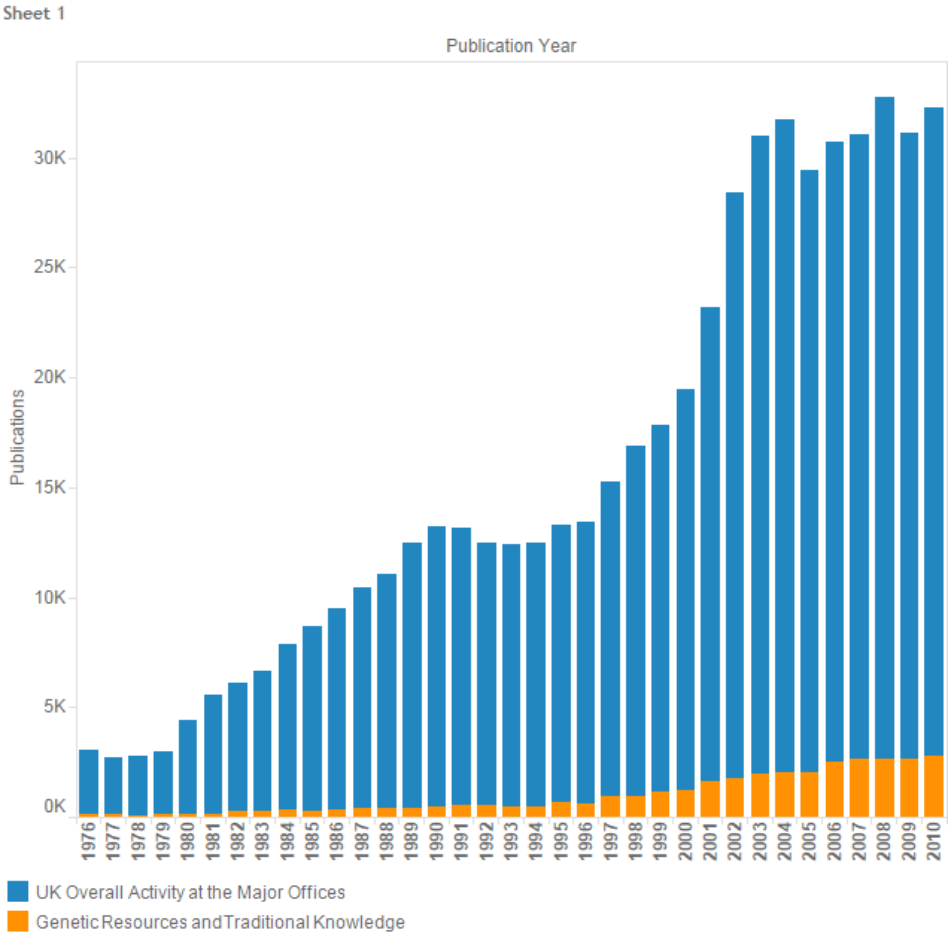


Figure 2.1: UK Patent Activity by Type

UK patent activity for genetic resources and associated traditional knowledge is dominated by Plants, Animals and Bacteria. Figure 2.2 displays a breakdown of UK activity by major kingdom.

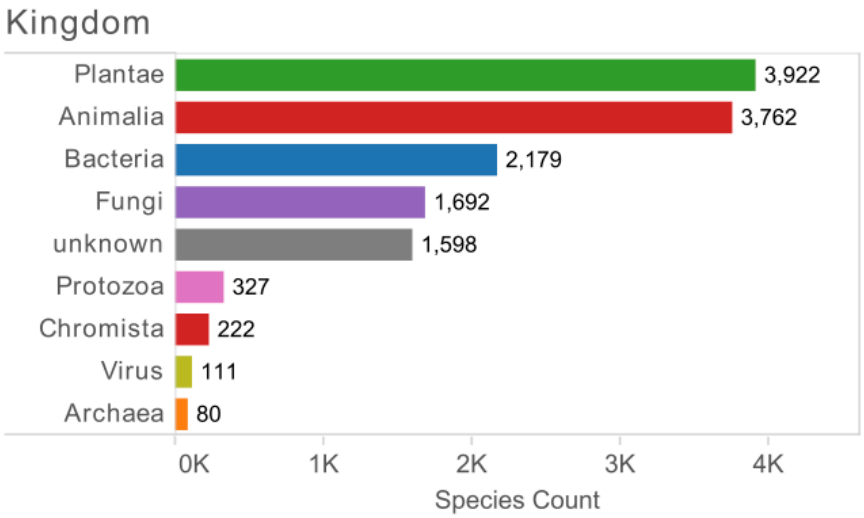


Figure 2.2: UK Patent Activity by Major Kingdom

It is important to place this data in perspective. As a proportion of the 76,274 species appearing in patent documents identified in the underlying Access and Benefit Sharing Patent Index informing this report, UK patent activity covers approximately 18% of species appearing in patent documents (see Methodology). Viewed in terms of approximately 1.9 million taxonomically described species UK patent documents cover just 0.7% of known species.[26] Assuming that there are 8.7 million species worldwide, UK patent activity covers just 0.15% of estimated global species.[27] This reflects the underlying reality that patent activity is narrowly focused on a small number of known species and less than 1% of predicted global species (assuming 8.7 million ± 1.3 million).[28] In considering the controversies that surround patent activity for genetic resources and traditional knowledge it is important to recognise that it would be in the longer term interest of society to find ways to open up biodiversity to research and development. The Nagoya Protocol could play an important role in this process if clarity and transparency is maintained on the wider context of research and development involving genetic resources and associated traditional knowledge. In this regard, transparency can remove uncertainties and form a foundation for building trust.

Consistent with these observations, UK patent activity is heavily concentrated in a small number of species that include model organisms such as *E. coli*, *Saccharomyces cerevisiae*, *Zea mays* (maize) and *Bacillus subtilis* among others. These model organisms are also frequently used as tools in biotechnology and appear in the top rankings for all countries. We therefore exclude them from the data. Figure 2.3 presents the top ranking species appearing in patent data ranked on numbers of publications.

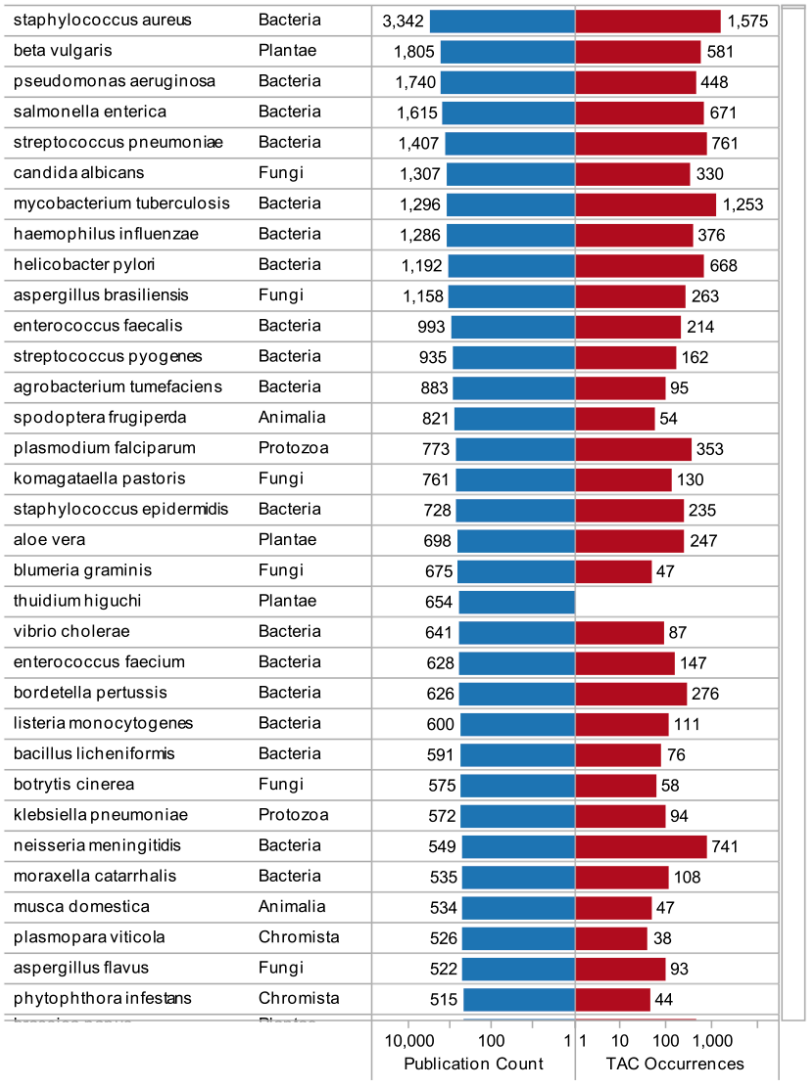


Figure 2.3: Top Ranking Species in UK Patent Activity

Figure 2.3 displays UK data in two ways. Counts of publications reveal the number of UK documents in the main patent offices that make reference to a particular species. The second column calculates the number of times that a species appears in the Title, Abstract or Claims section of the documents. This second measure focuses attention on documents that are fundamentally in some sense about the species. We can readily see that the top ranking species in UK documents are mainly pathogenic organisms led by *Staphylococcus aureus* as a causative agent of MRSA hospital borne infections and *Pseudomonas aeruginosa*, a bacteria that is also associated with hospital borne infections. This data demonstrates that on both measures UK patent activity is dominated by a small number of species.

This pattern is also reflected in the top technology areas for UK patent activity involving genetic resources and associated traditional knowledge. Figure 2.4 shows a breakdown of the top technology areas.

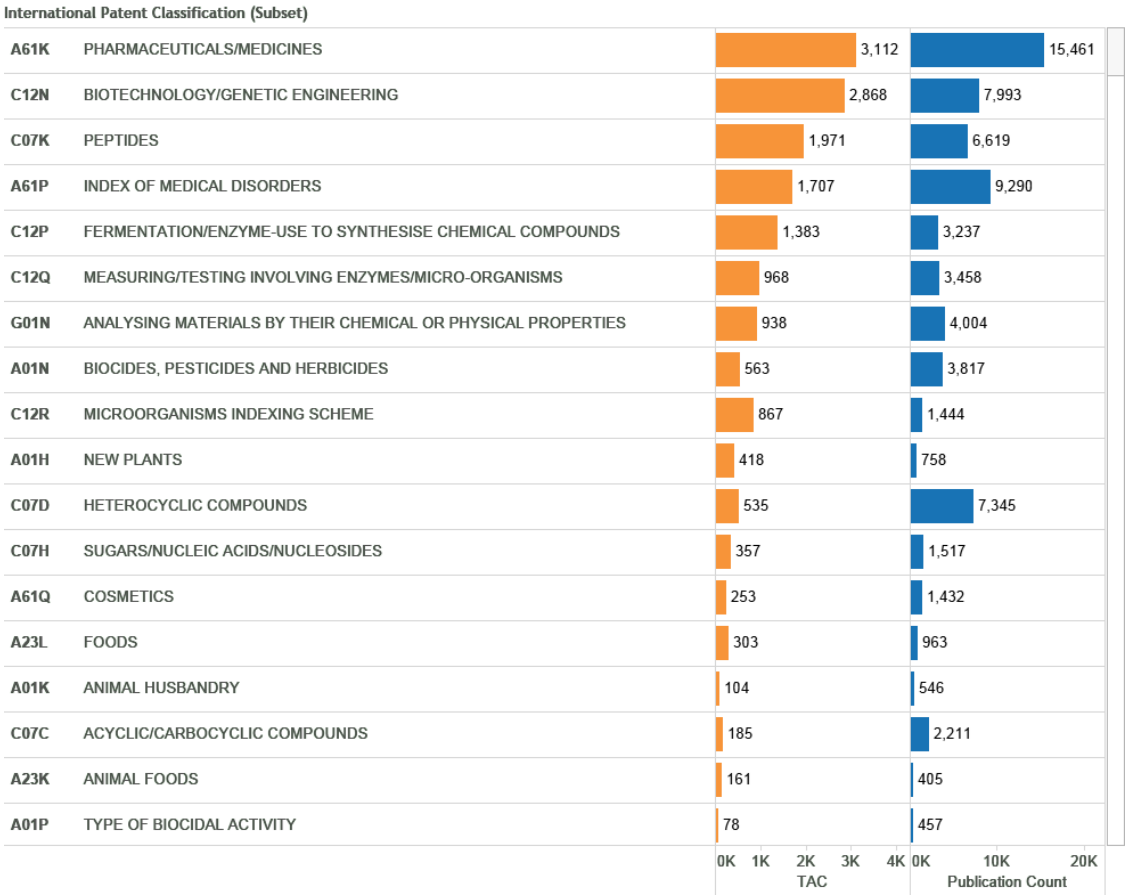


Figure 2.4: Top Technology Areas in UK Patent Activity

Figure 2.4 reveals that UK activity is dominated by pharmaceuticals, biotechnology, biocides and pesticides, plant agriculture, foodstuffs and cosmetics. However we would note that these broad technology sectors disguise novel uses of genetic resources in applications such as: biofuels, biosensors, bionanotechnology, carbon sequestration to address climate change, the recovery of valuable metals using plants, and synthetic biology.

Genetic resources and associated traditional knowledge appear in UK patent documents for four main reasons:

1. As the source of the invention (i.e. a chemical compound);
2. As the target of the invention (i.e. a pathogen that causes disease or an agricultural pest);
3. As a potential source of genetic material for inclusion in the invention;
4. As part of an example, a comparison, or reference from the scientific literature.

It cannot therefore be assumed that the appearance of a species in a patent document indicates that a claim is being made over a genetic resource from that species. At the same time, in the case of pharmaceuticals, a patent may claim a compound from a species without referencing the species in the Title, Abstract of Claims. For this reason we use a variety of measures.

Figure 2.5 displays the top patent applicants involving genetic resources and associated traditional knowledge.

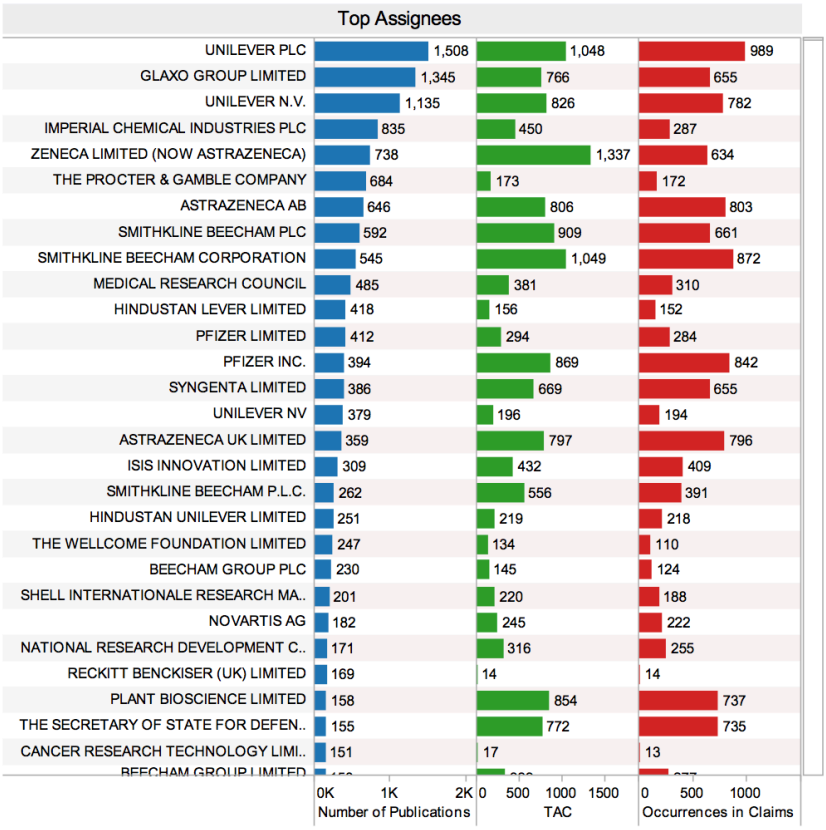


Figure 2.5: Top UK Patent Applicants

The top applicants for patent rights can be grouped into a number of categories. In the case of companies top applicants include Unilever, the Glaxo Group (notably GlaxoSmithKline or GSK), ICI, Proctor & Gamble and AstraZeneca. Government agencies include the Medical Research Council, the Ministry of Defence, and Health Protection Agency (now Public Health England), the Microbiological Research Authority and Natural Environment Research Council. Universities include Oxford University (Isis Innovation), Cambridge University, University College London, Imperial College, the University of Southampton and the University of York. Research institutes and charities include the Wellcome Foundation, Cancer Research UK, the Roslin Institute and the John Innes Institute among others. Small and Medium Sized Enterprises also appear in the data represented by companies such as Cyclops Genome Sciences, the bionanotechnology company Malvern Cosmeceutics and Biotica Technology (a leader in synthetic biology).

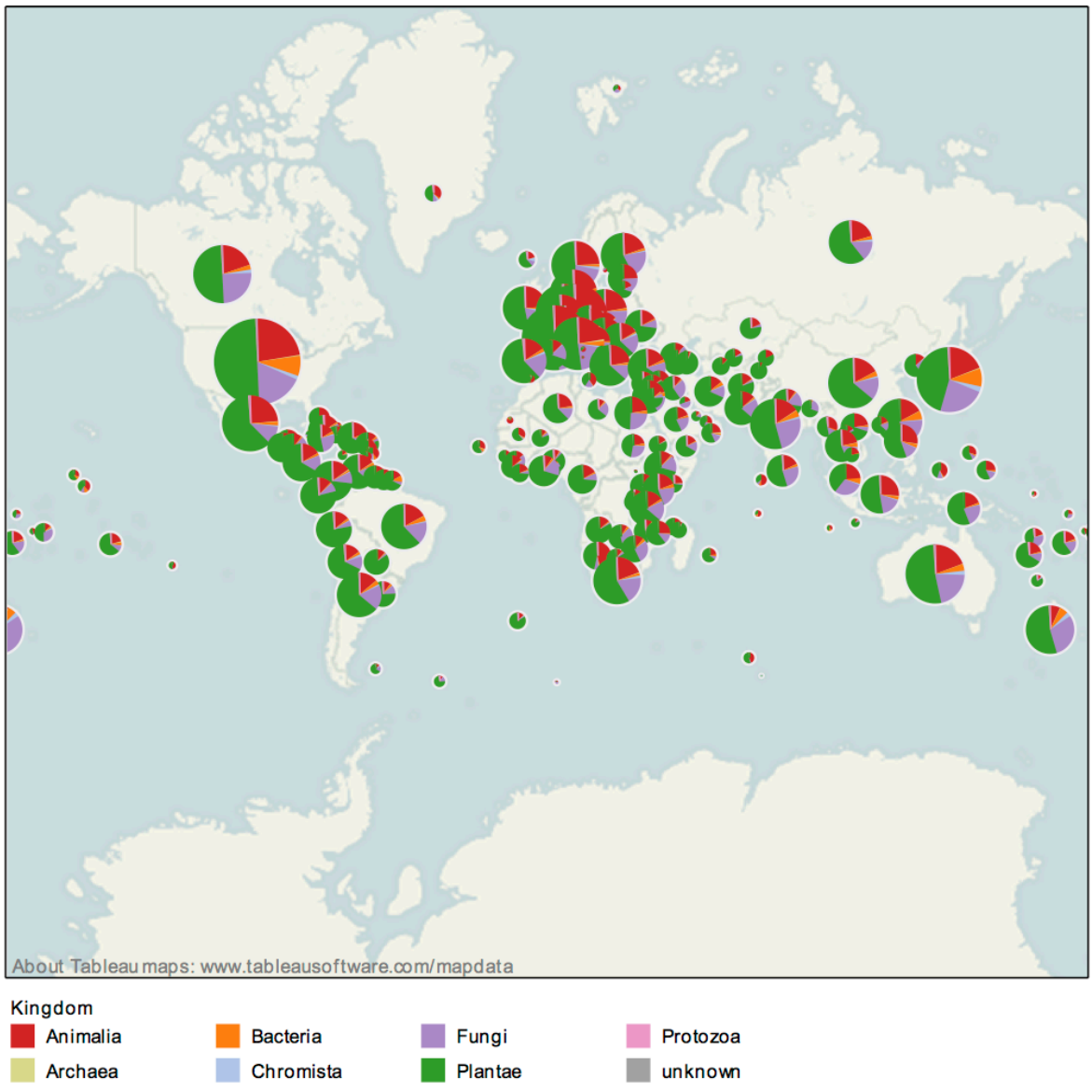
British companies frequently submit patent applications involving genetic resources and traditional knowledge in collaboration with non-UK based companies. An example in this area is Unilever UK which frequently submits joint applications with Hindustan Unilever (India) and Unilever NV (Netherlands). Figure 2.6 displays a network map by country of patent assignees collaborating with UK companies and research organisations in pursuing patent rights involving genetic resources and traditional knowledge.

Figure 2.6: Network Map of Collaborating Countries in UK Patent Documents

Figure 2.6 illustrates that collaboration between UK companies and other research organisations with those in other countries is an important feature of UK patent activity. We estimate that approximately 27% of UK activity at the major patent offices involves collaboration with a non-UK resident applicant.[29] While crude in nature, network mapping and this type of calculation illustrate that patent applications may involve natural or legal persons from more than one jurisdiction.

The Geographical Distribution of Species in UK Patent Activity:

Species that appear in UK patent data are geographically distributed in 178 countries around the world (Map 2.1). Many species that appear in patent documents are cosmopolitan and have a wide distribution. Species distribution is clustered around the United States (a biologically megadiverse country), and Europe with additional clusters around Japan, Australia, Mexico, India, China and South Africa.



Map 2.1: Distribution of Species Appearing in UK Patent Data

The wide distribution of species that appear in UK patent activity reflects the biological reality that many species are distributed in more than one country. However, we would emphasise that the biological properties of organisms may vary as a result of adaptations to local environmental conditions. For example, particular strains of bacteria may possess different properties than members of the same species elsewhere that can lead to the development of new antibiotics. In agriculture, the adaptive properties of a particular variety of a plant unique to one place can be used elsewhere to promote drought tolerance

or disease resistance. As such, recognition that species appearing in UK patent activity are widely distributed must be tempered by recognition that members of the same species from different environments may possess distinct properties.

These observations are important for two reasons. First, the Nagoya Protocol was informed by the view that species belong to, and are unique to, a particular country. This will only be true for some of the time. Species that are endemic (unique to) a particular country are also difficult to identify with certainty because of limitations in taxonomic knowledge of biodiversity around the world. What will matter for implementation of the Nagoya Protocol is identification of the country of origin of the genetic resource and associated traditional knowledge.

Second, as discussed in further detail below, patent applicants frequently list large numbers of species, genera or families of organism. These organisms are typically not directly material to the claimed invention. Rather, applicants are seeking to incorporate these species or genera into the scope of what is claimed on the grounds that they potentially possess the compound or genetic component of interest. We call this practice essential incorporation. We highlight it here because the practice of naming long lists of species, genera, or families of organisms in a patent description or patent claims may affect other countries, notably developing countries, and lead to future tensions in implementing the Nagoya Protocol.

Origins and Sources of Genetic Resources:

The Nagoya Protocol is intended to implement the third objective of the Convention on Biological Diversity. As part of this process it is expected to address the problem of biopiracy or misappropriation of genetic resources and associated traditional knowledge from countries of origin. Patents involving genetic resources and associated traditional knowledge have been a major target of allegations of biopiracy by developing countries and civil society organisations. These allegations can be damaging for the reputations of companies and research organisations. In at least one case allegations of biopiracy resulted in the cancellation of a major research project while in others concern about biopiracy has reportedly restricted research activities.[30]

The Nagoya Protocol responds to the demand for action on these issues by requiring prior informed consent from the Contracting Party and relevant indigenous and local communities for the collection of materials and the creation of a benefit-sharing agreement on mutually agreed terms.

To assess the source of genetic resources and associated traditional knowledge in UK patent documents we focused on manually reviewing patent documents relating to species from India, Brazil and China. We subsequently expanded the review to patent documents that contain a species and make reference to 72 other countries in the text. We reviewed and tagged the documents using qualitative data analysis software to assess whether patent documents contained any evidence of origins or sources.

We found that UK patent applications are frequently ambiguous on the precise origin or source of genetic resources and any associated traditional knowledge. However, a clear hierarchy emerged in documents that did make reference to a source. The principal sources of genetic resources in order of importance are:

1. Commercial suppliers;
2. Type Culture Collections (i.e. for microorganisms), public collections, universities and public databases;
3. Direct collection of samples.

Evidence for direct collection of samples in India and Brazil was limited. The review of data from China suggested that UK companies and organisations typically obtain materials from commercial sources in China. UK companies and research organisations do not typically engage in direct collection of biological samples for research and development. This leads us to conclude that:

> *On balance, the Nagoya Protocol will have a very limited direct impact on UK companies and research organisations*.

However, there are exceptions to this general conclusion. We found evidence of joint patent activity by a major UK company, Unilever, in collaboration with Hindustan Unilever in India. We also found evidence of the field collection of samples of genetic material from Kenya and China by UK research organisations using intermediaries. We anticipate that more detailed research would reveal additional examples of direct field collection by UK organisations. However, our existing research strongly suggests that examples of direct field collection will be few and far between relative to wider UK activity. With the exception of Unilever and its partner in India they will also be mainly confined to UK public research organisations. We therefore expect that direct field collection will constitute a small percentage of overall UK activity involving genetic resources and associated traditional knowledge across all countries.

However, we also anticipate that the Nagoya Protocol will have indirect impacts upon UK companies and research organisations. The reason for this is that it will become more important to know the precise sources of genetic resources and associated traditional knowledge when submitting patent applications in order to address potential allegations of misappropriation at a later date. It will also become more important for UK companies and research organisations to know whether commercial suppliers are operating in compliance with the access and benefit-sharing legislation of countries of origin. Experience demonstrates that it can be difficult to defend against allegations of misappropriation. It will therefore be important for UK companies and research organisations to prepare for its entry into force. This will be particularly true for companies and research organisations who are seeking to develop or expand partnerships with countries that are important to the UK economy such as India, Brazil, China and South Africa.

Suggestions on measures that UK companies and organisations may wish to consider to prepare for the entry into force of the Nagoya Protocol are provided in the summary at the opening of this report.

Valuing UK Patent Activity for Genetic Resources and Traditional Knowledge:

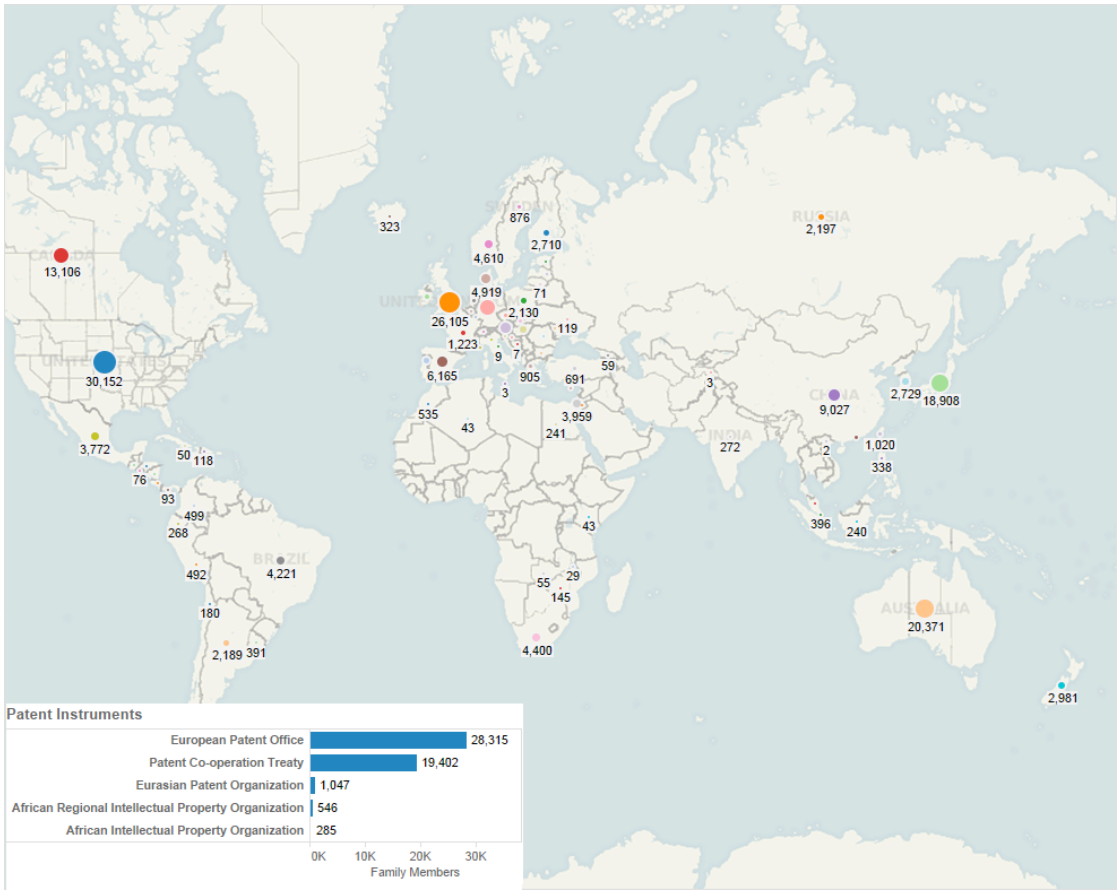
One major problem involved in debates on access and benefit-sharing is calculating the value of genetic resources and traditional knowledge that are involved in patent activity. The reason for this is that it is difficult to obtain information on revenue derived from the licensing of patents to third parties or income generated from the sale of products that are protected by patents.

Within the patent system there are two basic measures of the value of patents.

1. Patent Citations: Earlier patent filings will limit the scope of what can be claimed as inventive by later applicants. Where a patent affects the scope of a later application it is recorded by patent offices as a citation. Therefore the more often a patent is cited the more valuable it can be assumed to be. This measure values patents based on the impact of a patent upon other applicants
2. Patent Families. A patent application may be filed in multiple countries. An applicant must pay for each filing and to maintain a patent grant in each country where protection is required. A patent family is a stack of documents from multiple countries that link back to an original parent or "priority". Because an applicant must pay at each stage of the procedure the size of a patent family provides an indicator of the importance of an invention to an applicant.

In reviewing UK patent citation data we established that UK patent documents that are highly cited do not typically make a reference to a species name in the Title, Abstract or Claims. For example a highly cited patent by Cambridge Antibody Technology and the UK Medical Research Council makes reference to *Thermus aquaticus*. *Thermus aquaticus* is commonly referenced as the source of the enzyme Taq DNA polymerase that is used for the amplification of DNA. However, the highly cited patent makes no claims in relation to *Thermus aquaticus*. We therefore focused on examining patent documents that contain a reference to a species in the Title, Abstract or Claims. UK documents that contain a species in the Title, Abstract or Claims are dominated by Plants, Bacteria and Animals. We approached the data by Kingdom and established that highly cited UK documents do not typically involve access and benefit-sharing issues. We were able to identify a small number of cases where access and benefit-sharing issues are likely to be involved. However, our review of the data suggests that patents of this type are typically low to middle ranking based on citation scores. This does not mean that such patents are unimportant. Rather, it means that they are not UK patents with the highest economic importance measured on citation scores.

Patent family size is an indicator of the importance of a set of patents to applicants who seek protection in multiple countries and markets. In total the UK patent data involved 260,349 patent family members in 91 countries. Map 2.2 shows the distribution of UK patent activity on the global level based on counts of family members in these countries.



Map 2.2: UK global patent activity based on family members

The most important instruments for the pursuit of intellectual property in international markets are the Patent Cooperation Treaty and the European Patent Convention respectively. Map 2.2 reveals the major markets where UK patent applicants are pursuing protection. We can clearly see that activity is concentrated around the United States, Japan and a range of European countries. Australia also appears prominently in this data but is likely to overestimate actual activity for technical reasons.[31] We can also clearly see the growing importance for UK applicants of patent activity in China, South Africa, Brazil and Mexico. We would note also that activity for India is limited by access to data and may prove to be a more important emerging intellectual property market than is suggested by existing data.

We reviewed UK patent family data by initially examining patent families with 100 or more family members and progressively reviewing smaller families. We identified examples of important patent families that involve species as genetic resources in areas such as antibiotics, treatments for diabetes, a vaccine adjuvant, Antarctic species for use in frozen food products and a compound from a marine sponge for cancer treatments. However, as with patent citation data, patent activity involving genetic resources and associated traditional knowledge appears lower down the spectrum of economically important patents based on family size.

Uncertainties and Grey Areas:

The Nagoya Protocol is intended to improve legal certainty for exchanges of genetic resources and associated traditional knowledge by clarifying the rules and responsibilities for these exchanges. However, it is inevitable that a new Protocol produces uncertainties and grey areas. Our focus here is in identifying these uncertainties and grey areas and suggestions on how they might be addressed in the field of intellectual property.

Access and Utilization:

An important ambiguity or conflict is likely to arise in interpretation of the Nagoya Protocol that depends on whether the emphasis is placed on the conditions of *access* to genetic resources under Article 6 of the Protocol or *utilization* of a genetic resource (meaning research and development on the genetic and/or biochemical composition of genetic resources) under Article 2 of the Protocol. This ambiguity is linked with compliance and pre-existing genetic resources.

The *quid pro quo* of the Nagoya Protocol is that Contracting Parties who find themselves in a position as a 'user' of genetic resources will promote compliance with the access legislation of the Contracting Party providing the genetic resource (the provider). However, the Contracting Party providing the genetic resources must have access legislation in place to be able to demand compliance. The logic behind this is that a 'user' country must know what they are supposed to be complying with. Otherwise the Contracting Party in the position of a 'user' may be exposed to potentially arbitrary and changing demands. An important point here is that the UK may find itself in a position as a 'provider' of genetic resources in some circumstances and in a position as a 'user' in others. As such, the requirement for access legislation protects all Contracting Parties from arbitrary demands by a 'provider'.

The user/provider distinction depends on a simple model of access and benefit sharing in which a natural or legal person is under the jurisdiction of a 'user' and the providing country lodges some form of complaint regarding compliance. This situation only applies to transactions following the entry into force of the Nagoya Protocol.

However, an emphasis on utilization shifts the emphasis in two subtle ways. First, a user may purchase genetic material as a commodity (such as black pepper) from a shop in London that was originally imported from India (see case IN8). The user then conducts research and development on the genetic material and submits a patent application for the pharmaceutical uses of the compounds identified in black pepper. This transforms the material into a genetic resource. The Nagoya Protocol was deliberately designed to avoid including commodities in trade within its scope. However, the act of research and development on the biochemical properties of the material constitutes a clear utilization under Article 2.

The practical significance of the emphasis on the utilization of genetic resources in research and development is that it could be argued that:

a) A user should request access, but by definition cannot seek prior informed consent;
b) A user should engage in benefit-sharing with the country of origin.

In practice, these issues cannot easily be resolved. It may be that UK organisations in these circumstances exercise due diligence by recording the precise source of the materials and take no further action. Alternatively, an organisation could express a willingness to make voluntary benefit-sharing contributions directed to conservation and sustainable use. Article 10 of the Nagoya Protocol envisages the creation of a Global Multilateral Benefit-Sharing Mechanism. However, the form that this mechanism may take is under debate. In practice, the distinction between access and utilization may become settled in time as understanding improves and new practices are developed during the implementation of the Nagoya Protocol.

Utilization of a genetic resource in a patent:

The Nagoya Protocol defines utilization of genetic resources as "research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology...". In some cases a patent applicant may claim an essential oil or extract as an ingredient in a claimed invention without performing research and development on that component of the invention. This raises the question of whether the claimed invention falls within the scope of the Nagoya Protocol in connection with that specific component. The answer is likely to be no because it is the act of research and development that defines "utilization" as a genetic resource.

The practical significance of this is that the Nagoya Protocol would only apply to materials disclosed and claimed in patent applications where the research and development has been performed on that component. This situation is particularly relevant in claims for compositions of matter consisting of mixtures of biological ingredients (i.e. cosmetics/ foods).

This distinction is important because it reveals that the Nagoya Protocol will only apply to a subset of UK patents that involve research and development on genetic resources and associated traditional knowledge rather than all UK patents involving biological or genetic material. However, we anticipate that this distinction may be difficult for partner countries concerned about misappropriation and compliance to appreciate. It therefore appears likely that this type of patent activity could be a source of questions for the UK national authorities or potential legal challenge.

Plant Genetic Resources for Food and Agriculture:

A subset of UK patent activity involves plant genetic resources. Patent activity for plant genetic resources differs from other types of patent activity in two main respects. First, plant breeding typically involves the use of plant varieties from multiple countries and sources. Sources of germplasm may include germplasm covered under the Multilateral System of the International Treaty on Plant Genetic Resources for Food and Agriculture (the Plant Treaty) for major food crops and forages, commercial sources or other public collections.

Where the germplasm is an accession under the Multilateral System of the Plant Treaty through a Standard Material Transfer Agreement (SMTA) it is unlikely to be covered by the Nagoya Protocol. Article 4.4 of the Nagoya Protocol specifies that: "This Protocol is the instrument for the implementation of the access and benefit-sharing provisions of the Convention. Where a specialized international access and benefit-sharing instrument applies that is consistent with, and does not run counter to the objectives of the Convention and this Protocol, this Protocol does not apply for the Party or Parties to the

specialized instrument in respect of the specific genetic resource covered by and for the purpose of the specialized instrument."

However, where plant germplasm is obtained from outside the multilateral system from the jurisdiction of a Contracting Party to the Nagoya Protocol and is a focus of research and development leading to the claimed invention, the Nagoya Protocol would logically apply.

Because innovations involving plant genetic resources for food and agriculture frequently involve more than one genetic resource from multiple sources this produces a scenario with three basic components:

1. Material covered under a Plant Treaty SMTA;
2. Material subject to the Nagoya Protocol;
3. Material from commercial/private plant breeding collections inside or outside a Contracting Party.

In these circumstances, an applicant would presumably need to clarify the precise sources of the plant genetic material that are the subject matter of the invention. This would assist the applicant with determining the relative contributions of the material to the claimed invention and the allocation of benefit-sharing. In reality however, considerable preparation may be needed by applicants to identify the precise sources of germplasm. Furthermore, the calculation of benefit-sharing for the relative contributions of germplasm is likely to be complicated. For this reason, applicants in this sector may be well advised, for the purpose of certainty, to increasingly work under the umbrella of the Plant Treaty and/or use commercial material where the precise origin is clearly known. This option would simplify the legal situation and also simplify benefit-sharing arrangements which are defined under the Plant Treaty.

A separate issue in connection with plant genetic resources involves genetic engineering. In this case, two circumstances are likely to arise: a) the use of an expression vehicle such as a bacteria with specific properties that could be covered under the Nagoya Protocol; b) the expression of a genetic product in a plant where the gene product is covered under the Nagoya Protocol. Because expression vehicles (i.e. *E. coli*, *S. cerevisiae*) are highly standardised, the first situation would be unusual. However, the second is much more likely. For example, the soil bacterium *Bacillus thuringiensis* (known as Bt) is widely used in genetic engineering to confer resistance to pests in tobacco, cotton and other crops through the expression of Bt toxins. New strains of *B. thuringiensis* or other bacteria could confer other advantages when expressed in plants. Where those organisms were collected or sourced from a Contracting Party to the Nagoya Protocol, then the Nagoya Protocol would apply.

Essential Incorporation of Genetic Resources:

In reviewing patent documents from the UK and elsewhere, long lists of species, genera and families of organisms may be encountered in either the description or claims. This can happen for a number of reasons:

1. Where a pesticide or biocidal or similar composition can be targeted at a particular species;
2. Where a desired component can be expressed in a species (i.e. genetic engineering);

3. Comparative genetic analysis i.e. comparison of reference sequences from a number of species to identify the target sequence or organism;
4. For the purpose of incorporating species, genera and families into the claims.

The final category focuses on ensuring that the scope of patent claims extend to a component where it is discovered in any member species of a relevant genus or family. As such the applicants are seeking to maximise the scope of the claims.

Three brief examples will serve to illustrate the point. Patent Cooperation Treaty application WO2010106495A1 by H. L. Hall & Sons Ltd in South Africa and UK individual applicants focuses on an extract from the South African plant *Sceletium tortuosum*. The claimed invention is directed to the treatment of a range of psychiatric and psychological disorders using extracts containing two alkaloids. However, the patent claims are constructed at the family level:

> 1. A composition comprising as an active ingredient an extract of a plant or plants from the family Mesembryanthemaceae, the extract including the alkaloids mesembrenol and mesembrenone and having a total alkaloid content, and wherein the combined content of mesembrenol and mesembrenone is at least 50% (w/w) of said total alkaloid content.

In addition this application claims: "13. A composition as claimed in any one of the preceding claims in which the plant or plants from which the extract is derived is selected from the plant genus Sceletium." The claims are subsequently narrowed to *Sceletium tortuosum*.

This is an example of a case where the main claim (claim 1) is written to capture the alkaloids of interest where they occur in any member of this family.[32] The claims are then narrowed to the genus and the species. However, the practical significance of this type of claim, where granted, is that all members of the family that may contain the alkaloids of interest are incorporated into the claims.

A second example is provided by an application by Unilever UK, Unilever Netherlands and Hindustan Unilever (WO2004105718A1) for a skin lightening composition from the bark of Symplocos and Rubia species. The patent application claims:

> 1. A cosmetic skin lightening composition, comprising O.l by weight of an extract of plants from the families of Symplocos, Rubia or a mixture thereof.
>
> 4. The cosmetic skin lightening composition of any preceding claim, wherein the extract of Symplocos and/or Rubia is selected from Symplocos recemosa, Symplocos paniculata, Symplocos cochinchinensis, Rubia cordifolia or mixtures thereof.

In this case the patent application would apply to a skin lightening composition involving an extract of any member of the genus Symplocos or Rubia within the specified weightings.

These brief examples indicate a wider issue involving the construction of patent claims. That is, the inclusion of members of a family or genus within the scope of the claims where the species falling into these groups are not a focus of research and development or "accessed" within the meaning of the Nagoya Protocol. The practical significance of these

types of claims is that others seeking to conduct research and development directed to the same or similar purposes from countries of origin or elsewhere could be limited in their opportunities to develop the species by such claims. These types of claims could be considered to over-reward inventors relative to their inventive contribution and to have impacts on the quality of the overall patent system by promoting rights over genetic resources that have not in practice been a focus of research and development. Furthermore, in our view such claims run counter to the purposes of the Nagoya Protocol. We propose that more research is conducted to quantify and characterise the nature of this issue with a view to possible action to limit this type of practice.

Mergers, Acquisitions and Transfers:

One feature in UK patent data is mergers and acquisitions of companies by other companies in the UK or elsewhere in the world. This is a notable feature of the pharmaceutical sector but also applies to other sectors. A historical example involving the best-selling cancer drug Hycamtin from the Chinese tree *Camptotheca acuminata* (often spelled *Camptotheca accuminata*) illustrates the issues that arise.

In 1987 the US Company Smithkline Beckman Corp filed for patents on topotecan, a water soluble version of the compound camptothecin from *Camptotheca acuminata* (see US5004758A). In 1989 Smithkline Beckman became Smithkline Beecham following a merger with the UK Beecham Group. The patents were then reassigned to this new entity. In 2000 Smithkline Beecham and Glaxo Wellcome merged to become GlaxoSmithKline (GSK). In 2010 the key patent above was reassigned to GlaxoSmithKline LLC in Pennsylvania. The key patent does not appear in UK patent data because it's assignee is a US subsidiary of GSK and no UK inventors are listed.

This historical example highlights some broader issues:

1. Following the entry into force of the Nagoya Protocol companies acquiring or merging with other companies that involve acquisition of patent portfolios will need to exercise due diligence for compliance with the Nagoya Protocol for new patent holdings entering the company;
2. National authorities responsible for monitoring implementation of the Nagoya Protocol will need to be aware of the implications of mergers and acquisitions and could provide guidance to companies and research organisations to address this issue;
3. Patent rights may be reassigned at various times during their lifetime and sold or licensed to others;
4. Companies could, at least potentially, pursue loopholes by filing in a country that is not a Party to the Nagoya Protocol.

The Changing Landscape of Patent Disclosure Requirements:

One of the key demands of developing countries under the Convention on Biological Diversity, at WIPO and at the TRIPS Council has been for mandatory disclosure of the origin of genetic resources and associated traditional knowledge in patent applications. That is, at the very least, organisations should be required to disclose the source, where known, of the genetic resources and any associated traditional knowledge. These issues are presently under detailed discussion at the Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore.

However, an increasing number of countries including India, Brazil, China and South Africa have introduced requirements to disclose the country of origin or source of genetic resources and traditional knowledge in patent applications. A number of European countries, including Norway and Switzerland, have introduced disclosure of origin requirements into their national patent laws. In the case of China, failure to disclose may result in refusal or invalidation of a patent (Article 5 and Article 26, Patent law of the People's Republic of China, revised October 1, 2009). In contrast, Article 27 of the European Biotechnology Directive (98/44/EC) introduced a requirement for the disclosure of the geographic origin of animal or plant genetic material, where known. This is a voluntary measure and is without prejudice to the processing of a patent application or validity of patent rights.

This changing landscape presents challenges for UK companies and research organisations who seek patent protection in international markets. In most cases disclosure of origin will not be required. In other cases, countries in important emerging markets will require disclosure. The practical significance of this is that companies will be required to meet the differing requirements of states when seeking protection (i.e. under the Patent Cooperation Treaty). The need to adjust patent applications to meet the requirements of particular countries will already exist in certain areas of national patent laws. However, companies and research organisations seeking to avoid Nagoya Protocol requirements through non-disclosure, will discover that a requirement for disclosure in one jurisdiction will be sufficient for the identification of all other documents that do not disclose the country of origin submitted by the same applicants. The reason for this is that the patent system is designed to facilitate the identification of linked documents through the patent family system and citation system.

The main concerns of UK companies and research organisations in connection with disclosure are likely to focus on the *consequences* of disclosure. That is, whether disclosure of origin will result in major and, from a company perspective, unreasonable demands for monetary benefit-sharing. This concern is understandable. However, UK organisations will confront an international patent landscape in which disclosure of origin is increasingly required. We suggest that it will be increasingly important for UK organisations to prepare for this new reality by clarifying their sources of materials, adjusting patent drafting practices, and ensuring that prior informed consent and benefit-sharing agreements are in place in relevant cases. In our view this should be seen as part of the due diligence approach described in the draft EU regulation for the implementation of the Nagoya Protocol in Europe.

Multinational Companies:

UK companies involved in patent activity range from small and medium sized enterprises to large multinational companies and groups. UK companies that are also multinationals will have a variety of routes available to them in filing patent applications. This is important because a company may choose to file through a subsidiary or member of a group that is not a Contracting Party to the Nagoya Protocol. The question that would arise in these circumstances is whether a filing by a subsidiary of a UK company in a third country that was not Party to the Nagoya Protocol would fall under the Nagoya Protocol. This merits further discussion.

Patent Attorneys:

Patent Attorneys and patent agents are responsible for drafting patent applications. Patent attorneys typically seek to maximise the scope of protection to serve their clients interests in a particular technology sector or market. Under the Nagoya Protocol this expansive approach may not serve a clients interests where they are seeking to build and maintain relationships with countries providing genetic resources that are also major markets for end products (i.e. Brazil, India, China). We propose greater engagement with patent attorneys to explain the implications of the Nagoya Protocol for patent practices and issues to be considered in drafting patent applications following the entry into force of the Nagoya Protocol. We further suggest that patent attorneys recorded in UK patent records could be contacted as part of engagement activities.

Conclusions:

This report has examined UK patent activity involving genetic resources and associated traditional knowledge. We find that UK patent activity is an important subset of overall UK patent activity. However, UK patent activity is narrowly focused on a small range of known species.

We reviewed a total of 4,618 documents constituting 23% of UK first filings and 13% of publications at the major offices. We reviewed economically important UK patents involving species using citation counts and patent family size. We conducted detailed reviews of patent activity for species of relevance to India, Brazil and China and additional research on the potential origins of genetic resources in patents referencing 72 additional countries. Finally, we conducted exploratory thematic reviews of UK data on traditional knowledge, marine genetic resources and Antarctic species. The results are discussed in the report below and compiled in Annex 1.

UK patent applicants are frequently unclear on the precise origin or source of genetic resources and associated traditional knowledge. However, a clear hierarchy emerged in references to actual sources of material in UK documents. In order of importance these sources are: a) commercial suppliers; b) Type Culture Collections, public collections and databases, and; c) direct field collection of samples. Evidence for direct field collection of samples was very limited. We therefore conclude that:

> *On balance, the provisions of the Nagoya Protocol will have a limited direct impact on patent activity by UK companies and research organisations. However, there will be important exceptions. The Nagoya Protocol will also have indirect impacts on companies and research organisations operating in Contracting Parties to the Protocol.*

The exceptions will include companies such as Unilever who actively patent on genetic resources and associated traditional knowledge from India in collaboration with Hindustan Unilever in India. Exceptions will also include UK universities where researchers engage in field research. On the balance of available evidence we expect that these exceptions will be limited.

While examples of direct field collection of samples will make up a small percentage of sources of genetic resources and associated traditional knowledge in UK patent data these cases are the most likely to attract allegations of biopiracy or misappropriation. The impacts of these allegations could be disproportionate to their number because of the

sensitivities involved. For this reason, particular attention will be needed to research involving field collections and follow on research and development.

Because UK companies and research organisations typically obtain samples and materials from commercial or other suppliers, we believe that the impacts of the Nagoya Protocol will be indirect. However, we also conclude that adjustments will be needed to patent practices by UK applicants to meet the requirements of the Nagoya Protocol. In our view UK companies and research organisations should take active measures to prepare for entry into force of the Nagoya Protocol and identify opportunities to strengthen UK research and development through partnerships with Contracting Parties to the Protocol.

We suggest that the emphasis should shift from a defensive approach to the Nagoya Protocol to an active role in shaping implementation and pursuing opportunities for partnerships in research and development with other Contracting Parties to the Nagoya Protocol. This will involve significant challenges and unforeseen difficulties for UK organisations. To address these challenges, we suggest that guidance and support should be provided to UK organisations to successfully adjust to the requirements of the Nagoya Protocol. This guidance should provide a platform for the identification of best practice to inform engagement between UK organisations and potential partners in other countries under the Nagoya Protocol.

The report provides a series of suggestions on steps that could be considered by UK government agencies and UK companies and research organisations in preparing for ratification and implementation of the Nagoya Protocol. The suggestions are provided in full with the brief summary at the beginning of this report.

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[23] Mora C et. al. (2011) How Many Species Are There on Earth and in the Ocean? PLoS Biol 9: e1001127.

[24] For the purpose of this report a first filing is defined as the INPADOC First Family Member.

[25] Patent counts are based on counts of publications at the three patent offices with a UK applicant compared with counts of publications containing a species name in the same period. This figure includes model organisms. A number of methods are available for counting patent data. This method is the simplest. Because of variations in the availability of patent data for recent years the figures are approximate.

[26] Bisby FA, Roskov YR, Orrell TM, Nicolson D, Paglinawan LE, et al (2011) Species 2000 & ITIS Catalogue of Life: 2011 Annual Checklist. Digital resource at www.catalogueoflife.org/annual-checklist/2011/. Species 2000: Reading, UK. See also, Chapman AD (2009) Numbers of living species in Australia and the world. Canberra; Australian Biological Resources Study.

[27] Mora C et. al. (2011) How Many Species Are There on Earth and in the Ocean? PLoS Biol 9: e1001127.

[28] Oldham, Hall and Forero (forthcoming) Biological Diversity in the Patent System. PLOS One.

[29] A total of 18,499 patent publications possess a UK (GB) code in the applicant field. Of these 5,164 publications possess a co-applicant from another country. This is a crude measure when based on publication count. The numbers would rise if UK inventors were also taken into consideration.

[30] Rosenthal, J. P. 2006. Politics, culture, and governance in the development of prior informed consent in indigenous communities. Current Anthropology 47:119-142.

[31] Problems arise in interpreting patent data from Australia because in the early 2000s Australia counted designations of Patent Cooperation Treaty applications as if they were actual applications. In practice designations are an option to pursue protection rather than a formal application. For this reason patent data for Australia will be over counted.

[32] Mesembryanthemaceae may in fact be a subfamily of Aizoaceae

3. Methodology

There are two main challenges involved in examining UK patent activity for genetic resources and associated traditional knowledge:

1. Identifying genetic resources and associated traditional knowledge in patent documents.
2. Defining what counts as a UK patent document.

To focus in on genetic resources we use the appearance of Latin binomial species names as a proxy for the identification of genetic resources in patent documents. That is, we assume that a patent applicant will typically disclose the origins of a compound or preparation from a particular species in a patent document using Latin terms.

Previous work described by Oldham, Hall and Forero (forthcoming) used High End Computing to text mine 11 million patent documents from the main jurisdictions for 6 million Latin species names in the Global Names Index established by the Global Biodiversity Information Facility and the Encyclopedia of Life. The Global Names Index includes all known Latin species names including spelling variations. In an additional step the research also identified and harmonized known abbreviations of species names in patent documents to their full Latin Names.

Previous work identified 76,274 Latin Species names in 767,955 patent documents. For the present work we refined this approach to focus in on species names appearing in UK patent documents.

The use of Latin species names is the best available proxy for the identification of genetic resources and associated traditional knowledge within the patent system. However, it has a number of limitations. The first of these is that it is only as complete as the list of species names. In this case we used 6 million species names. However, this will not capture all variants of species names that may be present in patent data. Second, this approach will not capture the use of common names (i.e. for Chinese traditional medicines) where a Latin name is not used.

A third issue is that in some cases, i.e. pharmaceuticals, a compound that was originally isolated from a species (i.e. a plant) may become the subject of a patent application but where that compound is fully characterized or synthetic the document may not record the species from which the compound originated. In practice it is possible to trace such records using distinctive features of the patent system including citations of historic patents, literature citations and patent families (a group of patents filed anywhere in the world that link back to the same ‘parent’ or ‘priority’ filing). As such, it is possible to track through patent data over time to identify the underlying origins of compounds and related materials. However, this approach would be extremely time consuming and is beyond the scope of the present research.

Defining UK Patent Data:

There are three issues that need to be considered when defining UK patent applications.

1. UK patent filings:

A patent may be filed for the first time either in the UK or elsewhere (i.e. using the European Patent Convention or the Patent Cooperation Treaty). Because our research focuses on patent applications at the US, the European Patent Office and the Patent Cooperation Treaty we therefore sought to identify patents with an earliest filing in the UK.

To do this we used the EPO World Patent Statistical Database (PATSTAT, October 2011) to identify those cases where the first record for a patent containing a species name is registered as the UK (GB in the patent system). Figure 3.1 shows the raw results for all patent data in PATSTAT and the corresponding data for documents containing species names.

One issue we encountered is that a first UK filing does not necessarily involve a UK applicant (i.e. a company, university or government agency) or a UK inventor. These are patent records that were either first filed in the UK because of a choice made by an applicant based overseas, because their patent attorneys are UK based, or are recorded as such for technical reasons relating to the international patent family system. Because we wished to focus on activity by applicants resident in the UK we excluded these external records from the analysis.

2. Defining UK Applicants:

The second issue relates to UK applicants or assignees. For the purposes of this research we focus on legal persons falling within the jurisdiction of the UK. Figure 3.1 sets our the total number of records in PATSTAT and the ABSPAT species name index that contain a UK (GB) code following the applicant name.

An important feature of patent applicant data is that this field commonly includes companies or research organisations *and* individuals. In many cases the individuals listed as co-applicants are also inventors. We include both UK organisations and individuals in counts of UK applicants. In total we identified 5,091 documents that contained a species name and a UK applicant code.

3. UK Inventors:

The third issue involves UK inventors. In total we identified 15,258 patent documents that contained a species name and listed a UK inventor. However, UK inventors may be located in other countries around the world working for non-UK companies. This raises the question of whether such individuals (while affirming their status as UK citizens) are subject to the jurisdiction of the UK or the country where they are presently resident. For the purposes of this report we assumed that UK inventors should be confined to UK inventors working with UK companies and resident in the UK. For this reason we excluded UK inventors where they did not appear in the applicant field and included those linked with a first filing recorded in the UK.

Figure 3.1: Counting UK data (Patents Coded with GB)

GB Innovation	In Patstat (all applications, all years)	In ABSPAT (with a species name, 1976-2011)
GB Assignee Only	292,198	5,091
GB Inventor Only	270,442	15,258
GB Assignee and GB Inventor*	670,931	27,385
GB Assignee or GB Inventor*	123,3571	47,734
GB First Filing or GB Assignee or GB Inventor*	4,142,591	56,592
GB Assignee or (GB inventor and GB first filing)	1,104,981	39,223

* the operator “or” is expansive and means that any document that meets the condition of either containing a GB assignee or GB inventor will be included. The operator “and” is restrictive and means that the document must possess a UK assignee and a UK inventor to be included. The “and” score is therefore lower. The final formula means that all documents containing a GB assignee are included but only those documents that contain a GB inventor tied to a GB first filing are included. That is an application must have been originally filed in the UK and contain a UK inventor. This prevents the data expanding to include all UK inventors around the world.

The outcome of these definitional considerations was a dataset consisting of 39,223 patent documents. The data can as necessary be expanded to include all first filings registered in the UK or all UK inventors which would generate a dataset containing 56,592 documents.

The next step in the methodology was to remove patent data for human genetic resources and model organisms from the dataset of 39,233 documents.

Human Genetic Resources and Model Organisms:

Human genetic resources are explicitly excluded from the provisions of the Nagoya Protocol. In addition previous work by the authors has demonstrated that the top ranking species within UK patent activity, and activity globally, is dominated by organisms used as research tools and model organisms such as *Escherichia coli* and *Saccharomyces cerevisiae*. To address these two issues we created filters that allow us to exclude the most common model organisms and human genetic resources from the UK data. The exception to this is those situations where human genetic material or a model organisms appears in a patent document along with another organism. In this case the non-human/ model organism is retained and counted in the data.

Following the removal of model organisms and human genetic resources we identified 34,912 publications arising from 19,762 patent families in the period between 1976 and 2010 in the European, United States and Patent Cooperation Treaty Collections.

Calculating the Percentage of UK Patent Activity involving Genetic Resources and Associated Traditional Knowledge:

To calculate the percentage of UK patent activity that involves genetic resources and associated traditional knowledge we first needed to calculate total UK activity at the major patent offices (EP, USPTO, WO) for the period 1976 to 2010 using PATSTAT. We used publication counts for this task. We initially used the expanded definition (GB First Assignee or GB Assignee or GB Inventor) and arrived at 781,801 publications for all years up to 2011. We then ran the same calculation on UK documents containing a species. We arrived at 51,845 publications up to 2011. This constitutes 6.6% or a rounded 7% of overall UK activity. However, note that this figure includes data for all UK inventors irrespective of whether they are linked to a first filing in the UK.

To narrow the figure we simply calculated the percentage of UK activity using the narrow definition (GB Assignee or (GB inventor and GB first filing)) of 39,223 publications against the total number of UK publications at the main offices falling within that definition between 1976 and 2010 of 521,750 publications. This produces a figure of 7.5%. We then ran the same calculation using the number of publications excluding model organisms of 34,912 publications to arrive at the final percentage score of 6.6% (7%).[33]

Patent Assignee (Applicant) Name Harmonization:

The spellings of patent assignee or applicant names for the same organisation can vary considerably in patent data and is a major source of noise. To address this we used the EEE-PAT patent harmonized names list developed by EUROSTAT and the Catholic University of Leuven for use with the EPO World Patent Statistical Database.[34]

Our data does not take account of mergers and acquisitions of companies or transfers of ownership of rights (reassignments) listed in patent legal status data. Analysis of the structure of corporate ownership is beyond the scope of the present study. In certain cases of interest information on reassignments is provided in the case examples.

Addressing UK Multinational Corporations:

The research focused on the identification of UK patent activity based on country codes appearing in the Assignee and the Inventor fields and first filings of patent documents containing the country code GB.

However, in the course of our research it became clear to us that there is a limitation with this method in connection with UK based multinational companies. That is, UK multinationals (such as GlaxoSmithKline) possess offices in numerous countries, notably the United States. Because we focused on country codes in patent data this means that a filing in the United States by the US office of a company such as GlaxoSmithKline will not fall into the criteria established for the study.

As such activity by UK based multinationals represents a gap in the existing data. Furthermore, this represents a gap in potential implementation of the Nagoya Protocol and measures that may be adopted at WIPO. That is, a UK based company could submit patent applications of relevance to Access and Benefit-Sharing through a US or other office that may not be a Party to the Nagoya Protocol. The implications of this possibility merit further discussion and potential methodological development.

An additional issue arises from the reassignment of patents over time. Following a merger or acquisition patents are often reassigned to the new entity. However, this information is not recorded in the applicant field but instead is recorded in the legal status information as a reassignment. Unfortunately, legal status data is difficult to access and requires extensive cleaning and care in interpretation. The present research did not attempt to address this issue but highlights the desirability of addressing this gap in future work.

Country Studies and Distribution Data:

Later sections of this report present a series of examples of UK activity for species originating from India, Brazil, China and a range of other developing countries. The examples are accompanied by a set of tables that provide additional information on the species and patent activity.

Country level data has two components:

1. Data on species appearing in patents where there is a reference to a named country of origin or source (India, Brazil, China, other developing countries). This data is confined to country references where the species is known to occur in that country based on data from the Global Biodiversity Information Facility (GBIF).
2. Data on species that, based on available distribution data from the Global Biodiversity Information Facility (GBIF), could have come from the specific country (India and Brazil only).

Data involving a reference to a country was manually reviewed to test whether evidence was available on the collection or sourcing of a particular species from that country. The data is compiled in Annex 1 for ease of reference. Individual sections are provided for Brazil, India and China where in depth research was performed.

Examples based purely on distribution data, rather than a reference to a country, are cases where the Global Biodiversity Information Facility records indicate that their is only one recorded country where the species occurs. We call this data Distribution 1. However, we must emphasise that GBIF data on distribution is incomplete. This signifies that the species referenced in a patent may have come from another country. As such, Distribution 1 data simply provides a *clue* that a particular species referenced in a patent document could have come from that particular country (i.e. India or Brazil).

We include data for India and Brazil based purely on distribution for two reasons. First, it is presently at the discretion of applicants whether they include reference to a country of origin or source in patent applications. We are therefore interested in identifying more complete data on possible sources. Second, one purpose of this report is to promote transparency in the utilization of genetic resources and traditional knowledge with reference to the patent system. This is important because transparency is a foundation for building trust in access and benefit-sharing arrangements. The inclusion of data purely based on distribution data is intended to enhance transparency through completeness in assessing the available patent records for the UK. Due to time constraints we were not able to include data on distribution for the review of activity involving China.

Thematic Research:

We conducted research to identify potential candidate documents involving traditional knowledge associated with genetic resources. This experimental research was based on searches of UK data for sets of key terms likely to be used by applicants in describing traditional knowledge. The methodology is discussed in further detail in the Traditional Knowledge section of the full report.

Counting Patent Documents:

This report focuses on counts of species in UK patent documents at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty. The report then examines UK activity globally.

Patent data can be counted in a variety of ways. We use three principal counts in this report.

1. **Patent Publications**. Patent publications are publications by UK applicants at the USPTO, the EPO and under the PCT. Patent publications include republications of original patent applications as patent grants. Counts of patent publications are useful because it is at this level that patent grants can be identified. Administrative republications of patent documents (i.e. international search reports) are not included in the data because they typically do not include species names and fall outside patent counts.
2. **First Family Members**. We use the INPADOC (International Patent Documentation Centre) definition of a patent family. This is a family of documents published anywhere in the world that link back to an original filing. Counts of First filings are performed in the EPO World Patent Statistical Database (PATSTAT, October 2011) by identifying the first application number in a series of documents (appln_id). The data is then grouped on these documents.
3. **Family Members**. INPADOC Patent Families are documents published anywhere in the world that link to a UK document meeting the criteria outlined above (UK assignee, UK inventor linked to a UK first filing). This allows the research to move from the three main collections to identify linked activity anywhere in the world.

Counting Patent Documents by Section:

A species name may appear in a patent document for a wide variety of reasons. To tighten the focus to documents that are fundamentally ‘about’ a genetic resource involving the species the data can be confined to those records where a species name appears in the Title the Abstract or the Claims. This has the effect of radically reducing the size of the dataset. The results of this exercise are provided in Figure 3.2.

Figure 3.2: Counting Patent Documents by Section

	WIth Species Names	Patent Collections/ Countries	Title, Abstracts or Claims	Patent Collections/ Countries
Publications	34,912	3	6,631	3
Applications	32,689	3	6,317	3
INPADOC First Filings	19,762	-	4,115	-
INPADOC Family Members (Global)	270,849	91	58,210	89

At various points in this report we will present data for the Title, Abstract or the Claims. It should be noted that in the case of older documents there is no clear distinction between the Abstract and the Description which can result in over-counting. We introduced a filter to assist with controlling for the distortions created by this problem. However, we would note that counts of species in the Title, Abstracts or Claims are likely to be over-counted and require further work to clean the data. As such the figures are approximate.

In addition, and fundamentally, we would note that in the case of chemical compound patents the only reference that is made to the species of origin for the compound is often found in the description. For this reason while analysis of titles, abstracts and claims provides greater focus it has limited utility when examining country of origin in patent applications.

Valuing UK patents:

There are two main methods available for estimating the economic importance of patents.

1. Patent Citations:

When a patent is published for the first time it becomes prior art. This means that later patent applicants who submit a patent application for the same or similar invention will not typically be able to obtain a patent on the grounds that it is not new or novel and involve an inventive step when considered in light of the prior art. Patent applicants may however be able to limit the claimed invention or otherwise adjust the patent claims to overcome this objection.

When a patent application is affected by earlier patents the earlier patents are recorded as citations. Where an earlier patent is cited by many later applicants this is an indicator that the patent is economically important. Fundamentally, patent citations provide an indicator of the impact of a patent or set of patents on other applicants within the patent system.

Patent citations can be counted in two ways.

a) Counts of patent citations for a single patent document;
b) Counts of citations by patent family.

In this report we chose to use the first option of simple counts of citations linked to a single document. We recognise that counts of citations using patent families may provide a fuller picture and advocate this approach in future work.

2. Patent Family Size.

When an invention is important to a patent applicant they will typically seek protection in more than one country. An applicant must pay fees to apply for protection in a particular country and, in the case of a grant, pay fees to maintain the patents. The size of a patent family is therefore an important indicator of the economic importance of a patent or set of patents to the applicant based on their willingness to pay fees in multiple countries.

In this report we counted patent family size by mapping the INPADOC first family member number to the INPADOC family members field. Patent family size was established by counting the number of family members that linked to the first family member. The counts were performed using data from Thomson Innovation. The same counts can be performed using PATSTAT. However, counts using PATSTAT will be lower than for Thomson Innovation because Thomson Innovation data is more recent.

Counting of Patent Citations and Patent Family sizes proved to be among the most complex tasks performed during the research. In our view counts based on Patent Family size prove to be more useful than counts based on citations. Nevertheless, in future work counts of citations by patent family may prove more useful or intermediate measures combining family size and citation counts could also be tested.

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[33] See also, Oldham, P and Hall, S (2009) A European Patent Indicator for Access to Genetic Resources and Benefit-Sharing. Report to the European Environment Agency EEA/BSS/08/012.

[34] See: a) Du Plessis, M., Van Looy, B., Song, X & Magerman, T. (2009) Data Production Methods for Harmonized Patent Indicators: Assignee sector allocation. EUROSTAT Working Paper and Studies, Luxembourg. b) Magerman T, Grouwels J., Song X. & Van Looy B. (2009). Data Production Methods for Harmonized Patent Indicators: Patentee Name Harmonization. EUROSTAT Working Paper and Studies, Luxembourg. c) Peeters B., Song X., Callaert J., Grouwels J., Van Looy B. (2009). Harmonizing harmonized patentee names: an exploratory assessment of top patentees. EUROSTAT working paper and Studies, Luxembourg.

4. Status and Trends in UK Patent Activity

Introduction:

This section presents an overview of UK patent activity involving genetic resources and associated traditional knowledge. It begins with an analysis of the top species appearing in UK patent activity and adjustments for model organisms. It then presents data on the geographical distribution of species appearing in UK data to provide the wider context for UK activity and access and benefit sharing.

We then turn to an overview of patent trends including mapping the global nature of UK patent activity involving genetic resources. This is followed by a breakdown of UK activity by patent applicants (assignees) and technology areas.

Finally, we consider available measures for assessing the value of UK patent activity involving genetic resources and associated traditional knowledge using citation and patent family size measures.

4.1 Top Species

In total we identified approximately 13,970 species names in UK patent data in the United States, at the European Patent Office and under the Patent Cooperation Treaty in the period 1976-2010. This list includes model organisms, *Homo sapiens* (for human genetic resources) and unresolved abbreviations of species names. In total these species were identified in 39,223 patent publications originating from 21,731 first family members.

Figure 4.1 breaks down the data by Kingdom adjusted for Homo sapiens and model organisms.

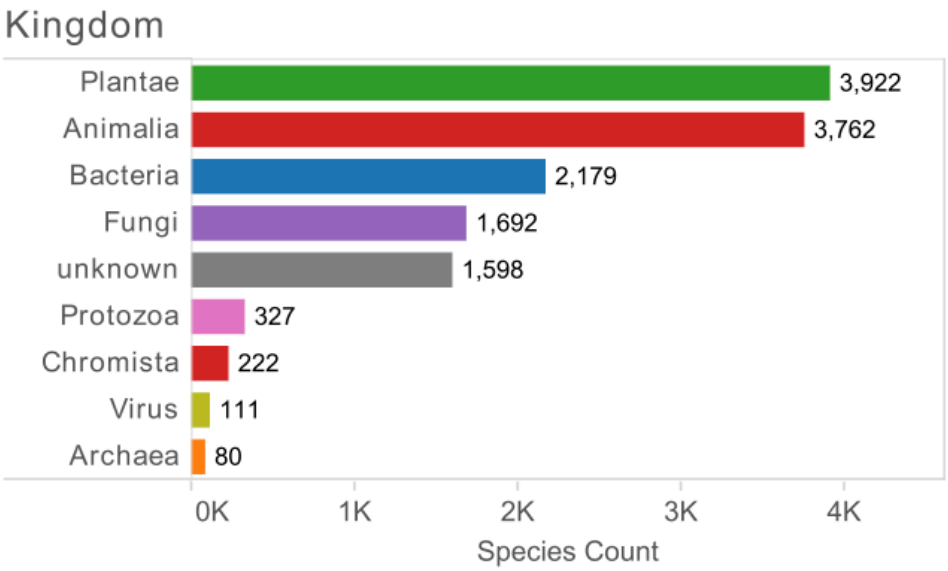


Figure 4.1 UK Patent Activity by Kingdom

This data demonstrates that UK activity is dominated by plants, animals and bacteria. The category unknown refers to species where we were unable to retrieve Kingdom data from GBIF. Viruses may be under-represented in the data because of the uncertainties of taxonomic nomenclature for viruses.

The data has been adjusted to remove *Homo sapiens* and common model organisms because human genetic resources are outside the scope of the Nagoya Protocol and because model organisms have a major impact on UK data. Figure 4.2 displays the unadjusted data with model organisms show in orange and other organisms shown in blue.

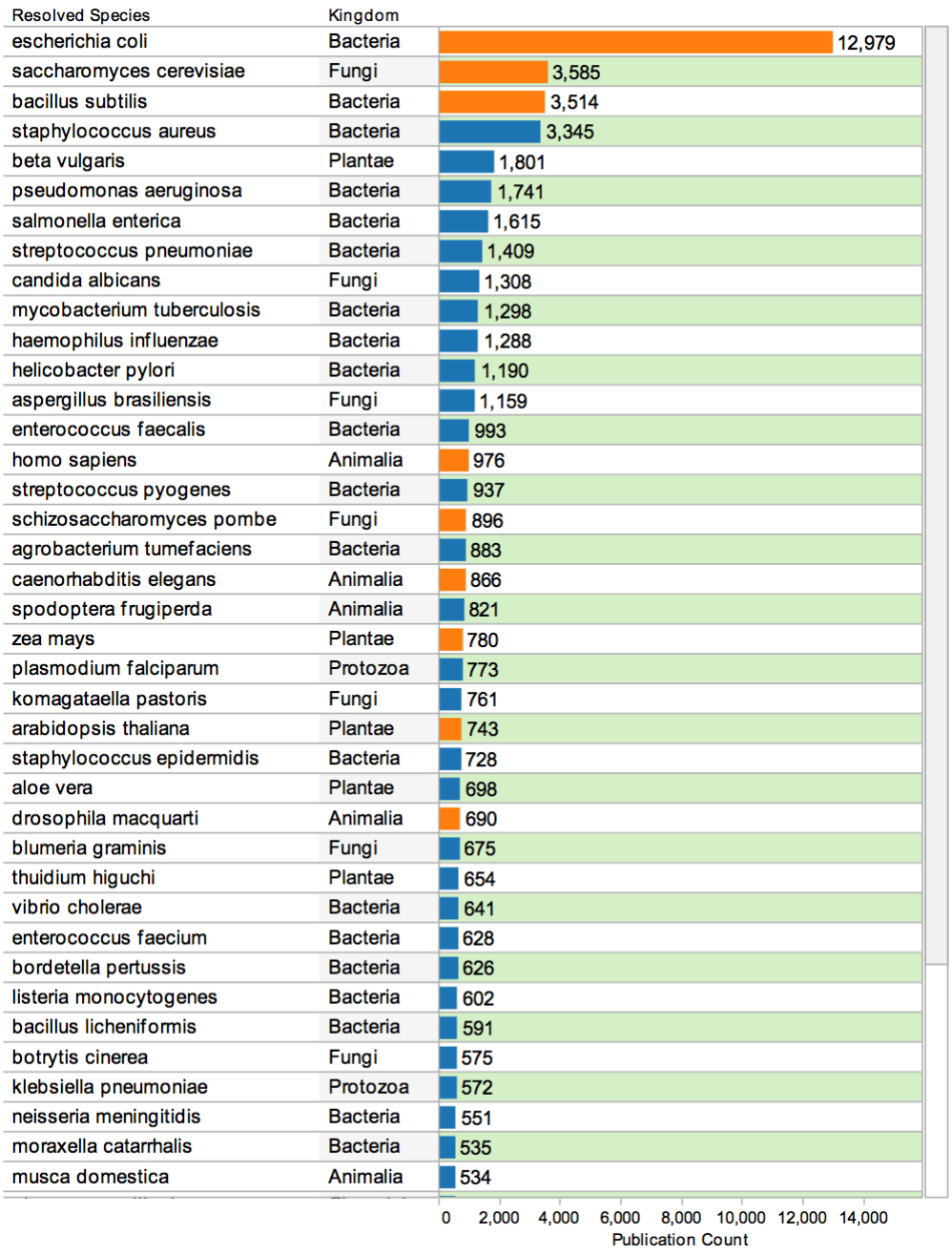


Figure 4.2 Species in UK Patent Activity

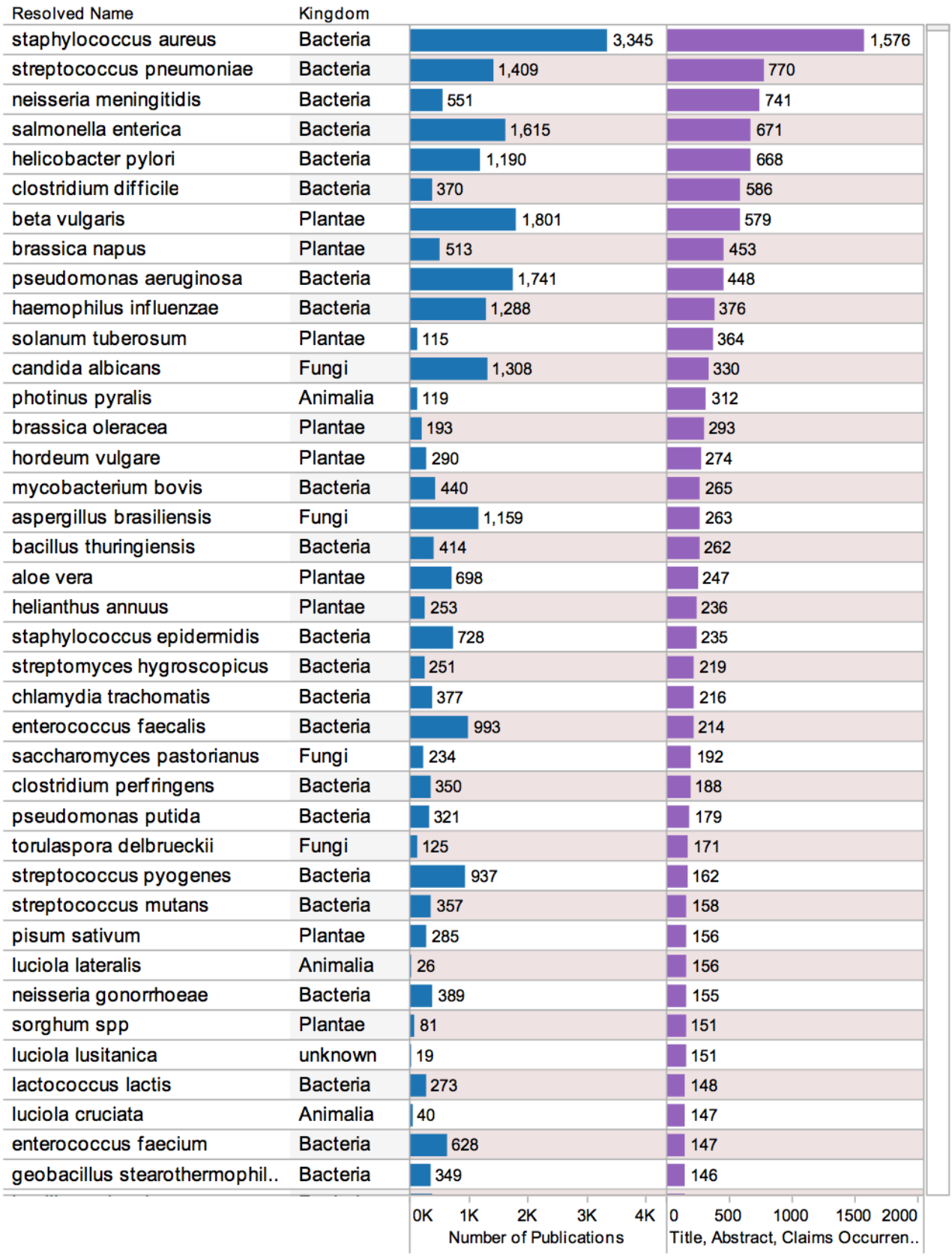
Figure 4.2 reveals that the top species across the UK portfolio at the major patent offices are dominated by model organisms (marked in orange). In particular *Escherichia coli*, *Saccharomyces cerevisiae* and *Bacillus subtilis* are commonly used as models and research tools in biotechnology and genetic engineering. In designing the research it was therefore decided to exclude model organisms from the results.[35] Because the Nagoya Protocol excludes human genetic resources we also exclude *Homo sapiens* from the results. Where *Homo sapiens* appears in a document alongside other species, the other species are retained in the data.

It is important to note that species included in the model organisms list may be a target of patent activity for a variety or reasons as well as being a model organism. For example, *E. coli* is an increasingly important source of antibiotic resistant infections. In contrast, *Zea mays* (corn) is one of the world's most important food crops. We decided to filter these species out in order to reduce the data to a more manageable and targeted set. However, the data has been retained for potential future investigation of its relevance to access and benefit-sharing and the International Treaty on Plant Genetic Resources for Food and Agriculture.

The model organisms list reduces the number of species appearing in UK data to 13,874. Excluding model organisms and *Homo sapiens* reduces the UK portfolio at the three major offices to 34,912 publications originating from 19,762 first family members. Figure 4.3 displays the top species in UK documents, excluding model organisms, and includes information on the kingdom to which the species belongs. Species are ranked by their appearance in the titles, abstracts or claims of patent documents (TAC). In total 6,631 UK patent publications contained a species name in the Title, Abstract or Claims.

This clearly demonstrates that the top species are bacteria, notably pathogens that are a focus of activity in the pharmaceuticals sector. In connection with plants *Beta vulgaris* (beet, notably for the production of sugar) features highly as does *Aloe vera* (i.e. for use in cosmetics and food products), *Brassica napus* (rapeseed, notably for oil), *Echinchloa crus-galli* (a common grass weed), and *Nicotiana tabacum* (tobacco). Fungi are represented by *Candida albicans* (a common source of fungal infections), *Komagataella pastoris* (also known as *Pichia pastoris* used as an expression system to produce proteins). *Blumeria graminis* causes mildew in grasses such as cereals while *Botrytis cinerea* (grey mould) causes mould in important agricultural crops. Members of the Animal kingdom are mainly reflected in *Spodoptera frugiperda* a moth caterpillar known as the Army worm that is a common plant pest in countries such as Africa but is also used in biomedical research. This is followed by the domestic house fly (*Musca domestica*) as a common pest. Chromista are represented by *Phyophthora infestans* as the source of potato blight.

Figure 4.3 Top Species excluding model organisms



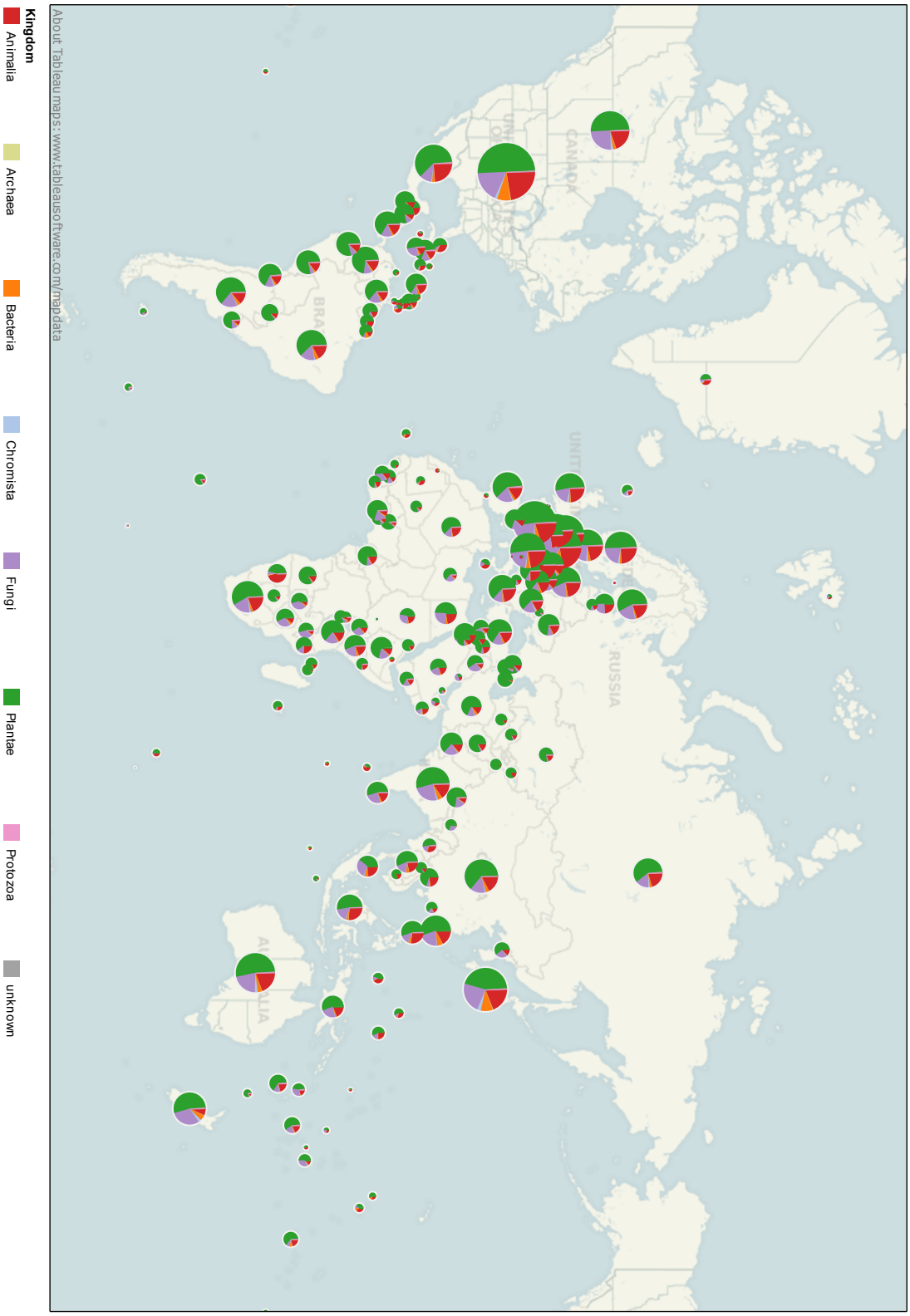
On balance, based on a global review of species appearing in patents, this list combining pathogens and pests of relevance to the UK and elsewhere around the world is what might reasonably be expected.[36]

4.2 Geographical Distribution of Species:

Debates on access and benefit-sharing under the Nagoya Protocol and related debates under the WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (the IGC) focus on the conditions of access to genetic resources that may result in commercial products and the terms for equitable benefit-sharing.

One of the important underlying assumptions in these debates is that a specimen of an organism collected in a country becomes the basis for an invention and/or commercially valuable product. This assumption appears to be informed by a perception that the species is unique to, or belongs to, a particular country. However, the perception that species are unique to a particular country or particular place will not be borne out in the majority of cases. The reason for this is that species do not recognise political boundaries and are typically distributed in more than one country either because of evolutionary history or because they have been introduced.

Map 4.1 shows the available data on the geographic distribution of species appearing in UK patents based on data from GBIF.



Map 4.1: Geographical Distribution of Species Appearing in UK Patent Data (GBIF data)

This map clearly demonstrates that the species appearing in UK data are widely distributed around the world. Particular clusters are located around North America (the United States is a megadiverse country), but also in Europe.

The Access and Benefit Sharing Patent Index allows for countries to be ranked in UK data based on distribution data from GBIF. Figure 4.4 displays distribution information by country based on the number of species recorded in each country.

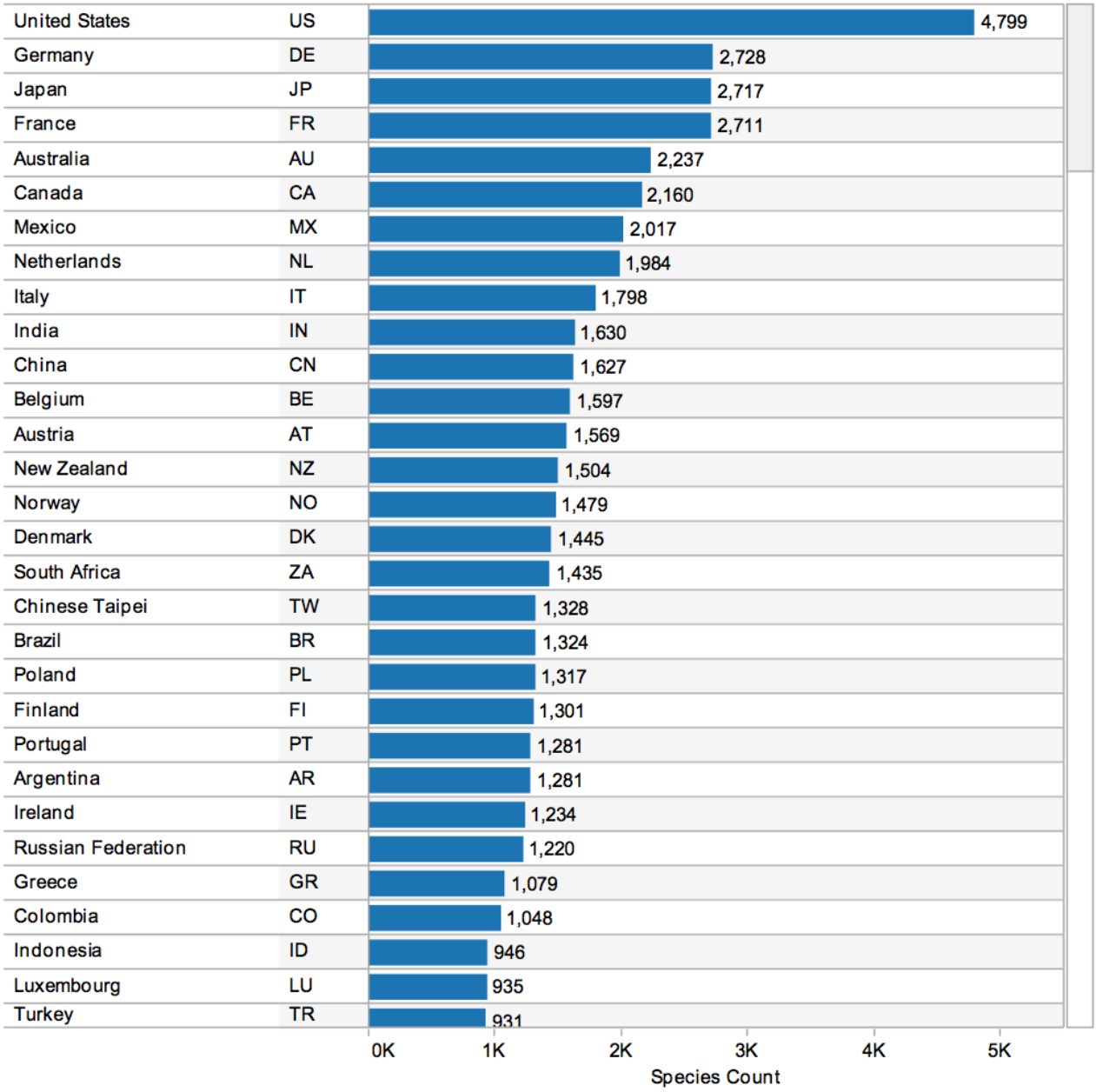
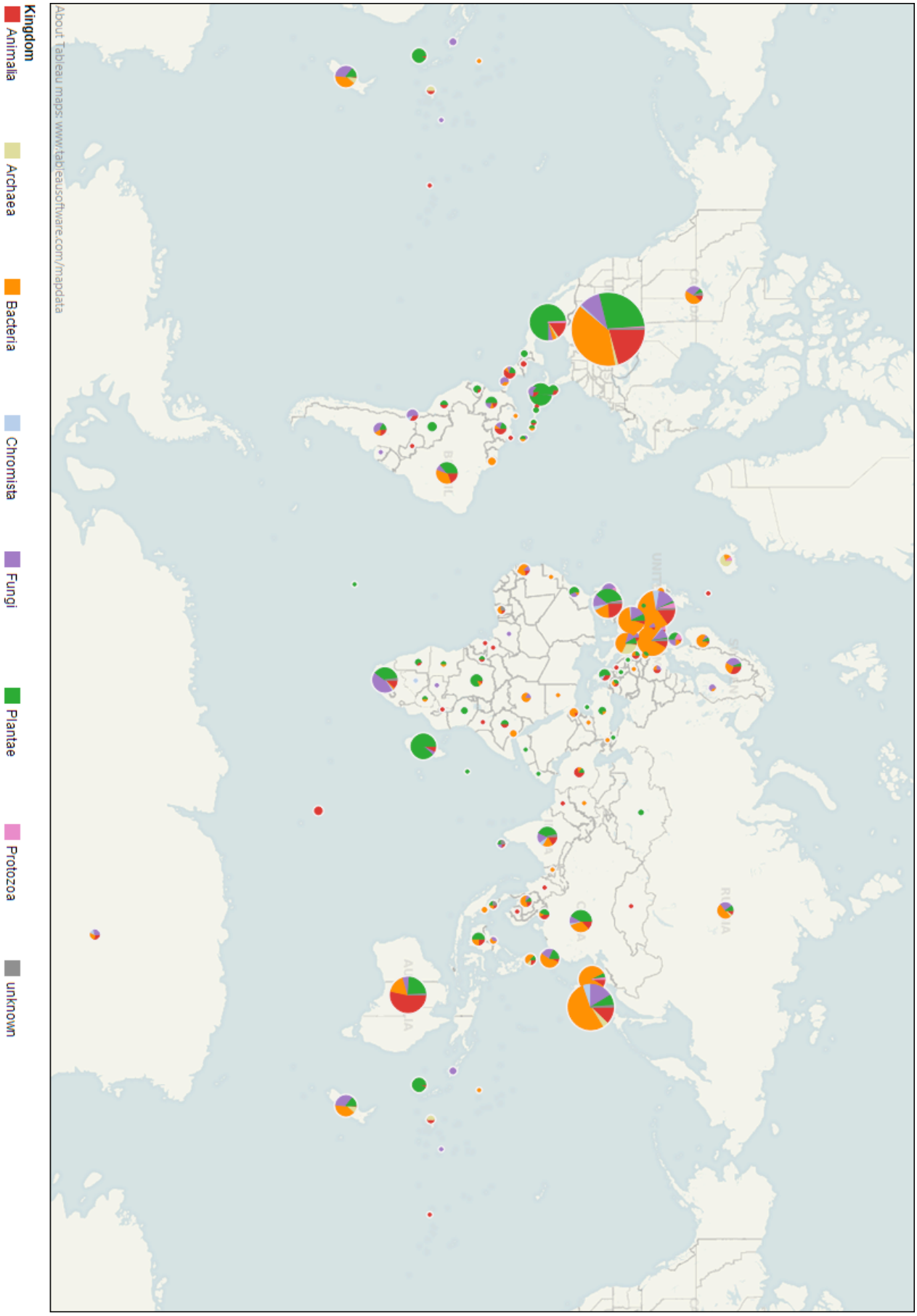


Figure 4.4 Distribution Data by Country (Number of Species)

In interpreting this data it should be noted that counts of species by country are dependent on the availability of taxonomic data. Some countries have much more complete taxonomic data on species diversity than other countries. For example, the relative paucity of species distributed in central Africa in Map 4.1 could reflect the lack of available taxonomic and distribution data from these countries. Nevertheless, this is presently the best data that is available for mapping distribution. In our view, in considering wider efforts to engage in monitoring under the Nagoya Protocol it will be particularly important to promote inputs into the Global Biodiversity Information Facility to facilitate improved access to basic taxonomic information on species distribution.

Taking these reservations into account it is nevertheless clear that megadiverse countries such as the United States, Australia, Mexico, China, South Africa, Brazil, Argentina, Colombia and Indonesia appear prominently in the data by distribution. In considering this data it is important to recognise that the species appearing in patents could come from one or more of these countries. It does not mean that a patent applicant actually obtained material from one of the specific countries that forms the basis for a claimed invention. We will consider the issue of the origins and sources of genetic resources in patent applications in detail in greater depth in later sections of the report and provide summary data in Annex 1.

We can gain a further clue to the potential origins of genetic resources in patent documents by interrogating GBIF data for species that, to date, have only been recorded in a specific country (i.e. India or Brazil). An important limitation of this approach is that taxonomic distribution records are inevitably incomplete. Nevertheless, distribution data can contribute to promoting transparency in the utilization of genetic resources in patent documents. Map 4.2 shows the distribution of species appearing in UK documents where there is only one record for a species listed in existing GBIF records. In total we identified 1,995 species appearing in patent documents with only 1 distribution record. 1,897 species with 1 distribution record appeared in the claims.



Map 4.2: Species Appearing in UK Patent Data with One GBIF Distribution Record

Geographical data on distribution of species is relevant for three main reasons. First, species may be distributed and sourced from a variety of countries for use in a claimed invention. Species also share a common genetic heritage that is conserved over evolutionary time. Third, as in the case of strains of bacteria, or plant varieties, species may develop particular useful characteristics that are distinct from other members of the species based on adaptations to local conditions.

The implications of this are that companies and research organisations may source species from multiple countries and individual countries will rarely have a monopoly on a useful species. However, patent claims over widely shared species (and extending to members of a genera or a family) may have important implications for the ability of researchers in other countries to engage in research and development leading to useful products. Finally, while it is important to bear in mind that many genetic resources are shared across countries, species may possess important and distinctive properties of use in research and development based on adaptations to local conditions.

We now turn to the analysis of trends in UK patent activity for genetic resources.

4.3 Patent Trends for Genetic Resources:

In this section we focus on trends in patent activity involving genetic resources as a basis for considering technology areas and the top applicants involved in UK patent activity.

Three measures can be used to map patent trends for the UK:

1. Trends in first filings;
2. Trends in publications to identify applications and grants, and;
3. Global Trends in Patent Families.

Figure 2.1 sets out trends in UK first filings and trends in UK patent publications at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty that involve a species in the period 1976-2010.

Trends in the first filings of patent applications are used by organisations such as the OECD as a proxy measure for innovation. The reason for this is that patent applications are an indicator of investments and outputs from research and development. The priority (first filing) year or date is normally used in measuring first filings because it is closest to the date of invention.

An important limitation of counts of this type is timeliness. A patent application is typically published 24 months from the date of filing. It is not available for analysis prior to publication. This has the consequence that as we move closer to the present the available data begins to steeply decline. This can give the mistaken impression that underlying activity is declining.

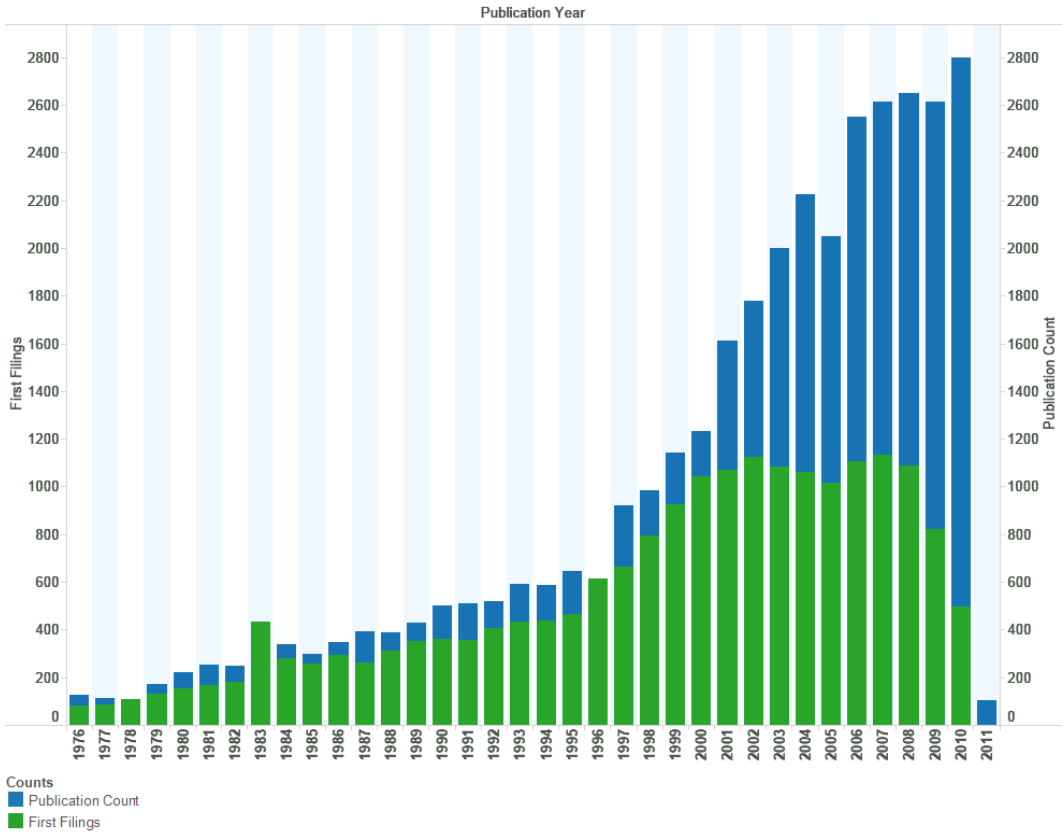


Figure 4.5 Filing and Publication Trends

As such, our view of the data on first filings is partial. However, the first filing data provided in Figure 4.5 reveals that UK first filings relating to genetic resources (displayed in green) rose steadily in the 1990s before peaking at 1,126 filings in 2002. A decline in patent filings from this period onwards is normally associated with the bursting of the biotech bubble. The sharp decline in filings from 2009 onwards is due to a lack of available data. It is also reasonable to expect, but is not yet demonstrable, that UK filings will have displayed a dip in the years immediately following the financial crisis.

Trends in patent publications provide an indicator of wider demand for patent protection because a patent applicant must pay fees at each stage of the procedure in order to gain protection. Typically a patent is published more than once (i.e. as an application in one or more countries) and may also be published as a patent grant. As such, patent publication counts introduce a multiplier effect that reflects demand by applicants. However, at this stage it is also possible to begin to map trends in patent applications and grants as provided in Figure 4.6.

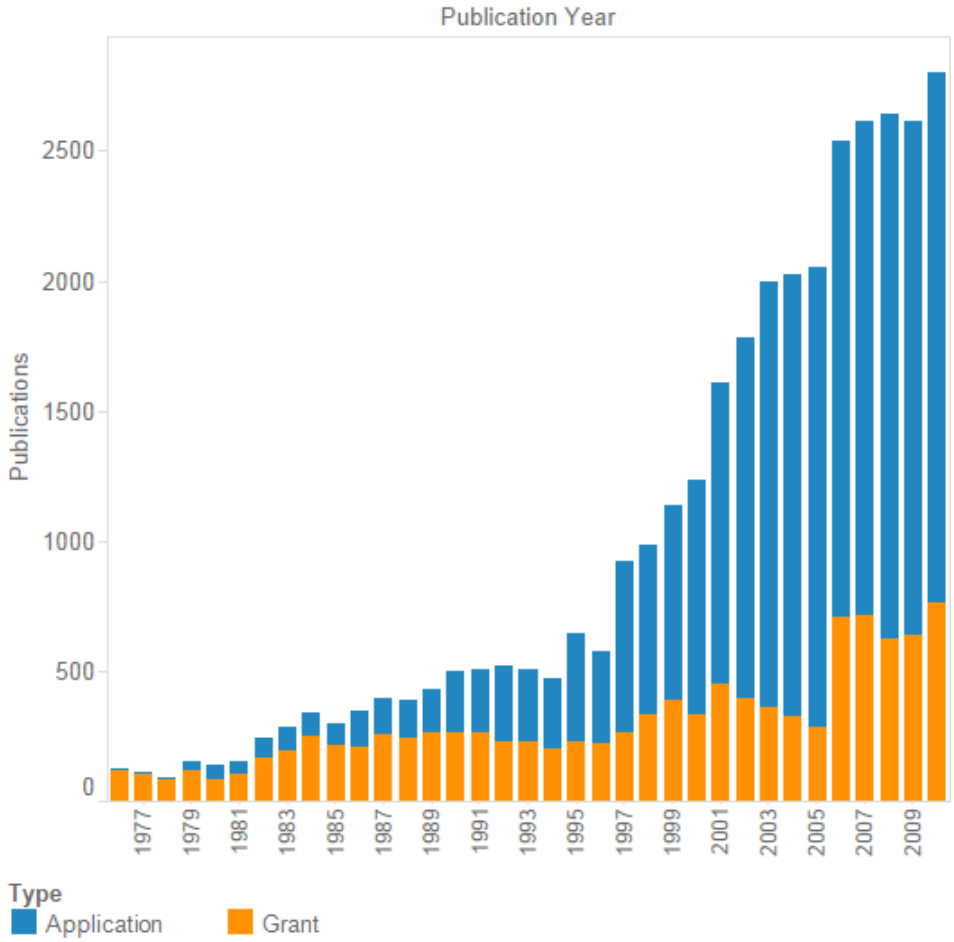


Figure 4.6. Trends in Applications and Grants
(USPTO, EPO, PCT only by Publication Year)

Figure 4.6 displays available data on UK activity for patent applications and grants between 1976 and 2010. In interpreting this data we would note that the steep increase in applications from 1995 onwards is potentially a response to the TRIPS agreement or increasing use of the European Patent Convention and the Patent Cooperation Treaty by applicants. A steep rise in patent activity in the 1990s is also closely associated with the rise of biotechnology patents culminating in steep decline in 2003 that reflected the bursting of the biotech bubble from 2001 onwards.

Figure 4.7 breaks down this data by the major offices. In considering the data for the major offices we would note that patent data for the European Patent Office is affected by the way in which patent grant information is recorded with some patent grants only recorded in the legal status field. This will result in an underestimate of patent grants at the European patent office. In the United States, prior to 2001 patents were only published when they were granted. This practice changed from 2001 onwards. This means that no data is available on patent applications prior to 2001. In contrast, the publication of applications from 2001 produces an apparent spike in US activity. This is a reporting effect and does not reflect a sudden surge in activity. As this suggests, the precise calculation of trends in patent applications and grants is affected by a number of factors and the figures should therefore be regarded as approximate.

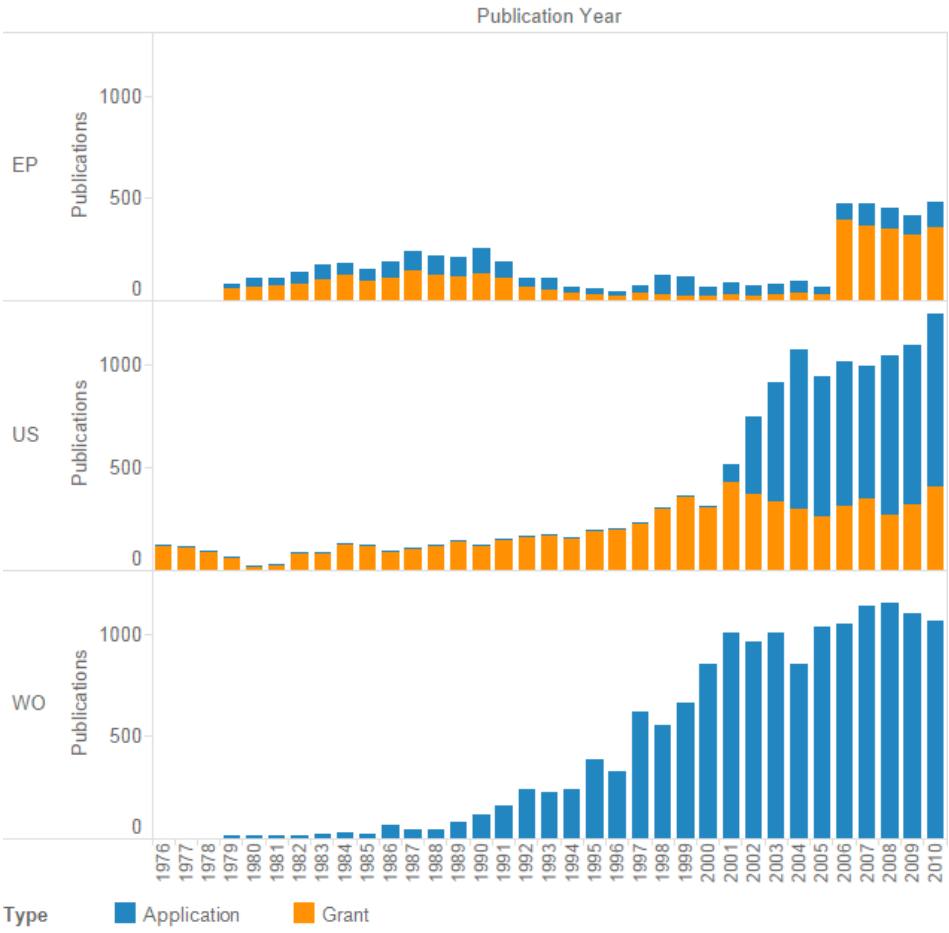


Figure 4.7 UK Trends at the Major Offices

4.3.1 Global Trends in Family Members

The direct data on publications that directly contain species names provided above is only part of the picture. A fuller picture is provided by examining trends in patent family members. That is, patents that are directly linked to a parent first filing or "priority" document.[37] This approach also allows global activity arising from the core data to be mapped. It is important to note that the data should be deduplicated before being mapped and that search reports (A3 and A4 documents at the EP and PCT) should be removed to focus on applications and grants.

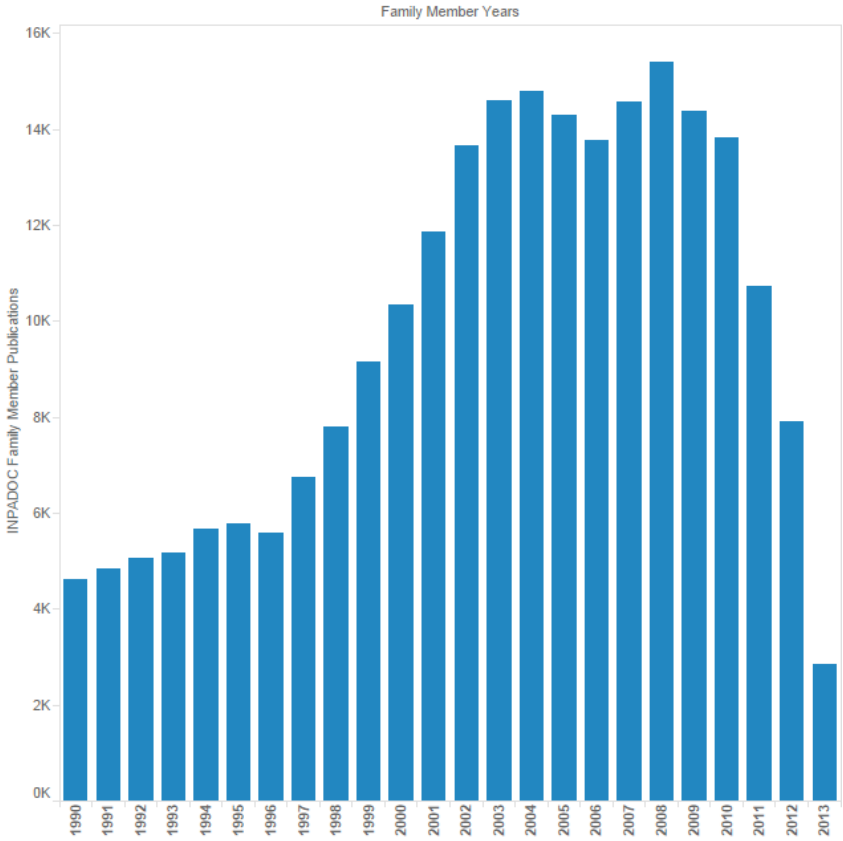


Figure 4.8 Global Family Trends

Figure 4.8 displays trends for 233,359 family members for the period 1990 up to available data in 2013 (of a total of 260,349 family members across all years). In comparing Figure 4.6 on publications in the core data with the wider family data in Figure 4.8 it should be noted that linked UK activity is significantly greater than activity in the core countries identified through text mining of the three major collections. As such, we get a much fuller picture of UK global activity involving genetic resources. Figure 4.9 displays the major countries where patent protection is being sought.

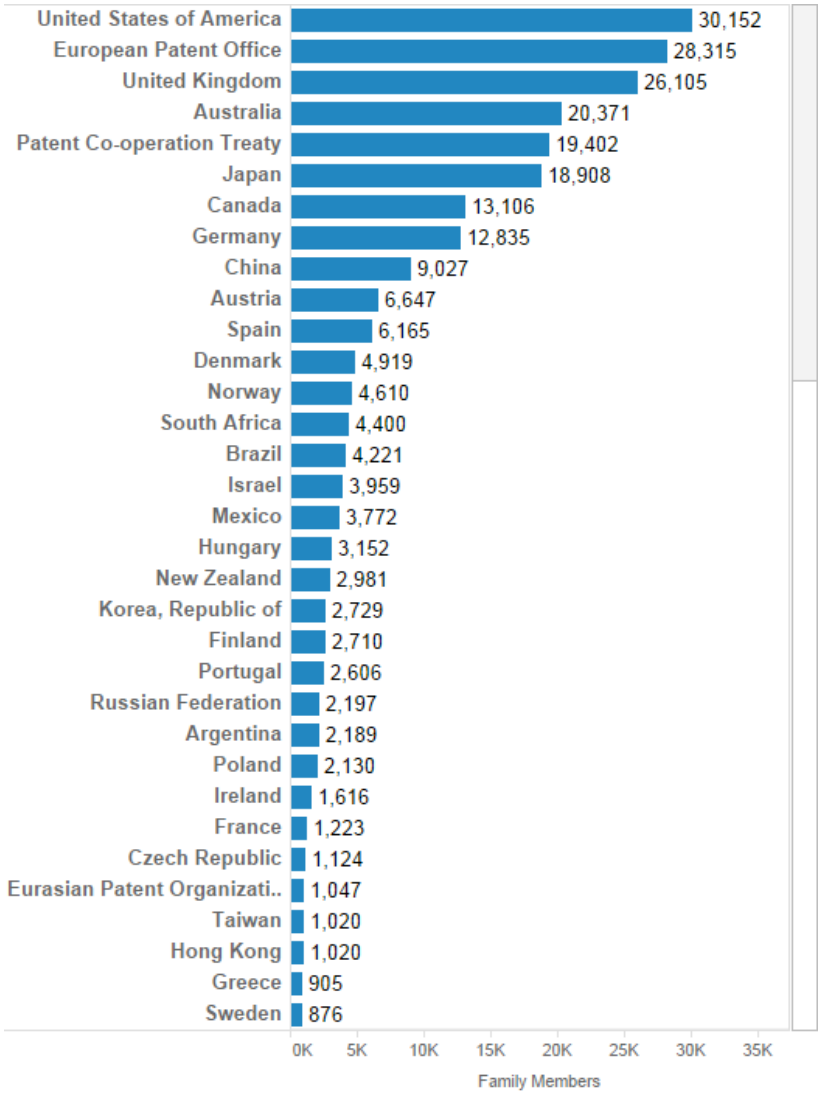
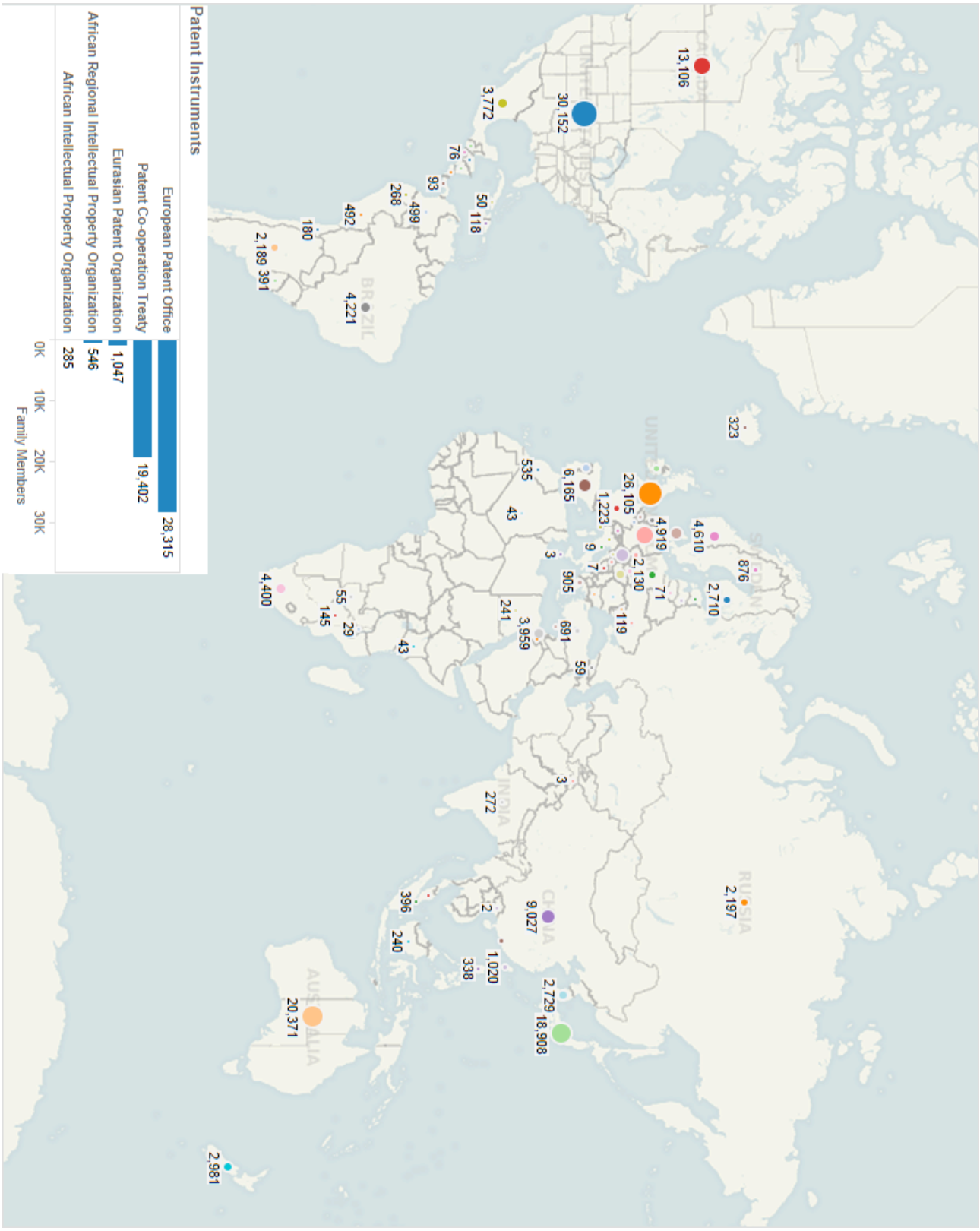


Figure 4.9: Top Countries by Family Members

What is clear from this data is that countries such as China, South Africa and Brazil, along with Mexico, are becoming an increasing focus for UK patent activity involving genetic resources. This is particularly relevant to debates on the disclosure of origin of genetic resources in patent applications. In particular, China, Brazil, South Africa, Costa Rica, India and member states of the Andean Community (Bolivia, Colombia, Ecuador and Peru) have adopted disclosure of origin requirements. From October 2009 onwards, China has required the disclosure of the direct source and the country of origin in patent applications. We estimate that this affects approximately 1,309 documents in the dataset. Future research could usefully investigate disclosure by UK applicants in countries requiring disclosure of origin.

Map 4.3 displays the full data across all years to 2013 in order to demonstrate the geographical distribution of UK patent activity involving genetic resources and associated traditional knowledge.



Map 4.3: UK Patent Family Members for Genetic Resources and associated Traditional Knowledge

Map 4.3 shows the global distribution of patent family members linked to UK data. In considering this map it is important also to focus on the ranked data as provided in Figure 4.9 A number of observations need to be made on counting global patent activity linked with genetic resources. The first of these is that data for the European Patent Office and the Patent Cooperation Treaty includes administrative republications of documents with search reports. These documents have been removed from the counts. Second, patent data from Australia suffers from a known problem that into the early part of the 21st century Patent Cooperation Treaty applications that names (designated) Australia treated these documents as actual applications even if they did not ultimately become applications on the national level (enter the national phase). The outcome of this is that demand for patent protection is inflated for Australia. However, this problem could, in our view, only be fixed by the Australian Intellectual Property Office or by a measure such as counting only patent grants.

A different kind of problem applies in the case of countries such as India. In this case demand for patent protection is likely to be higher than stated because Indian patent data is not fully available. We therefore expect that data for India is an underestimate.

This data is important in the context of the ratification of the Nagoya Protocol because it demonstrates that it is possible to track UK patent activity involving genetic resources and traditional knowledge around the world. As discussed in detail elsewhere it would also be possible to track a statement on disclosure of origin or reference to an international certificate of origin that appeared in a patent application around the world.[38]

Patent data of this type also provides a route in to the analysis of wider questions focusing on the role of patents in technology transfer and foreign direct investment (FDI) in third countries for research and development involving genetic resources. In addition, global family data is ultimately linked to the potential analysis of economic issues around licensing and links to income for marketed products in third countries based on genetic resources and traditional knowledge.

4.4 UK Patent Activity by Assignees (Applicants):

Figure 4.10 displays UK patent activity by top assignees (applicants) using three measure: a) the number of publications in the major jurisdictions; b) the appearance of a species name in the title, abstract or the claims, and; c) the occurrences of a species name in the claims. The data in Figure 4.10 is ranked on the number of publications (applications and grants).

Figure 4.10 demonstrates that based on the number of publications containing a species name, activity is dominated by Unilever UK and is accompanied by high rankings for its common co-applicants Unilever N.V. (Netherlands) and Hindustan Unilever. This UK based multinational is followed by the Glaxo group, and Astrazeneca (including the former Zeneca Ltd). The UK division of Swiss based Syngenta is active in the patent system for plant biotechnology. In other cases, foreign companies and universities appear in the list based on co-application with a UK inventor as an inventor or as co-applicants with a UK company. As this makes clear, patent assignee data for the UK is not a straightforward matter of simply UK domiciled companies but also involves UK subsidiaries of overseas firms and joint applications with overseas firms. Of these the most striking, and consistent, is joint patent applications between Unilever UK and Hindustan Unilever in India. As the prominence of Zeneca (now AstraZeneca) in the patent data suggests, it is also important to consider mergers, acquisitions and changes in country names over the years. This will affect the ability to adequately track access and benefit-sharing arrangements. However, commercial patent providers provide a “Corporate Tree” service which tracks all mergers and acquisitions in patent data.

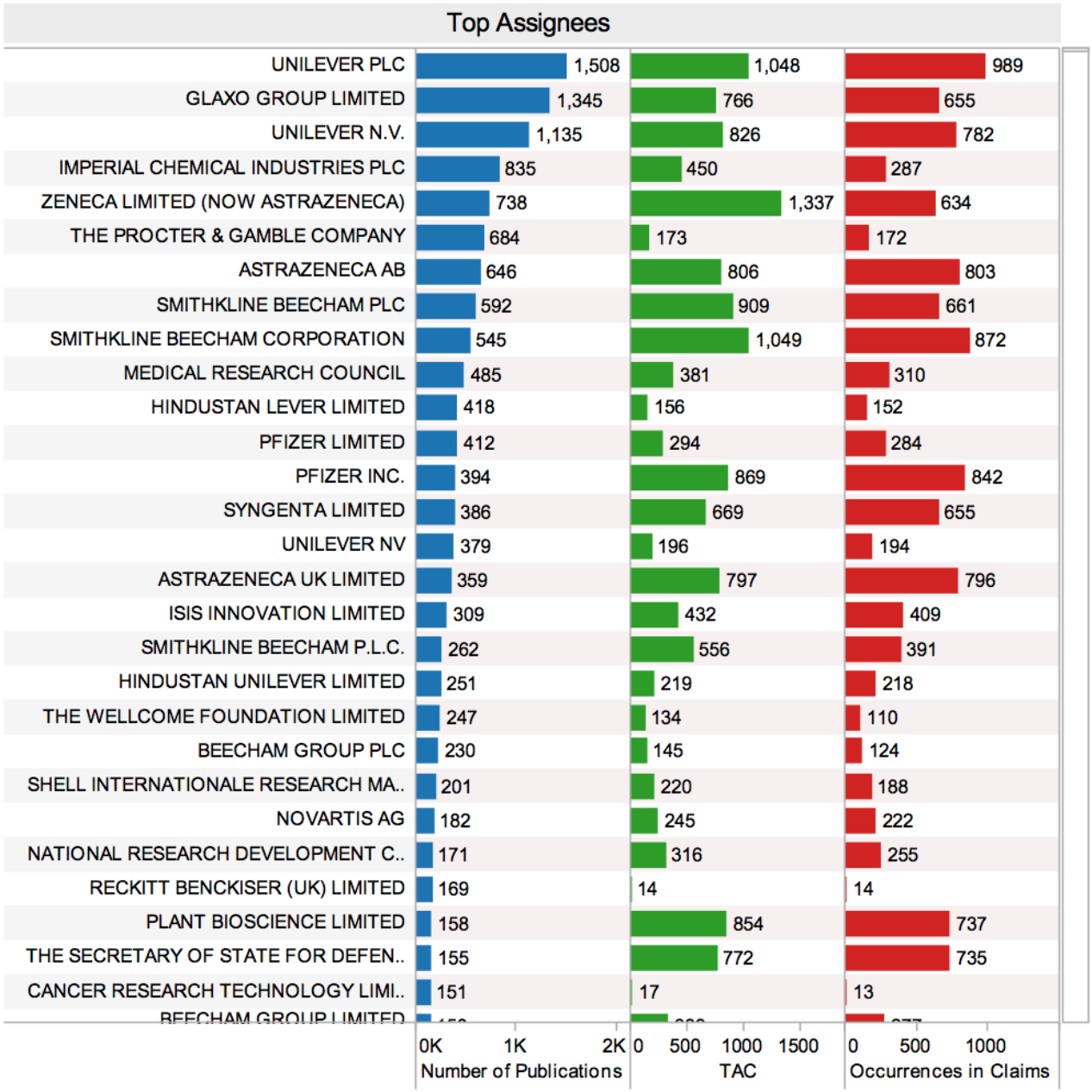


Figure 4.10: Patent Activity by UK Applicants Ranked on Publication Counts

Figure 4.11 switches the focus of the analysis of assignee data by ranking assignees based on the appearance of a species name in either the title, abstracts or the claims of a patent document. This type of analysis reveals who is working most intensively on genetic resources in patent documents. However, it may be noted that in some sectors (such as pharmaceuticals) a species name may only appear in the description section of a patent document. In contrast in agriculture related patents only the common name of a species (i.e. rice) may appear in the claims section. The data below does not address the issue with pharmaceutical companies but does include common name scores for major agricultural crops.

This approach elevates the ranking of Astrazeneca (formerly Zeneca Limited) and SmithKline Beecham (UK and US divisions). We also observe the prominence of a little known biotechnology company Ultra Biotech Limited. Ultra Biotech Limited applications are strongly associated with Hong Kong (China) and individual inventors with Chinese

nationality (CN). In a small number of cases the patents involve a UK inventor as a co-applicant. In practice Ultra Biotech Limited appears because it is registered in Douglas on the Isle of Man (a UK Crown Dependency). Ultra Biotech does not appear on the UK Companies House list of registered companies. However, it does appear as an active company in the Isle of Man registered companies maintained by the Isle of Man government.[39] It appears at least possible that Ultra Biotech Limited is a holding company for an operation that is based in Hong Kong. Nevertheless, as a non-EU crown dependency it raises the question of whether UK and EU legislation on access and benefit-sharing would apply in the case of filings submitted by applicants based in the crown dependency. This may merit further discussion.

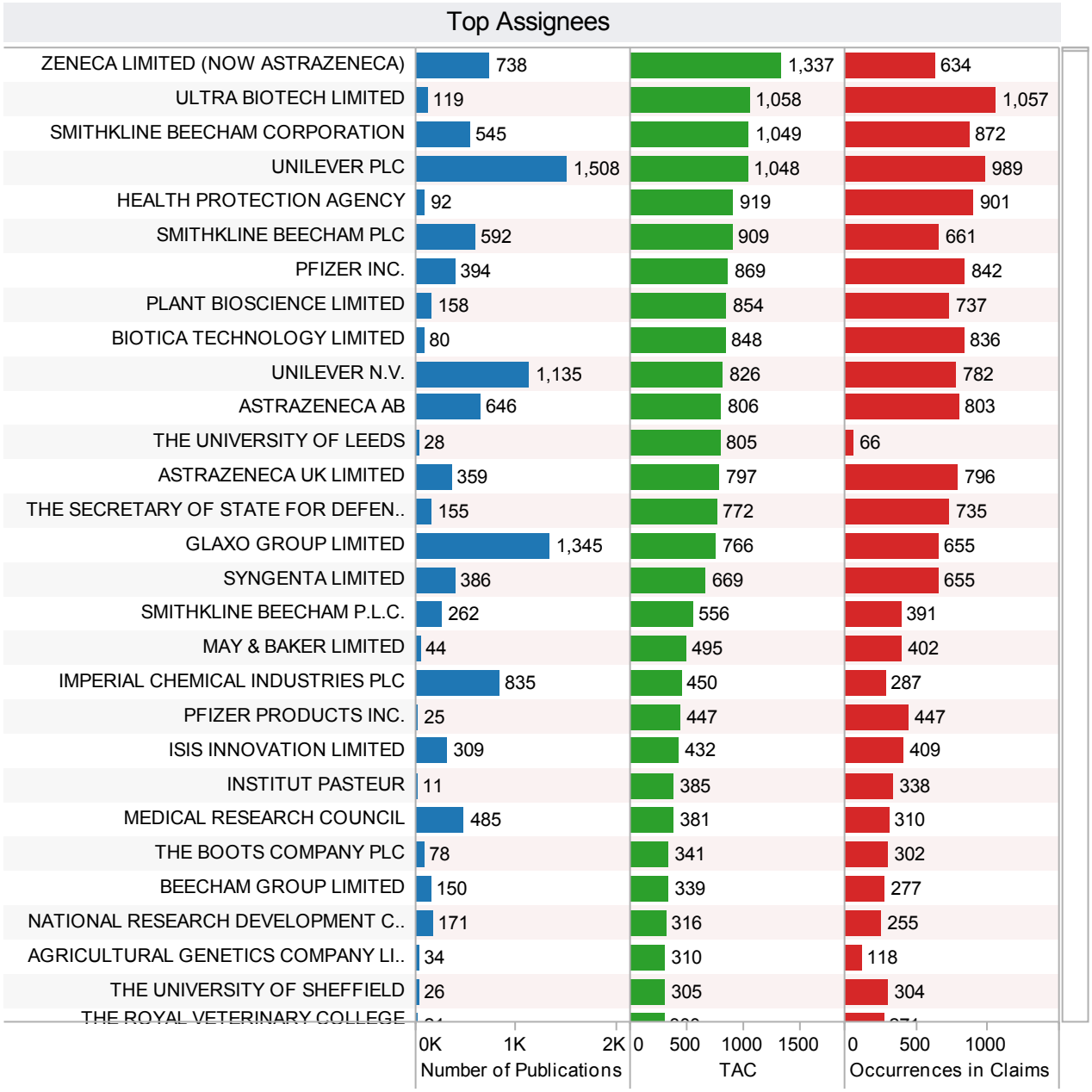


Figure 4.11: UK Patent Applicants Ranked on Species in the Title, Abstract and Claims[40]

4.5 Areas of Technology (sectors):

Technology areas for UK patent activity can be defined using the International Patent Classification (IPC). The IPC is a technical classification that describes the contents of patent documents. The IPC is a hierarchical classification that can be used to describe documents at different levels of detail. Figure 4.12 provides a broad view of a technology area. For example code A61K includes pharmaceuticals, traditional medicines from plants and cosmetics. The data is ranked based on the appearance of a species name in the Title, Abstract or Claims (TAC) and excludes model organisms.

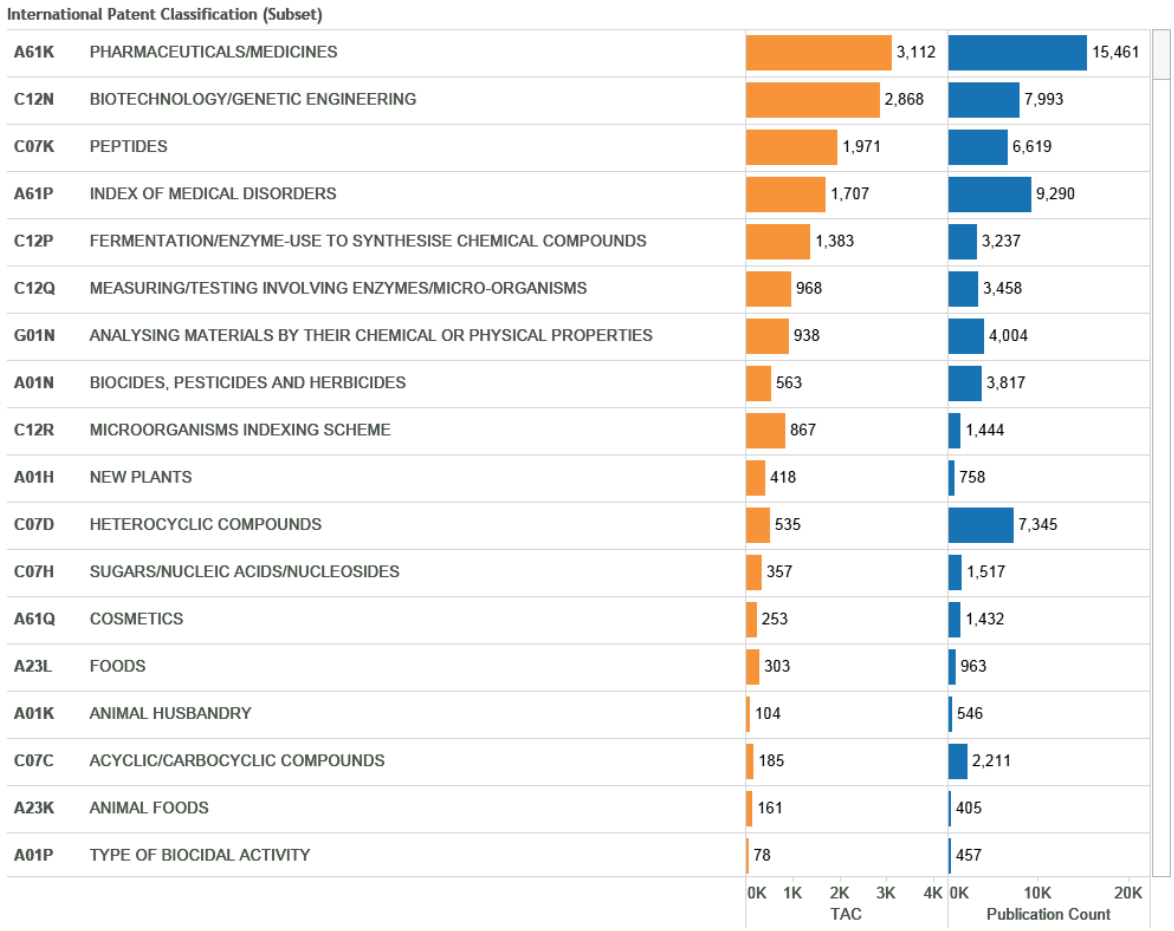


Figure 4.12: Technology Areas by Major Classification (Subclass Level)

Figure 4.12 is useful because it demonstrates that UK patent activity involving species is targeted towards pharmaceuticals, genetic engineering, and peptides. Heterocyclic compounds also appear prominently (typically as pharmaceutical compounds) with plant agriculture also featuring in the top ten. Genetic engineering involving animals (A01K) appears towards the base of the list. This type of data is relevant because, for example, cosmetics appears much lower in the range of technology areas where species appear in the title, abstract or claims than would be the case with other countries, notably France, where cosmetics is a larger industrial sector.

The most detailed level of classification is provided on the sub-group level as provided in Figure 4.13.

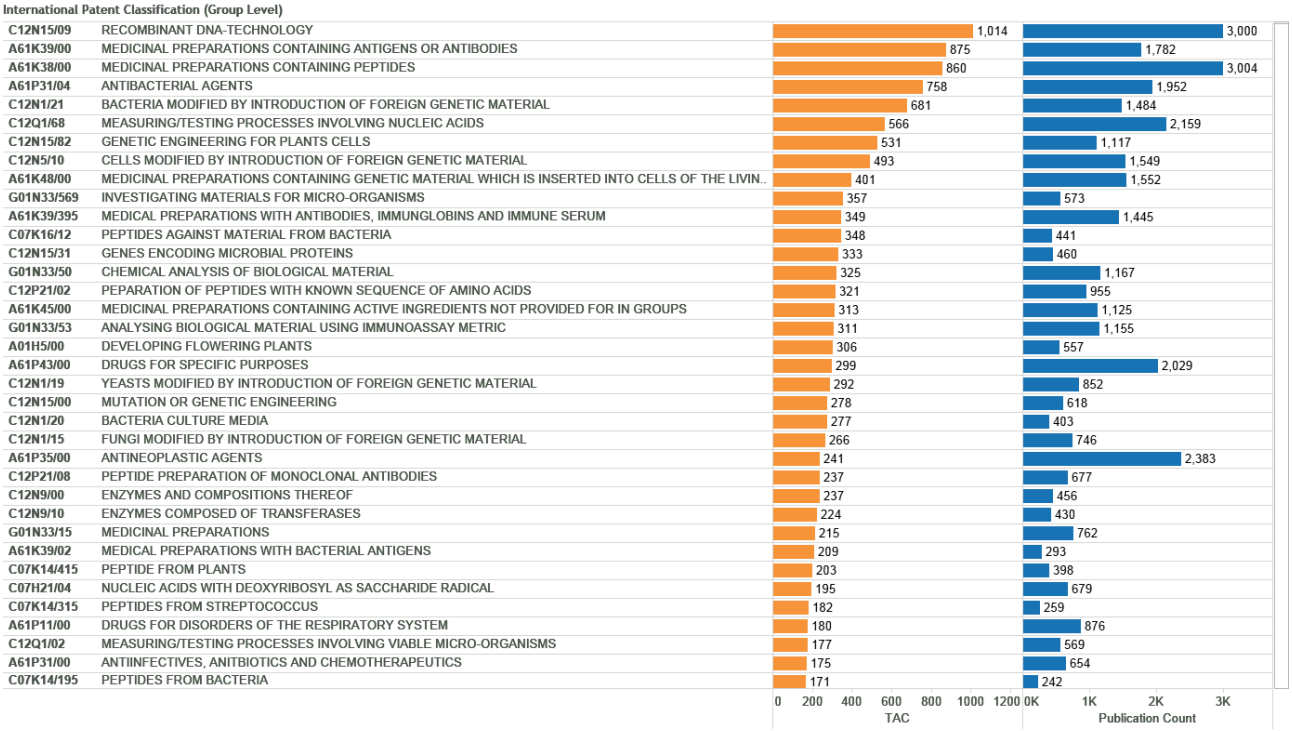


Figure 4.13: Technology Areas (Detailed)

At this level of analysis genetic engineering, notably recombinant DNA technology becomes prominent followed by pharmaceuticals containing antigens, antibodies, peptides and antibacterial agents. Towards the middle of the figure we observe genetic engineering techniques including transformation with viruses, the use of vectors for the expression of desired properties in plants. This is followed by a range of testing procedures such as immunological testing and assays. Towards the lower end of the figure we find descriptive classification codes for anticancer agents, cardiovascular and nervous disorders, with particular forms of heterocyclic compounds appearing at the end of the list.

As noted above, the IPC is a technical classification. In terms of estimating the economic value of patents involving genetic resources, further work may be desirable to explore harmonization with trade classification systems and establishing links between particular species in technology sectors and marketed products. This would require significant methodological development.

4.6 Identifying Valuable Patent Activity:

This section reviews the evidence for UK patent activity involving genetic resources that have economic value. Identifying economically valuable patents presents important challenges because the linkage between a marketed product and a patent document, or set of patents, can be difficult to establish.

Two main measures are used in patent analysis to identify valuable patents. The first is patent citations and the second is patent family size. We focus first on patent citation data.

4.6.1 Citation Counts:

One measure of the value of patents is their impact on later applicants through citations. These citations narrow the scope of claims by future applicants. This means that more frequently cited patents are more important because of the impacts that they have on other patent applicants. In compiling this data we used the latest available citation data from Thomson Innovation.[41] Figure 4.14 displays the top cited patent documents across the UK collection at the European Patent Office, the US Patent Office and the Patent Cooperation Treaty.

WO1992001047A1	1992	Methods for producing members of specific binding pairs	Cambridge Antibody Technology and the Medical Research Council	Biotech	Thermus aquaticus	966
US4816397A	1989	Multi-chain polypeptides or proteins and processes for their production	Celltech Ltd	Biotech	Staphylococcus aureus	848
US5565332A	1996	Production of chimeric antibodies-a combinatorial approach	Medical Research Council & Cambridge Antibody Technology	Biotech/ Medical	Thermus aquaticus	701
WO1986001533A1	1986	Production of Chimeric Antibodies	Celltech Ltd.	Biotech/ Medical	Dermatophagoides pteronyssinus; Staphylococcus aureus	561
US4545382A	1985	Sensor for components of a liquid mixture	Genetics Int Inc		Acinetobacter calcoaceticus; Pseudomonas aeruginosa	522

Figure 4.14: Top Cited Patent Activity (by species)

The top cited patent in the UK data is a patent by Cambridge Antibody Technology and the Medical Research Council, for methods of producing specific DNA binding pairs. This document makes reference to the well-known bacteria *Thermus aquaticus* in the body of the text but does not appear to involve a claim to the species. *Thermus aquaticus* is an

extremophile that was originally identified in Mushroom Pool in Yellowstone National Park in the United States. It is the source of Taq DNA polymerase that is widely used in the Polymerase Chain Reaction (PCR) techniques to amplify (multiply) samples of DNA. The remaining species in the top 5 cited UK patent documents also only contain species references in the description rather than in the title, abstract or claims.

One problem in interpreting patent data on citations is determining whether a genetic resource is material to (part of) the claimed invention. To achieve this the data can be analysed according to whether a species appears in the Title, Abstract of Claims. Because patent documents may be formatted in a variety of ways, determining the document section, notably the claims, can prove difficult. Furthermore, analysis restricted to the title, abstract or claims will not capture cases where a species that is the source of a claimed compound is only referenced in the description. For this reason it is important to be flexible in reviewing the data.

Figure 4.15 presents a breakdown of the overall UK data compared with data limited to the Title, Abstract and Claims (TAC) with one or more citations.

Type	All Species	Citing +1 (Species)	Species in TAC with citation*
Animalia	3,762	3,056	728
Archaea	80	57	29
Bacteria	2,179	1,933	832
Chromista	222	212	43
Fungi	1,692	1,544	538
Plantae	3,922	3,254	1,171
Protozoa	327	298	140
Virus	111	94	35
Total	**12,295**	**10,448**	**3,516**

Figure 4.15: Species in Title, Abstract or Claims and Patent Citations (Species Count)[42]

The summary in Figure 4.15 is useful because it highlights that only a proportion of species appear in patents with a citation and a smaller proportion of those species appear in the Title, the Abstract or Claims.

We now approach the citation data by focusing on the overall characteristics of the citation data for each kingdom and then focus the analysis where relevant based on species in the Title, Abstract or Claims.

Top Cited Species by Kingdom:

The top cited species can be approached by Kingdom to provide an overview of the most important categories of organisms to UK applicants.

Animalia:

In total we identified 3,762 animal species in UK patent data. Of these 3,056 species appeared in patent documents with one or more citation. This data is dominated by references to the Chinese hamster (*Cricetulus griseus*) as an experimental model. This is followed by *Spodoptera frugiperda* (the Army Worm) as a pest in crops. The domestic mouse (*Musca domestica*) ranks third followed by *Autographa californica* (the Alfalfa looper moth) as a crop pest and *Heliothis virescens* (the Tobacco budworm moth) as another significant pest. Finally the mosquito (*Aedes aegypti*) as a vector for Dengue and Yellow fever is another important focus of activity. As such, it is reasonable to argue that animals typically appear in UK patent activity because they are experimental models or because they are agricultural or other pests.

We then narrowed the focus to the 728 animal species with more than one citation that appear in the Title, Abstracts or Claims of UK patent data. The top cited animal species appearing in the Titles, Abstracts of Claims of UK patent data are as follows. *Cricetulus griseus*, or Chinese hamster, appears in a patent for humanised antibodies with 614 citations (WO1991009967A1). *Dermatophagoides pteronyssinus* (the house dust mite) ranks second in a patent with 561 citations for the production of chimeric antibodies (WO1986001533A1). 30 animal species appear in a highly cited patent for biocides led by *Aedes sp.* (mosquito species) with 485 citations (in EP295117A1). This and similar examples reveal the prominence of animalia as targets for inventions in the field of biocides. *Spodoptera frugiperda*, the army worm, also appears prominently in a patent for pyramidine compounds with 414 citations (WO2000039101A1). Again the species is the target of an invention rather than its source. This pattern is repeated in the top cited animal patents until we arrive in the middle rankings with 145 citations.

We move closer to results that are relevant to the Nagoya Protocol with *Crotalus adamanteus* (the diamond rattlesnake) as a source of the enzyme L-amino acid oxidase venom type 1llu in a patent by the Genetics Inst Inc involving UK inventors and a UK first filing for a Bioelectrochemical assay and apparatus with 145 citations (EP184909A2). However, the source of the samples used is not given. A similar case is found with *Crotalus atrox*, the western diamondback rattlesnake, as a source of a compound used in connection with creating nucleoside analogues in a patent by the Wellcome Foundation with 131 citations. However, the snake venom 5'-nucleotidase (EC 3.1.3.5) from the species appears to be involved in a reaction step leading to the claimed nucleoside analogues rather than being material to the claimed nucleosides (EP434450A2). It should be noted that this species is not directly referenced in the title, abstract or claims This highlights the technical difficulties that can be experienced in interpreting patent documents involving genetic resources.

Another relevant example is provided by a patent application by Zeneca Ltd for a gene switch comprising an ecdysone receptor that has been cited 116 times (WO1996037609A1). This case involves a number of insect species such as *Aedes aegypti*, *Bombyx mori* and *Heliothis virescens,* among others, that focus on an insect steroid receptor protein capable of acting as a gene switch that responds to a chemical inducer. The gene switch could potentially be used to treat cancers. This example

demonstrates that insects can be a source of useful products as well as targets. Because the claims focus on a DNA sequence for the *Heliothis virescens* ecdysone receptor this is also a potential access and benefit-sharing case. *Heliothis virescens* is a moth that is distributed in the USA, Mexico, Guatemala, Panama and the Antilles. Details of the source are not provided by the applicants although it is possible that the data came from a DNA library.

Marine Animals:

In a preliminary review of UK patent activity involving marine species we identified an initial 167 marine animals in UK patent data. Of these approximately 58 appeared in the Title, Abstracts or Claims with 45 species receiving one or more citation.

The most prominent example of a marine species in the UK citation data is the well known jelly fish species from the waters off Vancouver Island *Aequorea victoria,* which features in a patent cited 87 times that focuses on a Jellyfish Green Fluorescent Protein (GFP) (WO1996027675A1). This patent application by the Medical Research Council claims a DNA sequence encoding Green Fluorescent protein (GFP) that has been modified from the wild type to allow for more efficient expression in a plant cell. GFP is an important marker tool in biotechnology and patent activity in this area is a particular focus of concern in areas such as biotechnology and synthetic biology.

A second example is provided by the Spanish company Pharma Mar SA with UK individuals as co-applicants and inventors. A patent for dehydro-didemnin B with antiviral, anti-tumoural and cytotoxic activity and immuno-modulator properties is derived from the Mediterranean tunicate *Aplidium albicans* (sea squirt) and has received 78 citations. The references to the organism in the Title, Abstract and Claims are limited to the term “tucinate”. A second example by the Spanish company Pharma Mar SA with UK individuals as co-applicants and inventors has received 28 citations (WO2001077115A1). This patent focuses on Antitumoral Ecteinascidin Derivatives for use as potential antitumour agents that are derived from marine invertebrates such as *Ecteinascidia turbinata* with a particular focus on ecteinascidin derivatives. References to other patent literature suggest that the source of the organism may have been in the Caribbean although GBIF also records the species in Tunisia and Egypt.

Pharma Mar SA is also the lead applicant with UK individual co-applicants and inventors for a third patent, focusing on three new cytotoxic macrolides from a marine sponge, that has received 11 citations (WO1997010242A1). The three compounds derive from the marine sponge *Fasciospongia rimosa*. According to GBIF this species is known to occur in Australia, New Caledonia and Vanuatu.

Finally, in the case of Antarctica, the marine Krill (*Euphausia superba*) appears in a patent for a Bioeffective Krill Composition by the Norwegian company Aker Biomarine with UK individual co-applicants and inventors (WO2008117062A1). Patents relating to Krill have increased in the global patent system in recent years and raise questions about the conservation status of this important Antarctic marine species. The patent has received 14 citations situating it towards the lower end of UK citation data.

In conclusion for UK data involving animals, the UK data reveals that top cited animal organisms are typically either experimental models or pests that are the target of patent activity. In a small number of cases pests may also be the source of particular compounds or sequences that are material to an invention. Species that are more likely to fall within

the scope of the Nagoya Protocol appear much lower down the list of important UK patents when measured on document citation counts. The available data suggests that marine species are an important emerging component of UK activity that merits further research. Further details of marine organisms in UK data are provided in the marine section of this report.

Archaea:

Archaea are a kingdom of single celled organisms that lack a cell nucleus. We identified 80 members of Archaea in the UK patent data in 733 patent documents. Of these, approximately 29 species appeared in the Title, Abstract or Claims of patent documents with a citation. We discuss the citation data for Archaea in general terms and highlight cases where a species appears in the Title, Abstract or Claims.

Archaea are mainly of interest in science and technology as extremophiles. The top ranking Archaeon across the UK data is *Pyrococcus furiosus* which is an extremophile in terms of its ability to survive high temperatures. The species was originally discovered on Vulcano Island in Italy. The second ranking species is *Sulfolobus solfataricus*. This species is another extremophile that exists in volcanic springs. In contrast, *Thermococcus litoralis* is an extremophile that was originally discovered around a deep sea hydrothermal vent.

The Archaeon that has attracted the highest citation is *Thermococcus litoralis.* This species appears in a patent cited 248 times for end-complementary polymerase reaction by the Glaxo Group (US5834252A). This patent makes reference to the use of a commercial enzyme Vent from New England Biolabs.

Extremophile archaeon are also of interest in the emerging field of synthetic biology. For example a patent originating from the Scripps Research Institute in the United States with UK researcher Jason W. Chin listed in the inventor and assignee field focuses on expanding the eukaryotic code (WO2004094593A2). This patent makes reference to seven archaeon including *Pyrococcus furiosus* as sources of non-eukaryotic orthogonal translational components that can be used in eukaryotic cells. This patent has been cited 78 times and illustrates the importance of components of extremophile organisms in this emerging field. However, patent activity in this area does not depend on direct field collection of organisms.

We identified 54 documents where Archaea appeared in patent claims. The most important of these was an application by ASM Scientific Inc from the United States with a UK inventor listed as a co-applicant (WO2000053805A1). The patent is concerned with ‘A Method for Direct Nucleic Acid Sequencing’ and focuses on a method that deploys a DNA polymerase from *Pyrococcus furiosus* and *Thermococcus litoralis* with 109 citations. In the same field, a patent by Illumina Cambridge Ltd. and Solexa Ltd. with 78 citations for modified nucleotides makes reference to extremophile Thermococcus species as sources of a polymerase (enzyme) for the incorporation of molecules within modified nucleotides and references the species in the claims (GB200129012D0 & WO2004018497A2). However, references to Archaea in patent claims that have received a significant number of citations rapidly decline. For example, *Sulfolobus acidicaldarius* appears in the claims of a patent focusing on a method of effecting a bioreaction submitted by a company with a UK assignee and inventor (US5021069A). This patent focuses on bioleaching of ores to retrieve metals using microorganisms. However, this patent filing from 1988 has only received 11 citations suggesting that it is not of major significance.

In reviewing patent claims relating to Archaea it is notable that they typically refer to the use of a component in a method, rather than a *per se* claim over the component itself. This suggests that applicants are using components previously identified in the prior art rather than actively conducting collections and conducting research and development that might lead to *per se* claims over novel compounds from these organisms.

Bacteria:

In total we identified 2,179 bacteria across the UK collection with 1,933 bacteria appearing in documents with a citation. Approximately 832 bacteria appeared in the Titles, Abstracts or Claims sections of the UK data with citations. We discuss the citation data for Bacteria in general terms and highlight relevant cases where a species appears in the Title, Abstract or Claims.

Across the UK data, the top ranked species attracting citations that appear in the Title, Abstract or Claims were *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella enterica*, *Streptococcus pneumoniae* and *Mycobacterium tuberculosis*. These are all pathogenic species associated with medical conditions.

To focus the analysis we reviewed all patent documents containing a bacteria with 200 or more citations in the UK data. The top cited bacteria is *Thermus aquaticus*, an organism widely used in the amplification of DNA in the form of Taq DNA polymerase with 966 citations for Cambridge Antibody Technology and the Medical Research Council (WO1992001047A1 see above). As noted above, *Thermus aquaticus* is an extremophile that was discovered in Mushroom Pool in Yellowstone National Park. It is also one of the most important organisms in the history of biotechnology. However, it is now so commonly used that it is not surprising that it appears in a highly cited UK patent. The next highly cited bacteria is the pathogen *Staphylococcus aureus* that is responsible for antibiotic resistant MRSA hospital infections. *S. aureus* appears in a patent by Celltech Therapeutics on Multichain polypeptides for use in immunoassays that has been cited 848 times (US4816397A). *S. aureus* is an intense focus of research activity as a target for pharmaceutical development and treatments.

Acinetobacter calcoaceticus is a bacteria that is part of the human flora while *Pseudomonas aeruginosa* is a common bacteria that can cause disease. Both feature in a patent application for a sensor for the components of liquids (US4545382A) by Genetics Inst Inc and Medisense Inc with a UK co-applicant and inventor. This patent has been cited 522 times. *Salmonella enterica* is commonly associated with food poisoning but also appears in a patent focusing on methods for producing members of specific binding pairs in biotechnology (WO1992001047A1, see above). *Trypanosoma brucei* is a bacteria that is the causative agent of Sleeping Sickness in humans and Nagana in animals. It appears in a highly cited patent from UK Cancer Research for inhibiting gene expression with RNA that has been cited 395 times (WO2001036646A1). A number of Bacillus species including *Bacillus badiius*, *Bacillus cerus* and *Bacillus sphaericus* appear in a patent by Medisense Inc for biochemical electrodes focusing on a disposable element for use in equipment for bioelectrochemical determination (US5126034A), with 341 citations.

Bordetella pertussis and human rhinovirus strain appear in a highly cited patent for multivalent and multi-specific binding proteins for use in diagnostic assays in medicine by Cambridge Antibody Technology with 262 citations (WO1994013804A1). *Clostridium botulinum* and *Clostridium tetani* are both pathogenic bacteria associated with illness in humans and are typically a target of patent activity. However, a highly cited patent by the

UK Health Protection Agency and Microbiological Research Authority focuses on the use of a non-cytotoxic agent that controls the release of a neurotransmitter and neuromodulator for controlling pain, with 241 citations (US5989545A).

Finally, bacteria are an important source of antibiotics. In the UK data we identified approximately 55 Streptomyces species names in the Title, Abstract of Claims of UK documents. *Streptomyces rimosus* is the focus of a patent from the Glaxo Group for protein tyrosine inhibitors for use in cancer treatments that has been cited 206 times (WO1998002438A1). Streptomyces species may also be used as vehicles for the production of novel polyketides as in a patent from the John Innes Centre that has attracted 170 citations (US5672491A). *Agrobacterium tumefaciens* features in a patent with 203 citations in agricultural focused activity by Innes Centre Innovations Limited and Plant Bioscience Ltd in methods and means for gene silencing in a range of plants focusing on *Beta vulgaris* and *Nicotiana* species (WO1998036083A1).

Bacteria such as Streptomyces are a well known target of pharmaceutical and biotechnology research in discussions on access and benefits sharing. However, it does not necessarily follow that samples collected in developing countries result in highly cited patents. For example, a patent for 3-desmethylrapamycin or derivatives thereof and their use as anti-fungal agents and immunosuppressants awarded to SmithKlineBeecham (now GSK) makes reference to the collection of samples in the Gambia as follows:

> "A culture producing 29-desmethylrapamycin has been classified as Streptomyces sp. and has been deposited in the National Collection of Industrial and Marine Bacteria, 23, St. Machar Drive, Aberdeen AB2 1RY, Scotland, UKI under the accession number NCIB 40319. The culture was isolated from a termite hill at Abuke, Gambia." (US6358969B1)

At the time of writing this patent had been cited 3 times suggesting that it has not had a major impact within the patent system. As such the field collection of potentially important species does not necessarily translate into high impact patents.

Chromista:

Chromista describes a group within the eukaryotes. In total we identified 222 Chromista in UK patent data in 1,026 documents with 43 species appearing in the Title, Abstract or Claims with a citation. We discuss the citation data for Chromista in general terms and highlight relevant cases where a species appears in the Title, Abstract or Claims.

The appearance of Chromista in UK patent data is led by *Plasmopara viticola* (a cause of mildew), *Phytophthora infestans* (potato blight), *Pseudoperonospora cubensis* (water mould), *Bremia lactucae* (a plant pathogen), *Pythium ultimum* (a plant pathogen) and *Albugo candida* (water mould). Patent activity in relation to Chromista in this category is directed towards biocides and encompasses 548 documents across the records for Chromista.

A second group of Chromista are made up of marine kelp species. These include: *Laminaria hyperborea* (a kelp), *Ascophyllum nodosum* (a kelp), *Lessonia nigrescens* (grey weed kelp) and *Macrocystis pyrifera* (Giant bladder kelp). References to kelps typically refer to sources of alginates that are useful for fibres but the species are also referenced in inventions for laundry compositions, detergents and cosmetics suggesting a range of possible uses. In conclusion, the available data for Chromista suggests that they are

mainly a target of activity but, in the case of kelps, can be important sources for a range of useful products.

Fungi:

We identified 1,692 Fungi in 6,237 UK patent documents. Of these 1,544 species appeared in documents with a citation and 538 appeared in the Title, Abstract or Claims of documents with a citation. We discuss the citation data for Fungi in general terms and highlight relevant cases where a species appears in the Title, Abstract or Claims.

Patent activity for cited UK documents is dominated by *Candida albicans* (a common cause of fungal infections), *Aspergillus brasilensis* (formerly *Aspergillus niger* and an important tool in biotechnology), *Komaataella pastoris* (*Pichia pastoris*, frequently used as an expression system), *Blumeria graminis* (a cause of powdery mildew in grass crops) and *Botrytis cinerea* (a neotropic fungus affecting grape and other fruit crops).

Other fungi appearing in the top 10 in UK patent documents include *Thermomyces lanuginosus*, *Magnaporthe grisea*, *Emericella nidulans* (*Aspergillus nidulans*) and *Thanatephorus cucumeris*. *Thermomyces lanuginosus* is a source of thermostable enzymes for use in biotechnology and other enzymes of interest for industrial applications such as detergents (i.e. EP407225A1). *Magnaporthe grisea* is rice blast fungus and a target for biocides. *Emericella nidulans* (the sexual form of *Aspergillus nidulans*) is a model organism. *Thanatephorus cucumeris* (see also *Rhisoctonia solani*) is a plant pathogen.

This reveals a mixed picture for fungi where they may be model organisms, disease agents or pests. In other cases they may be sources of compounds and other useful components. We were unable to find clear evidence for access and benefit sharing issues in the top cited documents involving fungi until we reached a patent document with 55 citations involving a sample from China. This patent from Ultra Biotech, registered in Douglas in the Isle of Man, focuses on a biological fertilizer based on yeasts and describes the acquisition of a strain of *Saccharomyces cerevisiae* from a collection in China as follows:

> "Yeasts of the Saccharornyces genus are generally preferred. Among strains of Saccharmnyces cerevisiae, Saccharomyces cereviside Hansen is a preferred strain. The most preferred strains of yeast are Saccharomyces cerevisiae Hansen strains having accession numbers AS2.501, AS2.535, AS2.441, AS2.406, AS2. 382, and AS2.16 as deposited at the China General Microbiological Culture Collection Center (CGMCC). Generally, the yeast strains can be obtained from private or public laboratory cultures, or publically accessible culture deposits, such as the American Type Culture Collection, 10801 University Boulevard, Manassas, VA 20110-2209 and the China General Microbiological Culture Collection Center (CGMCC), China Committee for Culture Collection of Microorganisms, Institute of Microbiology, Chinese Academy of Sciences, Haidian, P.O. Box 2714, Beijing, 100080, China." (WO2002020431A1) (original spellings).

This patent claims:

> 1. A biological fertilizer composition comprising at least one of the following yeast cell components: (a) a first yeast cell component comprising a first plurality of yeast cells that fix nitrogen; (b) (c) a second yeast cell component comprising a second plurality of yeast cells that decompose phosphorus compounds; or a third yeast cell

component comprising a third plurality of yeast cells that decompose potassium compounds.

9. The biological fertilizer composition of claim 2 or 4 wherein the yeast cells of each yeast cell component are separately cells of the yeast strain Saccharomyces cerevisiae Hansen deposited at China General Microbiological Culture Collection Center having an accession number selected from the group consisting of AS2.5 0 1, AS2.5 3 5, AS2.44 1, AS2.406, AS2.3 82, and AS2.16.

This patent is unusual in being highly specific and including a reference to a type culture collection in China in the actual claims. A number of other cases involving this applicant and this strain of yeast are provided in Annex 1. This case would raise access and benefit-sharing issues under the Nagoya Protocol and demonstrates that specific strains of particular organisms are important.

In addition to this example we would note that fungi can be important in traditional medicine and related patent activity. We identified 119 UK documents involving fungi in this category ranging from dietary supplements to cancer treatments and skin lightening agents. However, with the exception of references to Traditional Chinese Medicine (see China and the Traditional Knowledge sections) we found limited evidence of access and benefit sharing issues.

Plantae:

In total we identified 3,922 plant species in the UK data. These species appear in 7,976 patent documents. However, 3,254 plant species appear in documents with more than one citation and approximately 1,171 plant species appear in the Title, Abstract or Claims of patent documents with a citation. We discuss the citation data for plants in general terms and highlight relevant cases where a species appears in the Title, Abstract or Claims.

Across UK plant related patents the top cited plant species in UK patent data is *Beta vulgaris* or sugar beet in patent activity by May & Baker Ltd. in conjunction with other applicants. This patent has received 485 citations and focuses on the application of a compound to plant species for use as a pesticide (EP295117A1). The focus on biocides is repeated in the next highly cited plant species which focuses on a method for controlling arthropods, plant nematodes of helminth pests using a particular compound (US5232940A). This is followed by patent activity focusing on *Beta vulgaris* and members of Nicotiana (tobacco) focusing on methods and means for gene silencing by Innes Centre Innovations and Plant Bioscience Ltd (WO1998036083A1). Again in biotechnology, *Acacia galpinii*, *Brassica napus* and *Nicotiana tabacum* feature in activity for a plant promoter (US5268463A). Chrysanthemum mutants (*Chrysanthemum morifolium*) with rapid growth are a focus of activity by an individual inventor (US4616099A). Species already highlighted above, along with members of the Brassicas (i.e. *Brassica napus*), dominate the top cited plant species in UK patents, along with the incidental occurrence of other species.

In reviewing patent documents the dominance of those linked to biocides (1,669 publications) was striking. In some cases plants and plant pathogens are the target of the claimed invention (i.e. the application of a pesticide). In other cases, they are a source of the invention. It can be difficult to distinguish between the two possibilities (i.e. using the International Patent Classification).

In an effort to address this problem we reviewed the top citations for species appearing in the Title, Abstracts or Claims from 485 citations to 100 citations. This was combined with a

review of all records that contained a reference to a country name in an attempt to identify highly cited candidates that could originate from a developing country. The review of highly cited documents revealed common and globally distributed species. References to country names in these records did not reveal access and benefit-sharing issues.

The top cited patent that makes reference to a plant species and a developing country identified in the review is a patent application with 96 citations from Zeneca Ltd for Novel Plants and Processes for Obtaining Them (WO1994009144A1). This document refers to samples from Mexico and Peru as follows:

> "The very best forms of SSS identified (from a screen of nearly 1,000 sources of Zea germplasm) were in 4 exotic lines from Peru (Lima 38 and Lima 45) and Mexico (Guanajuato 13) and teosinte' with Q10 as high as 1.0. Three of these lines were obtained from the Plant Introduction Centre, Iowa state University: Numbers P1515021, Ames 8545, P1490879 and one teosinte line obtained from Dr John Deobley Zea mays subsp. Mexicana, Doebley 479."

This patent claims:

> "Claim 1. A method of producing a plant with altered starch synthesising ability comprising stably incorporating into the genome of a recipient plant one or more than one donor gene specifying an enzyme involved in a starch or glycogen biosynthetic pathway. 2. A method as claimed in claim 1 in which the plant has an improved capacity to produce starch at elevated or lowered temperature."

The second ranking patent that makes reference to a developing country and a plant species involves pharmaceutical compositions for the treatment of skin disorders by UK company Phytopharm with 74 citations (US5466452A). The document focuses on a variety of herbal extracts from Chinese traditional medicines for the treatment of eczema and psoriasis.

The abstract describes the invention as follows:

> "A process is provided which is suitable for the preparation of herbal compositions for the treatment of skin disorders such as eczema and psoriasis. The process comprises preparing an extract or extracts of herbs which provide an anti-inflammatory agent, an adrenocortical stimulant and a cortisol protecting agent by steam distillation and decoction and then treating the extracts to reduce the polysaccharide and/or sugar content. This is achieved by fermentation or enzymic action or by extraction with a solvent having a polarity in the range E° 0.4 to 0.95 or by precipitation with an inorganic compound and/or colloid or by a combination of two or more of the above. As a final concentration step, the material is further purified by extraction with a solvent having a polarity in the range mentioned above. The reduction of the sugar/polysaccharide content greatly improves the handling characteristics of the extract which can be dried to a free flowing powder. Tablets and capsules for oral administration can be prepared from the extract and it is also suitable for the preparation of topical compositions." (US5466452A)

Only one reference is made to China in the document. However, the claims make clear the linkage with Chinese Traditional Medicine.

> "1. A process to make a composition for treating eczema, psoriasis, pruritis and inflammatory reactions of the skin which comprises:
> (a) subjecting a plurality of herbs having anti-inflammatory activity, adrenocortical stimulating activity and corticosol-protecting activity to steam distillation and decoction, to produce an extract of the herbs;
> (b) reducing the amount of polysaccharides and/or sugars, in the extract to less than 5% by weight under conditions which do not substantially reduce the content of glycosides which are present in said material by one or more of: (i) fermenting with barley malt or with a microorganism which produces amylase and/or saccharolytic enzymes or by using isolated amyolytic or saccharolytic enzymes,
> (ii) extracting with a solvent having a polarity in the range E° 0.4 to 0.99, or a mixture of solvents at least one of which has a polarity within said range,
> (iii) precipitating the polysaccharide and/or sugar with an inorganic compound; and
> (c) concentrating the active agents present in the extracted material by further extracting with a solvent having a polarity in the range E° 0.4 to 0.99, or a mixture of solvents, at least one of which has a polarity within said range, wherein the herbs are selected from the group consisting of Potentilla chinensis (Bai Tai Weng), Rehmannia glutinosa (Dihuang), Radix paeoniae lactiflorae/veitchii (Chi Shao), Dictamnus augustifolia (Bai Xan Pi), Glycyrrhiza uralensis (Gan Cao), Ledebouriella sesloides (Fang Feng), Tribulus terrestris (Ci Ji Li), Lopatheri gracile (Dan Zhu Ye), Schizonepeta tenuifolia (Jing Jie Sui), and Akebia trifoliata (Mu Tong)."

The document claims novelty from using separate extracts of each herb that are later mixed and assayed using markers. This example illustrates that in cases such as Traditional Chinese Medicine, patent activity will typically involve multiple species in the form of herbal extracts or ingredients. In some cases, as discussed in the China section of this report, patent activity may also involve species from other countries or be sourced from a variety of suppliers. Patent activity of this type is likely to be a focus of allegations of misappropriation or biopiracy. For this reason it would be important for applicants to state where they sourced the materials from.

This example also illustrates that a patent may achieve a significant number of citations but lose significance for the applicants. The Phytopharm patent was first filed in 1991 in the UK but expired due to failure to pay the maintenance fee in November 2003. This suggests that the patent had limited economic value for the company itself. However, its importance is reflected in the impact of the patent as prior art on other applicants in the same or similar technology areas.

Finally, another highly cited patent in this area is a Unilever patent with 74 citations focusing on a liquid based gel composition for use in personal care cosmetic products involving *Corymbia citriodora* (also known as *Eucalyptus citriodora*) among other species as sources of a polysaccharide (EP355908A1). However, the precise source of the species, which is distributed in a number of countries, is unclear and in this case it is unclear whether the species is simply an optional component or whether it is material to the claimed invention.

Because of the difficulties encountered with identifying high ranking patents involving plants of relevance to access and benefit sharing using citation counts we then switched to focus on traditional medicines using the patent library classification system.

Traditional Medicines from Plants:

The orientation of patent activity towards biocides and biotechnology in the top cited patent data raises the question of how the analysis might be focused to address species that may originate from developing countries. To achieve this we used International Patent Classification code A61K36 to focus on traditional or herbal medicines from plants.

A total of 585 UK patent documents have been classified for traditional medicines from plants originating from 299 filings. This is a low level of activity compared with countries such as China, Japan and the United States. As such, we would not expect UK patent activity to reveal a high incidence of access and benefit-sharing issues in this field.

The bulk of UK patent documents involving plants and traditional medicines do not receive high citation scores with 236 documents receiving 10 citations or less. This suggests they are of limited importance.

The top ranked patent, following the Phytopharm example above, has received 65 citations and focuses on an essential oil composition submitted by two UK individuals (US6280751B1). This patent involves essential oils from a large number of species as listed in the claims:

> "1. A medicinal or cosmetic composition for oral administration comprising at least one essential oil in combination with at least one spice selected from the group consisting of asapoetidia, coconut, coriander, fenugreek and horseradish; at least one herb selected from the group consisting of Acacia Catechu, Acanthopanax Gracilistylus, Cacsalpinia Sappan, Epimedium Spinosa, Paeonia lactiflora, Paeonia obovata, Atractylodes macrocephala, Glycyrrhiza uralexisis, Glycyrrhiza glabra, Lycium chinense, Nauclea rhyncholphylla, Cinnainomum cassia, Astragalus membranaceus, Scutellaria baicalensis, Schizonepeta tenuifolia, Ephedra sinica, Ophiopogon japonicus, Paeonia suffruticosa, Artemisia annua, Aretemisia apiacea, Panax notoginseng, Cornus officinalis, Acorius gramineus, Reluhania glutinosa, Gastrodia elata, Asparagus cochiichinensis, Cuscuta chinensis, Schizandra chinensis, Schizandra spenanthera, Magnolia liliflora, Epimedium brevicomum, Epimedium grandiflorun, Epimedium sagittatum, Houttuynia cordata, Polygala tenuifolia; and Perilla frutescens, and an Aloe Vera extract" (US6280751B1).

This example illustrates that a single invention may involve a large number of species that may originate from multiple countries. In this case the applicant refers to species from China and states that: "They are mostly imported from Hong Kong, although some come from mainland China via Beijing and Shanghai. Increasingly, as China opens its doors to the West, better access will be granted for importing herbs" (US6280751B1). This patent reflects a wider reality that applicants will, where possible, rely on commercial suppliers of materials rather than direct field collections.

A second highly cited patent in this area is US5693327A from a UK individual that claims "A therapeutic composition comprising a therapeutically useful form of the plants Melia azadirachta and Centratherum anthelminthicum". This patent has been cited 39 times. *Melia azadirachta* is listed by GBIF as occurring in Colombia, Cuba, India, Japan, Sri Lanka and Tanzania. In the United States it has been listed as an invasive species. *Centratherum anthelminthicum* is commonly known as black cumin and is used in Indian Ayurvedic medicine. The precise source of the materials claimed in this patent grant are unclear. However, the patent has not generated a significant patent family and is confined

to the United States. This strongly suggests that it has generated citations because of the broad nature of the claims. Thus the claims include:

> "1. A therapeutic composition comprising a therapeutically useful form of the plants Melia azadirachta and Centratherum anthelminthicum.
> 2. A composition as claimed in claim 1 further comprising a therapeutically useful form of at least one plant selected from the group consisting of Phyllanthus emblica, Hemidesmus indicus, Tinospora cordifolia, Curcuma longa, Terminalia chebula, Terminalia belerica, Berberis aristata, Zingiber officinalis, Piper longum, Piper nigrum, Rubia cordifolia, Smilex china, Glycerhiza glabra, Picrorhiza curroa, Curcuma aromatica and Asparagus racemosus." (US5693327A)

This type of patent grant could therefore be linked to issues of patent quality where broad claims to efficacy involving multiple species impact on future applicants operating in the same area of research and development.
A fourth example reveals that species may come from European countries. Patent document EP85579A2 by Efamol Ltd. for a topical pharmaceutical composition focuses on a skin treatment involving *Borago officinalis* and *Oenothera biennis* and has been cited 43 times (see also patent grant EP85579B1). This patent makes reference to oils with high y- linolenic acid from Evening primrose (*Oenothera biennis*) and Borage (*Borago officinalis*) for use in a process oriented invention focusing on mixing a lithium salt with linolenic acids to create prostaglandins for use in the invention. This case highlights that European species are a significant focus of inventive activity and extends to common species such as Rosemary among others.

Plant Species and Pharmaceuticals:

Looking outside the data for species listed in the patent classification as involving traditional medicines from plants we are able to identify a number of species connected with pharmaceuticals.

A potential South American species *Erythrina cristagalli,* along with its Australian cross *Erythrina x bidwillii,* appears in a patent from the Microbiological Research Authority and Speywood Laboratory. The patent focuses on Conjugates of Galactose-Binding Clostridial Neurotoxins as Analgesics and has been cited 102 times (WO1999017806A1). The applicants make general reference to *Erythrina* and provide scientific literature references but do not disclose the exact source of the material. This particular patent involves a combination of genetic material from Clostridium bacteria with a lectin from *Erythrina cristagalli* and thus demonstrates that species components can act in combination (see bacteria above) to produce a claimed invention.

A second example is the use of Saponins from *Quillaja saponaria* in a vaccine adjuvant composition by GlaxoSmithKline (GSK) in a patent that has been cited 70 times (US6544518B1). *Quillaja saponaria* is known as the Soap bark tree with occurrences recorded by GBIF in Bolivia, Chile, New Zealand, Panama, Spain and the United States. The applicants refer to Quil A as a known saponin "derived from the bark of the South American tree Quillaja Saponaria Molina" and provide references to other patents and the scientific literature (US6544518B1). However, no further information is provided on the precise source of the materials. In our view the nature of the references suggest that the patents relate to the use of a previously known compound in a vaccine adjuvant.

A third example is *Camptotheca acuminata* (sometimes spelled *Camptotheca accuminata*), the Chinese Happy Tree, which has been a focus of research and development leading to the anticancer treatment Topotecan (marketed as Hycamtin) by GlaxoSmithKline (GSK). The most important patent in relation to this species that is relevant to the UK was originally filed by a US company Smithkline Beecham Corp before being taken over by what is now GSK (US5004758A). In the UK patent data patent activity for *Camptotheca acuminata* includes activity by the University of Bristol, for increasing isoprenoid biosynthesis, that makes reference to genetic modification of plants including this species and the widely cultivated Madagascan periwinkle (*Catharanthus roseus*) (WO2001031043A1). The PCT application has attracted 8 citations by later filings.

What this data reveals is that unusual plant species which may originate from other countries typically feature much further down the list of highly cited species than more common and widely distributed species. As such, based on the available data, these species will typically be of less importance than more common species for UK research and development. However, it is important to recognize that there will be exceptions.

Protozoa:

Protozoa are unicellular (single celled) eukaryotic organisms. We identified a total of 327 protozoa in 3,494 UK patent documents. Of these, 298 Protozoa appeared in a document with a citation falling to 140 species appearing in the Titles, Abstracts or Claims in documents with a citation. Across the data as a whole references to protozoa are dominated by *Plasmodium falciparum* (malaria parasite), *Klebsiella pneumoniae* (pneumonia), *Trypanosoma cruzi* (Chagas disease), *Toxoplasma gondii* (toxoplasmosis), *Klebsiella aerogenes*, *Trypanosoma brucei* (sleeping sickness) and *Entamoeba histolytica* (amoebiasis). As the list of conditions associated with these organisms suggests, the main focus of UK activity that references these species is treatments, including antibiotics and other compounds.

A total of approximately 140 protozoa appear in the Title, Abstract or Claims of 2,609 documents that have received one or more citation. The top cited patent, with 485 citations, focuses on a biocide that can be applied to Plasmodium, Trypanosoma, Leishmania and Eimeria (a parasite in poultry) species (EP295117A1). Typically, these species are either the target of the invention or immunological reactions to these species in other species, notably humans, become the focus of the claimed invention. For example, a patent by Unilever and other applicants with 144 citations references reactions to a range of trypanosome species in camels as the basis for the identification of antibodies derived from heavy chain immunogblobulins in Camelidae (WO1994025591A1).

Patent documents that make reference to countries and Protozoa frequently refer to the occurrence of a disease, or drug resistant strains, in particular countries (i.e. mefloquine resistance in Thailand). In other cases a particular strain from a country may be the focus of research and development leading to a claimed invention. For example US20050070595A1, by a group of UK individuals, focuses on Trioxane derivatives as anti-malaria or anticancer compounds. The applicants explain that:

> "The antimalarial activity of the new dimers was tested against the chloroquine-resistant K1 strain of P. falciparum. A single uncloned K1, chloroquine resistant strain of P. falciparum from Thailand was used. Parasites were maintained in

> continuous culture using the method of Trager and Jenson. (J. Parasitol, 1977, 63, 983-886)." (US20050070595A1)

The focus of the invention is actually the protozoacidal activity of bis(deoxoartemisinin-10-ylethyl) methyl phosphate (P40) as a counter to the K1 strain of *P. falciparum*. As such, the sample of the organism from Thailand is the target of the invention rather than material to the invention.

In considering protozoa it is important to emphasise that these organisms are an important major health problem in biodiversity rich developing countries. Patent activity will typically target these species, or particular resistant strains of a species from a given country. It is therefore important to recognize that while the particular strain may be a focus of research and development it is not necessarily material to the claimed invention. That is, the invention does not typically include genetic material from the target organism. While there may be exceptions to this they are likely to be rare.

Viridae:

We identified 111 viruses in 1,573 patent documents from the UK with 94 species appearing in documents that contain a citation and 35 appearing in the Title, Abstract or Claims of documents with a citation. We would emphasise that information on viruses may be incomplete because of the difficulties of taxonomic nomenclature and the variety of terms that may be used i.e. HIV or human immunodeficiency virus etc.. We would expect that further research would increase the overall coverage of viruses in UK data. We discuss the citation data for viruses in general terms and highlight relevant cases where a species appears in the Title, Abstract or Claims.

The top ranking viruses in the UK data as a whole are human papillomavirus, human adenovirus, hepatitis viruses, human rhinovirus strain, goose adenovirus, bovine papillomavirus, human herpesvirus, canine parvovirus, bovine herpesvirus and canine adenovirus. As such the data mainly focuses on viruses that affect humans.

The highest cited patent that references a virus in the Title, Abstract or Claims is from Cambridge Antibody Technology and the Medical Research Council with respect to Human rhinovirus with 262 citations (WO1994013804A1). This is followed by human papillomavirus with 218 citations (US5232940A & WO1999015500A1), bovine papillomavirus with 162 citations (WO1996004388A1), and human adenovirus with 135 citations (WO1996004388A1).

We do not anticipate that viruses will raise major access and benefit-sharing issues with the exception of three important circumstances:

1. Where a specific strain of a virus is collected in a particular country and is claimed in the patent. We have not identified an instance of this in the UK data but it is known to exist (i.e. for a HTLV virus from Cameroon in US2010317034A1);
2. Where a patent claims components of a virus for use in a vaccine. In this case approximately 206 UK documents of 1,573 claim a use in a vaccine;[43]
3. The use of a component of a virus in a diagnostic tool. We have identified a preliminary 54 documents where this could be relevant. However, this would apply in circumstances where the viral component was collected from a contracting Party to the Nagoya Protocol;

The exchange of live viruses became a major access and benefit-sharing issue in connection with influenza virus samples from Indonesia in the context of fears of a pandemic. This resulted in the development of the World Health Organization (WHO) Pandemic Influenza Preparedness (PIP) framework in 2011.[44] The PIP framework is restricted to Pandemic influenza viruses and does not address other viruses.

In considering data on viruses, we would caution that in a significant number of cases research and development targeting a virus involve comparative analysis using a large number of samples to develop diagnostic tests or treatments. This is particularly notable in patents involving references to HIV or cross-species barrier viruses (i.e. Simian Immunodeficiency Viruses or SIVs). These patents typically involve long lists of virus samples from a wide range of sources for analysis. This could lead to misunderstandings where a reference to a sample is confused with an actual claim over a sample or its components originating from a Contracting Party to the Nagoya Protocol.

While recognising that there are circumstances where the Nagoya Protocol would apply in these cases it is also likely to be important to promote understanding that patent activity involving large numbers of samples is frequently directed to diagnostic tests that do not necessarily make a claim over the virus samples.

Conclusion:

The main conclusion that can be drawn from a review of top cited UK documents involving genetic resources and associated traditional knowledge is that highly cited UK documents do not typically involve access and benefit-sharing issues. At best, based on the available data, patents that involve access and benefit-sharing will in a limited number of cases be mid-ranking and in the majority of cases low to mid ranking in terms of citation scores. This does not mean that they are unimportant. Rather, it means that they are not UK patents with the highest impacts within the patent system.

On balance the available citation evidence suggests that the Nagoya Protocol will not have significant impacts on economically important UK patent activity. We now turn to the analysis of valuable UK patents based on the size of patent families.

2.6.2 Patent Family Data:

A patent family is a set of patent documents published anywhere in the world that link back to an original filing. The easiest way to understand a patent family is as a stack of documents published in multiple languages in different countries that link back to a parent document at the bottom of the stack. This document is known as the first filing or “priority” document within the patent system.

The size of a patent family is an important indicator of the economic importance of a patent to the applicant. The reason for this is that each time an applicant files to protect an invention in another country they must pay fees for the examination of the application and later maintenance of a granted patent. Furthermore, patent families provide an indicator of the international importance of patents, including links to technology transfer and Foreign Direct Investment in third countries by UK applicants.

As discussed above, we identified 19,762 first filings involving UK applicants that were linked to 34,912 publications of applications and grants at the European Patent Office, the

United States Patent and Trademark Office and the Patent Cooperation Treaty. These first filings were linked to 260,349 follow on filings in 91 countries around the world.

In this section we provide a brief over view of the top UK patent families involving a genetic resource or associated traditional knowledge. Because patent families are clustered on INPADOC numbers we provide a representative publication number for each patent family. We reviewed 128 first filings of patent documents with 100 or more family members worldwide on the basis that this would reveal the most important UK patent documents. We provide information on the top ten families and additional examples on high ranking marine and Antarctic organisms.

An Overview of UK Patent Families involving Genetic Resources:

The top patent families identified in UK data possessed 557 and 516 members respectively. The largest patent family refers to Albumin fusion proteins for a therapeutic protein to treat metastatic renal cell carcinoma, other cancers, HIV and a wide range of disorders, with 557 family members (US20050266533A1). The patent family belongs to Delta Biotechnology Ltd in the UK (now owned by Novozymes) and Human Genome Science Inc in the United States. The patent makes reference to a large number of species but focuses on a human serum albumin protein as a carrier molecule. The invention is actually concerned with fusing a therapeutic protein to albumin to stabilize the protein to allow for increased shelf life of a product. The extensive references to species in the document refer to the application of the invention to a range of therapeutic proteins that target diseases from the organisms. As such, while making use of a genetic resource the invention does not appear to raise access and benefit-sharing issues. The second ranking patent on family size relates to Monoclonal Antibody hPAM4 with 516 family members (WO2003106495A2) by Immunomedics Inc and a UK individual as a co-applicant that focuses on a humanized antibody. The patent makes reference to *Cricetulus griseus* as a model organism.

A third high ranking patent involves a historic sample from South America. The patent belongs to the Beecham Group and possesses a family with 495 members for Antibacterial agents involving β-lactam compounds (US4098897A). As such this is a patent for an antibiotic. The β-lactams are a large class of antibiotics that encompass penicillin and cephalosporins among others. One of the challenges with antibiotic resistance is that organisms acquire new β-lactamase that inhibits the activity of an antibiotic against the target.[45] The patent specifically focuses on Deoxyclavulanic acid and an isomer for combination with penicillin to overcome antibiotic resistance. We identified no direct reference to a source organism for the compound or its salts in the patent. However, Clavulanic acid is derived from *Streptomyces clavuligerus*, a gram positive bacterium that was reportedly first isolated by researchers from Eli Lilly from a South American soil sample.[46] While a passport number is provided in the literature from 1971 for a sample collected at the same location (NRRL 3584) we were not able to identify further information about the source in South America. What this example reveals is that the precise source of information may not be readily available and a considerable period may pass between the identification of an organism and the isolation and transformation of compounds (i.e. from clavulanic acid to deoxyclavulanic acid and its salts) and their combination with other compounds for specific purposes (preventing antibiotic resistance). Elsewhere in the UK data a related patent from Smithkline Beecham also focuses on polyamine salts of clavulanic acid with 179 family members (EP747383A2). This patent references the fermentation of Clavulanic acid using Streptomyces such as *S. clavuligerus*, *S.*

jumoninensis or *S. katsurahamanus*. While accession numbers are provided for the samples further information is not available on the source. In this case the lack of specific information on the samples probably reflects the fact that the focus of the invention is on salts of Clavulanic acid that may originate from a range of Streptomyces species.

A fourth important patent family, focused on Novel Polynucleotides and their uses by the Glaxo Group, possesses 480 family members (WO2008052933A2). This patent provides a new inhibitor of aggregation of immunoglobulin chains with antibacterial activity. However, the inhibitor consists of a non-naturally occurring polypeptide. The main focus of the patent is *Peptostreptococcus magnus* (the most common species of the genus) which is a commensal organism in humans living in the mouth, skin and body tracts that can become pathogenic in individuals with compromised immune systems. This patent does not involve a natural product but a non-natural polypeptide.

A fifth important patent from UK biotechnology company Domantis Ltd. (now owned by GSK) involves Drug fusions and conjugates for treating or preventing hyperglycemia, diabetes, obesity, hypertension, syndrome x and other disorders (WO2006059106A2). This patent also possesses 480 family members. The patent claims the following:

> "1. A drug fusion having the formula: a-(X)i-b-(Y)2-c-(Z)3-d or a-(Z)3-b-(Y)2-c-(X)1-d, wherein X is an insulintropic agent or an analogue thereof; Y is an immunoglobulin heavy chain variable domain (VH) that has binding specificity for serum albumin, or an immunoglobulin light chain variable domain (VL) that has binding specificity for serum albumin; Z is a polypeptide drug that has binding specificity for a target; a, b, c and d are independently a polypeptide comprising one to about amino acid residues or absent; ni is one to about 10; n2 is one to about 10; and n3 is zero to about 10." (WO2006059106A2)

What is significant about this patent is the reference in the description to the use of saporins from *Saponaria oficinalis* as follows:

> "As used herein "saporin" refers to a family of single-chain ribosome-inactivating polypeptides produced by the plant Saponaria officinalis. (Stirpe, F., et al., Biochem. J. 216:617-625 (1983), Bagga, S. et al., J. Biol. Chem. 278:4813-4820 (2003).) Saporin polypeptides exist is several forms that differ in length and/or amino acid sequence. (See, e.g., Id. and Barthelemy, I. et al., J. Biol. Chem. 268:6541-6548 (1993).) Saporin-6 is the most active form of saporin. (Bagga, S. et al., J. Biol. Chem. 278:4813-4820 (2003)." (WO2006059106A2)

Elsewhere in the description we learn that:

> "Accordingly, the term "saporin" includes precursor protein, mature polypeptide, native protein, polymorphic or allelic variants, and other isoforms (e.g., produced by alternative splicing or other cellular processes), and modified or unmodified forms of the foregoing (e.g., lipidated, glycosylated, PEGylated). Naturally occurring or endogenous saporin include wild type proteins such as mature saporin (e.g., mature saporin-6), polymorphic or allelic variants and other isoforms which occur naturally in-16-Saponaria officinalis. Such proteins can be recovered or isolated from Saponaria officinalis using any suitable methods." (WO2006059106A2)

Saponaria officinalis has the common name "common soapwort" or "soapweed" and, according to GBIF, is widely distributed. Saporin is a ribosome inactivating protein that was first described in 1983.[47] The patent makes use of this property in the preparation of a drug fusion for the treatment or prevention of diabetes or obesity.

The sixth high ranking patent with 407 family members focuses on molecules for disease detection and treatment (WO2003052049A2). This patent family belongs to Incyte Genomics in the US but records a UK inventor as a co-applicant. The patent focuses on an isolated polypeptide for the treatment of diseases caused by a range of organisms. As such the patent focuses on organisms as targets.

The seventh ranked patent with 335 family members refers to polynucleotides and polypeptides in plants by Mendel Biotechnology and lists a UK inventor as a co-applicant. This patent focuses on a transgenic plant that is useful in bioinformatic research methods (WO2004076638A2). The patent claims a transgenic plant with increased abiotic stress tolerance with a transgene encoding a specific polypeptide conferring abiotic stress tolerance. We did not identify any information in the patent suggesting the invention involves access and benefit-sharing issues.

The eighth ranked patent family with 255 members is from Procter and Gamble and refers to detergent tablets (US6589932B1). The patent makes reference to a range of Bacillus, Trichoderma and Hunicola species as sources of fungal cellulases for use in the invention. However sources of species such as Bacillus are mainly described in the background as sources of proteases. One example is a reference to a protease obtained from a strain of Bacillus that is marketed as ESPERASE by Novo Industries in Denmark along with references to a range of other commercial protease products. References to suitable proteases from Trichoderma and other genera mainly involve references to the scientific literature or patent prior art. This example suggests that companies will use commercial sources of materials such as proteases where they are available.

The ninth ranking patent family from Unilever has 228 family members and focuses on carrot antifreeze proteins (EP843010A1). The patent claims antifreeze polypeptides obtained from carrots with a particular molecular weight and alleles or derivatives of the polypeptides. However, one member of the wider patent family makes reference to Antarctica (EP959689B1) while two others refer to Greenland (WO1998041109A1, WO1998041107A1).

EP959689B1 refers to Antifreeze proteins for use in frozen products obtainable from Antarctic plants. The applicants state that Antarctic plants used in a comparison with non-Antarctic plants were harvested in mid-summer (February-March). This is therefore a rare case of a reference to direct field collection of material. However, the precise location of the collection in Antarctica is not given. Other references to Antarctica appear in species names such as *Nothofagus antarctica*, *Deschampsia antarctica* and *Umbilicaria antarctica*. This patent includes direct references to species in the claims as follows:

> "1. A frozen confectionery product comprising one or more anti-freeze polypeptides derived from Polystichum mohriodes, Ranunculus biternatus, Nothofagus antartica, Cerastium fontanum, Colobanthus quitensis, Rumex acetosella, Salix fragilis, Calluna vulgaris, Aceana magellanica, Pisum sativum, Acer saccharoides, Oxalis, Geranium, Daucus carota (carrot), Vinca minor (periwinkle), vinca major, Polemonium, Buddleia, Forsythia, Sambucus nigra, Juncus squarrosus, Carex

> aquatilis, Agrostis tenuis, Deschampsia antartica, Festuca contracta, Festuca rubra, Parodiochloa flabellata, Phleum alpinum, Poa annua (speargrass), Poa pratensis (Kentucky blue grass), Rostkovia magellanica, Bambosoideae, Chorisodontium aciphyllum, Drepanocladus uncinatus, Isothenicium myosuriodes, Polytrichum alpestre, Alectoria nigricans, Caloplaca regalis, Himantormia lugubris, Hypogymnia physodes, Parmelia subrudecta, Ramalina farinaceae, Stereocaulon glabrum, Umbilicaria antartica, Usnea subfloridana, Poa trivialis, Lolium perenne, Holcus lanatus, Bromus sterilis and Festuca contracta, wherein the anti-freeze polypeptides in an aqueous composition have an ice crystal size number average after quick freezing to-40 °C or less, followed by storage for 1 hour at-6 °C of less than 15 μm.
>
> 2. A frozen confectionery product according to claim 1, wherein the anti-freeze polypeptides are derived from Alectoria nigricans, Caloplaca regalis, Himantormia lugubris, Hypogymnia physodes, Parmelia subrudecta, Ramalina farinaceae, Stereocaulon glabrum, Umbilicaria antartica, Usnea subfloridana.
>
> 3. A frozen confectionery product according to claim 1, wherein the anti-freeze polypeptides are derived from Juncus squarrosus or Geranium." (EP959689B1)

WO1998041109A1 and WO1998041107A1 within the same patent family make reference to fish from cold climates as sources of antifreeze proteins (AFPs). However, the reference in both cases is restricted to potential sources as follows:

> "One possible source of AFP materials is fish. Examples of fish AFP materials are AFGP (for example obtainable from Atlantic cod, Greenland cod and Tomcod), Type I AFP (for example obtainable from Winter flounder, Yellowtail flounder, Shorthorn sculpin and Grubby sculpin), Type II AFP (for example.obtainable from Sea raven, Smelt and Atlantic herring) and. Type III AFP (for example obtainable from Ocean out, Atlantic wolffish, Radiated shanny, Rock gunnel and Laval's eelpout)." (WO1998041109A1)

In these cases the patents refer to a method of storing a frozen food product containing the Antifreeze proteins rather than the Antifreeze protein itself.

The tenth ranking family is represented by WO2007068907A2 from the Glaxo Group and Glaxosmithkline Biologicals with 204 family members. This patent focuses on claiming:

> "An immunogenic composition in a dose volume suitable for human use comprising an antigen or antigenic preparation, in combination with an adjuvant which adjuvant comprises an immunologically active saponin fraction derived from the bark of Quillaja Saponaria Molina presented in the form of a liposome and a lipopolysaccharide wherein said saponin fraction and said lipopolysaccharide are both present in said human dose at a level of below 30μg." (WO2007068907A2)

The patent explains that: "Quillaja saponins are a mixture of triterpene glycosides extracted from the bark of the tree Quillaja saponaria. Crude saponins have been extensively employed as veterinary adjuvants. Quil-A is a partially purified aqueous extract of the Quillaja saponin material" (WO2007068907A2). Elsewhere more detail is provided on the origins of the species:

> "A particularly suitable saponin for use in the present invention is Quil A and its derivatives. Quil A is a saponin preparation isolated from the South American tree

> Quillaja Saponaria Molina and was first described by Dalsgaard et a/, in 1974 ("Saponin adjuvants", Archiv. fur die gesamte Virusforschung, Vol. 44, Springer Verlag, Berlin, p243-254) to have adjuvant activity" (WO2007068907A2).

According to GBIF *Quillaja Saponaria* Molina is the Soap Bark Tree with records in Bolivia, Chile, New Zealand, Panama, Spain and the United States. More detailed analysis of the exact origin of the species would require investigation of the underlying literature that is not easily available because of its age.[48]

The use of this bark as part of an adjuvant for use in a vaccine combination is of significant economic importance and patents were filed in the mid-2000s. However, it appears that the original research on the species and its saponins was conducted in the 1970s. This is therefore a historic case.

Marine organisms are represented by the patent family for WO2001077115A1 with 192 members (see also WO2000069862A2). The patent is assigned to the company Pharma Mar with a UK individual co-applicant who is also listed as an inventor. This patent focuses on Antitumoral Ecteinascidin Derivatives for treating cancer. This patent claims a compound with a fused ecteinascidin five ring system with a particular structure. The patent explains that: "The ecteinascidins are exceedingly potent antitumour agents isolated from the marine tunicate Ecteinascidia turbinata. Several ecteinascidins have been reported previously in the patent and scientific literature" (WO2001077115A1).

This patent makes reference to a compound isolated from a marine sponge from Mexico and to Xestomycin found in a Xestospongia species collected from Sri Lankan waters. Additional reference is made to patent prior art to the Caribbean tunicate *Ecteinascidia turbinata* (US5478932 and US5654426A, both from the University of Illinois). This example illustrates the difficulty of precisely tracing the origin of organisms particularly where a patent refers to a class of compounds found across a multiple species. This can require the navigation of multiple family members where a species is referenced in the claims.

Patent US7138427B2 is part of a family with 162 members that focuses on sapogenins and pseudosapogenin derivatives for use in the treatment of dementia, submitted by the UK company Phytopharm. The patent focuses on a pharmaceutical composition that enhances cognitive function from an extract derived from the plant genus Smilax, Asparagus, Anemarrhena, Yucca or Agave. The application explains that key species of interest are as follows:

> "Some sapogenin derivatives of interest in the present invention may occur naturally in a range of plant species, notably from the genera Smilax, Asparagus, Anemarrhena, Yucca and Agave. The species presently of greatest interest include Smilax regelii Kilip & Morton--commonly known as Honduran sarsaparilla; Smilax aristolochiaefolia Miller--commonly known as Mexican sarsaparilla; Smilax ornata Hooker -- commonly known as Jamaican sarsaparilla; Smilax aspera -- commonly known as Spanish sarsaparilla; Smilax glabra Roxburgh; Smilax febrifuga--Kunth--commonly known as Ecuadorian or Peruvian sarsaparilla; Anemarrhena asphodeloides Bunge; Yucca schidigera Roezl ex Ortgies; and Yucca brevifolia Engelm. Sapogenin derivatives which may be of interest may also occur naturally in other genera, for example Dioscorea, Trillium, Solanum, Strophanthus, Digitalis and Trigonella. However, some sapogenin derivatives from these sources possess undesirable properties and are thus not recommended for use in the invention.

> Sapogenin derivatives of the invention may also be commercially available; suppliers are well-known from the one skilled in the art and may include Sigma Aldrich, Research Plus Inc., Steraloids Inc., etc." (US7138427B2)

This would suggest that the sapogenin compounds are derived from species that are relevant to access and benefit-sharing through reference to Honduras. Mexico, Jamaica, Ecuador and Peru. We also learn that the sapogenin derivatives are commercially available.

The importance of the genera of species mentioned above as the sources of the extract are highlighted at various points. For example:

> "In another aspect, the invention provides a pharmaceutical composition having cognitive function enhancing properties which comprises an effective amount of a sapogenin derivative of the invention in the form of an extract derived from a plant of the genus Smilax, Asparagus, Anemarrhena, Yucca or Agave." (US7138427B2)

However, with the exception of the species names provided above, the applicants are constructing their claims on the genus level. The patent claims then focus on a method of treating a condition such as Alzheimer's (among others) focusing on the compound of interest and its variants. While we were not able to identify specific references to sources beyond those highlighted above, *Anemarrhena asphodeloides Bunge* is used in Chinese medicine (zhi mu) and in Japanese medicine.

This review of the top UK patent families involving genetic resources and traditional knowledge has revealed examples of relevance to access and benefit-sharing, notably in the historic sense. However, as with the patent citation data, with the exception of the examples highlighted, patent activity involving genetic resources falls lower down the spectrum of economically important patents.

Conclusion:

This section of the report has focused on mapping genetic resources in UK patent data, identifying key trends and actors and identifying valuable UK patents using a combination of citation counts and patent family size.

In concluding this section we have demonstrated that UK patent activity typically involves a species as a target of activity. Important UK patent activity presents a mix of the species as targets and as the sources of an invention. Where an organism is the source of an invention in UK data it is typically mid-to-low ranking when the data is ordered by citation counts and family size. However, both the citation and family analysis revealed isolated examples of important UK patents that involve genetic resources and associated traditional knowledge as material to a claimed invention. Analysis of available data on the sources of material suggests the use of commercial sources, where available, and limited attention to field collection of novel organisms by the applicants. This supports the general conclusion that the impact of the Nagoya Protocol upon UK applicants will, with few exceptions such as Unilever or Phytopharm, be indirect.

The remaining sections of this report focus on in depth analysis of UK data with respect to countries of origin or source of genetic resources and thematic issues such as associated traditional knowledge.

Endnotes:

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[35] In certain cases, notably *E. coli*, top species may also be important pathogens. Exclusion of such species therefore impacts on UK activity in pharmaceuticals. However, it should be noted that *E. coli* is unlikely to be a species of interest in access and benefit sharing Arrangements.

[36] Oldham, P Hall, S and Forero O (forthcoming) Biological Diversity in the Patent System. PLOS One.

[37] Martinez C (2010) Insight into Different Types of Patent Families. STI Working Paper 2010/2. Paris: Organisation for Economic Co-operation and Development.

[38] Oldham, P. & Burton, G. (2010) Defusing Disclosure in Patent Applications. UNEP/CBD/COP/10/INF/44

[39] http://www.gov.im/ded/pvi/pvi_fr.html?menuid=21707

[40] Because patent documents are formatted in different ways (notably for older documents) it can be difficult to accurately distinguish the Title, Abstract and Claims from the Description. For this reason these figures are approximate.

[41] Citation data from PATSTAT will typically report lower scores because the data is confined to the information available at the time of the PATSTAT edition (i.e. October 2011). Data reported here is from Thomson Innovation in August 2013.

[42] This figure excludes species names falling into the unknown category on the Kingdom level. This reflects issues with synonyms, abbreviations and the ability to resolve such names in taxonomic databases.

[43] This observation is based on an initial review of first claims and the supplementary Thomson Innovation "Abstract Use" category for the UK patent data.

[44] Fidler DP (2010) Negotiating equitable access to influenza vaccines: Global health diplomacy and the controversies surrounding avian influenza H5N1 and pandemic influenza H1N1. PLOS MEDICINE 7: e1000247. See also, World Health Organization (2011) Pandemic Influenza Preparedness Framework for the sharing of influenza viruses and access to vaccines and other benefits. France: World Health Organization. http://www.who.int.

[45] Lewis, K (2013) Platforms for antibiotic discovery. *Nature Reviews Drug Discovery* 12, 371-387.

[46] Higgens C & Kastner R (1971). "Streptomyces clavuligerus sp. nov., a beta-lactam antibiotic producer". International Journal of Systematic Bacteriology 21 (4): 326–31

[47] Stirpe, F. Gasperi-Campani, A. et al. (1983). "Ribosome-inactivating proteins from the seeds of Saponaria officinalis L. (soapwort) of Agrostemma githago L. (corn cockle) and of Asparagus officinalis (asparagus) and from the latex of Hura crepitans L. (sandbox tree)". Biochemical Journal 216 (3): 617–625.

[48] See: Dalsgaard, K (1972) Saponin adjuvants. I. The presence of a non-dialysable fraction of *Quillaja saponaria Molina* with adjuvant activity in foot-and-mouth disease vaccines. Bull. Off. Int. Epiz.77 (7–8), 1289–1295.

5. India

5.1 Introduction:

This section forms part of a wider review of *UK Patent Activity for Genetic Resources and Traditional Knowledge.* The section presents the results of an in depth review of international patent activity by UK applicants involving species of relevance to India at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty between 1976 and 2010. The aim of the review is to improve transparency about the utilization of genetic resources and associated traditional knowledge involving species of relevance to India in UK patent activity. The review also highlights issues around the interpretation of the origins of genetic material and the utilization of a genetic resource in patent documents.

The data presented in this section is based on a manual review of 842 UK patent documents. 428 of the documents contained a reference to India while 314 documents contained reference to a species that may originate from India based on distribution data from GBIF. Additional searches were conducted to identify references to traditional knowledge from India and are presented in the thematic section on traditional knowledge in the report.

5.2 Biodiversity in India and UK Patent Activity:

India is a megadiverse country in terms of its biodiversity. The Global Biodiversity Information Facility (GBIF) contains records of 36,149 species that have been recorded in India. In ABSPAT UK we identified 2,364 species that are known to be distributed in India. As such, approximately 2,364 species that appear in UK patent activity could potentially relate to samples or specimens collected in India. These species are located in 11,884 UK documents.

The relevance of this to access and benefit-sharing is that it defines the universe of possibilities for UK applicants in relation to species that are known to occur in India. However, what this does not tell us is whether the actual sample or specimen was collected in India. Nevertheless, in the context of debates on biopiracy or misappropriation it is perhaps useful to have a clear view of the who and what in species of potential Indian origin in UK patent activity.

Figure 5.1 provides a summary of trends in activity for species in UK patent activity that are known to occur in India.

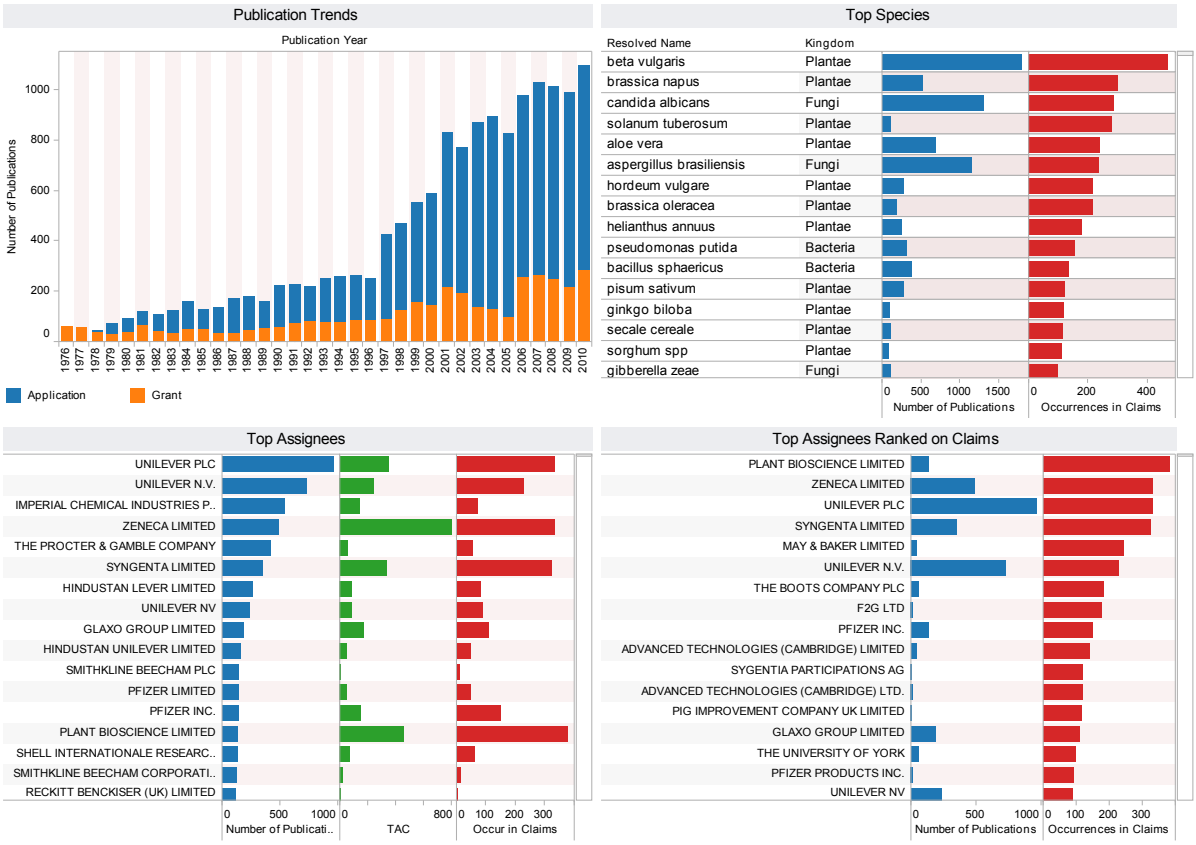
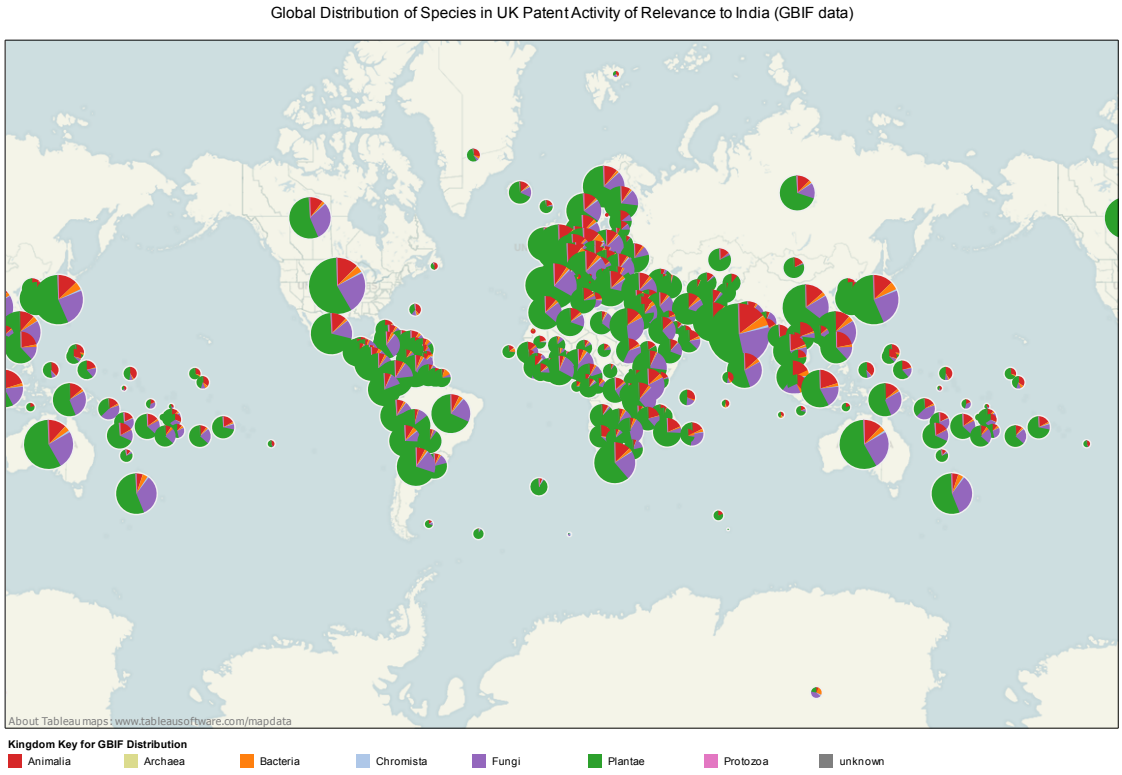


Figure 5.1 Species of Relevance to India in UK Patent Activity

Figure 5.1 suggests an increasing trend in patent activity for species of relevance to India in UK patent activity. A brief review of the top species (ranked on their appearance in patent claims) reveals important agricultural species such as sugar beet (beta vulgaris), rapeseed (brassica napus), the fungi candida albicans, and aloe vera among others. As such, the list exposes common and widespread species. The wide ranging distribution of these species is brought into focus by Map 5 which displays the available distribution data for species that appear in UK patent activity and occur in India.



Map 5 Global Distribution of Species Appearing in UK Patent Activity of Relevance to India

Map 5 makes clear that species of relevance to India that appear in UK patent activity also have a wide distributional range. This perhaps reflects the relatively narrow concentration of patent activity in general on a small number of species of economic importance.

Under the Nagoya Protocol the main question to be addressed is whether a specimen or sample that leads to the utilization of a genetic resources through research and development was actually collected in or sourced from India itself.

The only practical means through which this question can be addressed is through text mining the 11,884 documents for references to India. In total we identified 428 documents that made reference to India in the UK patent data and also contained a species known to occur in India. As this makes clear, a relatively small proportion of UK patent documents that make reference to a species that *could potentially* have originated from India actually make a reference to India. The results of a review of these documents is presented below.

One purpose of the Nagoya Protocol is to improve transparency and trust between countries. The disclosure of the geographic origin or source of genetic resources and associated TK in patent applications is presently at the discretion of applicants. This raises the question of how certainty and transparency might be improved in circumstances where applicants do not choose to name India as the country of origin.

To explore this issue we identified all species that appear in UK patent activity where the only country where the species has been recorded in the GBIF database is India. The idea behind this is to identify cases where a species (based on available distribution data) was

likely to have come from a country of interest. For the sake of simplicity we call this data Distribution 1.

In total we identified 29 species in the GBIF database that only possess records of distribution in India. These species were located in 314 documents. These documents were then selected for further review. Figure 5.2 displays the who and what of the distribution 1 data for India within UK patent activity.

Figure 5.2 UK Patent Activity for Distribution 1 Species for India

In considering this data it is important to emphasise that the data limited by distribution only provides a clue that the sample or specimen could have come from a specific country: it does not constitute evidence. Nevertheless, in our view by focusing on species that are likely to have come from a country such as India it will be possible to improve transparency and trust in access and benefit-sharing agreements.

5.3 General Observations:

To focus in on patent documents that may involve material originating from India we searched for UK documents that contain a species that is known to occur in India and that also contained reference to the country name India. We identified 428 documents that met these criteria. These documents were then processed in MAXQDA software where we identified 916 text segments that made reference to India. In reviewing the individual text segments we identified the following issues:

1. We found frequent references to commercial suppliers of chemicals and herbal materials from India;
2. In some cases material was indirectly sourced from India via an intermediary;
3. It proved difficult to establish in many cases whether the claimed material of the invention actually came from India;
4. References to direct field collection of material in India were very limited;
5. We identified 51 text segments that referred to Ayurveda or Ayurvedic traditional medicine from India.

5.4 India: Species Summary Cards

This section provides basic summary details of species appearing in UK patent activity where there is some form of reference to an origin or source for the material and associated traditional knowledge in the patent document. The tables are intended to provide a quick summary overview. Detailed examples are provided in the final section.

The data in this section is divided into two categories: a) species appearing in patents that refer to India as the origin or source of the material; b) species identified as relevant to India based purely on distribution data from GBIF.

One of the general challenges in examining patent documents for species originating in particular countries is that it is at the discretion of applicants to choose to mention a source or country of origin. However, a clue can be gained into patent activity for species that are likely to have come from a particular country, or region, by reviewing GBIF data for distribution data where there is only one record for a species. The problem with this approach is that GBIF data on species distribution is, and will remain, seriously incomplete for many species. As such, GBIF distribution data only provides a clue to possible origin in the absence of more complete information.

One particular challenge in identifying species that are likely to be restricted to India is that species are typically also distributed around the sub-continent in countries such as Sri Lanka, Nepal, Bangladesh, Pakistan and Bhutan. This means that there is a high likelihood that there will be patent documents where a particular species was sourced from a species of origin in India but is not captured by a country name or by a record specific to India. We list here examples of particular relevance for debates on access and benefit-sharing under the Convention on Biological Diversity and at the WIPO IGC. The categorization of a species as endemic to the country is based on wider research on the species. However, we would emphasise that establishing endemism is difficult and would benefit from consultations with relevant taxonomic specialists. For this reason we regard the categorization of endemic status as tentative.

Species summary cards are organised alphabetically. Each card also receives a reference number (IN1). These numbers are used to allow the reader to cross reference the species card with the patent data in Annex 1 and the detailed examples provided below. References to IND refer to India by Distribution.

India: Species by Country of Origin or Source

IN7

Species name: *Aeschynomene spp*	Kingdom: Plantae	
Brief description of species: Aeschynomene indica and Sesbania are annual or perennial herbs, widely distributed. Used as a green manure and sometimes as fodder.		
Distribution: Cosmopolitan	No of documents: 4	
Example Patent - **US20100116898A1** The invention is a burnable transfer wick for the delivery of fragrances from the genus Aeschynomene or Sesbania. The patent illustrates the issue of whether a patent utilizes genetic material as a genetic resource under the terms of the Nagoya Protocol.		

IN19

Species name: *Andrographis paniculata*	Kingdom: Plantae	
Brief description of species: An erect annual herb extremely bitter in taste. It is distributed and cultivated in tropical Asian countries. Used in traditional medicine.		
Distribution: Cosmopolitan	No of documents: 6	
Example Patent - **WO2010119294A2** - An invention relating to an orally administrable composition comprising as active ingredient a combination of materials derived from plants which improves hepatic function in animals and is also useful in treating or preventing arthritis, urinary tract infections and respiratory infections.		

IN10, IN13

Species name: *Anogeissus latifolia*	Kingdom: Plantae	
Brief description of species: A small tree. The source of gum ghatti, a gum which has many uses. Also the food of a silk producing moth. Found in Nepal, India, Sri Lanka and Myanmar.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **WO2009016362A2** - An invention relating to the use of polysaccharide gums in adhesives, especially in denture adhesives. It further relates to modified forms of naturally occurring polysaccharide gums, including ghatti...See also **WO2000042143A1**.		

IN14, IN15

Species name: *Asparagus racemosus*	Kingdom: Plantae	
Brief description of species: From India & Sri Lanka, aka Shatavari. Has traditional medicinal uses.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **WO2009077188A1** - A composition for a herbal tea and the manufacturing process of said tea. See also **WO2009077187A2**.		

IN19, IN21

Species name: *Boswellia Serrata*	Kingdom: Plantae	
Brief description of species: Indian Frankincense. Medicinal uses/traditional knowledge. Boswellic acid extract used for various cosmetic and medicinal purposes.		
Distribution: Endemic	No of documents: 1	
Example Patent - **WO2010119294A2** - An invention relating to an orally administrable composition comprising as active ingredient a combination of materials derived from plants which improves hepatic function in animals and is also useful in treating or preventing arthritis, urinary tract infections and respiratory infections.		

IN1

Species name: *Casuarina equisetifolia*	Kingdom: Plantae	
Brief description of species: A tree species described by Linnaeus in 1759 and distributed in South East Asia and the Pacific.		
Distribution: Cosmopolitan	No of documents: 8	
Example Patent - **EP1711174B1** Use of Casuarine in a a vaccine adjuvant consisting of a Th1- activating alkaloid		

IN16

Species name: *Eleusine coracana*	Kingdom: Plantae	
Brief description of species: A species of millet, originally from Africa but grown in India.		
Distribution: Cosmopolitan	No of documents: 4	
Example Patent - **WO2009083454A2** - A process for the enzymatic preparation of a gamma-glutamyl compound where the enzyme is derived from a plant belonging to the Graminaceae or Leguminaceae family.		

IN15

Species name: *Evolvulus alsinoides* *Convolvulus pluricaulis* *Clitorea turnatea*	Kingdom: Plantae	
Brief description of species: A group of plants known as Shankhpushpi.Found throughout Asia and the Middle East. Traditional medical uses.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **WO2009077188A1** - A composition for a herbal tea and the manufacturing process of said tea.		

IN17

Species name: *Mappia foetida*	Kingdom: Plantae	
Brief description of species: aka Nothapodytes foetida - Important as a source of camptothecin cancer treatment.		
Distribution: Endemic	No of documents: 2	
Example Patent - **WO2009111294A1** - Aqueous-based, ready to use topotecan-containing formulations for parenteral use having extended stability.		

IN5

Species name: *Morinda Citrifolia*	Kingdom: Plantae	
Brief description of species: A tree in the coffee family distributed throughout south east Asia and Australasia. Widely cultivated in the tropics.		
Distribution: Cosmopolitan	No of documents: 4	
Example Patent - **US20070298142A1** Morinda Citrifolia enhanced products for use as animal feed in both dry and liquid form including a pasteurized fruit puree.		

IN11

Species name: *Mucuna pruriens*	Kingdom: Plantae	
Brief description of species: Known as velvet bean, found across many tropical regions. Seeds used in treatment for neurological diseases.		
Distribution: Cosmopolitan	No of documents: 5	
Example Patent - **WO2004039385A2** - Relating to the use of mucuna pruriens seed powder or one or more Mucuna pruriens components, substances, fractions or mixtures or substances obtained therefrom for the preparation of a pharmaceutical composition for preventing, alleviating or treating neurological diseases.		

IN6

Species name: *Picrorhiza kurroa*	Kingdom: Plantae	
Brief description of species: Himalayan herb species (India & Nepal). Traditionally used as treatment for liver disorders and other ailments.		
Distribution: Cosmopolitan	No of documents: 12	
Example Patent - **US2009220624A1**. Compositions comprising apocynin, gingko and ginger and their uses for treating diseases such as CF and COPD.		

IN8

Species name: *Piper Nigrum*	Kingdom: Plantae	
Brief description of species: Black pepper, a vine cultivated for its fruit which is used as a seasoning.		
Distribution: Cosmopolitan	No of documents: 51	
Example Patent - **US6346539B1** The invention relates to the treatment of skin conditions using piperine or its active analogs or derivatives from Black Pepper (piper nigrum) purchased from a supermarket in London.		

IN12

Species name: *Rubia cordifolia*	Kingdom: Plantae	
Brief description of species: Common or Indian madder. Coffee family with red pigment in roots. Used for skin lightening product.		
Distribution: Cosmopolitan	No of documents: 7	
Example Patent - **WO2004105718A1** - Relating to an improved cosmetic composition for topical application to human skin to provide enhanced protection from sunlight.		

IN18

Species name: *Santalum album*	Kingdom: Plantae	
Brief description of species: Better known as Sandalwood, this tree is notable for being semi-parasitic, tapping roots of neighbouring trees to obtain nutrients.		
Distribution: Cosmopolitan	No of documents: 15 (total)	
Example Patent - **WO2009153572A1** Use of a sandalwood analogue as an additive to animal foodstuffs for the reduction of methane production and reducing bacterial mediated protein breakdown and bacterial growth in the stomach.		

IN3

Species name: *Shorea robusta*	Kingdom: Plantae	
Brief description of species: A tree native to the sub-continent known as Sal. Of religious significance and a major source of hardwood.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **EP53016A2** - Relating to melting properties of Sal fats in food manufacturing.		

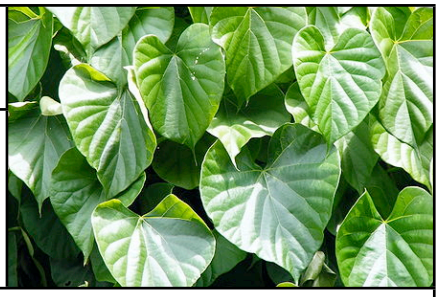
IN20

Species name: *Symplocos racemosa* *Symplocos cochinchinensis*	Kingdom: Plantae	
Brief description of species: The Lodh tree. Used for skin lightening products and has traditional medical uses.		
Distribution: Cosmopolitan	No of documents: 3	
Example Patent - **WO2010046316A2** - Relating to a topical composition and a method for reducing or preventing occurrence of acne on the skin.		

IN2

Species name: *Streptococcus orientalis*	Kingdom: Bacteria	No Image Available
Brief description of species: A spherical gram-positive bacillus found in soil.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **EP1996217B1** - Relating to an antibiotic Vancomycin produced from S. orientalis isolated in Indonesia and India.		

IN19

Species name: *Tinospora cordifolia*	Kingdom: Plantae	
Brief description of species: An herbaceous vine endemic to the subcontinent. Has history of traditional medicine. Active constituents include diterpene compounds, polyphenols, and polysaccharides		
Distribution: Cosmopolitan	No of documents: 7	
Example Patent - **WO2010119294A2** - An invention relating to an orally administrable composition comprising as active ingredient a combination of materials derived from plants which improves hepatic function in animals and is also useful in treating or preventing arthritis, urinary tract infections and respiratory infections.		

IN19

Species name: *Terminalia arjuna*	Kingdom: Plantae	
Brief description of species: Native to West Bengal & south/central India. Medicinal uses/traditional knowledge. Patent for herbal feed supplements.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **WO2010119294A2** - An invention relating to an orally administrable composition comprising as active ingredient a combination of materials derived from plants which improves hepatic function in animals and is also useful in treating or preventing arthritis, urinary tract infections and respiratory infections.		

IN15

Species name: *Trichopus zeylanicus*	Kingdom: Plantae	
Brief description of species: Small plant growing in sandy soils by streams, also known as Arogyapacha, from India and Sri Lanka. traditional medicinal uses.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **WO2009077188A1** - A composition for a herbal tea and the manufacturing process of said tea.		

IN9

Species name: *Trigonella foenum-graecum*	Kingdom: Plantae	
Brief description of species: Fenugreek. Cultivated worldwide as a semi-arid crop.		
Distribution: Cosmopolitan	No of documents: 4 (total)	
Example Patent - **WO1995021199A1** Galactomannan products as an ingredient in nutraceuticals and cosmetic products.		

IN23

Species name: *Lilium mackliniae*	Kingdom: Plantae	
Brief description of species: Alpine lily. Grows on border of India and Myanmar. Used widely in horticulture.		
Distribution: Uncertain	No of documents: 2	
Example Patent - **WO2005060977A1** - Relates to the use of known and novel compounds as inhibitors which have applications in therapy for diseases associated with raised activity of core 2 GlcNAc-T.		

India: Species by Distribution

This section focuses on the details of species appearing in patents where GBIF presently only records the species in India. Because GBIF records are incomplete and no reference is made to India in the documents the references should be taken purely as a *clue* of possible origin in India. Additional research was undertaken using available information to ascertain if a species is endemic to India.

IND1

Species name: *Actinoplanes teichomyceticus*	Kingdom: Bacteria	No Image Available
Brief description of species: Actinoplanes species belong to the so-called genera of filamentous actinomycetes.		
Distribution: Cosmopolitan	No of documents: 30	
Example Patent - **WO2004019970A2** - Relates to the use of glycopeptide antibiotics and their semisynthetic derivatives to treat or prevent viral infections and their use to manufacture a medicine to treat or prevent viral infections		

IND2

Species name: *Ancistrocladus heyneanus*	Kingdom: Plantae	
Brief description of species: A type of vine found in India but also central America. Has anti-HIV possibilities		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **US6627641B1** - Relates to naphthylisoquinoline alkaloids and derivatives thereof which exhibit in vitro and in vivo antimalarial activity.		

IND3

Species name: *Aspergillus cleistominutus*	Kingdom: Bacteria	No Image Available
Brief description of species: A genus of several hundred mold species.		
Distribution: Cosmopolitan	No of documents:2	
Example Patent - **WO2002064802A2** - Relates to regulatory elements and nucleic acid sequences coding therefore, and their use in controlling gene expression in organisms such as plants.		

IND4

Species name: *Boswellia serrata*	Kingdom: Plantae	
Brief description of species: Indian frankincense tree. Boswellic acid and other extracts used for anti-cancer and other medical treatments.		
Distribution: Endemic	No of documents: 20	
Example Patent - **WO2008077728A2** - Relates to compositions for improving the appearance of skin, particularly to provide good coverage over imperfections such as pores and uneven skin tone, while retaining a natural skin appearance.		

IND5

Species name: *Bothriochloa odorata*	Kingdom: Plantae	
Brief description of species: A species of grass. There are about 70 species of the genus found in tropical to warm temperate areas worldwide.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **US2009276912A1** - Relates to plant transcription factor polypeptides, polynucleotides that encode them.		

IND6

Species name: *Buthus tamulus*	Kingdom: Animalia	No Image Available
Brief description of species: Eastern Indian Red Scorpion. Highly venomous. Research likely to be about anti-venom.		
Distribution: Endemic	No of documents: 2	
Example Patent - **WO2006085075A2** - Relates to the area of oral drug delivery devices that administer active agents to the colon.		

IND7

Species name: *Carum roxburghianum*	Kingdom: Plantae	No Image Available
Brief description of species: Synonym of Trachyspermum roxburghianum. A herb used as medicine and spice across Asia.		
Distribution: Cosmopolitan	No of documents: 8	
Example Patent - **WO2007049027A2** - Relates to the new use of a known compound, to novel agricultural compositions containing that compound, to methods of preparing the compositions and to methods of their use, in particular in the treatment of plants.		

IND8

Species name: *Chainia minutisclerotica*	Kingdom: Bacteria	No Image Available
Brief description of species: A soil actinomycete.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **US5880101A** - Relates to the use of at least one polyene macrolide for the preparation of pharmaceutical compositions for the treatment of diseases that are associated with an impaired energy turnover.		

IND9

Species name: *Claviceps sorghi*	Kingdom: Fungi	
Brief description of species: C. sorghi is a pathogen of Sorghum bicolor found only in India and Southeast Asia.		
Distribution: Cosmopolitan	No of documents: 15	
Example Patent - **WO2010062751A1** - Relates to the field of agricultural biotechnology, particularly to methods for enhancing the resistance of plants to bacterial pathogens.		

IND10

Species name: *Comamonas acidovorans*	Kingdom: Bacteria	No Image Available
Brief description of species: Found globally. May have some uses in biodegrading petroleum products.		
Distribution: Cosmopolitan	No of documents: 12	
Example Patent - **US2007044169A1** - Relates to a method of producing male or female sterile plants comprising providing means for inactivating a herbicide.		

IND11

Species name: *Coronilla cannabina*	Kingdom: Plantae	
Brief description of species: More accurately called Sesbania cannabina. A leguminous plant which grows across Asia used in cooking and as a nitrogen fixer.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **US2010116898A1** - Relates to improved transfer elements comprising plant stem material from plants of the genus Sesbania.		

IND12

Species name: *Emblica officinalis*	Kingdom: Plantae	
Brief description of species: Synonym of Phyllanthus officinalis, the Indian Gooseberry, traditional herbal medicine as well as a food and cosmetic.		
Distribution: Endemic	No of documents: 7	
Example Patent - **WO2010086716A1** - Relates to provision of an organic body oil composition comprising extracts of organically certified herbs and organic essential oils.		

IND13

Species name: *Enterobacter amnigenus*	Kingdom: Bacteria	No Image Available
Brief description of species: A genus of common gram-positive bacteria, some of which are pathogenic.		
Distribution: Cosmopolitan	No of documents: 8	
Example Patent - **WO2000069886A2** - Relates to oligomers of chaperone or minichaperone proteins.		

IND14

Species name: *Madhuca indica*	Kingdom: Plantae	
Brief description of species: Tree from India used for food, toiletries and cosmetics as well as food for silk moth.		
Distribution: Endemic	No of documents: 4	
Example Patent - **US2010058648A1** - Relates to an integrated process for producing hydrocarbons useful as diesel boiling range fuel from renewable feedstocks such as the glycerides and free fatty acids found in materials such as plant oils.		

IND15

Species name: *Micromonospora chersina*	Kingdom: Bacteria	No Image Available
Brief description of species: A genus of gram-positive bacteria.		
Distribution: Cosmopolitan	No of documents: 5	
Example Patent - **WO2003006036A2** - Relates to provision of nucleic acid sequences and characterization of the gene cluster responsible for the biosynthesis of the enediyne C-1027.		

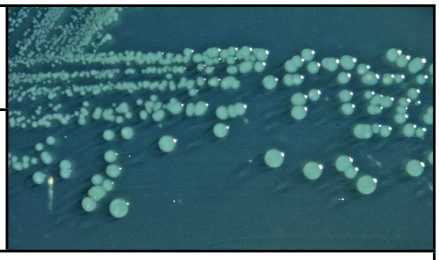
IND16

Species name: *Phytophthora drechsleri*	Kingdom: Fungi	No Image Available
Brief description of species: A plant pathogen with worldwide distribution.		
Distribution: Cosmopolitan	No of documents: 8	
Example Patent - **US2007136892A1** - Relates to a process for the production of unsaturated fatty acids in an organism by introducing, into the organism, nucleic acids which encode polypeptides.		

IND17

Species name: *Pseudomonas oxalaticus*	Kingdom: Bacteria	No Image Available
Brief description of species: Synonym of Cupriavidus oxalaticus.		
Distribution: Cosmopolitan	No of documents: 8	
Example Patent - **US4012572A** - Relates to a reactive matrix comprises a co-enzyme chemically attached to a water insoluble organic polymeric support material.		

IND18

Species name: *Shigella boydii*	Kingdom: Bacteria	
Brief description of species: A gram-negative bacteria that is known to cause dysentery in humans.		
Distribution: Cosmopolitan	No of documents: 49	
Example Patent - **WO2003035896A2** - Relates to an invention providing novel chromogenic enzyme substrates which are indoxyl beta -D-ribofuranosides.		

IND19

Species name: *Streptoalloteichus hindustanus*	Kingdom: Bacteria	No Image Available
Brief description of species: Streptoalloteichus is a genus of bacteria within the family Pseudonocardiaceae.		
Distribution: Uncertain	No of documents: 5	
Example Patent - **WO2001073082A2** - Relates to improved methods for the expression of recombinant protein products under the transcriptional control of an inducible promoter.		

IND20

Species name: *Tecoma undulata*	Kingdom: Plantae	
Brief description of species: Tree from India and Pakistan, also grows in Arabia. Has medicinal use for treating liver, urinary and SDI. Also used in Pakistan for treatment of hepatitis.		
Distribution: Cosmopolitan	No of documents: 3	
Example Patent - **WO2003006036A2** - Relates to pharmaceutical or medicinal preparation which comprises a mixture of herbs including Tecoma undulata.		

IND21

Species name: *Thozetellopsis tocklaiensis*	Kingdom: Fungi	No Image Available
Brief description of species: A species recorded only in NE India.		
Distribution: Uncertain	No of documents: 3	
Example Patent - **US2010116898A1** - Relates to provision of a novel process for the preparation of hydroxy-prostaglandins of a novel formula.		

IND22

Species name: *Tilletia indica*	Kingdom: Fungi	
Brief description of species: Karnal bunt is a fungal disease of wheat, durum wheat, and triticale. The smut fungus Tilletia indica invades the kernels and obtains its nutrition from the endosperm.		
Distribution: Cosmopolitan	No of documents: 26	
Example Patent - **WO2003006454A2** - Relates to fungicidal compositions, and methods for the control of phytopathogenic fungi of plants using these compounds or their compositions.		

5.5 Detailed Selected Examples

This section provides a set of examples that illustrate different aspects of patent activity involving species of relevance to India. One of the purposes of this section is to illustrate the range of possible references to species relevant to India and the need for care in interpretation of the utilization of genetic resources under the Nagoya Protocol. Further details of examples of traditional knowledge are provided in the Traditional Knowledge section.

IN1: EP1711174B1 Casuarina equisetifolia & Eugenia jambolana Summit Corp UK

This example is from a European patent granted to an Abingdon based company, Summit Corp PLC, for a composition that can be used in a vaccine or prophylactic for a range of virus infections such as HIV, influenza and a neglected disease cause by a parasite in the form of leishmaniasis. This example is interesting because it involved a casuarine compound that can be isolated from a number of different species including *Casuarina equisetifolia* which is used to treat diarrhea, dysentery and colic and has reportedly recently been prescribed in Western Samoa for the treatment of breast cancer. However, the applicant also notes an African plant *Syzgium guineense* as a source of casuarine that has reportedly been beneficial for AIDS patients. The applicant also makes reference to *Eugenia jambola* described as:

> "a well-known tree in india for the therapeutic value of its seeds, leaves and fruit against diabetes and bacterial infections."

The patent grant claims:

> "Use of one or more antigen(s) and an adjuvant composition comprising a Th1-activating alkaloid for the manufacture of a vaccine for use in vaccination for polarizing an immune response to the antigen(s) from type 2 towards type 1, wherein the alkaloid has the formula: wherein R is selected from the group comprising hydrogen, straight or branched, unsubstituted or substituted, saturated or unsaturated acyl, alkyl for example cycloalkyl, alkenyl, alkynyl and aryl groups, or a pharmaceutically acceptable salt or acyl derivative thereof."

The applicant has therefore been granted a patent on an alkaloid that can be used as an adjuvant to improve the effectiveness of a vaccine.

In terms of the importance of this patent a total of 13 family members are listed around the world including Austria, Australia, Canada, Germany and the United States. These filings share Robert James Nash as the inventor but include Assignees such as Summit Wales Ltd (2010) and MNL Pharma (2005). Summit (wales) is based in Abingdon Oxford as with the earlier assignee and describes itself as a UK company focused "on the discovery and development of novel drug candidates to treat areas of high unmet medical need" (http://www.summitplc.com). The range of company names in the family portfolio reveals the usefulness of the family system for tracking changes in company names over time or mergers, acquisitions and the formation of new companies. However, analysis of the citing patents reveals that these patents have not presently had a significant impact within the wider patent system.

What this example reveals is that an alkaloid may originate from more than one species of plant distributed in more than one country. In the absence of a disclosure requirement it is not possible to determine which country is the source of the claimed compound and therefore may be eligible for benefit sharing. In this case the non-patent cited literature reveals that the inventor is the author of a scientific article on the compound. In this case the Inventor, Robert James Nash is the author of an article with co-authors from the University of Strathclyde and the University of Oxford. This article reports the isolation of casuarine from the bark of *Casuarina equisetifolia L*. This suggests that the species of origin is not the Indian species, but that the applicant is incorporating the same alkaloid from the Indian species into the patent.

IN2: EP1996217B1 Streptococcus orientalis
Novel Antibiotic
Cambridge Enterprises Limited.

This European patent dating to 2010 was awarded to Cambridge Enterprises Limited (the technology transfer arm of Cambridge University) and involving inventors from the UK and Canada. It involves the antibiotic Vancomyin which it describes in the description as follows:

> "Vancomycin is produced by Streptococcus orientalis, an actinomycete isolated from soil samples in Indonesia and india".

The patent is concerned with claiming:

> "1. An antibiotic composition comprised of the following structure: T-L-P wherein: (a) T is a targeting moiety comprising a N-terminal peptide fragment of a lantibiotic where the peptide fragment comprises the following formula: X1X2A, X3X4X5A2A3PGA4X6 (SEQ ID NO:6) wherein A1, A2 and A4 are alanine and A3 is α-aminobutyric acid, and wherein A1 and A2 together form a lanthionine linkage and A3 and A4 together form a β-methyllanthionine linkage; X1, X2, X3, X4, X5 and X6 are each independently selected from any natural or non-natural amino acid, and wherein T is capable of binding interactions with a pyrophosphate of bacterial cell wall precursor Lipid II wherein said Lipid II comprises undecaprenyl-pyrophsophoryl-MurNAc-(pentapeptide)-GlcNAc; (b) L is a linker moiety selected from the group consisting of (i) a direct covalent bond linkage between T and P and (ii) a linker molecule covalently bonded to T and P; and (c) P is an antibiotic moiety that is capable of altering at least one activity of a bacterial membrane or a bacterial cell wall; or a pharmaceutically acceptable salt thereof."

What is novel about this example is the ring structure, a linker moiety and an antibiotic moiety that are capable of altering the activity of a bacterial membrane or cell wall. In particular the compound is directed to Staphylococci and Streptococci and gram-negative bacteria such as E. coli.

What is interesting about this case is that Vancomycin was reportedly first isolated by Edmund Kornfeld in 1953 while working at Eli Lilly. Its core compound is well known and it is the modifications to the compound, through the addition of the specified moieties, that is new and novel.

This example also illustrates the difficulties involved in tracking back on the sources of actual compounds. In this case the compound is reported to have been isolated from soil samples in Indonesia (Borneo) and in India. The question that would arise here in the case of such shared genetic resources is how would access and benefit-sharing criteria be addressed?

The importance of this patent to the applicants is revealed by a patent family that includes Austria, Germany, Spain, Japan and the United States with the only patent grant to date being under the European Patent Convention and Spain (translation). To date the patent has not been cited by other patents.

IN3: EP53016A2 *Shores robusta*
Refining fats in confectionary
Unilever.

This patent application dating to 1982 involved the British company Unilever and inventors listed from India. The patent application did not result in a patent grant in this family. The application is concerned with the refining of fats with co-gelled silica-alumina adsorbent for use in chocolate etc.

> "The tree Shores robusta of india is related botanically to S. stenopters, the source of Borneo tallow, and yields a vegetable fat similar in its chemical constitution and physical properties. Like Borneo tallow, the fat of s. robusta, known as sal fat, is prized particularly for its sharp melting characteristics in the region of body temperature and is used as a constituent in commercially valuable edible and non-edible formulations."

This is a distinctive patent application because the claims focus on a *process* for purifying the fats and the fats themselves where the Sal and other fats are prepared by the claimed process. This limits the scope of the claimed invention to fats prepared by the process rather than a general *per se* claim to the fats. As such this is more limited, or narrow, form of claim than is typically found in pharmaceutical or biotechnology related applications

While this patent application generated only a small patent family, it also generated 5 citing patents, notably by Unilever, relating to Metal-oxide-silica adsorbents for refining oil in the late 1980s and early 1990s (including patent grant EP269173B2) that had a significant impact in this technology space (notably EP269173A2 which attracted 26 citations from Unilever, WR Grace and others). What is unclear however is whether the synthetic metal-oxide-silica adsorbent described in EP269173A2 has its origins with *Shores robusta* or is the result of wider experimentation.

IN4: EP79794A1 *Sesbania aculeata*
Thickening composition for drilling
Kins Development Limited.

This patent application dates to 1983 from Kins Development Limited in London with two UK based inventors. The patent application claimed a composition acting as a thickening agent or binder that included Sesbania gum for use in drilling fluids, pipeline transportable coal slurries, printing pastes, textile conditioners, explosives, paper making, dyes and beneficiation of mineral oils.[49] The applicant describes the Sesbania aculeata as follows:

> "The plant Sesbania aculeata, Pers (syn. Sesbania bispinosa Jacq. Fawcet & Rendle-Family Leguminosae, Sub-family Papil ionaceae) and its cultivars, more particularly the seeds thereof, yield a galactomannan gum known as Sesbania gum. The natural habitat of this plant is the monsoon region of South Asia and Southeast Asia. Common names for this plant are Dhaincha and Jantar. A description of this plant and its cultivation can be found in Hooker, The Flora of British India, 1879 Vol. II pages 114-115; Lecomte, Flore Generale de L' Indochina, 1908 Tome II, pages 411-412; The Wealth of India, 1972, Vol. IX, pages 293-295."

The patent includes the following independent claims:

> 1. A composition which acts as a viening agent, or binder, which composition - Sesbania gum.
> 2. A drilling fluid composition comprising Sesbania gum either as a viscosifier or thickening agent, as a water-loss adjusting agent, or as a flocculant.
> 19. A method of producing a drilling fluid composition which method comprises mixing into water a viscosifying agent--including a Sesbania gum, subsequently mixing into the aqueous solution brine, alkali or other desired additives, and if desired finally adding to the solution barytes, galena or other weighing agents.
> 22. Use of Sesbania gum as a thickener in thickening compositions.
> 23. Use of Sesbania gum as a binder in binding compositions.
> 24. Use of Sesbania gum as a flocculant.
> 25. Use of Sesbania gum as a viscosifier or thickening agent, as a water-loss adjusting agent or as a flocculant-13-0079794-13 in drilling fluid compositions.
> 26. Use of Sesbania gum as a constituent of a coal slurry in the transport of coal in slurried form through pipelines.
> 27. Use of Sesbania gum as a thickener or binder in printing pastes, textile conditioning compositions, explosive compositions, in paper-making, or in dye stuffs.
> 28. Use of Sesbania gum for the beneficiation of mineral ores.

In practice the applicants were putting forward Sesbania gum as an alternative to the costly Guar gum from *Cyamopsis tetragonoloba* which is reportedly used as a thickening agent in many fields:

> "The said Sesbania gum is obtained from the seeds of the plant by removing the husks and cotyledons and germ materials from the seed thus leaving the clean splits which are then milled to an appropriate mesh thus affording a refined Sesbania gum.
>
> One advantage of Sesbania gum is that the Sesbania plant from which it is obtained can be grown on highly alkaline soils, or waterlogged soils on which other crops

> cannot be readily cultivated. Sesbania therefore does not require a crop displacement for its cultivation and will thus add considerably to the income of the rural farmer who can grow the crop as an additive source of income. Sesbania gum therefore can be produced less expensively than guar gum and it is envisaged that even if the demand for this material should increase it will remain less expensive owing to the ease with which the plant may be grown on soils that can yield no other more profitable crops."

Two points arise from these segments of the application. First, it raises the question of whether this patent falls into the scope of the Nagoya Protocol. The reason for this is that other than milling the seed of Sesbania and testing its viscosity the applicants do not appear to have utilized the material as a genetic resource in the sense of Article 2(c) of the Nagoya Protocol.

A second point raised by this application is environmental. The applicants think that there is a positive advantage from Sesbania for economic development because it does not involve displacement of crops and can grow in poor soils. This point is notable in light of wider debates about the environmental impacts of biofuels in terms of crop displacement.

This application is part of a patent family with four members including Australia, Norway and South Africa. Its longer term relevance is revealed in the citing patents which include four members from Bio Polymers in Australia for cultured plant cell gums that are useful for industrial, pharmaceutical and cosmetic applications and two United States grants to Merck & Co in the mid 1980s for quaternary ammonium salts of anionic gums. However, we would note that these patents did not necessarily involve Sesbania gum.

IN5: US20070298142A1 Morinda citrifolia
Animal Feed
Tahitian Noni International with a UK co-applicant and inventor

This patent application lists a UK resident in the applicant and inventor fields but is otherwise dominated by applicants from the United States and the company Tahitian Noni International Inc. The application involves an animal food product consisting of 0.01-30% of Morinda citrifolia pasteurized fruit puree along with other dry food and liquid components. The additives to the feed can include essential amino acids, essential fatty acids, minerals, peptide chains and whole seed and M. citrifolia seeds in a variety of forms (roasted, cracked, ground, flaked etc). The claimed invention is for an animal feed that reduces stress with significant health benefits for pigs, cows, poultry and pets etc.

The application describes Morinda citrifolia as follows.

> "The Indian Mulberry or Morinda citrifolia plant, known scientifically as Morinda citrifolia L. ("Morinda citrifolia"), is a shrub or small tree up to 10 m in height. The leaves are oppositely arranged with an elliptic to ovate form. The small white flowers are contained in a fleshy, globose, head-like cluster. The fruits are large, fleshy, and ovoid. At maturity, they are creamy-white and edible, but have an unpleasant taste and odor. The plant is native to Southeast Asia and has spread in early times to a vast area from India to eastern Polynesia. It grows randomly in the wild, and it has been cultivated in plantations and small individual growing plots. The Morinda citrifolia flowers are small, white, three to five lobed, tubular, fragrant, and about 1.25 cm long. The flowers develop into compound fruits composed of many small drupes fused into an ovoid, ellipsoid or roundish, lumpy body, with waxy, white, or greenish-white or yellowish, semi-translucent skin. The fruit contains "eyes" on its surface, similar to a potato. The fruit is juicy, bitter, dull-yellow or yellowish-white, and contains numerous red-brown, hard, oblong-triangular, winged 2-celled stones, each containing four seeds. When fully ripe, the fruit has a pronounced odor like rancid cheese. Although the fruit has been eaten by several nationalities as food, the most common use of the Morinda citrifolia plant had traditionally been as a red and yellow dye source."

What is clear from this description is that in addition to distribution in India the species is also distributed elsewhere in South and South East Asia. However, the application does not disclose the precise source or sources of the Morinda citrifolia.

The patent family contains 11 members for Morinda citrifolia products relating to animals but no patent grant is observable.

The application is cited by one later application from 2012 by Tahitian Noni International for Morinda citrifolia based antioxidant and antimicrobial formulations for improved color stability and shelf life of meat products.

IN6: US20090220624A1 Picrorrhiza kurroa
Chronic pulmonary disease
individual inventors

This is an example of a UK patent filing that was subsequently submitted to the Patent Cooperation Treaty and then the United States from 2006 to 2009 onwards. The application concerns a pharmaceutical or veterinary composition for dealing with chronic pulmonary disease. The focus of the application is Ginkgo biloba, apocynin and gingerol in a composition measured in milligrams of components that was tested on a 11 individuals of varying ages with conditions such as sinusitis, asthma and bronchitis. A randomised placebo controlled double-blinded cross-over trial at the University of Aberdeen involving 32 asthmatics is also reported with positive results and with a separate study in horses. These tests were the basis for control and quality of life questionnaires and, in the case of the horses, a series of samples and other tests.

The applicant specifies that they obtained the Ginkgo biloba from a commercial source in India as follows:

> "In the following *Picrorrhiza kurroa* is obtained from SAMI Labs Limited, of Bangalore, India; apocynin (acetovanillone) is obtained from Sigma-Tau (Aldritch); Ginkgo biloba and Ginger obtained from MediHerb (see above) and/or Cambridge Commodities Limited. These, lecithin, androsin, gingerols etc., and the other reagents are also widely available elsewhere."

As such the applicant provides a clear specification of the sources of the materials that form part of the claimed invention. The first claim also makes clear that the invention directly involved the material as:

> "1. A composition comprising ginkgo biloba or extract or component thereof; apocynin; and a gingerol; wherein at least 3.9% by weight of the composition is gingerol; and at least 0.05% by weight of the composition is apocynin."

However, given that the applicant makes no mention of tests on the genetic or biochemical composition of the claimed materials it is open to debate whether this application falls into the scope of utilization under the Nagoya Protocol. Such tests that do occur focus on a questionnaire and samples from horses rather than the genetic resource *per se* as a genetic resource.

This application forms part of a patent family of 5 documents dating between 2006-2009. To date none have become a patent grant. Furthermore the patent has not attracted any citations by other patents suggesting that in economic terms this patent is not important.

IN7: US20100116898A1 Family Fabaceae, Genus Aeschynomene
Givaudan with UK co-applicants and inventors

This patent application by the Swiss flavouring and fragrance company Givaudan lists two UK inventors as co-applicants. The patent application from 2010 focuses on a transfer element (or wick) for transferring volatile liquid for dissemination in the atmosphere made from dried plant stem material in the form of a rolled up sheet. The invention is directed to creating a plant stem based wick for dispersing fragrances.

The only reference to India in this document is to a commercial supplier in an example of the comparison of solid and rolled up transfer elements where

> "A length of a solid sola log/stem (commercially available from SB Enterprise, Kolkata, India), in precut form with the outer skin removed, was compared to a rolled cylinders (made from 1 mm thick sola sheets of material the same batch of sola logs, cut parallel to the surface spiralling inwards by a sharp blade and hand rolled tightly without leaving a gap applying minimal pressure)."

This patent application provides a good example of a type of application that references large numbers of species on the family, genus and species names in order to incorporate them into the scope of the claimed invention as the following sections of the application reveal.

> "Plant stem material that is useful for preparing the transfer element is taken from plants of the family Fabaceae, of the genus Aeschynomene or Sesbania. These include, without limitation, a number of species often called jointvetch, shola or sola, for example Aeschynomene afraspera (sola pith), Aeschynomene americana (American joint-vetch, joint-vetch or pega pega), Aeschynomene aspera (sola pith plant, sola), Aeschynomene falcate (Australian joint-vetch), Aeschynomene indica (curly indigo, hard sola, Indian joint-vetch, kat sola, northern joint-vetch, or sensitive joint-vetch) and Aeschynomene villosa. The stem material of sola plants is very light in weight and contains a characteristic central pith.
>
> Furthermore, useful Aeschynomene and/or Sesbania species include, for example, without limitation, the following:
>
> Genus Aeschynomene:
>
> A. abyssinica, A. acapulcensis, A. acutangula, A. afraspera, A. americana, A. amorphoides, A. angolense, A. aphylla, A. aspera, A. batekensis, A. baumii, A. bella, A. benguellensis, A. bracteosa, A. bradei, A. brasiliana, A. brevifolia, A. brevipes, A. bullockii, A. burttii, A. carvalhoi, A. chimanimaniensis, A. ciliata. A. compacta, A. crassicaulis, A. cristata, A. curtisiae, A. deamii, A. debilis, A. deightonii, A. denticulata, A. dimidiata, A. egena, A. elaphroxylon, A. elegans. A. evenia, A. falcata, A. fascicularis, A. filosa, A. fluitans, A. fluminensis, A. foliolosa, A. fulgida, A. gazensis, A. genistoides, A. glabrescens, A. glauca, A. goetzei, A. gracilipes, A. gracilis, A. grandistipulata, A. guatemalensis, A. heurckeana, A. hintonii, A. histrix, A. indica, A. interrupta, A. inyangensis, A. katangensis, A. kerstingii, A. langlassei, A. latericola, A. lateritia, A. laxiflora, A. leptophylla, A. leptostachya, A. lorentziana, A. lyonnetii, A. magna, A. marginata, A. martii, A. maximistipulata, A. mediocris, A. megalophylla, A. mimosifolia, A. minutiflora, A. mollicula, A. monteiroi, A.

montevidensis, A. mossambicensis, A. mossoensis, A. multicaulis, A. nana, A. neglecta, A. nematopoda, A. nicaraguensis. A. nilotica, A. nivea, A. nodulosa, A. nyassana, A. nyikensis, A. oligophylla, A. oroboides, A. palmeri, A. paludosa, A. paniculata. A. paraguayensis, A. pararubrofarinacea, A. parviflora, A. patula, A. paucifolia, A. paucifoliolata, A. petraea, A. pfundii, A. pinetorum, A. pleuronervia, A. pluriarticulata, A. podocarpa, A. pratensis, A. pringlei, A. pseudoglabrescens, A. pulchella, A. purpusii, A. pygmaea, A. racemosa, A. rehmannii, A. rhodesica, A. riedeliana, A. rivularis, A. rosei, A. rostrata, A. rubrofarinacea, A. rubroviolacea, A. rudis, A. ruspoliana, A. sansibarica, A. scabra, A. schimperi, A. schindleri, A. schliebenii, A. scoparia, A. selloi, A. semilunaris, A. sensitiva, A. siifolia, A. simulans, A. solitariiflora, A. sparsiflora, A. standleyi, A. stipitata, A. stipulosa, A. stolzii, A. tambacoundensis, A. tenuirama, A. tenuis, A. trigonocarpa, A. tsaratanensis, A. tumbezensis, A. uniflora, A. unijuga, A. upembensis, A. venulosa, A. vigil, A. villosa, A. virginica, A. viscidula, A. vogelii, A. warmingii, A. weberbaueri.

Genus Sesbania:

S. aculeate, S. aegyptica, S. benthamiana, S. bispinosa, S. brachycarpa, S. brevipedunculata, S. campylocarpa, S. cannabina, S. chippendalei, S. cinerascens, S. coerulescens, S. concolor, S. dalzielii, S. drummondii, S. dummeri, S. emerus, S. erubescens, S. exasperata, S. formosa, S. goetzei, S. grandiflora, S. greenwayi, S. hepperi, S. herbacea, S. hirtistyla, S. hobdyi, S. javanica, S. keniensis, S. leptocarpa, S. longifolia, S. macowaniana, S. macrantha, S. macrophylla, S. macroptera, S. madagascariensis, S. microphylla, S. notialis, S. oligosperma. S. pachycarpa, S. paucisemina, S. procumbens, S. punicea, S. quadrata, S. rostrata, S. roxburghii, S. sericea, S. sesban, S. simpliciuscula, S. somaliensis, S. speciosa, S. sphaerosperma, S. subalata, S. sudanica, S. tetraptera, S. tomentosa, S. transvaalensis, S. uliginosa, S. virgata, S. wildemanii.

The plant material of some plants is more easily harvested, as they produce a softer wood with a higher percentage of spongy pith. Usually the aquatic species produce such woods, some examples from the sesbania species are S. javanica , S. sericea, S. bispinosa, S. procumbens, and S. uliginosa. In contrast, non-aquatic species, for example, S. cannabina, S. concolor, S. sesban, S aegyptica, S. grandiflora, produce harder woods with little spongy tissue.

Many Aeschynomene, Sesbania, or Robinia species are very closely related or even identical; the following Sesbania species are also known as Aeschynomene, among other synonyms:

Sesbania cannabina (Retz.) Pers. (also known as Aeschynomene cannabina Retz., Coronilla cannabina (Retz.) Willd., Coronilla cochinchinensis Lour., Sesban aculeata xxx var. cannabina (Retz.) Baker, Sesban australis F. Muell., Sesban cannabinus (Retz.) Poir., Sesban cochinchinensis (Lour.) DC., Sesban sericea Domin, non (Willd.) Link, Sesbania aculeata (Willd.) Pers. var. cannabina (Retz.) Baker, Sesbania sericea (Willd.) Link var. glabra Domin.); Sesbania cannabina (Retz.) Pers. var. cannabina (also known as Aeschynomene cannabina Retz., Sesban cannabinus (Retz.) Poir., Sesbania sericea (Willd.) Link var. subsinguliflora Domin); Sesbania cannabina (Retz.) Pers. var. sericea (Benth.) N. T. Burb. (also known as Sesbania aculeata (Willd.) Pers. var. sericea Benth.); Sesbania sesban (L.) Merr. (also known as Aeschynomene sesban L., Emerus sesban (L.) Kuntze ,

> Sesban aegyptiaca Poir., Sesbania aegyptiaca Poir., Sesbania confaloniana (Chiov.) Chiov., Sesbania pubescens sensu auct.);
> Sesbania sesban (L.) Merr. subsp. sesban var. sesban (also known as Aeschynomene sesban L., Sesban aegyptiacus Poir., Sesbania aegyptiaca (Poir.) Pers., Sesbania atropurpurea Taub. , Sesbania confaloniana Chiov. , Sesbania pubescens auct., non DC., Sesbania punctata auct., non DC., Sesbania tchadica Chev.); Sesbania bispinosa wight (also known as Aeschynomene aculeata Schreb., Aeschynomene bispinosa Jacq., Coronilla aculeata Willd., Sesban aculeatus Poir., nom. illeg. , Sesbania aculeata Pers., nom. illeg. , Sesbania bispinosa (Jacq.) Spreng. ex Steud., Sesbania cannabina Merr.); Sesbania javanica Miq. (also known as Aeschynomene paludosa Roxb., Sesbania aculeata (Willd.) Pers. var. paludosa (Roxb.) Baker, Sesbania paludosa (Roxb.) Prain, Sesbania roxburghii Merr.); Sesbania procumbens Wigh & Arnot (also known as Aeschynomene procumbens (Roxb.)); Sesbania sericea, Sesbania sericea (Willd.) Link var. glabra Domin see under Sesbania cannabina (Retz.) Pers; Sesbania sericea (Willd.) Link var. inermis Domin, see under Sesbania cannabina (Retz.) Pers. var. sericea (Benth.) N. T. Burb; Sesbania sericea (Willd.) Link var. subsinguliflora Domin see under Sesbania cannabina (Retz.) Pers. var. cannabina; Sesbania grandiflora (L.) Pers. (also known as Aeschynomene coccinea L. f., Aeschynomene grandiflora (L.) L. (GRIN), Agati coccinea (L. f.) Desv., Agati grandiflora (L.) Desv. (GRIN), Coronilla coccinea (L. f.) Willd., Coronilla grandiflora (L.) Willd., Dolichos arboreus Forssk., Emerus grandiflorus (L.) Kuntze, Resupinaria grandiflora (L.) Raf., Robinia grandiflora L. (GRIN), Sesban grandiflorus Poir. (GRIN), Sesbania grandiflora (L.) Poir.); Sesbania speciosa Taub. (also known as Sesbania hildebrandtii Taub. ex Engl., Sesbania pubescens DC. var. grandiflora Vatke).
>
> Other related plants that also have a central pith, in particular those with aquatic stems with a distinct pith surrounded by spongy parenchyma, for example of the genus Robinia, including, for example, Robinia pseudoacacia L., may be similarly useful."

Throughout this application, the above mentioned plants are referenced as "sola" or "sola plants." The applicants explain that: "Sola plants are found growing around the world, usually in wet regions such as rice fields and are often regarded as weeds. The stems of the sola plant, usually stripped of the outer skin, are used in a number of decorative household items and are commonly processed into decorative shapes." The applicants claim:

> "1. A transfer element that comprises dried plant stem material, wherein the transfer element comprises said dried plant stem material in form of at least one rolled-up sheet.
>
> 2. The transfer element of claim 1 wherein the dried plant stem material is from a plant of the family Fabaceae selected from a plant of the genus *Aeschynomene*, a plant of the genus *Sesbania*, and a plant of the genus *Robinia*."

What is significant about these claims is that they are confined to the use of the plant material for the purpose of creating a wick. However, they are constructed such that they incorporate dried plant stem from the family Fabaceae and the genera Aeschynomene, Sesbania and Robinia. The practical implication of constructing the claims in this way is that any dried stem material from the family Fabaceae or Leguminosae used in a wick would infringe the patent. That is, the patent essentially incorporates plant stem material

from an estimated 745 genera and 19,500 species around the world (wikipedia) for use in a wick or transfer element.

To date this application forms part of a patent family with only two members and has attracted only 1 citing document for a fragrance release system having an optimised wick.

IN8: US6346539B1 *Piper nigrum* (black pepper)
Skin Cancer Treatment
BTG International UK

This example involves a UK company and UK inventors in a United States Patent grant with the University of Oregon as a co-applicant. The patent concerns the use of piperine active analogs and derivatives for stimulating melanocye proliferation that are useful in treating skin cancer.

This patent explains that the invention involves Piper nigrum or black pepper "originally from India". The black pepper was purchased from a shop described as the Food Centre at 70 Turnpike Lane in London. In addition other herbs involved in the invention were purchased from a UK company, East-West Herbs, in Oxfordshire and from a company called Cipla Limited in Mumbai (Bombay), India.

This patent claims a method of treating skin cancer involving the compound. Because it originates from a well known species it is possible that this patent is claiming a new use of a compound that is well known in the prior art. However, in practice a review of the patent family reveals a granted patent on the compound itself.

This example is of interest because it raises questions about the interpretation of the Nagoya Protocol. After prolonged discussion the Nagoya Protocol was deliberately designed to exclude commodities in trade. This was achieved through the focus on the utilization of a genetic resource as set out in Article 2(c).

In this case a UK company has purchased black pepper as a commodity from a shop. It has then conducted research and development on the biochemical composition of the commodity leading to the identification of a skin cancer treatment. The question therefore is whether this triggers a requirement to seek consent from the provider country and to establish an access and benefit-sharing agreement.

Prior informed consent to access material cannot logically take place after the event and the company purchased the material from a shop in London. This raises the question of whether this company (assuming the Nagoya Protocol to be in force) would be required to seek some form of post facto consent from the country of source printed on the label of the material utilized (which could in some cases be a blend from multiple countries). This also raises the question of what benefits might be shared and how? One answer in cases where the country of origin could not be identified is the Global Multilateral Benefit-Sharing Mechanism anticipated in Article 10 of the Nagoya Protocol.

What this example begins to bring into focus is the implications of a change of use of genetic material from use and consumption as a commodity that can be purchased on the high street, to utilization as a genetic resource in the form of research and development involving the biochemical composition of the purchased material. A legitimate argument could be made that this change of use brings the activity into the scope of the Nagoya Protocol.

IN10: WO2000042143A1 *Anogeissus latifolia*
Detergents
Unilever.UK, Netherlands and India

This patent application involves the UK company Unilever in a joint application with Unilever in the Netherlands and Hindustan Lever in India. Both inventors listed in the application are from India. The invention involves an active detergent combined with gum ghatti and water swellable branched hydrocolloids from Anogeissus. The claimed use of the detergent is for cleaning laundry or hard surfaces and for manual dishwashing. A range of examples are provided of the cleaning properties of the invention.

The Indian origin of the material is clearly specified as follows, however, note that the specific source of the material is not provided.

> "The present invention contains as an essential element gum Ghatti. Gum Ghatti is derived from Anogeissus latifolia a large gregarious tree belonging to the family Combretaceae, commonly found in the dry deciduous forests of India and Sri Lanka. The tree yields a gum or a water swellable, branched hydrocolloid commonly known as Indian gum or gum ghatti, which occurs in straw coloured vermiform tears and dries without cracking."

The patent application claims:

> "1. A detergent composition suitable for cleaning laundry or hard surfaces comprising up to 50%wt. of the total detergent composition of detergent active and gum ghatti, a gum of the water swellable, branched hydrocolloids obtained from the species belonging to the genera Anogeissus."

This PCT patent application has generated a patent family with 4 members including the UK, Australia, and Argentina. However, a patent grant is not observable in this family dating to the late 1990s and 2002. This suggests that the company decided not to proceed further with the application. A review of citing patents reveals other patents, including a European grant and document in China by Unilever for improved detergent compositions. Patent grant EP1625195B1 also involves Hindustan Lever Ltd and Unilever UK and Unilever Rotterdam but different inventors from India. This latter patent involves water swellable polymers but on this occasion involves Guar gum. The applicant references the earlier PCT application involving ghatti gum as water swellable. However, the patent grant focuses on a concentrated cleaning composition that can be converted to a ready to use product by adding water. It is unclear whether ghatti gum features in the composition claimed in this application which refers in the claims to "a water-swellable polymer is chosen from polyacrylic acids or partially neutralised sodium salts of cross linked polyacrylic acids.

IN11: WO2004039385A2 Mucuna pruriens (Velvet Bean)
Pharmaceuticals
Phytrix AG (Germany) with UK Inventor as co-applicant

This patent involves Mucuna pruriens which carries the common name of velvet bean or cowitch and is quite widely distributed in tropical countries. The patent application from 2005 refers to a pharmaceutical composition for treating neurological disorders filed by a German company Phytrix AG with a UK inventor as a co-applicant.

With respect to sources the patent applicant specified that the Mucuna pruriens seed powder was manufactured in Germany "from raw bean material obtained in India":

> "The mucuna pruriens seed powder preparation was a light, yellowish powder, which was manufactured and formulated under Good Manufacturing Practice (GMP) conditions in Germany (Wiewelhove GmbH TM) from raw bean material obtained in india and packed in sachets (unit) of 7.5 grams."

However, early on in the application they state that

> "Since mucuna pruriens and its use is so widespread that it is considered common fare from china to england, iran to spain, Africa to South America, it has a variety of common names like Nescafe, Cowage, Velvetbean, Fagiolo Di Rio Negro, Fogarate, Jeukerwt, Juckbohne, Nd, Pien Tou, Pois A Gatter, Pois Gratte, Swagupta, T'Ao Hung King, Kekara gatel or Rarawejah. Velevetbean, a vigorous annual climbing legume, originally came from southern china and eastern india, where it was at one time widely cultivated as a green vegetable crop. The genus Mucuna, belonging to the Fabaceae family, covers perhaps 100 species of annual and perennial legumes, including the annual velvetbean."

The applicant then claims:

> "1. A pharmaceutical composition comprising one or more Mucuna pruriens seed components, substances, fractions or mixtures of substances obtained therefrom and a pharmaceutical acceptable diluent, excipient or carrier."

In this case the material that is the focus of the invention was obtained from India and the applicants have conducted research and development. However, in this case the disclosure of the material from India lacks clarity.

IN12: WO2004105718A1 Symplocos racemosa and Rubia cordifolia
Skin Lightening compositions
Unilever

This example involves Unilever UK, Unilever in the Netherlands and Hindustan Lever in India with inventors exclusively from India. The patent concerns plant extracts that provide protection against ultraviolet radiation using natural products without the addition of other active chemicals. The extract involves the bark of what is described as *Symplocos racemosa*, *Symplocos paniculata*, *Symplocos cochinchinensis* and/or *Rubia cordifolia*. The composition further comprises extracts of Glycyrrhiza, Coriandum and/or Acorus. The Symplocos or Rubia is extracted from the bark of the plant. The patent describes the source of the material as follows:

> "It is an essential aspect of the present invention that the plant extracts of Symplocos or Rubia are incorporated in the cosmetic composition. However, other plant extracts from Glycyrrhiza, Coriandum, Acorus and useful conventional ingredients may be added to the composition.
>
> Symplocos, is a genus belonging to the family Symplocaceae, commonly available in India. It has several species of which S. recemosa, S. paniculata and S. cochinchinensis are the preferred species for use in the composition.-6
>
> Rubia, is a genus belonging to the family Rubiaceae of which R. cordifolia, commonly available in India is the preferred species."

The patent application claims:

> "1. A cosmetic skin lightening composition, comprising O.l by weight of an extract of plants from the families of Symplocos, Rubia or a mixture thereof.
>
> 7. The cosmetic skin lightening composition of any preceding claim further comprising extracts of Glycyrrhiza, Coriandum, Acorus or mixtures thereof.
>
> 8. The cosmetic skin lightening composition of any preceding claim wherein the Symplocos or Rubia is extracted from the bark of the plant."

This patent belongs to a family with 10 members including in Brazil, China, the UK, Japan, Korea, Mexico and South Africa suggesting that the patent is important to the company in these markets. One citing patent application, dating to 2011 (WO2011045150A2) involves the same applicants and focuses on a personal care composition comprising an extract of a plant source which comprises anthraquinones or naphtha quinones from the family Rubiaceae and specifically Rubia cordifolia. As such, while not appearing in the patent family, this is an extension of the earlier research and reveals the importance of citing patents in tracking developments over time.

This example highlights that members of the same multinational company group based in multiple countries may be involved in a patent application.

IN13: WO2009016362A2 *Anogeissus latifolia*
Gum in denture adhesive.
Phillips Hydrocolloids and Reckitt Benckiser

This PCT application involves two UK based companies and UK inventors. The patent application focuses on the use of a blend of two or more natural polysaccharide gums to create a denture adhesive with improved elasticity in the form of an ointment, cream or gel. The application focuses on:

> "modified forms of naturally occurring polysaccharide gums, including ghatti, karaya and kerensis gums, which are especially useful in this respect, either alone or blended with unmodified gums. The present invention further relates to the methods of preparation of such modified gums, and specifically to the control of hydrogel content of the modified gums, which is key for their performance in the aforementioned adhesive compositions."

The first gum is described as follows:

> "Gum ghatti, also known as Indian gum, is the dried exudate of Anogeissus latifolia, a large tree found abundantly in the dry deciduous forests of India. Gum ghatti was originally developed around 1900 as a substitute for gum arabic. However, several studies have demonstrated that the raw form of the gum is not currently suitable for certain applications due to the variation in solubility and viscosity of the raw material. Consequently, gum ghatti has never been established as major tree gum for industrial use.
>
> The unpredictable physical and chemical properties of gum ghatti have prevented its commercial application. Natural gum exudates, including gum ghatti, have adhesive qualities which are dependent on their natural viscoelasticity. These adhesive qualities can be variable, due to the unpredictability of the molecular properties of the gum. This is common for natural exudates whose properties often dependent on the geography, climate and soil origin of the tree from which the gum is obtained."

The second and third gums, gum karaya and gum kerensis are described as follows:

> "Gum karaya is obtained from Sterculia urens R and other Sterculia spp. (Sterculiaceae, Malvales) and has been used as a denture adhesive/fixative agent in its neat (powder) form. Similarly to gum ghatti, gum karaya exhibits a natural variation of the proportion of soluble and insoluble fraction depending on the location of the tree or season when the gum is extracted. Gum kerensis is a gum exudate obtained from acacia tree (otherwise known as A.senegal war. karensis.) by tapping."

The patent claims the resulting gums including derivatives in a denture adhesive:

> "1. A denture adhesive comprising a polysaccharide gum, wherein the average insoluble hydrogel content of the gum is >10%.
>
> 2. A denture adhesive according to claim 1 wherein the polysaccharide gum is, or is derived from, one or more of natural karaya, ghatti or kerensis gums.

> 7. A denture adhesive according to any preceding claim which comprises one or more adjuvants selected from but not restricted to oils, waxes, gums, further adhesive substances, fragrances and dyes.
>
> 14. A denture adhesive according to any preceding claim which has a viscosity of between 5 and 50 Pa.s at 10s 1, and a tube extrusion force of <16kg, measured at 25°C and atmospheric pressure.
>
> 15. A denture adhesive composition according to any preceding claim which comprises: 0.1 - 60 wt% of at least one modified polysaccharide gum according to the first aspect of the invention; • 0.1 - 90 wt% of a base for the cream, ointment or gel; and, • 0.1 - 50 wt% of at least one further adhesive substance based on the overall composition."

We were able to identify one reference to a specific source in this application from a commercial provider as follows "Commercial ghatti gum (Gums & Colloids India, regular gum ghatti Lot 40138) was used." Elsewhere the applicants state that they obtained other samples from the same supplier: "For the matching controlled experiments we have used a Karaya gum sample supplied by the Gums and Colloids Group (India) as white cleaned nodules. "

The Gums and Colloids Group is listed as a New Delhi company founded in 1940 that supplies Gum Acacia, Gum Ghatti and Gum karaya. As such the application is based on materials supplied from a commercial source in India including a Lot number in the case of Gum ghatti.

This patent application forms part of a patent family with five members including the UK, Australia and Europe. At present no patent grant is listed in the patent family. The application has attracted two citations for a hydrogel denture adhesive by Combe Inc. The history of the exploration of these gums is also suggested by earlier patent filings including three grants in the United States including for the use of gums in denture adhesive by Richardson Vicks Inc and Warner Lambert.

IN14: WO2009077187A2 Asparagus racemosus
Enhancing Immunity.
Unilever UK, Hindustan Unilever and Unilever Netherlands.

This 2009 PCT application by three Unilever co-applicants focuses on an edible composition with immuno-stimulant properties containing theanine and herbs from shankhpushpi and/or shatavari. The claimed immuno-stimulant was tested using in vitro cell culture assays. The main proposed use of the immuno-stimulant is for preventing or treating colds and/or influenza with the composition being provided in the form of a tablet, powder, syrup and as a food products such as tea, fruit juice, fruit or jam.

The theanine for use in the mixture with the herbs is derived from tea. The application makes reference to both Indian and Chinese traditional medicine as follows in the description.

> "However, in general, people do not prefer medicinal solutions to solving the problem of reduced immunity. This is because, although medicinal solutions are believed to be effective, they are believed to cause undesirable side-effects. Thus, there is a continuing demand for "natural" solutions to such problems. The science of herbal medicine is one of the ancient sciences, which finds place in modern medical research. Examples of herbal medicine include Ayurveda in India and Traditional Chinese Medicine in China."
>
> "Shatavari (sometimes spelt as Shatawari), also known as Shatamuli includes the herb Asparagus racemosus. It belongs to the family of Liliaceae. The plant is found throughout central and southern India and in lower Himalayas. The herb contains steroidal saponins.
>
> It has been traditionally used for making general tonics and is especially used as a tonic for female reproductive function and to increase lactation. Additionally it has been used for providing relief from dysentery, spasms, and also for antioxidant, immunostimulant, and antibacterial benefits. For the purposes of the present invention the preferred parts of Shatavari are tuberous roots."

The application includes a specific section on the source and origin of the ingredients used in the invention. This makes reference to a macrophage cell line (for use in assays) obtained from the National Centre for Cellular Sciences (NCCS) in Pune, India. An additional reference is made to obtaining a Geisma strain from S.D. Fine Chem Ltd. in India.

The patent depends on the results of experiments that demonstrate that the combination of theanine with the two herbs is more successful in stimulating the immune system than the individual components. The application claims:

> "1. An edible composition for enhanced immunity comprising theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof.
>
> 3. An edible composition as claimed in any one of the preceding claims wherein the theanine is derived from tea.
>
> 6. An edible composition as claimed in any one of the preceding claims wherein the composition is a tablet, capsule, powder or syrup form.

7. An edible composition as claimed in any one of the preceding claims 1 to 5 wherein the edible composition is a food product.

9. An edible composition as claimed in any one of the preceding claims wherein the theanine and the herb are present in a dry weight ratio in the range of 50:1 to 1:5.

10. A composition comprising theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof for use as a medicament in preventing or treating a disease related to reduced immunity in an individual.

11. Use of a composition comprising theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof in the manufacture of a medicament for preventing or treating a disease related to reduced immunity in an individual.

12. A method of preventing or treating a disease related to reduced immunity in an individual, the method comprising administering to the individual a composition comprising theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof.

13. Composition, use or method as claimed in any one of claims 10 to 12 wherein the disease is cold and/or influenza.

14. Composition, use or method as claimed in any one of claims 10 to 13 wherein the composition is edible and is administered orally to the individual."

What is observable in this case is that while reference is made to the distribution of the species in India, no reference is made to the specific source of the material within India. In contrast clear references are made to the sources of strains used in testing the efficacy of the claimed invention. As such, the application is inconsistent in its referencing of sources.

This application is part of a patent family with 8 members including China, Europe, Japan and the United States. One patent appears to have been granted in China. The patent has not attracted any citations but cited two earlier patents concerned with methods for reducing the risk of cold/or flu and, at the EPO, for an anti-aging agent submitted by Osaka Prefecture in Japan. The two cited literature references do not provide clear clues to the origin of the material although the PCT listed Journal of Ethnopharmacology forms one of the references.

IN15: WO2009077188A1 Tea composition for Enhancing Immunity.
Unilever UK, Unilever Netherlands, Unilever Hindustan. Indian Inventors.

This application appears to be a separate follow on application to IN14. It concerns a tea with immunostimulant properties "comprising shankhpushpi, shatavari, vidarikand and/or arogyapacha; and a flavoring agent (0.01-0.5 wt.%)." The tea has the advantage of looking, smelling and tasting like regular tea.

With respect to references to India we observe the following:

> "...in general, people do not prefer medicinal solutions to solving the problem of reduced immunity. This is because, although medicinal solutions are believed to be effective, they are believed to cause undesirable side-effects. Thus, there is a continuing demand for "natural" solutions to such problems. The science of herbal medicine is one of the ancient sciences, which finds place in modern medical research. Examples of herbal medicine include Ayurveda in India and Traditional Chinese Medicine in China."
>
> "Shankhpushpi includes the herbs Evolvulus alsinoides, Convolvulus pluricaulis, and Clitorea turnatea. The common name in English is Dwarf morning-glory. It is also sometimes spelt as Shankhapushpi. It is a perennial herb with prostrate branches, small elliptic to oblong leaves, and with flowers which are mostly solitary in upper axils. The whole herb has been used medicinally for fevers, nervous debility, and loss of memory.
>
> Shankhapushpi has also been used as a brain tonic. In the present invention any part of Shankhpushpi may be used.
>
> Shatavari (sometimes spelt as Shatawari), also known as Shatamuli includes the herb Asparagus racemosus. It belongs to the family of Liliaceae. The plant is found throughout central and southern India and in lower Himalayas. The herb contains steroidal saponins. It has been traditionally used for making general tonics and is especially used as a tonic for female reproductive function and to increase lactation."
>
> "Vidarikhand (also spelt as Vidaarikhand) also known as Vidari includes the herb Ipomoea digitata. It is also known as milky yam or alligator yam. It is a perennial climber with tuberous roots and pink or red flowers. It has been used for making general tonics, for increasing lactation and for general nutritive value. For the purposes of the present invention the preferred parts of Vidarikhand are tubers.
>
> Arogyapacha includes the herb Trichopus zeylanicus that predominantly grows in southern parts of India. The fruit is usually used for medicinal purposes. This herb is believed to provide vitality and vigor to the person consuming it. Modern pharmacological studies have proven that this plant is a very effective restorative tonic. In the present invention any part of the Arogyapacha plant, although preferably the leaves, are used."
>
> "Eletteria cardamomum is also known as cardamom and is a common flavouring spice used in India and other countries.
>
> When cardamom is used, it is present either as a powder or an oil, preferably as oil.

> Ocimum sanctum is also commonly known as Holy basil in Europe or as Tusli in India."

The application goes on to specify the same sources for the cell line and Geimsa strain as in IN14.

The patent application claims:

> "1. A composition comprising: (a) tea; (b) 0.1 to 15% by weight of herb selected from Shankhpushpi, Shatavari, Vidarikhand, Arogyapacha or a mixture thereof; and (c) 0.01 to 0.5% by weight of a flavouring agent.
>
> 2. A composition as claimed in claim 1 wherein the flavouring agent is cardamom, basil or a mixture thereof.
>
> 3. A composition as claimed in claim 1 or claim 2 wherein the flavouring agent is a natural oil.
>
> 4. A composition as claimed in any one of the preceding claims wherein the amount of flavouring agent is from 0.1 to 0.4% by weight of the composition.
>
> 5. A composition as claimed in any one of the preceding claims wherein at least part of the herb is in the form of an aqueous extract.
>
> 6. A composition as claimed in any one of the preceding claims wherein said herb is present in 0.5 to 10% by weight of the composition.
>
> 7. A composition as claimed in any one of the preceding claims additionally comprising a food grade binder.
>
> 8. A composition as claimed in claim 7 wherein said food grade binder is present in an amount of 0.05 to 5.0 % by weight of the composition.
>
> 9. A composition as claimed in claim 7 or 8 wherein said food grade binder is a polysaccharide, gum, polymer or a mixture thereof.
>
> 10. A composition as claimed in any of the preceding claims wherein said tea is leaf tea, instant tea or ready to drink tea.
>
> 11. A composition as claimed in claim 10 wherein the tea is leaf tea.
>
> 12. A composition as claimed in any one of the preceding claims wherein the tea is black tea.
>
> 13. A composition as claimed in any of the preceding claims wherein the amount of the tea is at least 80% by weight of the composition.
>
> 14. A process to prepare a composition according to any one of the preceding claims, the process comprising the step of blending the tea with the herb and the flavouring agent.
>
> 15. A process as claimed in claim 14 comprising the steps of: (a) dispersing a binder and the flavour agent in water to form a dispersion; (b) blending the tea with the dispersion to form a wet tea blend; (c) blending said wet tea blend with one or

> more herbs selected from Shankhpushpi, Shatavari, Vidarikhand, and Arogyapacha; and (d) drying to a moisture content of less than 8% by weight."

This patent application is narrowly focused on the inclusion of the components in a tea for stimulating the immune system.

The application forms part of a patent family with eight members including a patent grant in Europe and a patent application in China and the United States. The European patent has been translated in Austria. the application has attracted 1 citation from an Italian individual for a gastrointestinal and digestive composition.

This application also encounters existing patent prior art including a PCT patent application WO2004056382A1 by the Council for Scientific and Industrial Research (India) for an Ayurvedic Herbal Soft Drink and a second CSIR PCT application (WO200454379A1) for a process for preparing a spiced tea concentrate and products. In this case an Indian member of a UK based multinational in competition in patent space with the Indian government's CSIR for elements of the claimed invention.

IN16: WO2009083454A2 Eleusine coracana (sorghum/millet)
Enzymatic preparation of a gamma-glutamyl compound.
Unilever UK, Unilever Netherlands, Unilever Hindustan.

This 2009 PCT application focuses on a gamma glutamyl transpeptidase enzyme derived from plant material where:

> "The plant belongs to Graminaceae family and is sorghum, millet (preferably Eleusine coracana), wheat or rice, or the plant belongs to Leguminaceae family and is soya, green gram, black gram or mung bean." (Thomson Innovation WO2009083454A2).

The application goes on to state that any plant from the Leguminaceae family including soya, green gram, black gram, or mung bean may be used with green gram being preferred.

The first reference to India is encountered in connection with:

> "Plant material from any plant belonging to Graminaceae family can be used according to the present invention. The plant belonging to Graminaceae family is preferably selected from maize, wheat, rice, barley, sorghum, triticale, rye, millet, buckwheat, fonia, or quinoa. More preferably the plant is sorghum, millet, wheat or rice. More preferably still the plant is sorghum or millet but especially millet. The millet variety that is particularly preferred is Eleusine coracana, which is also known as Ragi in India. Ragi, also known as finger millet, originated in Eastern Africa and was introduced to India nearly 3000 years ago. It has relatively low commercial value and is considered to be a "poor man' s food"."

The enzyme is extracted through a process of grinding the plant material extracting the material in a liquid medium at pH 5-11. The insoluble solids from this mixture are then separated and the supernatant crude protein is then recovered (GGT). The protein material can then be used as is or further purified. The second major component is a Gamma-glutamyl acceptor which is a compound capable of accepting the gamma glutamyl moiety. An amine, amino acid or peptide or mixtures of them are mentioned as suitable.

In connection with the sources of the materials the applicants mention that Potassium hydroxide and Ethanol were obtained from the commercial supplier SRL in India. However,

> "Seeds of Ragi, maize, peas, green gram, and sorghum were purchased from local market in Bangalore, India. Tea seeds were procured from Tea gardens in South India."

The patent claims:

> "1. A process for the enzymatic preparation of a gamma-glutamyl compound, the process comprising a step of contacting a gamma-glutamyl donor and a gamma-glutamyl acceptor with an aqueous medium comprising a gamma glutamyl transpeptidase enzyme derived from a plant material where the plant belongs to Graminaceae or Leguminaceae family, or is Camellia sinensis .
>
> 5. A process as claimed in any one of the preceding claims wherein said enzyme has optimum activity at a pH between 6.5 and 8.5.

6. A process as claimed in any one of the preceding claims wherein the enzyme is derived by a method comprising the steps of: a . grinding the plant material; b . extracting the ground plant material with an aqueous medium buffered at pH between 5 and 11, thereby to produce a mixture of insoluble solids and supernatant crude protein extract; c . separating insoluble solids from the mixture; and d . recovering supernatant crude protein extract comprising said enzyme.

7. A process as claimed in any one of the preceding claims wherein: (a) the plant belongs to Graminaceae family and is selected from sorghum, millet, wheat, rice or (b) the plant belongs to Leguminaceae family and is selected from soya, green gram, black gram or mung bean.

8. A process as claimed in claim 7 wherein the plant is selected from sorghum, millet or green gram.

9. A process as claimed in claim 8 wherein said plant is millet.

10. A process as claimed in claim 9 wherein said millet is Eleusine coracana.

11. A process as claimed in any one of the preceding claims wherein said acceptor is selected from amine, amino acid, peptide or mixture thereof

14. A process as claimed in any one of the preceding claims wherein the gamma-glutamyl donor is selected from an amino acid, peptide or derivative thereof.

15. A process as claimed in any one of the preceding claims wherein said enzyme has an activity greater than 50 units.

16. A process as claimed in any one of the preceding claims wherein, a . said donor is a peptide or an amino acid having gamma glutamyl moiety, b . said acceptor is ethylamine or ethylamine hydrochloride, and; c . said gamma glutamyl compound is theanine.

22. A gamma-glutamyl compound obtainable by the process as claimed in any one of claims 1 to 18.

23. A tea product comprising a gamma-glutamyl compound as claimed in claim 22."

The focus of the claims is the process for producing the compound and the resulting tea product containing the compound. As such this is a product by process patent where the claims are limited to the product produced using the process. The key issue in this patent appears to be the pH of the solution for producing the enzyme which is described as a range.

This patent application is one of a family of four applications with no patent grants listed. The patent has not attracted any citations.

IN17: WO2009111294A1 Anticancer compounds
Eagle Pharmaceuticals with UK inventor as co-applicant

This example involves a US pharmaceutical company with inventors from the UK, India and the United States as co-applicants. In this case the applicant focuses on a compound from *Camptotheca accuminata*,(*Camptotheca acuminata*) a tree that is indigenous to China, and *Nothapodytes foetida* which is described as indigenous to China. In this case therefore the compound of interest can be obtained from two countries.

> "Background of the Invention Camptothecin is a water-insoluble, cytotoxic alkaloid produced by Camptotheca accuminata trees Indigenous to China and Nothapodytes foetida trees indigenous to India.
>
> Carnptothecin and a few close congeners thereof are the only class of compounds known to inhibit topoisomerase I.
>
> Inhibition of topoisomerase II is the major target of Important commercial oncolytic agents (e.g., etoposide) as well as other oncolytic agents still undergoing development.
>
> Carnptothecin (and its known congeners) have no effect on topoisomerase II and none of the known topoisomerase II inhibitors has any significant effect on topoisomerase I." (WO2009111294A120090911: 13-16).

The applicant claims:

> "1. A topotecan-containing composition, comprising: a) topotecan or a pharmaceutically acceptable sail thereof; and b) a pharmacologically suitable fluid comprising an aqueous diluent wherein: i) the pH of the composition is less than or equal to about 1.5; and ii) the composition is stable during long term storage; wherein the amount of 10-hydroxycamptothecin (10-HCPT) in said composition resulting from the degradation of said topotecan during said long term storage is less than about 6Âμg/mL".

In this case Camptothecin is commercially available as a traded compound under the trade name Hycamtin as a powder for use in injections. This example illustrates the importance of examining the claims with care. In this case the claims actually focus on the compound in a solution where it is the solution, rather than the compound, that is the focus of the claims.

IN18: WO2009153572A1 Sandalwood extract or analog
Animal foodstuff additive
Aberystwyth University and Compton Developments

This PCT application from 2009 focuses on a sandalwood extract or analog for use as an additive to animal feedstuffs on the basis that it has antimicrobial activity. In particular it reduces the growth of pathogenic bacteria such as E. coli or Listeria monocytogenes in the digestive system. This in turn can increase meat and milk production and reduce methane emissions and reduce protein breakdown. The invention is a response to the growing unease about the addition of antibiotic growth promoters to animal feed and the prohibition on the use of these promoters in the EU from 2006 onwards.

The patent application arises from work to screen 2,500 compounds that led to the identification of the sandalwood extract (*Santalum album*) and notes that sandalwood has been widely used as an essential oil in medicine and as a skin antiseptic. The main component is Santalols which have known antimicrobial properties but had not previously been tested in ruminant digestion.

References to India appear as follows:

> "Table 11 - Purity of chemical analogues by gc-ms: Javanol (sample A) Total %Purity = 98.62% Table 12 - Purity of chemical analogues by gc-ms: Javanol (sample B) Total % Purity = 98.02% Table 13 - Determination of Purity of Santaliff BHT by gc-ms (sample C) Total % Purity = 98.15% Summary of Results The santalol isomers were found to be the major chemicals present in the sandalwood oil obtained from India and Indonesia, showing a total santalol content between 78.1 - 84.7 %.
>
> The sandalwood oil procured from the Asia-Pacific/Australia region contained much lower amounts of santalol (mean 41.9%) with substantially high levels of α-trans-Bergamotol (mean 10.4%) and nuciferol (mean 12.6%) compared to sandalwood oil samples obtained from India and Indonesia. Oil from these latter two countries contained α-trans-Bergamotol and nuciferol at lower levels (5.4-7.6%) and (1.3-1.6%) respectively.
>
> The proportion of the two major santalol isomers (α and β), in the various sandalwood oils, varied greatly and favoured the α-isomer in sandalwood oil samples from India and Indonesia (approximately 2:1), whilst slightly favouring the β -isomer for the oils obtained from the Asia-Pacific /Australia region (mean 0.95: 1).
>
> The sandalwood oil procured from the Asia-Pacific/Australia region (Swiss Herbal Remedies) was the only oil found to contain the furano-sesquiterpene dendrolasin."

In the case of some of the sandalwood oils used in the examples the applicants are able to provide lot (batch) numbers:

> "Sandalwood oil, and control oils of commercial essential oil mixes or pure oils of eugenol or cinnamaldehyde were added in the amount of 500 *μ*g/ml to the 30ml buffered solution of rumen fluid prior to incubation. Sandalwood oil was obtained from Cardiff University and Sigma [SAFC (e.g. W30,050-0 lot no. 03722CC-396) and Sandalwood oil manufactured by Fluka (355263/1 lot no. 52706264)."

> "The low santalol level and high nuciferol content detected for the oil from Swiss Herbal Remedies, however, suggests its origin to be either from S. spicatum, a species of sandalwood indigenous to Western Australia or S. austrocaledonicum from the Pacific Islands. S. spicatum has been reported to contain high a farnesol content (Jirovetz et a/., 2006), which was not confirmed in these oils."
>
> "By "sandalwood extract" we include where the extract is the essential oil prepared from trees of the genus Santalum. The extract can be obtained commercially from very many sources. Examples of sandalwood extract that can be used in the present invention include: Sandalwood oil manufactured by SAFC (e.g. W30,050-0 lot no. 03722CC-396) and Sandalwood oil manufactured by Fluka (355263/1 lot no. 52706264), Sandalwood oil from Swiss Herbal Remedies (B/N 540)."

This example reveals that it can be difficult to maintain a clear view of the sources where, as in this case, a comparative study of the properties of samples from different sources is involved. In this application this is made more difficult by the reference to specific sources (such as companies and Cardiff University) but a lack of a clear reference to the specific source of the sandalwood oil from India and Indonesia. In fact, it is entirely unclear where the sandalwood oil from India and Indonesia was obtained.

The main patent claims are as follows:

> "1. The use of a sandalwood extract or a sandalwood analogue as an additive to animal foodstuff.
>
> 10. An animal foodstuff comprising a sandalwood extract or a sandalwood analogue.
>
> 17. The foodstuff of any of claims 10 to 16 packaged and presented for feeding a ruminant or a horse.
>
> 18. A method for reducing the growth of pathogenic bacteria in the digestive system of a ruminant or horse comprising supplying the ruminant or horse with a sandalwood extract or a sandalwood analogue.
>
> 27. A method of reducing methane emission by a ruminant or horse comprising supplying the ruminant or horse with sandalwood extract.
>
> 29. The use of a sandalwood extract or a sandalwood analogue to reduce the growth of pathogenic bacteria in the digestive system of a ruminant or horse.
>
> 30. The use of a sandalwood extract or a sandalwood analogue to increase meat and/or milk production from a ruminant or horse.
>
> 31. The use of a sandalwood extract or a sandalwood analogue to reduce protein breakdown in the digestive system of a ruminant or horse.
>
> 32. The use of a sandalwood extract or a sandalwood analogue to reduce methane emission by a ruminant or horse.
>
> 33. The use, foodstuff or method of any previous claim in which the sandalwood analogue has the structure: where: R = OH

34. The use, foodstuff or method of any previous claim in which the sandalwood analogue has the structure: where R = CH2OH and R 1 = H; or R = H and R 1 = CH2OH

35. The use, foodstuff or method of any previous claim in which the sandalwood analogue has the structure: where: R =3 methyl pentanol, 3-methyl pent-4-en-2-ol, (£)-2-methylbut-2-en-1-ol, or (E)-2- ethylbut-2-en-1-ol

36. A use substantially as described herein with reference to the figures and examples.

37. A foodstuff substantially as described herein with reference to the figures and examples.

38. A method substantially as described herein with reference to the figures and examples."

This patent application is part of a patent family with 7 members including filings in Europe (EPC), Australia, the UK, New Zealand and the United States. No patent grant is presently recorded in the patent family.

No citing patents are presently recorded. The international search report identified three patents originating from Japan (notably Takasago Perfumery) and a PCT application by Lonoza AG for L-Carnitine that impacted on the novelty of the original patent claims. It is therefore likely that this application will only proceed with modified claims that address the prior art. Recent filings in the US and New Zealand (2011 and 2012) suggest that the application is proceeding.

IN20: WO2010046316A2 Azadirachta indica et. al.
Acne treatment
Unilever UK, Unilever Netherlands, Unilever Hindustan.

This 2010 PCT application by 3 Unilever companies and inventors from India focuses on a treatment for acne involving a combination of plant extracts:

> "Azadirachta indica, also known as Melia azadirachta, is a large evergreen tree which can grow up to a height of 18 meters and can have a girth of up to 2.4 meters. It grows in the wild throughout India and in similar tropical climatic countries. It is also cultivated widely in India. The tree is deeply associated with Indian culture and is known as Neem, Nim, Nimba, Nimb, Veppa, Bevinamara, Limba, Vembu etc. in different languages of India. Outside India, the tree is known as Indian Lilac, Margosa or Neem Tree. The extract of neem for use in the present invention is preferably from the leaves of the neem tree. Leaves of neem have been used in the traditional Indian medicinal system known as Ayurveda for treatment of various disorders. It has been reported to be used in treating various skin disorders, and for preventing wound infections. Decoction of the leaves is added to bath water to get rid of skin problems."
>
> "Momordica charantia, commonly known as karela in India, is a cucurbitaceous climber cultivated throughout the tropical climate across the globe. The herb is also called bitter melon, bitter gourd, balsampear, kaippavalli, pavakka in different languages."
>
> "Sesamum indicum is also known as Sesamum orientale. The common name is sesame. It is an erect, branched plant that grows to a height of about 60-180 cm. It is an annual plant. It is cultivated throughout the plains of India and also in the hills up to an altitude of about 1200 metres. It is also grown in other countries having climatic conditions like the tropical plains of India mostly as a source of oil seed. It is also used as a spice for seasonings. Sesame is known as Tila, Till, Til, or Gingelli in different regions of India. There are many varieties of sesame grown in India. The varieties are based on the colour of the seed coat which ranges from white to black."
>
> "There are many intermediate varieties as well. However, the black and white Sesame are two varieties largely cultivated in India. Of these two varieties, the white sesame is more preferred for use in the present invention."

The main patent claims are as follows:

> "1. A topical composition comprising (i) an extract of a first active which is Azhadirachta indica; and (ii) an extract of a second active selected from Momordica charantia or Sesamum indicum.
>
> 5. A composition as claimed in any one of the preceding claims comprising a cosmetically acceptable vehicle
>
> 9. A method of preventing or reducing the occurrence of or treating acne comprising the step of applying to the skin a composition as claimed in any one of the preceding claims.

> 10. Use of a composition comprising extract of a first active which is Azhadirachta indica; and an extract of a second active selected from Momordica charantia or Sesamum indicum for preventing or reducing the occurrence of or treating acne."

This patent application forms part of a family of 11 applications including Europe, Australia, Canada, China, Japan, Korea, Mexico and the United States. A grant has been awarded in Europe as EP2341917B1. Two patents, both by individual inventors, a Shah Eladevi based in the UK and an inventor in the US, cite the Unilever application.

The cited literature reveals a likely reference to traditional medicinal uses, notably:

AJOSE F O A: "Some Nigerian plants of dermatologic importance" INTERNATIONAL JOURNAL OF DERMATOLOGY, vol. 46, no. Suppl.1, 1 January 2007 (2007-01-01), pages 48-55, XP009122136 ISSN: 0011-9059

IN21: US6280751B1 *Boswellia serrata* et. al.
Cosmetic/sports injuries
UK Individuals

This 2001 United States Patent grant was awarded to two UK inventors from Warwickshire for a Medical or cosmetic composition comprising:

> "a ≥ 1 essential oil in combination with ≥ 1 spice and/or ≥ 1 herb. The essential oil is preferably selected from bergamot, chamomile, german, chamomile maroc, chamomile roman, cinnamon zeylanicum, clove buds, eucalyptus globulus, frankincense, fennel, hyssop, juniper, lemon grass, mountain savoury, niaouli, red thyme, rosemary, rose geranium, tagestes and ylang ylang. The Chinese herbs are selected from Acaia Catechu, Acanthopanax granilistylus, Caesalpinia Sappan and Epimedium Spinosa. The spices are selected from asapoetidia, coconut, coriander, fenugreek and horseradish. The composition also contains Aloe vera extract , a honey product and ≥ 1 vitamin, mineral, amino acid, enzyme, flavouring and/or Bach flower remedy." (Thomson Innovation DWPI, Abstract Novelty US6280751B1)

The preparation is described as being useful for treating disease, physical disability or sports injuries or for maintenance of the immune system and protection against disease or pollution. The cosmetic can be used for skin care and/or weight management.

This is an example of an increasingly popular type of patent application involving mixtures of different plant extracts and essential oils. In this case, with the exception of a general reference to Indian spices, the application simply states that:

> "All components are from commercial sources. Vegetable enzymes are obtained as a commercially available product from "G and G Foods (UK)"."

The main claims in this patent are as follows:

> "1. A medicinal or cosmetic composition for oral administration comprising at least one essential oil in combination with at least one spice selected from the group consisting of asapoetidia, coconut, coriander, fenugreek and horseradish; at least one herb selected from the group consisting of Acacia Catechu, Acanthopanax Gracilistylus, Cacsalpinia Sappan, Epimedium Spinosa, Paeonia lactiflora, Paeonia obovata, Atractylodes macrocephala, Glycyrrhiza uralexisis, Glycyrrhiza glabra, Lycium chinense, Nauclea rhyncholphylla, Cinnainomum cassia, Astragalus membranaceus, Scutellaria baicalensis, Schizonepeta tenuifolia, Ephedra sinica, Ophiopogon japonicus, Paeonia suffruticosa, Artemisia annua, Aretemisia apiacea, Panax notoginseng, Cornus officinalis, Acorius gramineus, Reluhania glutinosa, Gastrodia elata, Asparagus cochiichinensis, Cuscuta chinensis, Schizandra chinensis, Schizandra spenanthera, Magnolia liliflora, Epimedium brevicomum, Epimedium grandiflorun, Epimedium sagittatum, Houttuynia cordata, Polygala tenuifolia; and Perilla frutescens, and an Aloe Vera extract.
>
> 2. A medicinal or cosmetic composition according to claim 1, wherein the essential oil is selected from the group consisting of bergamot, chamomile german, chamomile maroc, chamomile roman, cinnamon zeylanicum, clove buds, eucalyptus globulus, frankincense, fennel, hyssop, juniper, lemon grass, mountain savory, niaouli, red thyme, rosemary, rose geranium, tagestes and ylang ylang."

This patent is unusual because it involves 2 individuals but has generated a patent family with 14 members including the United States, Austria, Australia, Germany, Denmark, Europe, Hong Kong and Japan. This represents a significant investment in pursuing protection. However, legal status data suggests that the patent family is lapsing due to failure to pay maintenance fees.

The patent is also significant because it has attracted 64 citations by later patent filings Including applications in China, Germany, Spain, the US and the PCT from quite a wide diversity of companies including the Sichuan Institute of Chinese Materia Medica, WM Wrigley, Tahitian Noni International, Moringa Mik, East West Pharmaceuticals, Playtex products and Advanced Bionutrition Corp. This is likely to reflect the scope of the medicinal or composition claim and the range of species that are referenced in the claims.

IN22: US20100062067A1 Boswellia serrata
Bionanotechnology
Malvern Cosmeceutics

This example of a US patent application in 2010 involves Malvern Cosmeceutics, a UK company based in Tewkesbury. The company website describes it as a bionanotechnology company that is "positioned at the interface between cosmetic and pharmaceutical industries and has developed an expertise in areas of skin whitening, collagen stimulation and pain relief". The company engages in original equipment manufacture and contract work for clients, partners and licencees.

As a bionanotechnology company Malvern Cosmeceutics is an example of the application of a new and emerging area of technology to genetic resources in the UK. The 2010 US patent application is concerned with a composition used as a solubilizing agent made of a lipid and surfactant with hydrophilic lipophilic balance where the lipid/surfactant is in the form of macromolecular assemblies of specific diameter that is less than 100 nm in diameter (Thomson Innovation DWPI record). That is to say the composition is on the nano level. The intended use of the composition is in an aqueous solution in a cosmetic or pharmaceutical or as a solubilizing agent or for screening and investigation. In addition the use of the invention on a hydrogel patch is claimed along with use in conjunction with antigens and vaccine adjuvants for enhancing immunity. As such the applicants anticipate quite a wide range of uses for the claimed invention.

Boswellia serrata (typically referred to by its genus name) appears as part of an extensive list of potential active agents for inclusion in the composition:

> "Oil-soluble actives based upon a triterpenoid structure include natural extracts (for example from *Centella asiatica* (Hydrocotyl), such as TECA, asiaticoside, asiatic acid and madecassic acid (in particular TECA, alternatively asiaticoside), which are of use in regulating and activating collagen synthesis; or liquorice (*Glycyrrhiza glabra*) extracts such as glabridin (e.g. PT-40), which is of use as an anti-tyrosinase and anti-microbial, and licochalcone A, which is of use as an inhibitor of 5-alpha-reductase and as an anti-microbial. Additional triterpenoid actives include extracts from *Aesculus* (Horse chestnut), including escin and also the coumarin esculoside (esculin). Further triterpenoid actives include extracts from *Ruscus* (Butcher's broom), including ruscogenin and neuroruscogenin. Extracts of *Boswellia* (Frankincense) including Boswellin CG® from Sabinsa Corporation USA are also examples of actives in this class. Stearyl glycrrhetinate which is of use as an anti-inflammatory. Glycyrrhiza inflate extracts such as licochalcone A (e.g. as P-U) which is of use as an inhibitor of 5-alpha-reductase and as an anti-microbial. Polyphenol-containing extracts derived from *Curcuma longa*, including tetrahydrocurcuminoids, are of use as anti-inflammatory agents."

One of the characteristics of this application is that it is extremely specific about the sources of the components of the invention. Boswellia features as part of an extensive list that is partly reproduced below.

- Camphor (D-Camphor) Ph Eur/BP/USP grade supplied by Merck KGaA. (Germany)
- Totarol® (Totara-8,11,13-trien-13-ol) is an extract of Podocarpus totara supplied by Mende-Biotech Ltd. (New Zealand)

- Jambu—Jambu oleoresine extract of Spilanthes acmella containing 30% spilanthol supplied by Robertet S.A. (France)
- SepiWhite™ MSH (Undecylenoyl phenylalanine) supplied by Seppic S.A. (France)
- Phyto-Age™ is an extract of Cimicifuga racemosa supplied by Seppic S.A. (France)
- Boswellin® CG is an extract of Boswellia serrata (β-boswellic acids) supplied by Sabinsa Corp. (USA) CAS: 97952-72-2
- Sichuan Pepper Extract—prepared from Sichuan pepper supplied by Incense Magic Ltd. (UK)
- Prickly Ash Tincture is an extract of Zanthoxylum clava herculi supplied by G. Baldwin & Co. (UK)
- 7-dehydro-cholesterol, pro-vitamin D3, supplied by MMP Inc. (USA) CAS 000434-16-2
- Apricosal (AFL-3607/E) supplied by Arriva Fragrances (UK)
- Ascorbyl Palmitate, is a vitamin C monopalmitate derivative supplied by DSM N.V. (Netherlands) CAS 137-66-6
- Avobenzene supplied by Unifect (UK). CAS 70356-09-1
- Boswellin CG extract of Boswellia serrata (β-boswellic acids) supplied by Sabinsa Corp. (USA) CAS 97952-72-2

What is interesting about this list is that it specifies a range of sources accompanied by the relevant Chemical Abstracts Services code (CAS). Elsewhere, and specifically with reference to India, we learn of a supplier of material in India.

> "Yohimbine 10% Extract is an extract of Pausinystalia yohimbe supplied by Chemical Resources Ltd. (India)"

This patent is also unusual because it originally included 177 claims of which the majority have been cancelled. The main claim is a lipid and surfactant in the form of a macromolecular assembly of less than 100nm that contains an active agent selected from a list including extracts of a range of plants as follows:

> "1. A composition comprising lipid and surfactant, characterised in that the surfactant is an ether surfactant and in that the lipid and surfactant are in the form of macromolecular assemblies of less than 100 nm in diameter.
>
> 92. A composition according to claim 1, further comprising an active agent.
>
> 113. A composition according to claim 92 wherein the active agent is selected from TECA, Myristyl ester of L-pyrrolidone, lauric ester of L-pyrrolidone carboxylic acid, Ciclopirox olamine, Econazole nitrate, Red clover extract, Centella extract, Butcher's broom extract, Benzyl nicotinate, Piroctone olamine, acetyl hexapeptide-3, extract of *Ginkgo biloba*, Horse chestnut extract, Nettle extract, *Aesculus* extract, Yohimbine free base, Hydrocortisone, Salmeterol xinafoate, Progesterone, Devil's claw extract, Gatuline® Expression, extract of *Picea abies*, D-Camphor, Totara-8,11,13-trien-13-ol,

> extract of *Spilanthes acmella*, Undecylenoyl phenylalanine, extract of *Cimicifuga racemosa*, extract of *Boswellia serrata*, Sichuan pepper extract and Prickly ash extract.
>
> 114. A composition according to claim 92 wherein the active agent is selected from 7-dehydrocholesterol, apricosal, ascorbyl palmitate, avobenzene, betamethasone 17-valerate, *Boswellia*, camphor, capsaicin, Cha-Plu extract, cholesterol sulphate, cholesterol, clobetasol propionate, clotrimazole, Cosmoperine, diclofenac, *Echinacea angustafolia, Echinacea purpurea*, Edemine, erythromycin sulphate, eserine, Eusolex 4360, Fougere, *Galanga, Ginkgo, Heliopsis* extract, hops tincture, hydrocortisone 17-butyrate, Japanese pepper extract, ketaconazole, ketoprofen, maca, melaleucol, minoxidil, naproxen, NDGA, neomycin sulphate, nystatin, octyl salicylate, PABA, PT-40, P-U, Questice CQ U/A, rosemary extract CG, rosmarinic acid (90%), soy isoflavones CG (50%), *Spilanthes* supercritical CO_2 extract, stearyl glycrrhetinate, tarragon extract, tasmanian pepper extract, THC CG, THC Ultra Pure, Unisex Bouquet, Unisol S-22, vitamin C palmitate, vitamin D_3, vitamin E."

This appears to be a case where the main claims is for the macromolecular assembly at the nano level with the active agents as the preferred ingredients within those assemblies that are drawn from a range of natural and other sources, notably the plant extracts. If this interpretation is correct then this means any subsequent scope would apply to the extracts as ingredients inside the specified macromolecular structure rather than to the active agents *per se*. The significance of this in broader terms is that patent applicants from elsewhere would only be constrained by this patent where the active agents were included in a macromolecular assembly falling into the scope of this patent.

This application forms part of a family with 19 members from the United States, Australia, Canada China, Europe, the UK, Israel, Japan and under the PCT. Within the patent family a patent has been granted in the UK as GB2464393B. To date the US patent application has only attracted 1 patent citation from Lipoid GMBH in Germany.

Image Credits:

Aeschynomene spp - Harry Rose 800px-Aeschynomene_indica_pod.jpg
Andrographis paniculata - JM Garg
Andrographis_paniculata_(Kalpa)_in_Narshapur_forest,_AP_W2_IMG_0867.jpg
Anogeissus latifolia - Lalithamba800px-
Anogeissus_latifolia_(Roxb_ex_DC)_Wall_ex_Gill.jpg
Asparagus racemosus -Neha.Vindhya 800px-Asparagus_racemosus.JPG
Boswellia Serrata - JM Garg
Boswellia_serrata_(Salai)_in_Kinnarsani_WS,_AP_W2_IMG_5840.jpg
Casuarina equesitifolia - Ethel Aardvark 798px-Casuarina_equesitifolia_tree.jpg
Eleusine coracana - J Wilson 800px-Finger_millet_3_11-21-02.jpg
Clitorea turnatea - Srini 450px-Clitoria_(253000626).jpg
Mappia foetide - Dr.K. Ravikumar Mappia foetida.jpg
Morinda Citrifolia - Wilfredo Rodriguez 413px-Noni_fruit_(Morinda_citrifolia).jpg
Mucuna pruriens - Agong1 400px-Mucuna_pruriens_flower.jpg
Picrorhiza kurroa - HADRI 23.jpg
Piper Nigrum - Franz Eugen Köhler Piper_nigrum_-_Köhler–s_Medizinal-Pflanzen-107.jpg
Rubia cordifolia - Vinayaraj 744px-Rubia_cordifolia.jpg
Santalum album - JM Garg
Santalum_album_(Chandan)_in_Hyderabad,_AP_W2_IMG_0023.jpg
Shorea robusta - Pankaj Oudhia Shorea_robusta_in_Chhattisgarh.jpg

Symplocos cochinchinensis - Vinayaraj 479px-Symplocos_cochinchinensis_09.JPG
Tinospora cordifolia - TMD 450px-Tinospora_cordifolia.jpg
Terminalia arjuna - JM Garg Fruit_I_IMG_9577.jpg
Trichopus zeylanicus - Nyanatusita Bhikkhu 449px-Trichopus_zeylanicus1.jpg
Trigonella foenum-graecum - Prof. Dr. Otto Wilhelm Thomé 363px-Illustration_Trigonella_foenum-graecum0_clean.jpg
Lilium mackliniae - Tabish Siroi_Lily.jpg
Ancistrocladus heyneanus - Vinayaraj 431px-Ancistrocladus_heyneanus.jpg
Boswellia Serrata - JM Garg
Boswellia_serrata_(Salai)_in_Kinnarsani_WS,_AP_W2_IMG_5840.jpg
Bothriochloa odorata - Mark Marathon 377px-Bothriochloa_pertusa_habit.jpg
Claviceps sorghi - G Munkvold Fig08_ergot_sorghum.jpg
Coronilla cannabina - CD Daniel 455px-SesbaniadrummondiiPlant.jpg
Emblica officinalis - L Shyamal Phyllanthus_officinalis.jpg
Madhuca indica - Nvvchar Mahuwa_trees_in_Chattisgarh.jpg
Shigella boydii - CDC (PHIL #6670), 1976 800px-Shigella_boydii_01.jpg
Tecoma undulata - RL Burdak Rohida1.jpg
Tilletia indica - FAO y4011e15.jpg

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[49] CHEMICAL ABSTRACTS, vol. 81, no. 16, October 21, 1974, Columbus, Ohio, USA FAROOQI, M.I.H. et al. "Sesbania aculeata seeds. A new source for gum" page 108, column 1, abstract no. 93 365 h

6. Brazil

6.1 Introduction:

This section forms part of a wider review of *UK Patent Activity for Genetic Resources and Traditional Knowledge.* The section presents the results of an in depth review of international patent activity by UK applicants involving species of relevance to Brazil at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty between 1976 and 2010. The aim of the review is to improve transparency about the utilization of genetic resources and associated traditional knowledge involving species of relevance to Brazil in UK patent activity. The review also highlights issues around the interpretation of the origins of genetic material and the utilization of a genetic resource in patent documents.

The data presented in this section is based on a manual review of 759 UK patent documents.192 of the documents contained a reference to Brazil while 567 documents contained reference to a species that may originate from Brazil based on distribution data from GBIF. Additional searches were conducted to identify references to traditional knowledge and are presented in the thematic section on traditional knowledge in the report.

6.2 Biodiversity in Brazil and UK Patent Activity:

Brazil is a megadiverse country with globally important ecosystems in regions such as Amazonia and diverse indigenous peoples. Brazil has been at the forefront of debates on the Nagoya Protocol and related debates under the World Intellectual Property Organization (WIPO) Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC).

We begin this section by providing an overview of the species appearing in UK data that are relevant to Brazil. We then provide an overview of the smaller number of species where available distribution data suggests that a species appearing in a patent may have come from Brazil.

This data is followed by a series of summary tables that describe the species and patent activity involving the species. This data falls into two categories a) Patents where there is reference to Brazil and a species distributed in Brazil; b) Patents where there is no reference to Brazil but distribution data suggests the species may have originated from Brazil (referred to as ‘Distribution 1’).

We then turn to a set of in-depth examples of patent documents that refer to Brazil. This data is intended to inform debates on disclosure of origin in patents by focusing on actual examples.

The Global Biodiversity Information Facility (GBIF) presently records 70,586 species for Brazil. Within the UK data we identified 1,326 species that are known to be distributed in Brazil.

Figure 6.1 provides a summary of trends in activity for species in UK patent activity that are known to occur in Brazil.

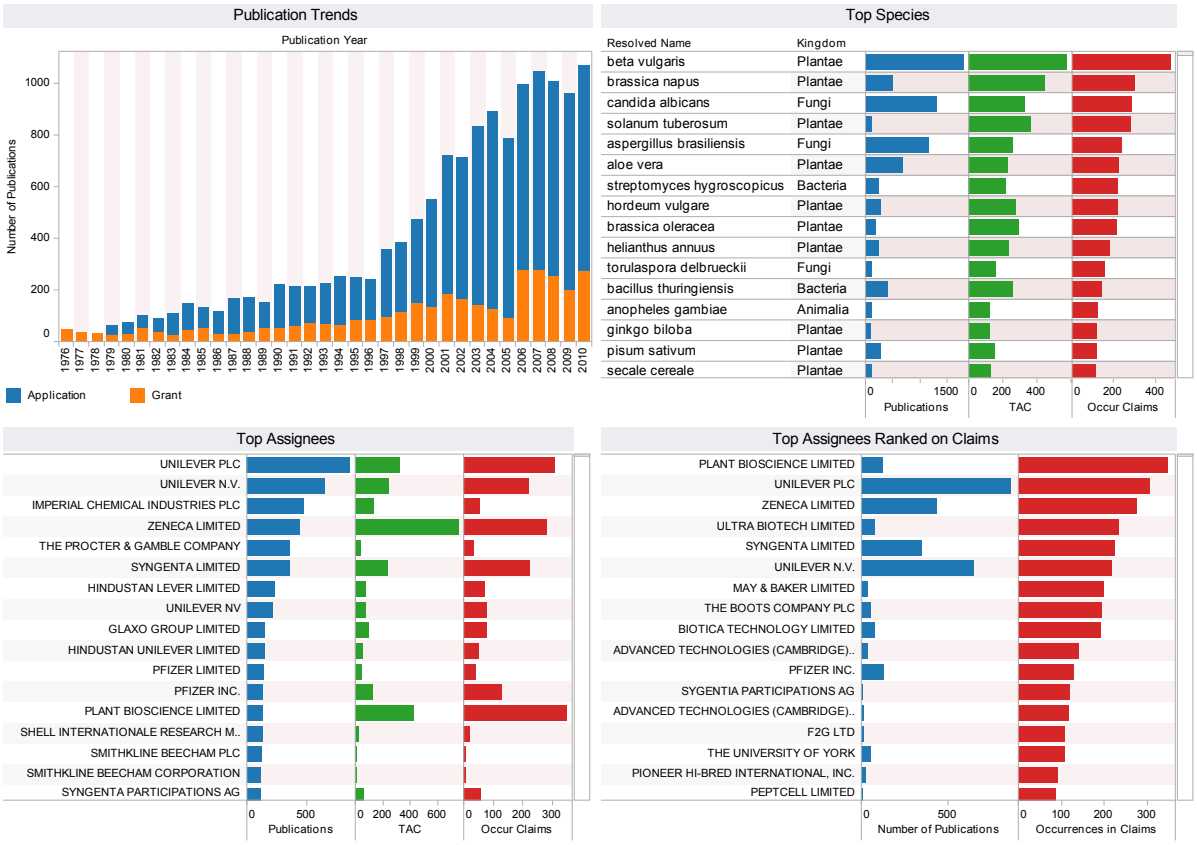
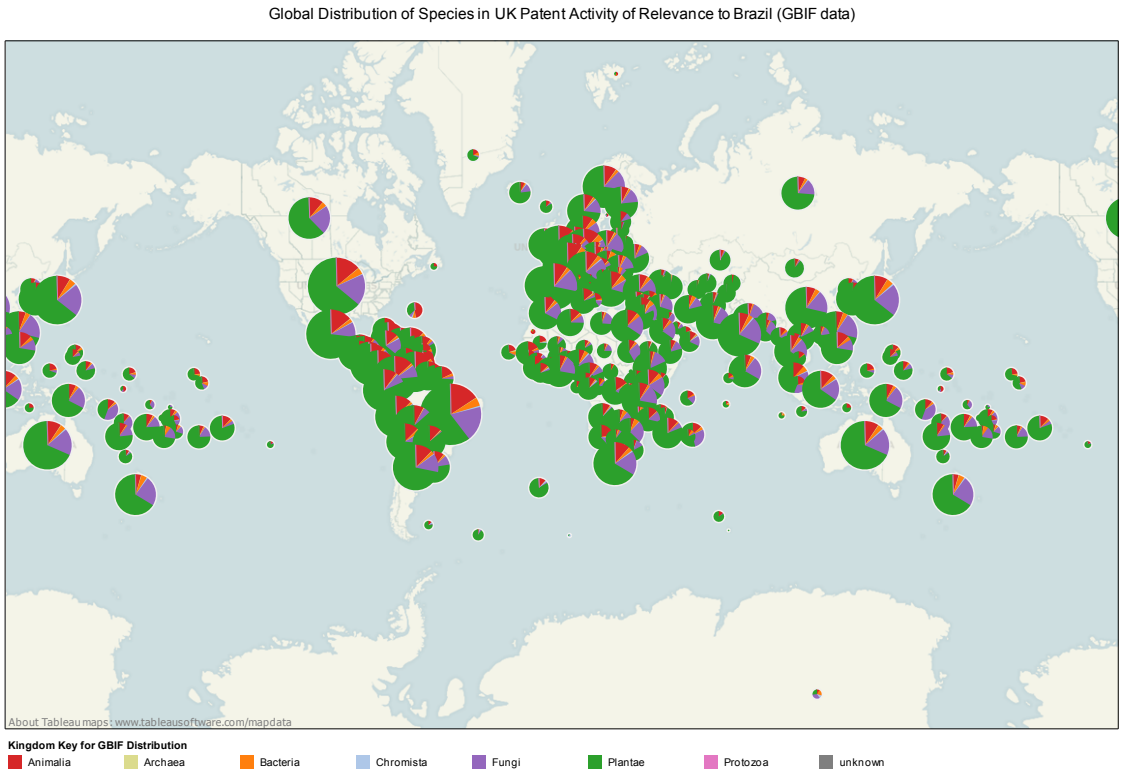


Figure 6.1 Species of Relevance to Brazil in UK Patent Activity

In considering the data in Figure 6.1 we would note that the data does not refer exclusively to species that are known to have been collected in or sourced from Brazil. Instead, the data provides an overview of trends, species and actors of relevance to species known to occur in Brazil. Figure 6.1 demonstrates that the species of relevance to Brazil in UK data are frequently widely distributed in countries around the world.



Map 6: Global Distribution of Species of Relevance to Brazil in UK Data

This raises the question of how to identify which genetic materials and associated traditional knowledge in UK patent activity originated from Brazil. In total, across the UK data we identified 192 documents that contain some form of reference to both Brazil and a species known to occur in Brazil. These documents were selected for manual review in MaxQDA software and are considered in the detailed examples provided below.

We also conducted an experiment with searching for place names from Brazil using data from Geonames.org which lists all known place names by country. While providing a promising avenue of enquiry in enhancing transparency in access and benefit-sharing arrangements as they relate to patents, this approach requires further exploration focusing on the reduction of noise in the results.

In order to enhance transparency and extend data capture for genetic resources that could have originated from Brazil we identified those species in patent data that presently possess only one global distribution record that references Brazil. We call this data Distribution 1. In total we identified 567 patent documents containing Distribution 1 species for Brazil for review. As discussed with reference to India, because GBIF distribution data is incomplete it is not possible to be sure that a species came from a particular country. However, in the absence of a disclosure of origin requirement the distribution data provides a clue that a particular specimen or sample could have come from Brazil. We must emphasise that this does not constitute evidence because a species may in fact be distributed and sourced from elsewhere as illustrated by Map 6. Nevertheless, in the absence of measures such as a disclosure of origin requirement, this approach provides a route to improving transparency and achieving greater clarity of understanding on the results.

Figure 6.2 provides a summary of the data on species that are potentially from Brazil based purely on distribution data.

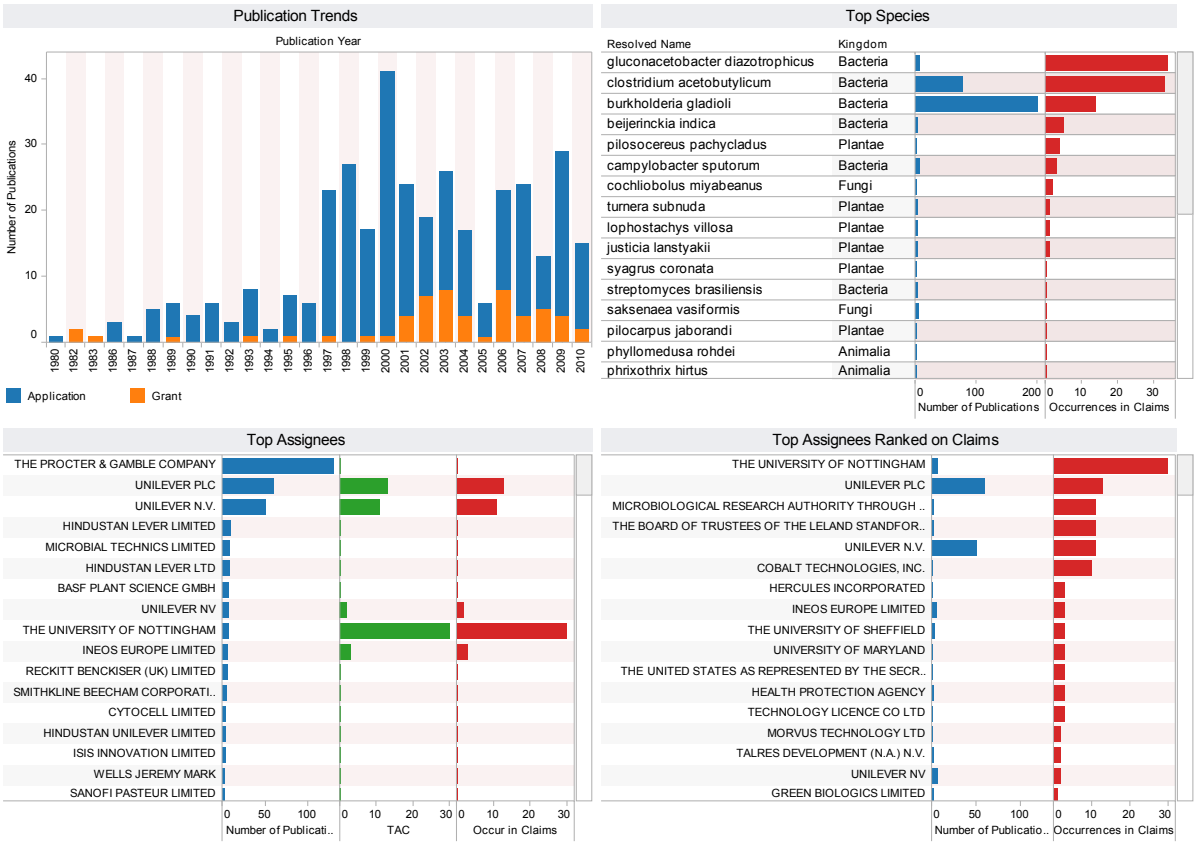


Figure 6.2 UK Patent Activity for Distribution 1 Species for Brazil

Details of species that may have, or are likely to have originated from Brazil are provided in the Distribution Tables provided below and discussed in the section on examples.

6.3 Brazil: Species Summary Cards

This section provides basic summary details of species appearing in UK patent activity where there is some form of reference to an origin or source for the material and associated traditional knowledge in the patent document. The summary cards are intended to provide a quick summary overview. Detailed examples are provided in the final section.

The data in this section is divided into two categories: a) species appearing in patents that refer to Brazil as the origin or source of the material; b) species identified as relevant to Brazil based purely on distribution data from GBIF.

The summary cards below provide a brief summary of in-depth review of UK patent activity that makes reference to Brazil in conjunction with a species known to be distributed in Brazil. This data includes a small number of cases where Brazil forms part of the name (i.e. Brazil nut) for species with limited distributional range in South America. Examples are discussed in greater detail below.

In opening these examples a number of general observations can be made about the appearance of species. We found frequent general references to Brazil nuts (for example, the use of Brazil nut husks in drilling fluid in the oil industry). We also found regular references to Brazilian coffee. In some cases Brazil forms part of a species name i.e. *Leishmania braziliensis*. We also found references to samples from Brazil in connection with HIV. One British company made reference to the production of biofuels in Brazil. In still other cases we found references to sanitary products that were tested in Brazil. As this suggests, references to Brazil varied within the documents and commonly did not refer to the sourcing of a species in Brazil.

The summary cards and examples provided below should be read in conjunction with the data for Brazil provided in Annex 1.The summary cards are organised alphabetically by species and the numbers in bold (i.e. BR4) refer to relevant examples below. Reference numbers also link to the patent data in Annex 1 for ease of reference. References to BRD refer to Brazil by Distribution.

Brazil: Species by Country of Origin or Source

BR4

Species name: *Aniba rosaeodora*	Kingdom: Plantae	
Brief description of species: A magnoliid tree which grows in the tropical forest. It is the source of 'Bois de Rose' essential oil. Used as a blooming agent in surface cleaner. Rainforest tree.		
Distribution: Cosmopolitan	No of documents: 5	
Example Patent - **WO1999053011A1** - Relates to an aqueous concentrated liquid hard surface cleaning composition which blooms when added to a larger volume of water which comprises… ...botanical oil constituent... See also **US6143703A**.		

BR7

Species name: *Bertholletia excelsa*	Kingdom: Plantae	
Brief description of species: The Brazil nut tree. Grows across tropical America. Brazil nut trees produce fruit almost exclusively in pristine forests, as disturbed forests lack the large-bodied bees needed for pollination.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **WO2005116085A1** - Relates to a protein-cyclodextrin derivative obtained by the reaction of a reactive cyclodextrin and a protein useful in the preparation of hair care and skin care compositions.		

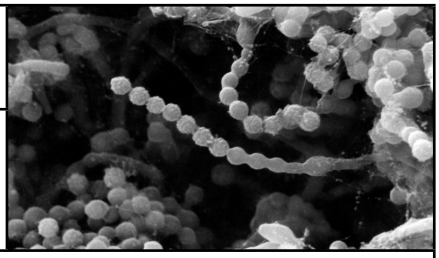
BR1

Species name: *Ilex paraguariensis*	Kingdom: Plantae	
Brief description of species: A Holly species native to subtropical South America. Source of Yerba mate beverage. Also used in weight reduction compositions.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **WO2010062751A1** - Relates to a composition and method for reducing food intake. The composition of the invention is composed of yerba maté extract...See also... **EP1407778A1**.		

BR8

Species name: *Montrichardia arborescens*	Kingdom: Plantae	
Brief description of species: Member of Araceae family, found across tropical America.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **WO2007144588A1** - Relates to a process for the production of a paper pulp, comprising preparing the pulp from a raw material derived from a plant of the Araceae family.		

BR2

Species name: *Paecilomyces variotii*	Kingdom: Fungi	
Brief description of species: A genus of nematophagous fungus which can be used as a bio-nematocide.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **US2003072726A1** - Relates to compounds having a formula which may be used as skin lightening agents.		

BR3, BR6

Species name: *Paullinia sorbollis* *Paullinia cupana*	Kingdom: Plantae	
Brief description of species: (Synonym - *Paullinia sorbollis)* A climbing plant native to the Amazon Basin. It is the source of Guarana. Used in weight reduction compositions, and an anti-platelet aggregation property is used as a pharmaceutical.		
Distribution: Cosmopolitan	No of documents: 3	
Example Patent - **WO1997042957A1** - Relates to pharmaceutical compositions having anti-platelet aggregating activity, the composition comprising a xanthine such as caffeine… The invention also provides an active fraction from Paullinia cupana. See also **US2011003021A1**.		

BR5

Species name: *Phyllomedusa rohdei*	Kingdom: Animalia	No Image Available
Brief description of species: Phyllomedusa rohdei is a species of frog in the Hylidae family. It is endemic to Brazil. Its natural habitats are subtropical or tropical moist lowland forests, moist savanna, rivers etc. Note that this frog is not the source of the invention but is referenced in a case focusing on a Mexican tree frog Pachymedusa dacnicolor sourced from the United States.		
Distribution: Endemic	No of documents: 1	
Example Patent - **WO2004074312A2** - Relates to vasodilatory tryptophyllin peptide, PdT-1, isolated from a frog defensive skin secretion.		

BR1

Species name: *Turnera diffusa (Var aphrodisiaca)*	Kingdom: Plantae	
Brief description of species: A small shrub aka Damiana. Aphrodisiac and other stimulant uses. Not endemic but sourced from Brazil. Also used in weight reduction compositions.		
Distribution: Cosmopolitan	No of documents: 2	
Example Patent - **WO2010062751A1** - Relates to a composition and method for reducing food intake. The composition of the invention is composed of a damiana extract.		

Brazil by Distribution (BRD)

This section focuses on the details of species appearing in patents where GBIF presently only records the species in Brazil. Because GBIF records are incomplete and no reference is made to Brazil in the documents the references should be taken purely as a *clue* of possible origin in Brazil. Additional research was undertaken using available information to ascertain if a species is endemic to Brazil.

BRD1

Species name: *Acetobacter diazotrophicus (syn: Gluconacetobacter diazotrophicus)*	Kingdom: Bacteria	No Image Available
Brief description of species: Nitrogen fixing bacteria used to aid growth of non-fixing plants. (syn: *Gluconacetobacter diazotrophicus*)		
Distribution: Uncertain	No of documents: 9	
Example Patent - **WO2007017537A1** - Relates to a method of obtaining industrially-viable prebiotic oligosaccharides, using a novel extracellular enzyme.		

BRD2

Species name: *Aspergillus fumaricus*	Kingdom: Fungi	No Image Available
Brief description of species: Aspergillus is a genus consisting of several hundred mold species found in various climates worldwide - listed as being a possible source of DNA for encoding.		
Distribution: Cosmopolitan	No of documents: 5	
Example Patent - **WO2001012792A1** - Relates to a novel DNA is provided which encodes an enzyme having phytase activity isolated from Penicillium.		

BRD3

Species name: *Beijerinckia lacticogenes* *Azotobacter lacticogenes* ***Beijerinckia indica***	Kingdom: Fungi	No Image Available
Brief description of species: The Beijerinckia are free living nitrogen fixing bacteria. All the named species now named B. indica. Source of indican, a polysaccharide.		
Distribution: Cosmopolitan	No of documents: 3	
Example Patent - **US4372785A** - Relates to the use of a microbial polysaccharide as a suspending, emulsifying or gelling agent.		

BRD4

Species name: *Bothrops insularis*	Kingdom: Animalia	
Brief description of species: Bothrops insularis, commonly known as the golden lancehead, is a venomous pit viper species found only on Ilha da Queimada Grande, off the coast of São Paulo state, in Brazil.		
Distribution: Endemic	No of documents: 2	
Example Patent - **US6492494B1** - Relates to fibrinogen-converting enzyme extracted from snake venom potentially including B. insularis		

BRD5

Species name: *Burkholderia tropica* *Burkholderia sacchari*	Kingdom: Bacteria	No Image Available
Brief description of species: Burkholderia is a genus of proteobacteria. Patent for alginate oligomers for fighting antibiotic resistance.		
Distribution: Cosmopolitan	No of documents: 3	
Example Patent - **WO2010139959A2** - Relates to a method for inhibiting the adherence of a microorganism to a surface, said method comprising contacting said microorganism and/or the surface with an alginate oligomer.		

BRD6

Species name: *Cocos coronata*	Kingdom: Plantae	
Brief description of species: Synonym of *Syagrus coronata*. The Licuri Palm is a species of palm tree that plays an important role in the diets of tropical rainforest animals.		
Distribution: Endemic	No of documents: 1	
Example Patent - **WO2007020465A1** - Relates to a process for producing biodiesel from natural oils and/or fats.		

BRD7

Species name: *Campylobacter sputorum*	Kingdom: Bacteria	No Image Available
Brief description of species: Campylobacter is a genus of bacteria that are Gram-negative, spiral, and microaerophilic. Motile, with either unipolar or bipolar flagella. Species causes bronchitis.		
Distribution: Cosmopolitan	No of documents: 6	
Example Patent - **WO2001044505A2** - Relates to a method for determining whether a test compound binds to a target RNA.		

BRD8

Species name: *Convolvulus tiliaceus*	Kingdom: Plantae	
Brief description of species: A synonym for Ipomoea tiliacea. A common vine of open and semi-open dry and moist areas.		
Distribution: Cosmopolitan	No of documents: 8	
Example Patent - **US2007136892A1** - Relates to a process for the production of Delta5-unsaturated fatty acids in transgenic organisms comprises transforming an organism with nucleic acid encoding a Delta5-desaturase.		

BRD9

Species name: *Copernicia cerifera*	Kingdom: Plantae	
Brief description of species: A palm which grows only in north east Brazil. It is the source of carnauba wax (Brazil wax) of which Brazil exports over 22,000 tonnes p/a.		
Distribution: Endemic	No of documents: 19	
Example Patent - **US2009274629A1** - Relates to multi-associative polymers, their production and their use as rheology modifiers for water-and/or oil-based compositions, especially for water-and/or oil-based personal care products.		

BRD10

Species name: *Cordia multispicata*	Kingdom: Plantae	
Brief description of species: A successional shrub from which extracts are used for a hair growth agent. Extracts are antiandrogenic.		
Distribution: Endemic	No of documents: 3	
Example Patent - **WO2009109402A2** - Relates to a composition for influencing hair growth.		

BRD11

Species name: *Erwinia psidii*	Kingdom: Bacteria	No Image Available
Brief description of species: Erwinia psidii is a Gram-negative bacterium and a phytopathogen of the Common Guava, causing rot in branches, flowers and fruits.		
Distribution: Uncertain	No of documents: 7	
Example Patent - **US2009019559A1** - Relates to nucleic acid derived from Perkinsus marinus which encodes a 9-elongase, a Delta8-desaturase and a Delta5-desaturase enzyme.		

BRD12

Species name: *Justicia lanstyakii* *Lophostachys villosa* *Turnera subnuda*	Kingdom: Plantae	
Brief description of species: Three plants are native to the Cerrado region of Brazil.		
Distribution: Endemic	No of documents: 4	
Example Patent - **WO2000028093A1** - Relates to recovering metals, such as nickel and cobalt, by phytomining or phytoextracting soils rich in metals wherein the desired metal is selectively accumulated in hyperaccumulator plants.		

BRD13

Species name: *Orbignya oleifera*	Kingdom: Plantae	
Brief description of species: The Babassu palm is found in the southern regions of Brazil. Babassu contains a high content of lauric and myristic acids which have melting points relatively close to the body temperature.		
Distribution: Cosmopolitan	No of documents: 3	
Example Patent - **US2009274629A1** - Relates to a sanitizing composition in the form of a viscous liquid or gel suitable for use as a handwash composition.		

BRD14

Species name: *Pilosocereus pachycladus*	Kingdom: Plantae	
Brief description of species: A blue cactus with hairy areoles that emit golden spines.		
Distribution: Endemic	No of documents: 3	
Example Patent - **WO2004006944A1** - Relates to flower essence-containing medicaments that comprise one or more orchid essences, the medicaments may also contain other, or secondary, flower essences.		

BRD15

Species name: *Phrixothrix hirtus*	Kingdom: Animalia	No Image Available
Brief description of species: Bioluminescent 'railroad worm' luciferase enzymes used as biosensors.		
Distribution: Cosmopolitan	No of documents: 1	
Example Patent - **WO2010035001A1** - Relates to a method for preserving a polypeptide.		

BRD16

Species name: *Pseudomonas gladioli*	Kingdom: Fungi	No Image Available
Brief description of species: Now designated *Burkholderia gladioli*. Burkholderia is a genus of proteobacteria. P. gladioli often given as an example of a lipase for use in detergents.		
Distribution: Cosmopolitan	No of documents: 354	
Example Patent - **US7166565B2** - Relates to compositions, articles and methods for supplying fabric care benefits to clothing or fabrics in an automated washing machine and by manual washing.		

BRD17

Species name: *Streptomyces brasiliensis*	Kingdom: Bacteria	No Image Available
Brief description of species: A unique "molecular beacon" sequence useful in a sequence detection method		
Distribution: Cosmopolitan	No of documents: 3	
Example Patent - **US2003064370A1** - Relates to a method of detecting the presence of a nucleic acid target sequence.		

BRD18

<table>
<tr><td>Species name:
Trichoderma stromaticum</td><td>Kingdom: Fungi</td><td rowspan="2">No Image Available</td></tr>
<tr><td colspan="2">Brief description of species:
Trichoderma stromaticum, a biocontrol agent of the cacao witches' broom pathogen *Moniliophthora perniciosa*.</td></tr>
<tr><td colspan="2">Distribution: Uncertain</td><td>No of documents: 2</td></tr>
<tr><td colspan="3">Example Patent - **WO2005095579A1** - Relates to an improved process for preparing a composition comprising dried microorganisms… which supports germination of seed, stimulation of plant growth or biological protection of seed...</td></tr>
</table>

6.4 Detailed Selected Examples

BR1: EP1407778A1 Paullinia cupana (Guarana)
Phytofit and Natures Remedies et al.

This patent application focuses on herbal extracts that combine to make a weight loss product. This example links to example BR3 below. References to Brazil are confined to the following paragraph:

> "A composition of the present invention comprising a combination of selected herbal extracts was administered to patients in a double blind controlled clinical trial. The combination tested included Guarana, Damiana, and Paraguay. Guarana is a dough from the seeds of Paullinia sorbolis, which grows in Brazil and Venezuela. It contains 3-6% caffeine, 5-8.5% tannin, 7.8% resins, 2-3% fat, 0.06% saponin, 5-6% starch, and 1.5% colouring agents. Paraguay is a extract of Ilex paraguensis which grows in Brazil, Argentina, and Paraguay. It contains 1-1.5% caffeine, 4-10% tannin, and 3% resins and fat. Damiana is obtained from the leaves of the plant Turnera diffusa var. aphrodisiaca from California, Mexico and Brazil, and Bolivia and contains ethereal oils, resins, and tannin. These extracts were obtained as powders. The components were mixed and prepared as capsules. Each capsule contained 95 mg Guarana, 112 mg Paraguay, and 36 mg Damiana extract. The subjects for the study were 20 otherwise healthy subjects, complaining of light-moderate overweight with a body mass index between 25 and 30 kg/m^2. None of the subjects were taking any drug or dietary supplement at the time of the study. All were briefed on the protocol and gave consent to the trial."

The patent claims:

> "1. A composition which produces weight loss in a patient comprising a combination of selected herbal extracts wherein said combination comprises at least one herbal extract capable of inhibiting gastric emptying and one herbal extract which increases metabolic rate in a patient.
>
> 2. A composition according to claim 1 characterised in that the herbal extract which increases metabolic rate contains caffeine.
>
> 3. A composition according to claim 1 or claim 2 characterised in that it comprises at least one herbal extract capable of modifying metabolic rate through the presence of significant concentrations of caffeine.
>
> 4. A composition according to claim 2 or claim 3 characterised in that the herbal extract which contains caffeine is Guarana, Paraguay or Kola.
>
> 5. A composition according to any preceding claim characterised in that the herbal extracts are selected from Buchu, Vervain, Guarana, Damiana, Paraguay, Kola and Ginseng.
>
> 6. A composition according to any preceding claim wherein the combination of selected herbal extracts comprises Guarana, Damiana and Paraguay.
>
> 7. A composition according claim 6 characterised in that the ratio of Guarana: Damiana: Paraguay: is 2.6:1:3.1.

> 8. A composition according to claim 7 characterised in that the proportions of the herbal extracts used are, by weight: Guarana 95:Damiana 36:Paraguay 112."

The patent forms part of a family of 26 members, signifying significant activity, and including applications in Australia (granted), Brazil (application), Canada, China, Germany Span, Hong Kong, New Zealand, Poland (granted), Turkey and the United States.

The legal status for the family members reveals an interesting story. The European patent application was deemed to be withdrawn as of July 2012. In Australia the granted patent was reassigned from Natural Medico tech to Natures Remedies. In Brazil the patent was refused on the 5th of May 2009 with an appeal lodged in December 2009 but no further information. In Germany the patent was opposed in 2005 but held fully valid after opposition proceedings in 2008. In New Zealand a patent appears to have been granted and renewal fees paid in 2005. In China the patent was granted. In Europe a patent was granted as EP1037644B1.

In the case of family member EP1037644A1 a long list of payments of annual renewal fees at European patent offices are provided. This suggests that this is the main patent in the family. The payment of annual fees is also listed for EP1037644B1.

In the case of EP1037644A1 an opposition to the European Grant was filed by Jemo-Pharm in May 2005. However, despite a number of oppositions being recorded in the patent family we were not able to identify citing patents.

The following literature references demonstrate a link to South America.

ANDERSEN ET AL: "Weight loss and delayed gastric emptying following south American Herbal preparation in overweight patients." J. HUM.NUTR.DIETET, vol. 14, 2001, pages 243-250, XP001157224

CATHERINE GEISSLER ET AL: "DOUBLE-BLIND TRIAL OF HERBAL SLIMMING PILL" LANCET THE, LANCET LIMITED. LONDON, GB, August 1986 (1986-08), page 461, XP002099076 ISSN: 0140-6736

BR2: US2003072726A1 Paecilomyces varioli
UK individuals.

The applicants make reference to Paecilomyces variotii IMI 379001 described as a filamentous fungus producing light brown powdery spores that was isolated "From fruiting body of a fungus growing in Amazon in Brazil". IMI stands for the International Mycological Institute in Egham, Surrey, UK. The information is contained in a Table (distorted in the machine translation of the text) and a soil isolation protocol for the listed specimens is provided.

The patent is for skin lightening agents and focuses on compounds from natural biological materials such as plant material that have skin lightening properties. The compound is the focus of the claims rather than the organism. The sample from Brazil is referenced with respect to the preparation of Protocatechuic Acid From Caffeic Acid. Protocatechuic acid appears in claim 9. Note the references in the claims and also the claim to the treatment of plant material using a microorganism. This merits closer inspection. Legal status data suggests that the application did not progress to the grant stage. However, a reassignment to company Zylepsis was recorded in June 2002.

BR3: US2011003021A1 Paullinia cupana (Guarana) & ZOTRIM
Nature Remedies Ltd, Amersham, Buckinghamshire.

This 2011 US patent application by two UK inventors with Natural Remedies Ltd focuses on a weight loss composition consisting of dietary fibre and herbal extracts where one of the herbal extracts inhibits gastric emptying and another increases metabolic rate. The application involves a combination of an extract of Guarana with other extracts tested in health subjects over a 45 day period agains a placebo group.

The application involves at least two South American species described as follows:

> "The composition of the present invention is composed of soluble extracts of yerbe maté (leaves of *Ilex paraguayensis, I. vomitora*, or *I. dahoon*), guarana (seeds of *Paullinia cupana* or *P. sorbalis*) and damiana (leaves of *Turnera diffusa* var. *aphrodisiaca, T. opifera*, or *T. ulmifoliei*). Soluble extracts of the invention can be prepared by conventional methods of drying and/or grinding plant biomass and subjecting the same to one or more suitable solvents, thereby providing an extract, which may be either used as a crude extract or further fractionated. "
>
> "Study Supplement. The ZOTRIM formulation contained 112 mg Yerbe Mate, 95 mg Guarana and 36 mg Damiana. Guarana, a dough made from the seeds of *Paullinia cupana*, which grows in Brazil and Venezuela, contains 3-6% caffeine, 5-8.5% tannins, 7.8% resins, 2-3% lipid, 0.06% saponin, 5-6% starch and 1.5% coloring agents (Schery (1954) *Plants for Man*. London: George Allen and Unwin, pp. 518-519). Yerbe maté is an extract of *Ilex paraguayensis* from Brazil, Argentina and Paraguay containing 1-1.5% caffeine, 4-10% tannins and 3% resins and lipids (Hill (1952) *Economic Botany*. New York: McGraw-Hill Book Company, pp. 479-481.). Damiana is obtained from the leaves of the plant *Turnera diffusa* var. *aphrodisiaca* from California, Mexico, Brazil and Bolivia and contains ethereal oils, resins and tannins (Bradley (1992) *British Medical Compendium*, Vol. 1. London: British Herbal Medical Association, pp. 71-72.)."

The origin of the material appears to be from a commercial sources but is in practice unclear:

> "The placebo contained lactose and other ingredients minus the active ingredients. ZOTRIM and placebo were supplied as individual tablets and packaged in coded containers labeled A or B to ensure the double-blind status of the study. All capsule components (active and inert ingredients) were those approved and commonly used for commercial supplements and health ingredients and produced by a commercial capsule manufacturer. The inulin fiber (FIBRESURE) was derived from chicory root and packaged in powder form in 5.8 g individual stick packs, containing 5 g fiber per pack. Each dose of 5 grams of fiber was mixed into 100 grams of water."

What we observe here is a patent application linked with the herbal slimming pill ZOTRIM that is marketed by Natures Remedies (naturesremedies.uk.com) through zotrim.com and is a registered mark. Zotrim is described on the company website as follows:

"Zotrim® is a unique natural formulation which has been shown to aid weight loss through controlling hunger and boosting satiety, the feeling of fullness. Zotrim® is available in tablet form through major retailers such as Boots in the UK and is available in many other countries through licencing and distribution agreements." naturesremedies.uk.com

http://www.zotrim.com/ingredients.php

This is an unusual application because it links directly to a marketed product. The main patent claims are as follows:

> "1. A composition comprising yerbe maté extract, guarana extract, damiana extract and a dietary fiber.
>
> 8. A method for reducing food intake comprising administering to a subject in need thereof an effective amount of yerbe maté extract, guarana extract, and damiana extract in combination with a dietary fiber thereby suppressing the subject's food intake."

This patent application forms part of a patent family of 7 applications with the most recent being EP2448591A2 published on the 09-05-2012. The legal status data reveals a request for examination in Canada and an extension of the country coverage of the European patent application. As such this example appears to remain live at the time of writing.

To date no patents have cited this application. However, the cited patent field reveals 7 citations. Their relevance to restricting the patent claims is not revealed. One cited academic article reveals the following: Ruxton: EFFICACY OF ZOTRIM: A HERBAL WEIGHT LOSS PREPARATION; Nutrition & Food Science, Volume 34, Number 1, 2004 pp. 25-28

BR4: US6143703A Aniba rosaeodora (Bois de Rose) Reckitt Benckiser. See also US6143703A US6143703A US6177388B1 WO1999053011A1 WO2004104309A1 WO2005001212A1

This example is one of a set of five patent applications by the UK company Reckitt Benckiser that were originally filed by its US subsidiary and subsequently reassigned to the UK arm of the company.

The patents make reference to Bois de Rose oil from *Aniba rosaeodora* or Brazilian Rosewood which is an endangered tree in Brazil and other Amazonian countries. As will be seen from this case example, Bois de Rose appears as an ingredient in the claimed invention but is not the main focus of the invention.

US6143703A is a patent grant by the US arm of the UK company Reckitt Benckiser Inc with a UK first priority filing dating to 1998. The patent grant was awarded for a disinfectant comprising a botanical oil, germicidal cationic surfactant, an organic solvent and other surfactants that produce a blooming effect when added to water (Thomson Innovation DWPI). The disinfectant is targeted to cleaning hard surfaces in the kitchen or bathroom and is claimed to be effective against gram positive bacteria such as S. aureus and gram negative bacteria such as S. choleraesuis and P. aeruginosa. An advantage of the claimed invention is that it does not exhibit the pungent smell arising from pine oil or leave a residue on surfaces. It also has low irritancy levels for users.

The reference to Bois de Rose from Brazil is found as part of a list of botanical or essential oils that are useful in producing a blooming effect as follows:

> “As an essential constituent in the concentrate compositions according to the present invention there are present one or more botanical oils, sometimes also referred to as "essential oils" which are useful in providing a blooming effect. By way of non-limiting example these include one or more of: Anethole 20/21 natural, Aniseed oil china star, Aniseed oil globe brand, Balsam (Peru), Basil oil (India), Black pepper oil, Black pepper oleoresin 40/20, Bois de Rose (Brazil) FOB, Bomeol Flakes (China), Camphor oil, White, Camphor powder synthetic technical, Canaga oil (Java), Cardamom oil, Cassia oil (China), Cedarwood oil (China) BP, Cinnamon bark oil, Cinnamon leaf oil, Citronella oil, Clove bud oil, Clove leaf, Coriander (Russia), Coumarin 69° C. (China) , Cyclamen Aldehyde, Diphenyl oxide, Ethyl vanilin, Eucalyptol, Eucalyptus oil, Eucalyptus citriodora, Fennel oil, Geranium oil, Ginger oil, Ginger oleoresin (India), White grapefruit oil, Guaiacwood oil, Gurjun balsam, Heliotropin, Isobornyl acetate, Isolongifolene, Juniper berry oil, L-methhyl acetate, Lavender oil, Lemon oil, Lemongrass oil, Lime oil distilled, Litsea Cubeba oil, Longifolene, Menthol crystals, Methyl cedryl ketone, Methyl chavicol, Methyl salicylate, Musk ambrette, Musk ketone, Musk xylol, Nutmeg oil, Orange oil, Patchouli oil, Peppermint oil, Phenyl ethyl alcohol, Pimento berry oil, Pimento leaf oil, Rosalin, Sandalwood oil, Sandenol, Sage oil, Clary sage, Sassafras oil, Spearmint oil, Spike lavender, Tagetes, Tea tree oil, Vanilin, Vetyver oil (Java), Wintergreen. Each of these botanical oils is commercially available. As noted previously, the inventive compositions do not include pine oil which is known to the prior art to provide blooming effects.”

However, it appears from the description that Bois de Rose is not a preferred oil which are described as follows:

> "Particularly preferred oils include those which are exemplified by the examples, following, and include: peppermint oil, and lavender oil."

Nevertheless, Bose de Rose oil appears in the claims as follows

> "1. An aqueous concentrated liquid disinfectant composition which blooms when added to a larger volume of water which comprises the following constituents:
>
> from 0.001% to 20% wt. of a botanical oil constituent;
> from 0.001% to about 15% wt. of a germicidal cationic surfacant having germicidal properties;
> from about 0.001% to about 50% wt. of an organic solvent constituent;
> at least one botanical oil solubilizing surfactant, selected from amine oxides present in an amount of from about 0.001% to about 30% wt.,
> alkylpolyoxycarboxylates and alkylarylpolyoxycarboxylates present in an amount of from about 0.001% to about 20% wt.;
> from about 0.001 to about 10% wt. of a biphenyl solvent constituent having the formula; wherein: R_1 is hydrogen or a straight chained or branched C_1 -C_{10} radical,
> R_2 is a straight chained or branched C_1 -C_{10} radical,
> m is an integer from 1-3 inclusive; and,
> n is an integer from 1-3 inclusive,
> optionally one or more constituents selected from: chelating agents, coloring agents, light stabilizers, fragrances, thickening agents, hydrotropes, pH adjusting agents, pH buffers and one or more detersive surfactant constituents,
> characterized in that the composition does not contain pine oil.
>
> 10. The composition according to claim 1 wherein the botanical oil constituent is one or more of: Anethole 20/21 natural, Aniseed oil china star, Aniseed oil globe brand, Balsam (Peru), Basil oil (India), Black pepper oil, Black pepper oleoresin 40/20, Bois de Rose (Brazil) FOB, Borneol Flakes (China), Camphor oil, White, Camphor powder synthetic technical, Canaga oil (Java), Cardamom oil, Cassia oil (China), Cedarwood oil (China) BP, Cinnamon bark oil, Cinnamon leaf oil, Citronella oil, Clove bud oil, Clove leaf, Coriander (Russia), Coumarin 69° C. (China), Cyclamen Aldehyde, Diphenyl oxide, Ethyl vanilin, Eucalyptol, Eucalyptus oil, Eucalyptus citriodora, Fennel oil, Geranium oil, Ginger oil, Ginger oleoresin (India), White grapefruit oil, Guaiacwood oil, Gurjun balsam, Heliotropin, Isobornyl acetate, Isolongifolene, Juniper berry oil, L-methhyl acetate, Lavender oil, Lemon oil, Lemongrass oil, Lime oil distilled, Litsea Cubeba oil, Longifolene, Menthol crystals, Methyl cedryl ketone, Methyl chavicol, Methyl salicylate, Musk ambrette, Musk ketone, Musk xylol, Nutmeg oil, Orange oil, Patchouli oil, Peppermint oil, Phenyl ethyl alcohol, Pimento berry oil, Pimento leaf oil, Rosalin, Sandalwood oil, Sandenol, Sage oil, Clary sage, Sassafras oil, Spearmint oil, Spike lavender, Tagetes, Tea tree oil, Vanilin, Vetyver oil (Java), and Wintergreen."

What is important about this example is that while Bois de Rose from the Brazilian species Aniba rosaeodora is referenced in the patent, in practice Bois de Rose is listed as an ingredient in the invention. That is the scope of the claims relating to Bois de Rose is limited to those circumstances where it is included in a claimed invention meeting the exact criteria of claim 1.

The question here, viewed from the perspective of other such as those in Brazil who may wish to include Bois de Rose in a disinfectant, would be whether claim 1 was so broadly constructed as to capture all uses of Bois de Rose in a disinfectant. In reality this appears unlikely because claim 1 is quite narrowly constructed.

The legal status data for this patent reveals that it was transferred to Reckitt Benckiser LLC based in Dansom Lane, Hull on the 31st of December 2010.

This patent grant forms part of a patent family with 15 members with the most recent member published in Canada in 2008. The patent is also cited by 12 other patents (including 3 by Reckitt Benckiser) that suggest a competitive space involving Unilever, Clariant Finance and Melaleuca Inc. It is not known whether these citing patents contain Bois de Rose.

One important issue arising from this application is the problem of confusion and the possibility of error. Bois de Rose is commonly described as Rosewood and is associated as a common name with a rare tree species in Madagascar.

In Brazil Bois de Rose is a tropical forest tree that from 1998 onwards has been listed in the IUCN Red List as endangered A1d+2d although the Red List notes this listing requires updating[50] (http://www.iucnredlist.org/details/33958/0).

The IUCN Red List describes the species range as: “Brazil (Amapá, Amazonas, Pará); Colombia; Ecuador; French Guiana; Guyana; Peru; Suriname; Venezuela”. The major threats are described as:

> “Populations throughout the species range have seriously declined because of rosewood oil extraction. where there has been exploitation the population is devoid of mature trees and significant signs of regeneration are absent. Trees of all sizes are harvested indiscriminately, the whole tree and its roots being destroyed. The sole producer at present is Brazil, although the species was wiped out through exploitation over large areas in French Guiana between 1910 and 1930. Harvesting is costly and is taking place in more and more remote locations concentrated around Amazon tributaries, principally in Amazonas and Pará states. Mobile distillation factories have also moved deep into the forest and trees. Levels of exploitation have significantly declined with increased use of synthetic oils, the current world market resting at about 100 tonnes pa.”

BR5: WO2004074312A2 *Pachymedusa dacnicolor*
University of Ulster.

This PCT patent application dating to 2004 focuses on a tryptophyllin peptide isolated from a New World leaf from *Pachymedusa dacnicolor* that works as a muscle relaxant (vasodilator) for the potential treatment of asthma, heart disease and for a range of other potential uses. In particular, the patent focuses on an analog of the tryptophyllin or prodrug in a form suitable for intravenous administration to a patient. In classification terms the tryptophyllin is an amidated heptapeptide of non-amidated octapeptide defined by the position of amino acid residues at particular positions in the sequence. The description section provides the detail of the origin of the peptide and the source of the material used in the claimed invention.

> "The subfamily Phyllomedusinae of the New World phyllomedusine leaf frogs, represented by species distributed from Mexico to Argentina, contains three well-known genera, Phyllonzedusa, Agalychnis, Pachymedusa, and three less well-known genera, Hylomantis, Phasmahyla and Phrynomedusa, found only thus far in Brazil and until now unstudied (Walls, "Red-eyes and other leaf-frog," Published in the U.S.A. by T.F.H."
>
> "The tryptophyllins are a large but heterogeneous peptide family first isolated from Phyllomedusa rohdei skin (Montecucchi, Peptides 6:187 195(1985)) and subsequently from the skin of Phyllomedusa sauvagei and Phyllomedusa bicolor."
>
> "A novel tryptophyllin (herein referred to as PdT-1) has been isolated from the skin secretion of the Mexican leaf frog, Pachymedusa dacnicolor, and its biosynthetic precursor deduced from cloned skin cDNA. In contrast to previous reports on studies on tryptophyllins, PdT-1 exhibits potent myoactive effects."
>
> "As described below, a peptide, termed Pachymedusa dacnicolor Tryptophyllin-1 (PdT-l)(SEQ ID NO: 1) has been isolated, and has been found to have particularly potent vasodilatory activity. Accordingly, in I particular embodiments of the method of the invention, the peptide is: Pachymedusa dacnicolor Tryptophyllin-1 (PdT-l) (SEQ ID NO: 1) or a I biologically active analogue or fragment thereof."
>
> "Specimens of Pachymedusa dacnicolor (n=3) were obtained from a commercial source and had been captive-bred in the United States. The frogs were metamorphs (2cm snout to vent length) on receipt and were grown to adult size (8cm snout to vent length) over a two-year period prior to secretion harvesting. They were maintained in a purpose-designed amphibian facility at 20-25°C under a 12h/12h light/dark cycle and fed multivitamin-loaded crickets three times per week. Skin secretion was obtained from the dorsal paratoid folds by transdermal electrical stimulation (6v DC, 4 msec pulse width, 50 Hz) through platinum electrodes for two periods of 15s duration (Tyler, et al., J. Pharmacol. Toxicol. Meth. 28:199-200(1992)). The obvious t viscous white secretion was washed from the skin using deionized water, snap-frozen in liquid nitrogen and lyophilized. Lyophilizate was stored at-20°C prior to analysis."

The main claims in this patent application are as follows:

> "1. An isolated peptide comprising the amino acid sequence Lys Pro-Hyp-Ala-Trp-Val-Pro.NH2 (SEQ ID NO: 1).

> 2. An isolated peptide comprising an amino acid sequence selected from the group consisting of Lys-Pro-Hyp-Ala-Trp-Val-Pro.NH (SEQ ID NO: 1) ; Lys-Pro-Hyp-Ser-Trp-Ile-Pro.NH2 (SEQ ID NO: 2); Lys Pro-Pro-Pro-Trp-Val-Pro-Val (SEQ ID NO: 3); and Lys-Pro-Pro-Pro-Trp-Ile Pro-Val (SEQ ID NO: 4) .
>
> 3. An isolated peptide having vasodilatory activity comprising the amino acid sequence Baa-Pro-Pro/Hyp-Xaa-Aaa-Haa-Pro/Hyp-XaO, wherein Baa is any basic amino acid residue, natural or synthetic; Aaa is any aromatic amino acid residue, natural or synthetic; Haa is any hydrophobic aliphatic amino acid residue, natural or synthetic; Xaa is any amino acid, natural or synthetic; and XaO is any amino acid, natural or synthetic, or absent.
>
> 19. A peptide or peptide prodrug of any of the preceding claims, wherein the vasolidatory activity of the peptide or prodrug is such that the peptides or prodrugs exhibit an ECso at arterial smooth muscle that is less than I the ECso of bradykinin at arterial smooth muscle.
>
> 20. A pharmaceutical composition comprising a peptide of any of claims 1-19.
>
> 59. A tryptophyllin, wherein said tryptophyllin is a biologically active analogue or fragment of Pachymedusa dacnicolor Tryptophyllin-1 (PdT-l) (SEQ ID NO:1), said analogue or fragment comprising the amino acid sequence encoded by the nucleotide sequence shown as SEQ ID NO:17 or the nucleotide sequence shown as position 214 through position 240 of SEQ ID i NO: 17. 1

As this makes clear, this is a complex and wide ranging patent application in connection with the peptide. However, the patent application does not appear to have gone forward because of a very negative international search report.

Specifically, the examiner found UK patent application GB2217329A from 1989 for Erba Carlo SPA with inventor Montecucchi Pier Carlo for a Heptapeptide particularly significant such that the application could not be considered novel or to involve an inventive step. In addition the examiner identified the following references to earlier work that appear to have been fatal, in most cases, to the claims to novelty and inventive step. References preceded by an X are fatal to the application as it stands.

> X. “DATABASE EMBL [Online] 3 November 2002 (2002-11-03), XP002303678 retrieved from EBI Database accession no. AJ507318
>
> X. CHEN TIANBAO ET AL: "Bradykinins and their precursor cDNAs from the skin of the fire-bellied toad (Bombina orientalis)" PEPTIDES (NEW YORK), vol. 23, no. 9, September 2002 (2002-09), pages 1547-1555, XP002303673 ISSN: 0196-9781
>
> X. MONTECUCCHI P C ET AL: "ISOLATION STRUCTURE DETERMINATION AND SYNTHESIS OF A NOVEL TRYPTOPHAN-CONTAINING HEPTAPEPTIDE BASIC TRYPTOPHYLLIN FROM THE SKIN OF PHYLLOMEDUSA-ROHDEI" INTERNATIONAL JOURNAL OF PEPTIDE AND PROTEIN RESEARCH, vol. 33, no. 5, 1989, pages 391-395, XP009039250 ISSN: 0367-8377
>
> MONTECUCCHI P C: "Isolation and primary structure determination of amphibian skin tryptophyllins" PEPTIDES 1985 UNITED STATES, vol. 6, no. SUPPL. 3, 1985, pages 187-195, XP002303675

ERSPAMER V ET AL: "ACTIVE PEPTIDES IN THE SKINS OF TWO HUNDRED AND THIRTY AMERICAN AMPHIBIAN SPECIES" COMPARATIVE BIOCHEMISTRY AND PHYSIOLOGY C PHARMACOLOGY TOXICOLOGY AND ENDOCRINOLOGY, vol. 85, no. 1, 1986, pages 125-138, XP001203632 ISSN: 0742-8413

J. CHEN TIANBAO ET AL: "Pachymedusa dacnicolor tryptophyllin-1: Structural characterization, pharmacological activity and cloning of precursor cDNA." REGULATORY PEPTIDES, vol. 117, no. 1, 15 January 2004 (2004-01-15), pages 25-32, XP002303677 ISSN: 0167-0115”

It is interesting to observe that the original patent filing in the UK by Montecucchi (listed as a resident of Italy) for a heptapeptide and the author of some of the key publications on tryptophan did not itself succeed. The legal status data records that the application was withdrawn, taken to be withdrawn or refused in the UK. In practice, it is possible that this was a defensive patent application.

BR6: WO1997042957A1 Paullina cupana (Guarana)
Pharmaceuticals comprising Xanthine and a Catechin. Rio Pharmaceuticals

This is a historic example from what appears to be a dissolved start up pharmaceutical company Rio Pharmaceuticals that dates back to 1997. The patent focuses on pharmaceuticals as follows:

> "This invention relates to pharmaceutical compositions having platelet aggregation inhibitory activity and more particularly to pharmaceutical compositions containing a xanthine such as caffeine and a polyphenol such as a catechin of the type found in Paullinia cupana, Sapindaceae.
>
> Paullinia cupana, commonly known as guarana, is a woody vine or sprawling shrub native to the central Amazon Basin. In the Amazon region, the fruits of guarana are dried under the sun, the seeds are crushed, and aqueous extracts are taken orally. The principal article of commerce of guarana in Brazil is a carbonated soft drink. Guarana is widely used in Brazil as a high caffeine stimulant and in certain local medicines, and has been claimed to have some thinning effects on blood. US Patent No. 48161594 and a related paper by M.T.R. Subbiah et al, Brazilian J Med Biolo Res (1988) 21:535-538 disclose that an aqueous extract of guarana decreases platelet aggregation in vitro and in vivo. Subbiah et al attempted to isolate the active fractions of guarana. They found that xanthines, mainly caffeine, present in the guarana extract have some anti-aggregatory activity, but the main fraction responsible for the platelet aggregation Inhibitory activity was a water-soluble, heat-resistant fraction of unknown composition which appeared to be different from salicylates, nicotinic acid or known xanthines."

The main claim of the patent is as follows:

> "1. A pharmaceutical composition comprising a xanthine, and a catechin or oligomer or polymer thereof corresponding substantially to the antiplatelet aggregating catechin compounds isolable from Paullinia cupana, together with a pharmaceutically acceptable carrier."

The legal status information reveals that this patent did not proceed beyond the year 2000 and, with the exception of the United States, did not enter into the national phase. This and other examples from the UK data highlight that it is important to remember that patent applications do not always lead to patent grants.

BR7: WO2005116085A1 Bertholletia excelsa
Croda International UK

This patent application by UK company Croda International involves a protein-cyclodextrin derivative that is useful as a cosmetic composition in hair or skin care products and for retaining and delivering fragrance in a cosmetic. The main advantage of the invention is that hair retains fragrance for a longer period than without the component. In addition, hair retains the moisturizing and conditioning properties of the protein. The description makes reference to Brazil nut as follows:

> "Preferably R4-(NH) is the residue of a protein, more preferably a hydrolysed protein and even more preferably a vegetable protein hydrolysate such as a hydrolysate derived from potato, wheat, soya or brazil nut protein, and preferably potato protein."

This makes clear that the protein residue could be derived from a range of sources and is preferably from a potato protein.

> "The protein may be derived from either animal or vegetable sources or by fermentation. It may be in the form of a chemically modified protein For example, quaternised, silanised or copolymerised) provided that at least one free amino groups is still present in the protein molecule. Examples of proteins which are currently used in cosmetic formulations and can be used as the protein component of the current invention include collagen (including bovine, porcine marine and avian), elastin (including bovine, porcine and marine), casein (milk and whey), cereal (including wheat, soya, maize [corn], oat), rice, pea, proteins from seeds or nuts (eg., brazil nut, sesame, cotton, apricot etc) , algal, keratin (including hoof and horn, wool, human hair, etc.), silk, egg and potato. In this specification the term "protein" is used to include both native and hydrolysed proteins and it thus i comprises both proteins properly so-called polypeptides, peptides, peptones and amino acids, since the latter can all be categorized as hydrolysed proteins.
>
> The present invention encompasses any residue derived from or found in a protein."
>
> "Especially preferred is when the protein hydrolysate is a vegetable protein hydrolysate, particularly wherein the vegetable protein hydrolysate is of potato, wheat or brazil nut origin."

Elsewhere we learn that: "i R' is preferably the residue of a hydrolysed protein, more preferably a hydrolysed vegetable protein, such as hydrolysed wheat, potato or brazil nut protein, especially potato protein."

The patent application claims:

1. A protein-cyclodextrin derivative obtained by the reaction of a reactive cyclodextrin and a protein.

4. A protein-cyclodextrin derivative according to Claim 3 wherein the hydrolysed protein is a vegetable protein hydrolysate such as a hydrolysate derived from potato, wheat, brazil nut or soya protein, and preferably potato protein.

25. The use according to Claim 24 wherein R'-(NH) is the residue of a hydrolysed protein.

26. The use according to Claim 25 wherein the hydrolysed protein is a vegetable protein hydrolysate such as a hydrolysate derived from potato, wheat, brazil nut or soya protein, and preferably potato protein.

This application forms part of a patent family with three members of which 2 are in the UK. The patent has not attracted other patent citations within the wider patent landscape. However it is negatively affected by patents by Consortium Clektrochem IND for a "Cyclodextrin derivatives having at least one nitrogen-containing heterocycle, their preparation and use". The last action recorded for legal status dates to 2007 indicating that the European patent application is not entering the European phase. In practical terms this suggests that the patent application is dead.

BR8: US2010186912A1, WO2007144588A1 Montrichardia arborescens Ecopulpa Limitada (Colombia) and UK co-applicant and inventor

This patent application involved a collaboration between a UK inventor and a Colombian company Ecopulpa Limitada. It is highlighted here as an example of collaboration between the UK and Colombia for a species that occurs in a number of South American countries. The patent application is concerned with a method for preparing pulp from the raw material of a plant of the Araceae family involving the treatment of the plant material with sodium hydroxide at 160-170 degrees. The target industry is the production of paper pulp.

A claimed advantage of the method was that the plant materials are readily available in specific geographical areas can readily be grown. The application is thus mainly concerned with providing an alternative source of paper pulp as described below:

> "The present invention provides a further alternative source of raw material such as cellulose fibres and lignin for producing paper pulp, fiber agglomerated products and paper-related products. The inventors have surprisingly demonstrated that plants of the Araceae family, and especially *Montrichardia arborescens*, are highly suitable for producing paper pulp and fiber-related products. These plants therefore provide an attractive non-wood resource for industrial use, which is available in many geographical areas where the harvesting of woody trees for paper production is not feasible due to their scarcity, slow growth rates, or environmental concerns. Moreover, paper pulp produced using plants of the Araceae family as raw material shows desirable properties which may make it superior to pulp produced from a number of other non-wood species."

> "According to the present invention, the Aroideae are a preferred sub-family of plants within the Araceae family. More preferred are the Montrichardieae tribe and especially the *Montrichardia* genus. A most preferred member of the Araceae family is *Montrichardia arborescens*, commonly known as Arracacho, mocou mocou, or moko moko. *M. arborescens* has been reported in all countries from Guatemala to Panama, and in Puerto Rico and in the lesser Antilles, Guyana, Dutch Guyana, French Guyana, Venezuela and Northern Brazil (Bunting, 1973)."

> "M. *arborescens* has an important place in the dynamics of the succession process in many lacustrine and riverine environments, given that once it is established it can influence the establishment of other species in the community through shading out or the build-up of litter. The species can thus be used in plans for the control of erosion and the stabilisation of sediments (Gordon, E. 2002, Taxonomy and ecology of vascular aquatic plants)."

> "Associations or co-associations of Arracacho, *M. arborescens*, are the most widespread community throughout the alluvial flood plain of the Rio Atrato (Colombian National Natural Parks, 2004). This member of the Araceae is the physically dominant member, forming a very homogeneous continuous layer, and the herbaceous layer frequently contains the species: *Blechnum cerolatum, Thelypteris* sp, *Scleria pterota, S. secans, Panicum* sp, *Ceratopteris* sp and *Achrosticum aureum* (Zuluaga, 1987 cited by Colombian National Natural Parks, 2004)."

The main patent claims are as follows:

> 1. A process for the production of a paper pulp, comprising preparing the pulp from a raw material derived from a plant of the Araceae family.
>
> 2. A process according to claim 1, wherein the plant is from the genus Montrichardia.
>
> 3. A process according to claim 2, wherein the plant is the species Montrichardia arborescens.
>
> 10. A method according to any preceding claim, wherein the raw material comprises a stalk of a plant of the Araceae family.
>
> 11. A paper pulp obtainable by a process of any preceding claim.
>
> 12. A process for the production of paper, comprising preparing a paper pulp according to any of claims 1 to 10, and producing paper from the paper pulp.
>
> 14. A process for the production of lignin, comprising preparing the lignin from a raw material derived from a plant of the Araceae family.
>
> 15. A process for the production of a fibreboard material, comprising preparing the fibreboard from a raw material derived from a plant of the Araceae family.
>
> 16. A paper pulp comprising an aqueous suspension of plant fibres, wherein the fibres have a mean length of 1.5 to 2.1 mm and a mean diameter of 26 to 36 µm.
>
> 24. A paper product or fibreboard comprising cellulose fibres derived from a plant of the Araceae family.
>
> 25. Use of a plant of the Araceae family for the production of paper pulp, paper products, lignin or fibreboard.

This patent application is a mix of a process, method and product claims. However, we will focus here on the two broadest and final claims. In claim 24 we observe a claim to a paper product or fibreboard made of cellulose fibres from the Aracheae family. In claim 25 we observe a claim to the use of any member of the Araceae family to produce paper pulp, paper products, lignin or fibreboard.

This is in reality an example of the *essential incorporation* of a biological resource within patent claims. In effect, if granted as written this patent would prevent others for making, using or offering for sale members of the Araceae family as paper of fibreboard products in countries where a patent was in force.

This applications forms part of a family of five documents. To date no grants have been recorded. Legal status data for the application reveals that in 2011 the patent application in the UK was taken to be withdrawn or refused. In the United States the patent entered into the national phase in March 2010 with no further information available. In Europe a first examination report was provided in January 2013. It remains to be seen what the outcomes of the examination process will be.

To date no patents have cited the application. Cited references are confined to: ROUSU et al., Sustainable pulp production for agricultural waste, 2002, Resources: Conservation and Recycling, 35, pg.85-103. With respect to Brazil, the patent application makes clear that Brazil is one among other countries where the species has been found

Brazil: Example Patents by Distribution (BRD)

This section provides details of a sample of patents where species that potentially originate from Brazil were identified in UK patent documents based on distribution data.

BRD1: US2009106865A1 Acetobacter diazotrophicus
Nitrogen fixing in plants using an endosymbiotic bacteria.
University of Sheffield. See also EP1422997B1 EP1714545A1 US7470427B2 US2004235663A1 WO2003020014A2

This is one of a set of patent applications and grants for the University of Sheffield involving the bacteria Acetobacter diazotrophicus (syn: Gluconacetobacter diazotrophicus).

The European family member patent provides a new non-leguminous or leguminous plant that contains nitrogen fixing bacteria located inter-cellularly in the plant cells that provides fixed nitrogen to the plant. The patent is claimed to be useful for producing members of the grass family Gramineae including rice, wheat, and maize and extends to Solanaceae to include tomato, potato, tobacco along with Brassicacea and other plant families.

The nitrogen fixing bacteria can be either *Acetobacter diazotrophicus* or a member of Herbaspirillum. The bacteria are present in membrane bound vesicles in the cytoplasm of the plant cell preferably in colonies that are polyhedral or rhomboidal in form. The bacteria then spread between the plants cells during cell division. The plants are produced through vegetative propagation or sexual propagation. The bacterial colonies are introduced to the plant through inoculation following germination. Alternatively the bacteria may be provided in the seed coat.

The patent addresses the challenge that crops such as wheat, rice and maize do not form nodules and depend for their nutrition on fixed nitrogen from soil or fertilizers. This invention overcomes this problem by enabling the plants to fix nitrogen endophytically.

The patent explains the use of the bacteria as follows:

> "However, energy and environmental concerns arising from the overuse of nitrogenous fertilisers have highlighted a need for non-leguminous crops to obtain more of their nitrogen from the air by biological nitrogen fixation.
>
> It is known that an intercellular, systemic, endophytic nitrogen fixing interaction with Acetobacter diazotrophicus and Herbaspirillum spp., without the need for nodulation, occurs naturally in Brazilian varieties of sugar cane. Sugar cane is a member of the grass family, Gramineae, which also includes cereals. This non-nodular, intercellular, endophytic nitrogen fixing relationship may also be possible in rice, wheat, maize and in other non-legume crops."
>
> "Accordingly, the present invention, in a first aspect, provides a non-leguminous or leguminous plant, containing nitrogen fixing bacteria, Acetobacter diazotrophicus (syn. Gluconacetobacter diazotrophicus), said bacteria being located intracellularly in living plant cells and providing fixed nitrogen to said plant.
>
> According to the second aspect, the present invention further provides a method of inoculating a non-leguminous or a leguminous plant with nitrogen fixing bacteria,

> Acetobacter diazotrophicus (syn. Gluconacetobacter diazotrophicus), located intracellularly in living plant cells and providing fixed nitrogen to said plant which comprises inoculating said plant with between 1 and 100 of said bacteria per millilitre of inoculum when germination of said plant occurs or up to seven days thereafter."
>
> "We have found that using a very low concentration of bacteria in the inoculum we can obtain plants that are healthier that those inoculated with higher concentrations of bacteria. We have also found that *Acetobacter diazotrophicus* secretes large amounts of indole acetic acid (IAA), a plant growth hormone. It is known that the response of various plant species to external (microbially released) IAA can vary from beneficial to deleterious effects, depending on the concentration of IAA in the plant root. In general, when IAA is present in higher concentrations than would normally be found in a plant, the increased concentration of IAA inhibits growth, and alters the phenotype of the plant. Also, at low concentrations IAA (or other plant growth substances) secreted by bacteria may be acting as a plant-bacterial (and other plant growth substances) signalling molecule for the intracellular endophytic establishment of *Acetobacter diazotrophicus.*"

*"*Two strains of *Acetobacter diazotrophicus* were used:

- *A.diazotrophicus* UAP 5541/p RGS561 (GUS)
- *A.diazotrophicus* UAP 5541/p RGH562 (*Nif*H-*GUS*A)"

The patent claims:

"1. A non-leguminous or leguminous plant containing nitrogen fixing bacteria, *Acetobacter diazotrophicus* (syn. *Gluconacetobacter diazotrophicus),* said bacteria being located intracellularly in living plant cells and providing fixed nitrogen to said plant.

8. A method of inoculating a non-leguminous or a leguminous plant with the nitrogen fixing bacteria, *Acetobacter diazotrophicus* (syn. *Gluconacetobacter diazotrophicus*)*,* located intracellularly in living plant cells and providing fixed nitrogen to said plant, which comprises inoculating said plant with between 1 and 100 of said bacteria per millilitre of inoculum when germination of said plant occurs or up to seven days thereafter.

9. A method according to claim 8 wherein the non-leguminous or leguminous plant is inoculated with 1-10 bacteria per millilitre of inoculum.

10. A method of producing a leguminous or non-leguminous plant in accordance with claim 1, wherein said bacteria are introduced by inoculation of between 1 and 100 bacteria per millilitre of inoculum when germination of said plant occurs or up to seven days thereafter, and wherein said bacteria become systemic by division of plant cells and subsequent divisions thereof."

This patent grant forms part of a patent family with 18 members encompassing Austria, Australia, Canada, Germany, Spain, the UK, the US, and the PCT. Legal status information suggests it is being actively maintained in a number of countries. However, to date the patent has not attracted citations from other applications.

Patent family member WO2003020014A2 has attracted 7 citations to date. These include two from the University of Nottingham and 5 from the University of South Carolina for a method for micropropagation of monocots, including four patent grants.

We were unable to identify any reference to the source of the Acetobacter used in the invention.

BRD3: US4372785A Beijerinckia lacticogenes et. al.
Tate and Lyle and Hercules International. UK inventor with UK priority See also. EP0015691A2 US4338432A

The three patents listed above date between 1980 and 1983 and are therefore of purely historic interest. The patents form part of a family of 12 documents. The patents focus on a thixotropic polysaccharide (Indican) that is useful as an emulsifying and suspending agent that is prepared by culturing a strain of Beijerinckia indica to obtain Indican. The source of the microorganism is described as follows:

> "The polysaccharide according to the present invention is derived from a microorganism deposited at the American Type Culture Collection under the No. ATCC 19361 by H. Jensen in 1957. The microorganism was originally deposited under the name Azotabacter lacticogenes. However, in the latest edition of Bergey's Manual of Determinative Bacteriology (8th Edition 1974), A. lacticogenes is no longer recognised as a separate species, but, together with Beijerinckia lacticogenes and several other species is now classified as B. indica. The nomenclature of the microorganisms in question is thus rather complex and is apt to be misleading. We have compared the microorganism ATCC 19361 with the type strain of B. indica, deposited as NCIB 8712, and also, for reference, with A. indicus var. myxogenes ATCC 21423. From our experiments, it is clear that the microorganism deposited as ATCC 19361 should, in fact, be classified as a strain of B. indica, and will now be referred to in this specification as B. indica ATCC 19361. From our experiments, it is also clear that A. indicus var. myxogenes ATCC 21423 differs significantly from both the other organisms tested. It is indeed a species of Azotobacter rather than Beijerinckia since: (i) it grows readily in nutrient broth and on nutrient agar; (ii) it forms a pellicle in most liquid media; and (iii) it forms a yellow non-water soluble pigment."

> "The present invention utilises indican, a polysaccharide comprising (1. fwdarw.3) glucose, (1→4) mannose, (1→4) rhamnose and (1. fwdarw. 3 or 4)0-(1-carboxyethyl)-rhamnose units in a molar ratio of about 2:1:1-2:1 respectively, containing 12-15% by weight acetyl units, . alpha.!.sub.D. sup.20 about-61° , having principle absorption bands in the infra red band at 3390, 1735, 1615, 1375, 1250 and 1050 cm. sup.-1 , a solubility of at least 1% by weight of at least 1% by weight in methanol and in ethylene glycol, and an inherent viscosity of about 33. 5 dl/g, and especially substantially cell-free indican obtained from a culture of Beijerinckia indica ATCC 19361."

The patent claims both a method and a liquid containing the materials as follows:

> "1. A method of modifying the viscosity of a liquid by incorporating therein an effective amount of indican, a polysaccharide comprising (1→3) glucose, (1→4) mannose, (1→4) rhamnose and (1→3 or 4) -O-(1-carboxyethyl)- rhamnose units in a molar ratio of about 2:1:1-2:1 respectively, containing 12-15% by weight acetyl units, $[\alpha]_D^{20}$ about -61°, having principle absorption bands in the infra red band at 3390, 1735, 1615, 1375, 1250 and 1050 cm^{-1}, a solubility of at least 1% by weight in methanol and in ethylene glycol, and an inherent viscosity of about 33.5 dl/g.

> 5. A pseudoplastic, thickened liquid containing indican, a polysaccharide comprising (1→3) glucose, (1→4) mannose, (1→4) rhamnose and (1→3 or 4) -O-(1-carboxyethyl)- rhamnose units in a molar ratio of about 2:1:1-2:1 respectively, containing 12-15% by weight acetyl units, $[\alpha]_D^{20}$ about -61°, having principle absorption bands in the infra red band at 3390, 1735, 1615, 1375, 1250 and 1050 cm^{-1}, a solubility of at least 1% by weight in methanol and in ethylene glycol, and an inherent viscosity of about 33.5 dl/g, substantially free of cells of B. indica."

The patent documents in this set attracted a total of 6 citations suggesting that they had a limited impact. Legal status data reveals that the patents lapsed in 1999.

The example is of interest because it reveals that species names may be transformed over time.

BRD4: US2002064517A1 & US6492494B1 Bothrops insularis
Bristol Myers Squibb (US) With UK inventor as applicant

These documents involve a kit for preparing a fibrin sealant containing enzymes and proteins. This device is to be used to seal cuts during surgery. One advantage of the invention is that the fibrin can be derived from the patients.

There are a number of components of this invention that are operating in conjunction.

The first is fibrin which is described as: “One of a number of derivatives of fibrinogen {e.g., fibrin I (i.e., desAA-fibrin), fibrin II (i.e., desAAdesBB fibrin) or des BB fibrin} that can polymerize to form a precipitate of fibrin polymer. The derivatives are created by cleaving the A or B fibrinopeptides from fibrinogen.” Fibrin is a protein that is involved in blood clotting.

The second component is a fibrinolysis inhibiting protein which is derived from mammalian body fluid. The third component in the device is a fibrinogen converting enzyme.

> “In the exemplified schemes of FIGS. 1 and 2, the fibrinogen-converting enzyme is batroxobin ("Btx"), a proteinase from the snake venom of snakes of the genus Bothrops. Other proteinases of appropriate specificity can also be used. Snake venom proteinases are particularly suitable, including without limitation the venom enzymes from Agkistrodon acutus, Agkistrodon contortrix contortrix, Agkistrodon halys pallas, Agkistrodon (Calloselasma) rhodostoma, Bothrops asper, Bothrops atrox, Bothrops insularis, Bothrops jararaca, Bothrops Moojeni, Lachesis muta muta, Crotalus adamanteus, Crotalus durissus terrificus, Trimeresurus flavorviridis, Trimeresurus gramineus and Bitis gabonica.”
>
> Bothrops insularis (golden lancehead) is a pit viper that is reportedly only found on an island of Sao Paolo State in Brazil. However, according to the Working Standard of the UK National Institute for Biological Standards and Control (NIBSC), “Batroxobin is a hydrolytic enzyme derived from the venom of Bothrops atrox. Batroxobin clots plasma by converting fibrinogen to fibrin by the release of only fibrinopeptide A rather than fibrinopeptides A and B as does thrombin. The 1st British Standard (75/527) was established in 1975 and defined the unitage of Batroxobin. This standard has expired and a new proposed British Standard (93/526) has been prepared.”[51]

This information suggests that *Bothrops atrox* is the likely source of the Batroxobin. It also suggests that the Batroxobin is from a commercial source because of the long standing UK standard on this enzyme. However, it is worth pointing out that *Bothrops atrox* is a species of pit viper known as the common lancehead or fer-de-lance and narba amarilla that is found in the tropical lowlands in South America.

As the quote from the patent grant suggests, the applicant has included the reference to the range of species that may be a source of suitable proteinases in order that proteinases from other potential sources, and notably with particular properties, are incorporated into the claims of the invention. That is references cover the possibility of the uses of such proteinases in the claimed invention.

The patent grant makes the following independent claims:

> "1. a method of forming a fibrin sealant from an animal comprising:
> 2. contacting a first extract from the animal containing a FIP with a clot inhibitor-binding ligand bound to an extraction implement;
> 3. isolating a first composition comprising a FIP;
> 4. contacting a second extract from the animal, which contains fibrinogen and which can be the same as the first extract, with a fibrinogen-converting enzyme; and
> 5. isolating a second composition comprising a clot-forming effective amount of fibrin monomer from the contacted second extract, wherein the amount of isolated FIP is sufficient to stabilize at least a clot-forming effective amount of the second composition; and
> 6. a method of sealing a tissue against fluid loss or to prevent a tissue adhesion involving the tissue or coating a material to increase its biocompatibility comprising forming a fibrin polymer on the surface of the tissue by:
> 7. applying a FMP to the tissue or material;
> 8. applying a stabilizing preparation containing a clot-preserving effective amount of a FIP to the tissue or material; and
> 9. applying a non-enzymatic polymerizing agent preparation effective to convert the FMP into a fibrin clot to the tissue."

This patent grant forms part of a patent family of nine documents. In 2011 the patent grant lapsed in the United States due to failure to pay the maintenance fee. A patent application in Australia also lapsed, an application in Norway was rejected, it was also refused in 2009 in Japan and declared dead in Canada in the same year. In Europe the application was deemed to have been withdrawn in 2008 following the first examination report. This may reflect the impact of other patent grants in the United States issued to Bristol Myers Squibb in the late 1990s inserted into the cited patents by the examiner.

BRD5: WO2010139957A1. Burkholderia tropica Adherence. Algipharma (Norway) with UK applicant/inventor. See also WO2010139958A1 WO2010139959A2

This set of PCT applications involve alginate oligomers to inhibit the adhesion of a microorganism to a surface or combating an infection. The target of the invention includes food and drink processing, the storage of machinery and equipment and medical and surgical instruments among other uses. In particular the application could be used externally or internally on the body (i.e. in the case of hospital borne bacterial infections). The alginate oligomer is used in combination with an antimicrobial agent. The patent is of interest because, in contrast with applications that focus on killing bacteria, this patent focuses on interfering with the mechanisms through which they attach themselves to surfaces.

The patent employs Alginate oligomers. Alginates are described as:

> "...linear polymers of (1-4) linked β-D-mannuronic acid (M) and/or its C-5 epimer α-L-guluronic acid (G). The primary structure of alginates can vary greatly. The M and G residues can be organised as homopolymeric blocks of contiguous M or G residues, as blocks of alternating M and G residues and single M or G residues can be found interspacing these block structures."

With respect to the sources of alginates we learn that:

> "Alginates have been isolated from marine brown algae (e.g. certain species of Durvillea, Lessonia and Laminaria) and bacteria such as Pseudomonas aeruginosa and Azotobacter vinelandii. Other pseudomonads (e.g. Pseudomonas fluorescens, Pseudomonas putida, and Pseudomonas mendocina) retain the genetic capacity to produce alginates but in the wild they do not produce detectable levels of alginate. By mutation these non-producing pseudomonads can be induced to produce stably large quantities of alginate."

The importance of these alginate polymers originating from natural sources is that they interfere with the way in which microorganisms adhere to surfaces.

Burkholderia sacchari and Burkholderia tropica appear in a long list of microorganisms that could be a focus of the application of the oligomers. For example the patent states that:

> "Bacteria or fungi represent preferred classes of microorganism and accordingly the alginate oligomers may be preferably viewed as having antibacterial or anti-fungal activity. Examples of genera or species of bacteria include, but are not limited to, Abiotrophia, Achromobacter, Acidaminococcus, Acidovorax, Acinetobacter, Actinobacillus, Actinobaculum, Actinomadura, Actinomyces, Aerococcus, Aeromonas, Afipia, Agrobacterium, Alcaligenes, Alloiococcus, Alteromonas, Amycolata, Amycolatopsis, Anaerobospirillum, Anaerorhabdus, Arachnia, Arcanobacterium, Arcobacter, Arthrobacter, Atopobium, Aureobacterium, Bacteroides, Balneafrix, Bartonella, Bergeyella, Bifidobacterium, Bilophila Branhamella, Borrelia, Bordetella, Brachyspira, Brevibacillus, Brevibacterium, Brevundimonas, Brucella, Burkholderia, Buttiauxella...."

As such, the Brazilian species are a target of the invention rather than the source and the species themselves do not appear in the patent claims. This is a useful reminder that a

species may appear in a patent because it is a target of a claimed invention. This is frequently the case for known pathogens and other disease causing agents. Burkholderia species are not mentioned in the claims of the three closely related patents.

BRD6: WO2007020465A1 Cocos coronata
Petroleo Brasilero S.A. Petrobras, and UK inventor as co-applicant.

This 2007 PCT patent application lists the Brazilian petroleum company (Petrobras) and a UK inventor as co-applicants. The patent application focuses on the preparation of biodiesel from natural oils/fats by mixing or reacting the oil/fat with alcohol and a catalyst and separation of the dense and light phases of the resulting mixture. The claimed advance of the process is that it is cost effective and minimises the moisture content of the recovered alcohol.

With respect to *Cocos coronata* the application specifies that this species is one of a number of possible sources of natural oils/fats for use in the process to create biofuel.

> "The present invention pertains to the field of processes for producing biodiesel from natural oils and/or fats, and more specifically vegetable oils such as castor oil, pine nut oil, soybean oil, cottonseed oil, rapeseed oil, sunflower oil, ouricury palm (Cocos coronata) oil, and/or any natural fats, and more specifically configured for producing biodiesel from castor seed oil."

A total of 23 claims are listed in the application with the first claim listed below.

1. A process for producing biodiesel from natural oils and/or fats in the presence of a low molecular weight alcohol and a catalyst, comprising the following steps of reaction ((a) to (e)) and purification ((f) to (g)) a) directing, under process conditions of temperature from ambient temperature to 14000, pressure from atmospheric pressure to 10 bars and a molar ratio of alcohol/(oil or fat) of 3 to 30, oil or fat (1), alcohol (2) and catalyst (3), to a first reaction module (MR-lA), to mix, react, and separate a first dense phase (5), and a first light phase (4), formed during the reaction; b) directing oil or fat (12) and alcohol (13) to a second reaction module (MR-1B), together with a fraction (11)... (continues in an extensive list)

In practice, no reference is made to a specific species in the process focused claims. As such, the reference to the species only occurs as a possible option and would be relevant where another applicant sought to use the species in the claimed process.

The patent application forms part of a family of 5 applications submitted up to 2009. In the legal status information for Brazil an objection is listed requiring translation of documents. A patent grant has been registered in Peru, while no information is available in the case of the United States application after 2008. However, the patent application has attracted 9 citations from other applicants.

BRD12: EP1133576B1 Justicia lanstyakii
Lophostachys Villosa, Turnera subnuda
University of Sheffield, University of Maryland, US Secretary of Agriculture
See also. US7268273B2 US2002174451A1 WO2000028093A1.

This European patent grant focuses on methods for recovering metal from metal containing soil using plant species from the genus Allysum. As such this patent crosses the boundary between industrial and agricultural biotechnology. The methods described in the patent focus on the recovery of metals such as nickel and cobalt by phyto-mining or phyto-extracting soils rich in metals.

Metals covered by the method include: barium, gold, beryllium, mercury, molybdenum, copper, arsenic, selenium, antimony, manganese, silver, thallium, tin, lead, rubidium, chromium, cerium, vanadium, cesium, uranium, plutonium, strontium, yttrium, technetium, iridium, ruthenium, palladium, rhodium, platinum, osmium, rhenium, zinc or cadmium. The main advantage of the method over other methods is that nickel can be removed in an economically acceptable way without further contamination of the soil.

In terms of focus the main focus of the patent and its claims concerns members of the genus Allysum, including A. murale, A. pintodasilvae, A. serpyllifolium, A. malacitanum , A. lesbiacum, A. fallacinum, A. artenteum, A. bertolonii, A. tenium, A. heldreichii, A. corsicum, A. pterocarpum and/or A. caricum.

The Brazilian species, belonging to the family Acanthaceae include *justicia lanstyakii and lophostachys villosa* and Turnera subnuda (Turneraceae) are mentioned as other examples of metal hyperaccumulators.

The patent explains that having been planted on metal rich soils:

> “After cultivation, the hyperaccumulator plant is harvested in a conventional fashion, i.e., by cutting the plant at soil level. The harvested materials are then left to dry in the field in the manner in which hay is dried. Alternatively, the harvested materials are dried in much the same fashion that alfalfa is dried, so as to remove most of the water present in the plant tissue by forced heated air drying. After drying, the plant tissue is collected by normal agricultural practices of hay-making, incinerated and reduced to an ash with or without energy recovery. Alternatively, the dried plant material may be hydrolyzed with concentrated acid to produce sugars and the metals recovered according to , and . The sugars may then be fermented to produce ethanol.
>
> The resulting dried plant material may alternatively be further treated by known roasting, sintering or smelting methods which allow the metals in the ash or ore to be recovered according to conventional metal refining methods such as acid dissolution and electrowinning.”

The main patent claims are as follows:

1. A method for selectively increasing the amount of at least one first metal recovered from metal-containing soil, comprising:

- obtaining a soil pH of at least about 6.3 where the at least one first metal is nickel; or

- obtaining a soil pH between about 6.3 and about 7.0 where the at least one first metal is cobalt; and
- cultivating at least one metal-hyperaccumulator plant in the soil under conditions sufficient to permit the at least one plant to accumulate the at least one first metal from the soil in above-ground tissue.

25. The method of claim 1, wherein the at least one metal-hyperaccumulator plant cultivated in the soil under conditions sufficient to permit the at least one plant to accumulate the at least one first metal from the soil in above-ground tissue is selected from the group consisting of *Cyanotis longifolia, Bulbostylis mucronata, Combretum decandrum; Crassula alba, Crassula vaginata, Crassula argyrophylla, Clethra barbinervis, Geissois intermedia, Geissois magnifica, Geissois montana, Geissois trifoliate, Geissois racemosa, Psychotria douarrei, Rinorea bengalensis, Pearsonia metallifera, Dichapetalum gelonioides ssp. tuberculatum and amanicum, Blepharis acuminata, Justicia lanstyakii, Lophostachys villosa, Phidiasia lindavii, Ruellia geminiflora, Adiantum sp., Rhus wildii, Chromolaena sp. cf. meyeri, Dicoma niccolifera, Gochnatia crassifolia, Gochnatia recurva, Koanophyllon grandiceps, Koanophyllon prinodes, Leucanthemopsis alpha, Penfacalia, Senecio pauperculus, Shafera plaryphylla, Solidago hispida, Heliotropium sp., Bornmuellera, Cardamine resedifolia, Cochlearia aucheri, Cochlearia sempervivium, Peltaria emarginata, Buxus, Campanula scheuchzeri, Arenaria, Minuartia laricifolia, Minuartia verna, Garcinia bakeriana, Garcinia polyneura, Garcinia revolute, Garcinia ruscifolia, Merremia xanthophylla, Pancheria engleriana, Shorea tenuiramulsoa, Argophyllum grunowii, Argophyllum laxum, Baloghia sp., Bonania, Cleidion viellardii, Cnidoscolus sp. cf. bahianus, Euphorbia, Gymnanthes recurva, Leucocroton, Phyllanthus, Sapium erythrospermum, Savia, Anthyllis sp., Trifolium pallescens, Casearia silvana, Xylosma, Luzula lutea, Walsura monophylla, Myristica laurifolia, Mosiera araneosa, Mosiera ekmanii, Mosiera x miraflorensis, Mosiera ophiticola, Psidium araneosum, Psidium havanense, Brackenridgea palustris and ssp. foxworthyi and kpllbergii, Ouratea nitida, Ouratea striata, Chionanthus domingensis, Oncotheca balansae, Trisetum distichophyllum, Ranunculus glacialis, Ariadne ssp. Shaferi and moaensis, Mitracarpus sp., Phyllomelia coronata, Psychotria clementis, Psychotria costivenia, Psychotria douarrei, Psychotria glomerata, Psychotria osseana, Psychotria vanhermanii, Rondeletia, Planchonella oxyedra, Saxifraga, Esterhazya s.p., Linaria alpina, Tetralix brachypetalus, Tetralix cristalensis, Tetralix jaucoensis, Tetralix moaensis, Tetralix nipensis, Trichospermum kjellbergii, Turnera subnuda, Vellozia sp., Agatea deplanchei, Rinorea javanica, Acer pseudoplatanus, Minuarfia vernai, Polycarpaea synandrai, Cistus incanus ssp. creticus, Armeria maritime var. halleri, Agrostis stolonifera, Agrostis tenuis, Arrhenatherum elatius, Festuca ovina, Rumex acetosa, Viola calaminaria, Pandiaka metallorum, Celosia trigyna, Anisopappus chinensis, Anisopappus davyi, Gutenbergia pubescens, Millotia myosotidifoliab, Vernonia petersii, Minuartia verna ssp. hercynicia, Silene cobalticola, Commelina zigzag, Cyanotis longifolia, Ipomoea alpina, Ascopepis metallorum, Bulbostylis cupricola, Bulbosfylis pseudoperennis, Monadenium cupricola, Phyllanfhus williamioides, Crotalaria cobalticola, Vigna dolomitica, Gladiolus gregarious, Aeollanthus subacaulis var. linearis, Aeollanthus homblei, Aeollanthus saxatilis, Aeollanthus subacaulis var. ericoides and var. linearis, Becium grandiflorum var. vanderystii, Haumaniastrum homblei, Haumaniastrum robertii, Haumaniastrum rosulatum, Hibiscus rhodanthus, Abies balsamea, Eragrostis racemosa, Rendlia altera, Sporobolus congoensis, Actiniopteris sp., Alectra sessiliflora var, senegalensis, Buchnera henriquesii, Crepidorhopalon tenuisa, Crepidorhopalon perennisa, Sopubia mannii, Sopubia metallorum, Sopubia neptuniii, Striga hermontheca, Triumfetta*

dekindtiana, Triumfetta digifata, Triumfetta welwitschii var. descampii, Xerophyta retinewis var. equisetoides, Alyxia rubricaulis, Maytenus bureaviania, Maytenus pancheriana, Maytenus sebertiana, Garcinia amplexicaulis, Eugenia clusioides, Beaupreopsis paniculata, Macadamia angustifolia, Macadamia neurophylla, Haplopappus fremontii, Machaeranthera glabriuscula, Machaeranthera ramosa, Machaeranthera venusta, Sfanleya pinnata, Stanleya bipinnata, Atriplex confertifolia, Lecythis ollaria, Acacia cana, Astragalus bisulcatus, Astragalus osterhoutii, Astragalus pattersonii, Astragalus pectinatus, Astragalus racernosus, Neptunia amplexicaulis, Morinda reticulafa and Castilleja chromosa.

28. The method of claim 1, wherein the at least one metal-hyperaccumulator plant cultivated in the soil under conditions sufficient to permit the at least one plant to accumulate the at least one first metal from the soil in above-ground tissue is selected from the group consisting of *Leucocroton sp., Phyllanthus sp. and Psychotria sp*.

33. The method of claim 1, wherein the accumulation of said at least one first metal is accompanied by the recovery of at least one second metal.

In considering this extensive list we are presented with an example of the essential incorporation of a large number of plant species into the claims for the method such that others seeking to reproduce the method using the included species would infringe the patent. Given that the focus of the method is on named members of the Alyssum genus this extension to what appears to be all known metal hyper-accumulating plants could be considered excessive. In practice it will be designed to protect the inventors from those seeking to invent around what is otherwise a simple method using other plant species.

This European patent grant forms part of a patent family with 25 members including in Austria, Australia, Brazil, Canada, Germany, Indonesia, Japan, Turkey, the United States and South Africa. A review of the legal status of the patent reveals that in the case of the Brazilian application there was a “notification to applicant to reply to the report for non-patentability or inadequacy of the application” in 2008 and again in 2010. This was followed on the 19th of February 2013 by a decision to refuse the patent.

To date no citing patents are recorded for the European grant. The cited literature provides an introduction to this area of technology.

Raskin et al: 'Bioconcentration of Heavy Metals by Plants' CURRENT OPINION IN BIOTECHNOLOGY vol. 5, 1994, pages 285 - 290, XP002922961

Kumar et al.: 'Phytoextraction: The Use of Plants to Remove Heavy Metals from Soils' ENVIRON. SCI. TECHNOL. vol. 29, no. 5, 1995, pages 1232 - 1238, XP002922963

Robinson et al.: 'Soil Amendments Affecting Nickel and Cobalt Uptake by Berkheya coddii: Potential Use for Phytomining and Phytoremediation' ANNALS OF BOTANY vol. 84, 1999, pages 689 - 694, XP002922964

Romero et al.: 'Metal Plant and Soil Pollution Indexes' WATER, AIR AND SOIL POLLUTION vol. 34, no. 4, 1987, pages 347 - 352, XP002922962

The US version of this patent US2002174451A1 carries the following entry for Government Interest and is repeated in patent grant US7268273B2:

> "STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER FEDERALLY-SPONSORED RESEARCH AND DEVELOPMENT [0002] Part of the work performed during development of this invention utilized U.S. Government funds. The U.S. Government has certain rights in this invention."

This declaration is a requirement for recipients of US federal funding leading to patent applications under the 1980 Bayh-Dole Act.

BRD14: WO2004006944A1 Pilosocereus pachycladus
UK Individual Inventor

This 2004 PCT patent application was submitted by an individual UK inventor for a claimed invention "Flower Essence Containing Medicaments". The invention involved orchid essences that could optionally be combined with flower essences, essential oils and other oils to reduce stress. The aim is to create a mood enhancing composition to relieve or reduce stress. As such the invention falls into the realm of aromatherapy.

> "This invention relates to the use of flower essence-containing medicaments, particularly those that are useful for the alleviation of stress. More particularly, though not exclusively, the invention relates to topical creams e.g. facial creams." The reference to *Pilosocereus pachycladus* appears as part of a very extensive list of secondary flower essences that is partially reproduced below.

> "The secondary flower essences are selected from Aesculus hippocastanum, Bromus ramosus, Rosa canina, Salix vitellina, RQ5 (Cherry plum, clematis, mpatiens, Rock rose and Star of Bethlehem) and RQ8 (Cherry plu clemats, mpatiens, Rock rose, Star of Bethlehem Lotus and Self-heal); essences Dom cacti and succulent plants such as; 5 Caralluma russelliana, Cereus peravianus, Ceropeginfusca, Cleistocactus ritterei, Cleistocactus stausii Echinocactus grusonii, Echinocereus scheeri Echinopsis oxygona, Ferocactus schwarzii, Hylocereus undatus, Mammillaria rubrograndis, Myitillocactus geometrizans, Opuntia cardiosperma, Opuntia dejecta, Orbea variegata, Pilosocereus pachycladus, Selenicereus grandifiorus, Seticereus icosagonus, Stenocereus marginatus and Stopelia desmetiana; rose essences such as Rosa roxhourghii Rosa majulis, Rosa spinosissima..."

The species is specifically referenced in Formulation 4. "Formulation 4 25 Orchid essences (10% by vol.): Anguloa clowesii, Oncidium abortivum, Cattleya warscowiczii and Amazonas 30 Secondary flower essences (5% by vol.): Rosa Moyesii, Strelitzia reginae, I Passiflora bryonioides, Pilosocereus pachycladus, Prunella vulgaris, Aloe Vera, Arnica montana, Rosa roxbourghii Rosa moyesii..."

The patent application claims:

1. Use of one or more orchid essences in the preparation of medicaments for reducing 5 stress levels.

5. Use according to any preceding claim wherein the secondary essences are selected from Aesculus hippocastanum, Bromus ramosus, Rosa canina, Salix vitellina, RQ5 (Cherry plum, clematis, impatiens, Rock rose and Star of Bethlehem) and RQ8 (Cherry plum, clematis, impatiens, Rock rose, Star of Bethlehem Lotus and Self heal (prunella vulgaris)), Caralluma russelliana, Cereus peruvianus, Ceropegia fusca, Cleistocactus

ritterei Cleistocactus stausii, Echinocactus grusonii, Echinocereus scheeri, Echinopsis oxygona, Ferocactus schwarzii, Hylocereus undatus, Mammillaria rubrograndis, Myitillocactus geometrizans, Opuntia cardiosperma, Opuntia dejecta, Orbea variegata, Pilosocereus pachycladus...

10. Use of a composition comprising Anguloa clowesii Oncidium abortivum, Rosa 15 Moyesli, Strelitzia reginae, Passiflora bryonioides, Pilosocereus pachycladus, Prunella vulgaris, Aloe vera, Arnica Montana, Rosa centifloria abs, Cananga odorata, Pelargorium gravea and Citrus paradisi in the preparation of medicaments for the treatment of stress.

11. Use of a composition comprising Anguloa clowesii, Oncidium abortivam, Cattleya I warscewiczii, Amazonas, Rosa Moyesii Strelitzia reginae, Passiflora bryonioides, Pilosocereus pachycladus, Prunella vulgaris, Aloe vera, Arnica montana, Rosa roxbourghii, Rosa moyesii, Orbea variegata, Opurtia cardiosperma, Lilium bulbiferum, Rosa centifloria abs, Cananga odorata, Pelargonium gravea, Citrus 25 paradisi and Cocos nucifera in the preparation of medicaments for the treatment of stress.

12. A topical cream comprising one or more orchid essences.

18. A cream or body oil formulated in accordance with any of Examples 1 to 4 described herein above.

This patent application generated a family with 7 members including in Australia and the UK. However, the legal status data reveals that the application was withdrawn/taken to be withdrawn or refused in the UK in 2007 and lapsed in Australia in 2005. As such this application is dead.

However, this application has attracted three citations including applications in Spain and to the PCT in the period between 2005 and 2011. They do not mention the potential Brazilian species.

This example serves to demonstrate that biodiversity (in this case from a wide variety of countries) may appear in patent applications. However, those patent applications do not necessarily succeed.

BRD15: WO2010035001A1 Phrixothrix hirtus
Biosensors. Stabilitech UK. http://www.stabilitech.com

Stabilitech is a UK company based in Burgess Hill, West Sussex that specialises in stabilisation for vaccines and biopharmaceuticals.

Phrixothrix hirtus is a bioluminescent "railroad" worm that is a source of a luciferase enzyme. The applicant explains that:

> "The invention relates to methods of preserving a polypeptide from thermal degradation and desiccation. The invention also relates to products comprising such preserved polypeptides.
>
> Background to the Invention Some biological molecules are sufficiently stable that they can be isolated, purified and then stored in solution at room temperature. However, this is not possible for many materials and techniques involving storage at low temperature, addition of stabilisers, freeze-drying, vacuum-drying and air-drying have been tried to ensure shelf preservation."

The aim of the invention therefore is to improve the preservation of protein materials. It is anticipated that the invention can be used in preserving hormone, growth factor, peptide and other compositions useful in vaccines and related products.

Reference to *Phrixothrix hirtus* appears in discussion of a luciferase enzyme for "real-time imaging of gene expression in cell cultures, individual cells and whole organisms." The applicant states that:

> "The luciferase enzyme may be a firefly, beetle or railroad worm luciferase, or a derivative thereof. In particular, the luciferase may be derived from a North American firefly (Phorinuspyralis), Luciola cruciata (Japanese firefly), Luciola lateralis (Japanese firefly), Liiciola mingelica (russian firefly), Beneckea hanegi (marine bacterial luciferase), Pyrophorus plagiophthalamus (click beetle), Pyrocelia miyako (firefly) Ragophthalamus ohbai (railroad worm), Pyrearinus termitilluminans (click beetle), Phrixothrix hirtus (railroad worm), Phrixothrix vivianii, Hotaria parvula and Photuris pensilvanica, and mutated variants thereof."

This makes clear that the luciferase enzyme may be derived from a variety of organisms that may be distributed in a range of countries. The patent claims:

1. A method for preserving a polypeptide comprising: (i) providing an aqueous solution of one or more sugars, a polyethyleneimine and said polypeptide wherein the concentration of polyethyleneimine is 25 μM or less based on the number-average molar mass (Mn) of the polyethyleneimine and the sugar concentration or, if more than one sugar is present, total sugar concentration is greater than 0.1M; and (ii) drying the solution to form an amorphous solid matrix comprising said polypeptide.

17. The method according to any one of claims 1to 9 in which the polypeptide is an enzyme.

18. The method according to claim 17 in which the enzyme is an oxidoreductase, a transferase, a hydrolase, a lyase, an isomerase or a ligase.

19. The method according to any claim 17 or 18 in which the enzyme is selected from an α-galactosidase, β-galactosidase, luciferase, serine proteinase, endopeptidase, caspase, chymase, chymotrypsin, endopeptidase, granzyme, papain, pancreatic elastase, oryzin, plasmin, renin, subtilisin, thrombin, trypsin, tryptase, urokinase, amylase, xylanase, lipase, transglutaminase, cell-wall- degrading enzyme, glucanase, glucoamylase, coagulating enzyme, milk protein hydrolysate, cell-wall degrading enzyme, coagulating enzyme, lysozyme, fibre- degrading enzyme, phytase, cellulase, hemicellulase, protease, mannanase or glucoamylase.

24. A dry powder comprising preserved polypeptide, obtainable by the method as defined in any one of claims 1 to 22.

25. A preserved product comprising a polypeptide, one or more sugars and polyethylenimine, which product is in the form of an amorphous solid.

26. A sealed vial, ampoule or syringe containing a dry powder as defined in claim 24 or a preserved product as defined in claim 25.

45. A vaccine comprising a preserved product as defined in claim 42 and optionally an adjuvant.

46. Use ofan excipient comprising: (a) sucrose, stachyose or raffinose or any combination thereof, and (b) polyethylenimine at a concentration based on Mn of 25μM or less, for the preservation of a vaccine immunogen.

48. A method of preparing a vaccine comprising a vaccine immunogen, which method comprises: (a) providing an aqueous solution of one or more sugars, a polyethyleneimine and said vaccine immunogen wherein the concentration of polyethyleneimine is 15 μM or less based on the number-average molar mass (Mn) of the polyethyleneimine and the sugar concentration or, if more than one sugar is present, total sugar concentration is greater than 0.1 M; and (b) optionally adding an adjuvant, buffer, antibiotic and/or additive to the admixture; and (c) drying the solution to form an amorphous solid matrix comprising said vaccine immunogen.

The main focus of the claimed method is upon the use of polyethyleneimine (a polymer). The use of a luciferase in the described method is one among other options and the luciferase may be drawn from a range of sources as described in the species list above.

This patent application was clearly important to the applicants and has generated a family with 20 members including Australia, Canada, Europe, the UK, Japan, Korea, Mexico and Russia. The legal status data suggests that the application was proceeding in most jurisdictions including a request for examination in China in November 2011. The patent has attracted 3 citations of which two are later applications by Stabilitech in 2011 and 2012 for stabilising viral particles, polypeptides or biological material.

BRD16: EP407225A1 Pseudomonas gladioli

We identified 323 patent documents (including from individual inventors) that make reference to Pseudomonas gladioli (now Burkholderia gladioli). We have selected one document with a high citation score for the purpose of illustration.

Unilever (1991) A lipase for use in detergents.

This patent application filed in 1989 in the UK is for a lipase produced by a microorganism by rDNA (recombinant DNA) techniques where at least one amino acid mutation confers greater stability against proteases and/or oxidising agents when compared with the parent enzyme (Thomson Innovation DWPI data). The patent also claims a process for producing the lipase, a transformed vector encoding for the lipase along with a polynucleotide, recombinant DNA vector and finally an enzymatic detergent composition and associated subtilisin protease (Thomson Innovation DWPI data).

> "Within the preferred class of lipases the lipase produced by Pseudomonas glumae (formerly and more usually called Pseudomonas gladioli) is a preferred basis for the processes and products of this invention. Neither the amino acid sequence nor the nucleotide sequence of the gene coding for the preferred lipase was previously known. The present inventors have isolated the gene coding for the preferred lipase of this bacterium as will be illustrated below."

This is the only reference to Pseudomonas gladioli and the patent proceeds through exclusive reference to P. glumae. With reference to sources of the P. glumae strains we learn that:

> "The following strains referred to herein have been deposited at the Centraal bureau voor Schimmelcultures at Baarn, Netherlands, under the accession numbers following:
>
> Pseudomonas glumae strain PG1 as CBS 322.89
> Pseudomonas glumae strain PG3 as CBS 323.89
> Pseudomonas glumae strain PGT89 as CBS 262. 90"

A selection of the independent claims within the application are as follows:

"1. A lipase enzyme produced from a microorganism by rDNA technique, and carrying at least one mutation of its amino acid sequence conferring improved stability against attack by protease and/or oxidising agents and/or increased activity by comparison with the corresponding parent enzyme.

7: A lipase having an amino acid sequence substantially homologous with that of a bacterial lipase, e.g. that of Pseudomonas glumae, and produced by a heterologous and eukaryotic host microorganism on the basis of rDNA technique to introduce into said host microorganism a gene encoding the corresponding bacterial lipase or a mutant thereof, whereby said lipase is differently glycosylated than the lipase produced by the parent microorganism from which said gene originated.

12: A lipase according to any preceding claim, having an amino acid sequence substantially as shown in Figure 2 or a functional equivalent thereof, and derived from an

artificially modified microorganism containing a modified gene substantially corresponding to a prepro-lipase sequence also as shown in Figure 2 or a functional equivalent thereof.

17: An artificially modified microorganism carrying a gene encoding a bacterial lipase or a mutant form of a prokaryotic or eukaryotic lipase originating in a different microorganism, the lipase being for example one that shows immunological cross-reactivity with an antiserum raised against lipase from Chromobacter viscosum var lipolyticum NRRL B-3673, or against lipase from Alcaligenes PL-679, ATCC 31371 or FERM-P 3783, or against lipase from Pseudomonas fluorescens IAM 1057; thereby to constitute said microorganism a heterologous host able to express said lipase.

18: An artificially modified microorganism carrying a gene encoding a lipase that is introduced into the microorganism by fusion at its 5′-end to a gene fragment encoding a (modified) pre-sequence functional as a signal-or secretion-sequence for the host organism.

33. An enzymatic detergent composition comprising a lipase enzyme or protein according to any of claims 1 to 13, and optionally a subtilisin protease enzyme, wherein the remainder of the detergent composition...” (continues).

This patent application forms part of a patent family with seven members including Brazil, Canada, the UK, Japan and the United States. Legal status data for the reference example reveals that it was judged withdrawn in the year 2000. In Brazil the application was dismissed in 1999 and in Canada it was declared dead in 1998. In the United States, the patent grant was judged to have expired following failure to pay the maintenance fee in 2009.

This is an important patent document that has attracted 180 citing patents. These citing patents are dominated by later documents from Novozymes, Colgate Palmolive, Genencor, Danisco and Unilever itself. What this makes clear is that this is a competitive innovation space at the level of intellectual property.

BRD17: US6287770B1 Streptomyces brasiliensis
Cytocell Ltd UK, and British Biocell International

This patent grant to Cytocell Limited and British Biocell International is one of 3 documents . The patent focuses on a new method for the detection of nucleic acid target sequences involving in vitro transcription from an RNA promoted and detection of a de novo synthesized nucleic acid with a particular focus on detecting pathogens or genotype determination (Thomson Innovation DWPI).

The patent involves a method for adding nucleic acid probes to a sample of the sequence of interest, followed by the addition of a polymerase recognizing a promoter causing the de novo synthesis of a nucleic acid and detection, directly or indirectly, of the de novo synthesized nucleic acid. The description explains that:

> "The present invention relates to nucleic acid hybridization probes and complexes formed therefrom, their use in nucleic acid amplification and/or nucleic acid detection processes and to kits comprising the probes and for forming said complexes. The present invention is particularly concerned with transcription and amplification of hybridized nucleic acid probes such that sensitivity of hybridization reactions is increased."

With respect to the genetic resource of relevance to Brazil the document highlights that:

> "In a further embodiment, the template portion of the complex (preferably on the promoter strand) could contain sequences that can be used to identify, detect or amplify the de novo synthesized RNA copies (see, for example, WO 93/06240, U.S. Pat. No. 5,554,516, or, for example, using molecular beacon sequences such as those disclosed by Tyagi & Kramer 1996 Nature Biotech 14, 303-308). These sequences are conveniently placed adjacent to, and downstream of, a +12 region (as described above) and may comprise, but are not limited to, one or more of the following: unique "molecular beacon" sequences; capture sequences; detection probe complementary sequences; alternative RNA promoter sequences for use in an isothermal amplification cycling reaction (see below). A particular unique sequence especially useful in the present invention is provided by bases 791-820 of 16S ribosomal RNA from *Streptomyces brasiliensis* (Stackebrandt et al, 1991 Appl. Environ. Microbiol. 57, 1468-1477), which sequence has no alignment with any known human DNA or DNA of a known human pathogen."

However, it is difficult to ascertain whether the 16S ribosomal RNA from Streptomyces brasiliensis is material to the invention or forms part of the claims. The main claim is as follows:

> 1. A method of detecting the presence of a nucleic acid target sequence of interest, the method comprising the steps of: (a) adding first and second nucleic acid probes to a sample comprising the sequence of interest, so as to form a complex comprising three strands of nucleic acid, wherein the first probe comprises the full length sequence of a first strand of a double stranded promoter, the target sequence comprises an end part of a second strand of the double stranded promoter which is complementary to a part of the first strand, and the second probe comprises the rest of the second strand of the double stranded promoter which is complementary to a part of the first strand, such that a functional promoter is formed when the first probe is hybridized to both the target sequence and to the

second probe; (b) adding a polymerase which recognizes the promoter, so as to cause the de novo synthesis of nucleic acid from the promoter present in the complex; and (c) detecting directly or indirectly the de novo synthesized nucleic acid.

This patent forms part of a family of 28 documents including Europe, Austria, Australia, Canada, Germany, the UK and Japan along with the PCT. The patent has attracted citations from 3 later filings.

Image Credits:

Aniba rosaeodora - Comision Naconial Contra La Biopirateria Aniba_rosaeodora.jpg
Bertholletia excelsa - USDA Bertholletia_excelsa.jpg
Ilex paraguariensis - Franz Eugen Köhler Ilex_paraguariensis_-_Köhler–s_Medizinal-Pflanzen-074.jpg
Montrichardia arborescens - Maarten Sepp 742px-Montrichardia_arborescens_-_plant_-_Suriname.jpg
Paecilomyces variotii - Janice Haney Carr lossy-page1-800px-Paecilomyces_variotii.tif.jpg
Paullinia cupana - Franz Eugen Köhler Paullinia_cupana_-_Köhler–s_Medizinal-Pflanzen-234.jpg
Turnera diffusa - Unattributed Wikimedia Commons 416px-Tunera_diffusa_2.jpg
Bothrops insularis - Otavio Marques - Jararaca-ilhoa.jpg
Cocos coronata - Alex Popovkin 337px-Syagrus_coronata.jpg
Convolvulus tiliaceus - Alex Popovkin Ipomoea_tiliacea_(Willd.)_Choisy_(2574615349).jpg
Copernicia cerifera - Tacarijus 800px-Carnauba.jpg
Cordia multispicata - theplantencyclopedia.org 600px-Cordia_boisseri_flowers.jpg
Justicia lanstyakii - João Medeiros 725px-Justicia_lanstyakii.jpg
Orbignya oleifera - João Medeiros 399px-Attalea_brasiliensis.jpg
Pilosocereus pachycladus - João Medeiros 399px-Flickr_-_João_de_Deus_Medeiros_-_Pilosocereus_pachycladus.jpg

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[50] Varty, N. 1998. *Aniba rosaeodora*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 07 March 2013

[51] http://www.nibsc.ac.uk/documents/ifu/93-526.pdf

7: China

7.1 Introduction:

This section forms part of a wider review of *UK Patent Activity for Genetic Resources and Traditional Knowledge.* The section presents the results of a review of international patent activity by UK applicants involving species of relevance to China at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty between 1976 and 2010. The aim of the review is to improve transparency about the utilization of genetic resources and associated traditional knowledge involving species of relevance to China in UK patent activity. The review also highlights issues around the interpretation of the origins of genetic material and the utilization of genetic resources in patent documents.

The data presented in this section is based on a manual review of 1,096 UK patent documents. Additional searches were conducted to identify references to traditional knowledge from China and are presented in the thematic section on traditional knowledge in the wider report.

The data consists of a series of summary tables that briefly describe the species and patent activity involving the species. This data falls into two categories:

a) Patent documents where there is a reference to China and a species distributed in China;
b) Patents documents where there is reference to Chinese Traditional Medicine or Chinese Herbal Medicine which is important to the claimed invention.

Each of the species summary cards has been given a code (CN) which cross references the species information with patent data presented in Annex 1.

7.2 Biodiversity in China and UK Patent Activity:

The Global Biodiversity Information Facility (GBIF) contains records of 44,941 species that have been recorded in China. In the UK data we identified 1,627 species that are known to be distributed in China. As such, approximately 1,627 species that appear in UK patent activity could potentially relate to samples or specimens collected in China. We focused on a subset of this data consisting of 1,096 documents containing 506 species where the document also contains a reference to China. The data is confined to UK patent documents filed at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty in the period 1976-2010.

The relevance of this to access and benefit-sharing is that it defines the universe of possibilities for UK patent activity in relation to species that are known to occur in China. We focus on a subset of the data that makes reference to China in order to explore information on the origin or sources of genetic material and associated traditional knowledge in UK data that is relevant to China.

Species Appearing in Patents that Refer to China:

To analyse the data we manually reviewed and tagged the 1,096 documents using MAXQDA qualitative analysis software. As part of this process we identified 292 documents that make reference to China clay (Kaolinite) as a component of an invention. These documents were excluded. We then focused on whether genetic material was obtained from China or suppliers along with identifying references to China in the academic literature, or references to Traditional Chinese Medicine (TCM). Because of the range of terms that could be used for Traditional Chinese Medicine this issue was also considered in greater depth in separate searches. The results are discussed in greater detail in the section on Traditional Knowledge.

One particular challenge in identifying species that are likely to be from China is that species are often also naturally distributed across other Asian countries. In other cases the species have become established or naturalised in countries across the globe through human activity. This is particularly true for commercially valuable species, such as tea, that are being cultivated or bred in countries far from their original natural range. This means it can be very difficult to distinguish materials sourced from China rather than other countries in the absence of a specific reference to an origin or source in China. This is linked to debates on a disclosure of origin requirement in patent applications.

In reviewing the data we conducted additional research to establish whether a species appearing in a patent is endemic to China. In reviewing the summaries below, we would emphasise that establishing endemism is difficult and would benefit from consultations with relevant taxonomic specialists. For this reason we regard the categorization of endemic status as provisional.

Chinese Traditional Knowledge References in Patents:

China has a rich and well documented heritage of traditional medicinal practices which provided a second approach to identify species which may have originated from China but also to identify where Chinese traditional knowledge is an aspect of the claimed invention. A search was undertaken of patent documents for terms referring to traditional knowledge. Phrases such as ‘Chinese Traditional Medicine’ and ‘Chinese Herbal Medicine’ and ‘Traditional Chinese Medicine’ were identified. These documents were analysed using MAXQDA software. Where these phrases were linked to the use of a named species an examination of the document was made to ascertain whether the reference was pertinent to an aspect of the invention. One of the difficulties in examining documents where such a connection is stated is that the link between the traditional use and the claimed novel use of a species in the invention is often unclear. In addition, it is not always clear whether the properties or components of a species that are utilized in traditional medicine are the same as those being utilized in a patent claim. These issues highlight a basic problem with a lack of detail in patent documents on these issues.

Finally, because the species referenced in the patent are frequently cosmopolitan, the reference to traditional knowledge does not necessarily mean that the genetic material was obtained from China. Rather, references to Traditional Chinese Medicine could be considered to be ‘self standing’ and not directly linked to the origin or source of the material. As this suggests, interpreting the relationship between the origins and use of genetic material in relation to references to traditional knowledge proved more challenging than expected.

General Observations:

1. In many cases the reference to Chinese traditional knowledge was made in the context of an introduction to the background of the named species rather than to its use within the invention.

2. On occasion the reference to Chinese traditional medicine was associated with the traditional name of a species where the current binomial nomenclature could not be identified.

3. Sometimes traditional knowledge was applied to species not from China, for example *Panax quinquefolium* (*Panax quinquefolius*), which is a north American ginseng species that was sold by a Chinese supplier. The native Chinese ginseng is *Panax ginseng*.

4. References were often made to Indian and Ayurvedic medicines alongside a reference to Chinese traditional knowledge. We identified 43 text segments that referred to Ayurveda or Ayurvedic traditional medicine from India in association with Chinese traditional knowledge.

5. In many cases it proved difficult to establish whether the material for the claimed invention actually came from China.

6. Many of the species were found to be very widely distributed beyond China and there were very few references to direct collection from China.

7. In some cases material was indirectly sourced from China via a commercial supplier.

8. Species found in China (but not necessarily endemic to China) were obtained from Chinese suppliers. An example being *Artemia nauplii* in WO2004062379A2, a widely distributed shrimp species, obtained from a commercial supplier in Shandong. Similarly, micro-organisms such as *Saccharomyces* spp were obtained from a type culture collection, namely the China General Microbiological Culture Collection Center ("CGMCC"), a depository recognized under the Budapest Treaty.

Products:

The majority of the claimed products derived from Chinese biodiversity are pharmaceutical or medicinal in nature. Examples include: treatments for hepatitis C and liver disease, cardiovascular disorders, asthma, obesity, urinary complaints, skin lighteners and anticancer treatments. The vast majority are also derived from plants, though one comes from the endemic toad species *Bombina maxima* and another from the cosmopolitan fungus *Ganoderma lucidum.* Non-pharmaceutical products include a sweetener derived from the fruit of *Momordica grosvenorii,* and a fish feed which utilises the shrimp *Artemia nauplii.* One applicant, Ultra Biotech Ltd, has submitted a series of patent applications involving specific strains of Saccharomyces from the China Microbiological Culture Collection Center in multiple areas of invention. Ultra Biotech Ltd is registered in Douglas in the Isle of Man, UK. However, the patent applications list inventors in China (and former Kong Kong) suggesting that the UK registration may possibly be a holding company.

Conclusions:

References to China appear frequently in UK patent data at the international patent offices. However, these references are made for a variety of reasons including references to diseases known to occur in the country or materials such as China clay.

The review of patent documents revealed very little concrete evidence of direct collection of genetic resources in China by UK applicants. UK applicants appear to obtain samples through a combination of commercial suppliers or public collections. However. it is important to note that in most cases the precise source of the material referenced in a patent is unclear. References to Traditional Chinese Medicine (TCM) generally occur in the background section of the patent document for known uses of a species and are not necessarily linked with the focus or claims of the invention.

7.3 China: Species Summary Cards

This section primarily provides details of the species of relevance to China that appear in UK patent data with brief details of the focus of the inventions. Fuller details on references to China in the texts are provided in the country summaries in Annex 1. The examples are organised alphabetically by species and numbered in accordance with the numbering in Annex 1 for ease of cross reference. A separate section is provided for Traditional Chinese Medicines and an additional listing where large numbers of species are listed in one document. Note that a single species may appear in different patents and that in other cases a single patent may contain multiple species.

CN52

Species name: *Allium sativum*	Kingdom: Plantae	
Brief description of species: Allium sativum, commonly known as garlic, is a species in the onion genus, Allium. Its close relatives include the onion, shallot, leek, chive, and rakkyo.		
Distribution: Cosmopolitan	No of documents: 1	
WO2010100486A2		
Detail: The invention relates to a process for the preparation of ajoene, and to processes for the preparation of allicin, and to a process for freeze concentrating allicin. Ajoene is presently of interest in a number of fields of endeavour, but predominantly in the medicinal field, including both human and animal pharmaceuticals. It is extracted from garlic.		

CN28

Species name: *Artemia nauplii*	Kingdom: Animalia	
Brief description of species: The brine shrimp Artemia constitute the most widely used live food item for larval fish in aquaculture, and over 2000 tonnes of dry Artemia cysts are marketed worldwide annually.		
Distribution: Cosmopolitan	No of documents: 1	
WO2004062379A2		
Detail: The invention provides a fish feed comprising a live feed component which has been fed with an acylglycerol composition which comprises mono and/or diacylglycerols of at least one fatty acid selected from eicosapentaeneoic acid and docosahexaeneoic acid.		

CN7, CN15, CN19, CN38, CN49

Species name: *Astragalus membranaceus*	Kingdom: Plantae	
Brief description of species: Synonym for Astragalus propinquus, a herbaceous perennial plant of the pea family. It has been used in Traditional Chinese Medicine for thousands of years. It was often combined with other herbs to strengthen the body against disease.		
Distribution: Cosmopolitan	No of documents: 8	
WO2007144569A2 WO2007020382A2 WO2005079823A1 US7422760B2 EP1732578B1 WO2009068872A1 US2010158864A1 US2007160693A1		
Detail: WO2007144569A2 WO2005079823A1 US7422760B2 EP1732578B1 single herb Astragalus extract for use as an antiviral in the treatment of hepatitis C. WO2007020382A2 A botanical drug or dietary supplement for use in the treatment of patients suffering from liver disease. WO2009068872A1 Antiviral product and its use in the treatment of the flaviviridae family of viruses, particularly Dengue.		

CN16

Species name: *Bombina maxima*	Kingdom: Animalia	
Brief description of species: The Large-webbed Bell Toad is a species of toad in the Bombinatoridae family. It is endemic to Sichuan, Yunnan and Guizhou in China.		
Distribution: Endemic	No of documents: 2	
US2008044463A1 WO2004068928A2		
Detail: A bradykinin B2-receptor antagonist peptide, kinestatin, isolated from toad (Bombina maxima) defensive skin secretion which can be used to treat and/or prevent disorders associated with bradykinin, including cardiovascular disorders, inflammation, asthma, allergic rhinitis, pain, angiogenesis and the like.		

CN39

Species name: *Cassia obtusifolia*	Kingdom: Plantae	
Brief description of species: A leguminous plant of the Senna genus. Used in traditional medicine and as a food.		
Distribution: Cosmopolitan	No of documents: 2	
WO2008007063A2 US2010021568A1		
Detail: The invention relates to compositions comprising one or more anthraquinones extracted from Cassia for use in the treatment of obesity and related metabolic and liver disease.		

CN22

Species name: *Desmodium styracifolium*	Kingdom: Plantae	
Brief description of species: Desmodium styracifolium is a legume which originates in China and East Asia, where it has a long history of use for its medicinal properties.		
Distribution: Cosmopolitan	No of documents: 1	
WO2000074697A1		
Detail: A herbal composition comprises cranberry fruit, pharmaceutical grade DL-methionine and at least one Chinese herb selected from Ilex chinensis, Desmodium styracifolium and Schisandra chinensis. The herbal composition is useful for treating the symptoms of urinary cystitis.		

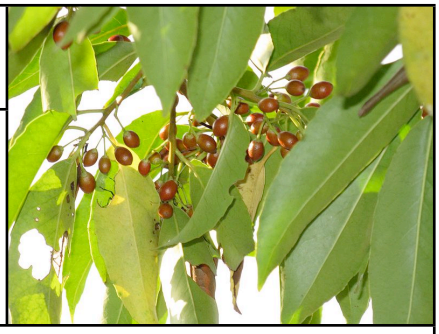
CN20, CN50

Species name: *Ganoderma lucidum*	Kingdom: Fungi	
Brief description of species: Cosmopolitan fungus which has been used in Traditional Chinese Medicine for up to two millennia.		
Distribution: Cosmopolitan	No of documents: 2	
WO1998013512A1 WO2009087368A1		
Detail: This invention relates to a method of production of a novel extract from Ganoderma lucidum that contains significant levels of anti-inflammatory ganoderic acids for treating a pre-cancerous lesion, inhibiting cancer cell proliferation, for combining with one or more existing anti-cancer medicaments, and inhibiting angiogenesis.		

CN35

Species name: *Geum japonicum*	Kingdom: Plantae	
Brief description of species: Geum japonicum is a yellow-flowering perennial plant native to North America and East Asia, especially Japan. As a traditional herbal remedy it is known as an astringent and used in poultices.		
Distribution: Cosmopolitan	No of documents: 2	
WO2007049089A1 WO2007049088A1		
Detail: This invention relates to methods of stimulating growth of functional blood vessels and/or regeneration of myocardium in damaged tissues, particularly damaged heart tissues and muscle tissues. An extract from G. japonicum, collected from China, is used in the invention.		

CN22

Species name: *Ilex chinensis*	Kingdom: Plantae	
Brief description of species: Ilex chinensis is a species belonging to the family Aquifoliaceae. It is one of the 50 fundamental herbs used in traditional Chinese medicine, which has Chinese name: Dong qīng.		
Distribution: Cosmopolitan	No of documents: 1	
WO2000074697A1		
Detail: A herbal composition comprising cranberry fruit, pharmaceutical grade DL-methionine and at least one Chinese herb selected from Ilex chinensis, Desmodium styracifolium and Schisandra chinensis. The herbal composition is useful for treating the symptoms of urinary cystitis.		

CN21

Species name: *Ligustrum lucidum*	Kingdom: Plantae	
Brief description of species: Ligustrum lucidum (Chinese privet, glossy privet or broad-leaf privet) is a species of flowering plant, a privet (Ligustrum genus) in the olive family.		
Distribution: Cosmopolitan	No of documents: 1	
WO2000074696A1		
Detail: This invention relates to herbal formulations comprising glucosamine and Chinese herbs which can be administered to humans and animals as dietary supplements and as pharmaceutical dosage forms to alleviate the symptoms of arthritis.		

CN29

Species name: *Mycobacterium ulcerans*	Kingdom: Bacteria	No Image Available
Brief description of species: Mycobacterium ulcerans (M. ulcerans) is a slow-growing mycobacterium that classically infects the skin and subcutaneous tissues.		
Distribution: Cosmopolitan	No of documents: 1	
WO2005047509A2		
Detail: The invention relates to Mycobacterium ulcerans virulence plasmid, pMUM001 and particularly to a cluster of genes carried by this plasmid that encode polyketide synthases (PKSs) and polyketide-modifying enzymes necessary and sufficient for mycolactone biosynthesis. Isolates obtained from Chinese patients.		

CN1

Species name: *Mesona chinensis*	Kingdom: Plantae	No Image Available
Brief description of species: Synonym for Platostoma palustre. Mesona chinensis is a species of plant belonging to the genus Mesona of the mint family. The species grows extensively in East Asia such as south east China.		
Distribution: Cosmopolitan	No of documents: 1	
EP0195555A1		
Detail: A structured food or animal feed product comprising a gel containing starch, characterised in that the gel is formed by the interaction of water soluble components of Chinese grass with amylose or high amylose starch.		

CN45, CN46,CN47

Species name: *Momordica grosvenorii*	Kingdom: Plantae	
Brief description of species: Siraitia grosvenorii is an herbaceous perennial vine native to southern China and best known for its fruit, the LHG. Botanical synonyms include Momordica grosvenorii		
Distribution: Cosmopolitan	No of documents: 3	
WO2008102133A1 WO2008102137A1 WO2009016374A1		
Detail: A new sweetener composition and a method of improving the taste of an extract of a fruit from the Cucurbitaceae family provided as a liquid containing the extract.		

CN25,CN31

Species name: *Monascus ruber*	Kingdom: Fungi	
Brief description of species: This fungus is most important because of its use, in the form of red rice yeast, in the production of certain fermented foods in China. However, discoveries of cholesterol-lowering statins produced by the mold has prompted research into its possible medical uses.		
Distribution: Cosmopolitan	No of documents: 4	
WO2005104871A1 WO2005104864A1 WO2002063976A1 EP1357807B1		
Detail: A food product containing statins which are produced by filamentous fungi with health benefits for a number of conditions.		

CN42

Species name: *Pelargonium graveolens*	Kingdom: Plantae	
Brief description of species: The true Pelargonium graveolens is an uncommon species in the Pelargonium genus, which is native to South Africa, Zimbabwe and Mozambique, hybrids are grown elsewhere.		
Distribution: Cosmopolitan	No of documents: 1	
WO2008029136A1		
Detail: A cancer treatment composition includes geranium oil or its chemical constituents and a chemotherapeutic agent or plant extract selected from the group consisting of plant-derived bioactive compounds. Oil preferred from P. graveolens grown in China.		

CN40

Species name: *Rhodosporidium toruloides*	Kingdom: Fungi	No Image Available
Brief description of species: Rhodosporidium toruloides is an oleaginous yeast. It is a red basidiomycetous isolated from wood pulp from conifers.		
Distribution: Cosmopolitan	No of documents: 1	
WO2008011811A1		
Detail: The invention relates to the use of microorganisms to produce fatty acids and/or esters thereof from polysaccharides, using R. toruloides obtained from China General Microbiological Culture Collection Centre.		

CN48

Species name: *Salvia miltiorrhiza*	Kingdom: Plantae	
Brief description of species: Also known as red sage, Chinese sage, tan shen, or danshen, is a perrenial plant in the genus Salvia highly valued for its roots in traditional Chinese medicine.		
Distribution: Cosmopolitan	No of documents: 4	
US20070160693A1 WO2009050451A1 EP1732578B1 WO2007020382A2		
Detail: EP1732578B1 US20070160693A1 WO2007020382A2 The invention relates to a botanical drug or dietary supplement for use in the treatment of patients suffering from Hepatitis C. WO2009050451A1 The invention relates to a selectively purified tanshinone compound containing extract from the root of a Salvia spp		

CN22, CN33, CN34

Species name: *Schisandra chinensis*	Kingdom: Plantae	
Brief description of species: Schisandra chinensis is a deciduous woody vine native to forests of northern China and the Russian far east.		
Distribution: Cosmopolitan	No of documents: 5	
WO2000074697A1 US2008233220A1 US2007160693A1 EP1732578B1 WO2006117566A2 WO2007020382A2		
Detail: WO2000074697A1 A herbal composition comprising cranberry fruit, pharmaceutical grade DL-methionine and at least one Chinese herb selected from Ilex chinensis, Desmodium styracifolium and Schisandra chinensis. The herbal composition is useful for treating the symptoms of urinary cystitis. US2008233220A1 A botanical drug or dietary supplement for use in the treatment of patients suffering from liver disease. US2007160693A1 EP1732578B1 WO2007020382A2 A botanical drug or dietary supplement for use in the treatment of patients suffering from Hepatitis C. WO2006117566A2 A composition for inducing apoptosis or cell cycle arrest and inhibiting angiogenesis or tumor cell metastasis.		

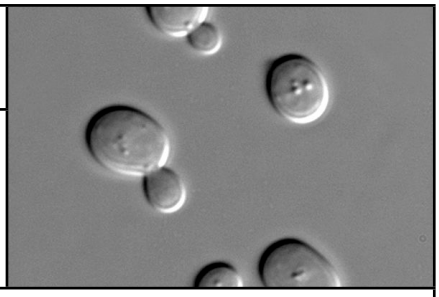
CN32

Species name: *Sophora alopecuroides*	Kingdom: Plantae	
Brief description of species: Sophora is a genus of about 45 species of small trees and shrubs in the pea family. Sophora alopecuroides grows across China.		
Distribution: Cosmopolitan	No of documents: 1	
WO2006056317A1		
Detail: Extracts of Sophora alopecuroides L. as cosmetic skin lightening agents. Plants harvested in the County of Ding Bian, Shanxi province, China. The roots of the plant are used in traditional Chinese medicine.		

CN22

Species name: *Tripterygium wilfordii*	Kingdom: Plantae	
Brief description of species: Tripterygium wilfordii, or lei gong teng, sometimes called Thunder God Vine, is a vine used in traditional Chinese medicine for treating fever, chills, edema and carbuncles.		
Distribution: Cosmopolitan	No of documents: 1	
WO2000074696A1		
Detail: A herbal composition comprising glucosamine and at least one Chinese herb selected from Tripterygium wilfordii, Ligustrum lucidum and Erycibe schmidtii. The herbal composition is useful for alleviating the symptoms of ailments that involves the inflammation or degeneration of joint tissues, such as arthritis.		

CN2, CN3, CN4, CN5, CN6, CN8, CN10, CN11, CN12, CN13, CN14, CN17, CN24

Species name: *Saccharomyces spp*	Kingdom: Fungi	
Brief description of species: Saccharomyces is a genus in the kingdom of fungi that includes many species of yeast. Many members of this genus are considered very important in food production.		
Distribution: Cosmopolitan	No of documents: 21	
US2002123128A EP1375653A1 EP1375650A1 EP1375642A1 EP1375641A1 EP1374877A1 EP1375640A1 US2008233625A1 US2007053932A1 US2007053931A1 US2006029614A1 US2004253255A1 US2004001815A1 US2003064487A1 US2002123126A1 US2006029613A1 US2004253260A1 WO2002020431A1 US2006024326A1 US2006024325A1 US2004253262A1		
Detail: US2004253255A1 An oral composition comprising yeast cells that can produce a health benefit in a subject with nasopharyngeal cancer. US2006029613A1 US2004253260A1 pharmaceutical compositions and a dietary supplement comprising yeast cells that can produce a health benefit in a subject with cervical cancer.US2003064487A1 WO2002020431A1 A biological fertilizer that comprises yeasts for fixing atmospheric nitrogen. ALL OTHERS Compositions comprising a plurality of yeast cells, wherein said plurality of yeast cells have been cultured in the presence of an alternating electric field. Yeast cells that can be included in these inventions are stated as being available from the China General Microbiological Culture Collection Center ("CGMCC"), a depository recognized under the Budapest Treaty.		

Traditional Chinese Medicine:

The following summary tables show species referred to as being of relevance to traditional knowledge.

CN51

Species name: *Andrographis paniculata*	Kingdom: Plantae	
Brief description of species: Andrographis paniculata is an erect annual herb, extremely bitter in taste in all parts of the plant body. The leaves and roots are used for medicinal purposes.		
Distribution: Cosmopolitan	No of documents: 1	
WO2010046710A1		
Detail: A herbal composition for treating neurological disorders.		

CN43

Species name: *Artemisia annua*	Kingdom: Plantae	
Brief description of species: A sweetly aromatic herb with small, yellow flower heads, sweet wormwood contains the chemical artemisinin and its aerial parts are used in making anti-malarial drugs.		
Distribution: Cosmopolitan	No of documents: 1	
WO2008038030A2		
Detail: This document is for the development of a synthetic alternative to artemisinin		

CN44

Species name: *Cucumis melo*	Kingdom: Plantae	
Brief description of species: Muskmelon (Cucumis melo) is a species of melon that has been developed into many cultivated varieties.		
Distribution: Cosmopolitan	No of documents: 1	
WO2008071968A1		
Detail: Cucurbitacins and compositions comprising cucurbitacin B. Methods for preventing or treating various diseases and disorders. Extracted from traditional Chinese medicinal part of the plant.		

CN27

Species name: *Fagopyrum dibotrys*	Kingdom: Plantae	
Brief description of species: Known as perennial buckwheat, this plant grows in moist valleys across central Asia.		
Distribution: Cosmopolitan	No of documents: 1	
WO2003105877A1		
Detail: Compositions made by extracting rhizomes of Fagopyrum dibotrys. The extract is an anti-cancer agent. Its activity at the gene level was analysed in developing the invention.		

CN23, CN37

Species name: *Gingko biloba*	Kingdom: Plantae	
Brief description of species: A tree with no living relatives, native to China but widely cultivated. It has a number of uses in traditional medicine and food.		
Distribution: Cosmopolitan	No of documents: 2	
WO2007107914A1 WO2001043753A2		
Detail: WO2007107914A1 A cosmetic composition is provided comprising a Gingko biloba extract, an alkyl ss,ss- diphenylacrylate and/or a-cyano ss,ss-diphenylacrylate derivative, and a dibenzoyl methane derivative. WO2001043753A2 A dietary supplement consisting essentially of a combination of Ginseng and Ginkgo to improve the speed of memory.		

CN41

Species name: *Griffonia simplicifolia*	Kingdom: Plantae	No Image Available
Brief description of species: A woody climbing shrub native to west and central Africa. The seeds of the plant are used as a herbal supplement for their 5-hydroytryptophan (5-HTP) content.		
Distribution: Cosmopolitan	No of documents: 2	
WO2008012555A2 WO2009001097A2		
Detail: WO2008012555A2 The invention provides the use of an inhibitor of glycolipid biosynthesis in the manufacture of a medicament for the treatment of a glycolipid-mediated autoimmune disease. WO2009001097A2 The invention provides a compound which is an inhibitor of sphingolipid biosynthesis for use in the treatment of a disease which has a secondary Niemann-Pick type C disease like cellular phenotype. Purchased from suppliers in China.		

CN23

Species name: *Panax ginseng*	Kingdom: Plantae	
Brief description of species: A slow growing perennial with fleshy roots. It has a number of uses in traditional medicine and food.		
Distribution: Cosmopolitan	No of documents: 1	
WO2001043753A2		
Detail: A dietary supplement consisting essentially of a combination of Ginseng and Ginkgo to improve the speed of memory.		

CN36

Species name: *Panax quinquefolium*	Kingdom: Plantae	
Brief description of species: American ginseng (*Panax quinquefolius*) is a herbaceous perennial plant in the ivy family, commonly used as Chinese or herbal medicine.		
Distribution: Cosmopolitan	No of documents: 1	
WO2007054208A1		
Detail: An edible product comprising ginseng polysaccharides in combination with bacteria which provide resistance to infections. The source of ginseng materials is Lanzhou and Guang Zhou factories (China).		

CN18, CN26, CN30

Species name: *Scutellaria spp*	Kingdom: Plantae	
Brief description of species: The root, known as Radix Scutellariae, is the source of the Chinese medicine Huang Qin. It has been in use for over 2000 years as a remedy for conditions such as hepatitis and diarrhea.		
Distribution: Cosmopolitan	No of documents: 2	
WO2005082388A1 US20100028262A1 WO2003029176A1		
Detail: WO2005082388A1 Pharmaceutical compositions exhibiting antiviral activity against Coronavirus, and more particularly still against those viruses responsible for Severe Acute Respiratory Syndrome (SARS). US20100028262A1 WO2003029176A1 Synthetic compounds developed as analogues to those found in Scutellaria barbata for use as an anti-tumor treatment.		

The following are all from one patent used in a pharmaceutical composition

CN9(a)

Species name: *Clematis armandii*	Kingdom: Plantae	
Brief description of species: A genus of about 300 species within the buttercup family Ranunculaceae.		
Distribution: Uncertain/cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(b)

Species name: *Dictamnus albus*	Kingdom: Plantae	No Image Available
Brief description of species: Dictamnus is a genus of flowering plant in the family Rutaceae, with a single species, Dictamnus albus, which has several geographical variants, from southern Europe, North Africa and much of Asia.		
Distribution: Cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(c)

Species name: *Glycyrrhiz auralensis*	Kingdom: Plantae	
Brief description of species: The root has been used in traditional medicine throughout Asia and the Middle East for thousands of years. In China, licorice is second in popularity only to ginseng and written records of its use go back as far as 3,000 years. It is used to treat wounds, strengthen bones, and promote muscle growth.		
Distribution: Cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(d)

Species name: *Ledebouriella divaricata*	Kingdom: Plantae	
Brief description of species: Radix Ledebouriella is the root of this plant used in Chinese herbal medicine.		
Distribution: Uncertain/endemic	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(e)

Species name: *Lophatherum gracile*	Kingdom: Plantae	
Brief description of species: Lophatherum is a genus of grass in the Poaceae family. It can also be called Bamboo leaf and Dan Zhu Ye in traditional Chinese medicine. This plant resembles a bamboo hence the name Bamboo leaf.		
Distribution: Cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(f)

Species name: *Paeonia sp.*	Kingdom: Plantae	
Brief description of species: Red Peony Root is the dried root of Paeonia lactiflora Pall., or Peaonia veitchii Lynch, an herbaceous plant originally from Asia, but now grown worldwide.		
Distribution: Cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(g)

Species name: *Potentilla chinensis*	Kingdom: Plantae	
Brief description of species: A genus containing over 300 species of annual, biennial and perennial herbaceous flowering plants in the rose family.		
Distribution: Cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(h)

Species name: *Rehmannia glutinosa*	Kingdom: Plantae	
Brief description of species: Rehmannia is a genus of six species of flowering plants in the order Lamiales, endemic to China.		
Distribution: Endemic	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs		

CN9(i)

Species name: *Schizonepeta tenuifolia*	Kingdom: Plantae	
Brief description of species: Schizonepeta Tenuifolia is a herb that is commonly called Japanese Catnip or Jing Jie and is a traditional Asian remedy (Chinese, Korean, and Japanese) for the common cold, head colds, and allergic skin eruptions.		
Distribution: Cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

CN9(j)

Species name: *Tribulus terrestris*	Kingdom: Plantae	
Brief description of species: Tribulus terrestris is a flowering plant in the family Zygophyllaceae, native to warm temperate and tropical regions of the Old World in southern Europe, Asia and Australasia.		
Distribution: Cosmopolitan	No of documents: 1	
US2004101581A1		
Detail: Relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising Chinese herbs.		

Image Credits:

Allium sativum - Rüdiger Wölk 800px-Knoblauch_2995.jpg
Artemia nauplii - Hans Hillewaert 800px-Artemia_salina_4.jpg
Astragalus membranaceus - Doronenko Astragalus_membranaceus.jpg
Bombina maxima - 2013 Kai Wang 0720.jpeg
Cassia obtusifolia - Jeevan Jose 800px-Senna_obtusifolia_with_flower_and_pods.jpg
Desmodium styracifolium - Forest & Kim Starr 450px-Starr_080415-3989_Desmodium_sp..jpg
Ganoderma lucidum - Eric Steinert Ganoderma_lucidum_01.jpg
Geum japonicum - Alpsdake 800px-Geum_japonicum_in_Mount_Ibuki_2010-07-10.JPG
Ilex chinensis - KENPEI 800px-Ilex_chinensis6.jpg
Ligustrum lucidum - Fanghong 450px-FloweringLigustrumLucidumTree.jpg
Momordica grosvenorii - Kasuga Huang 800px-Fructus_Momordicae.jpg
Monascus ruber - Fotoos Van Robin 442px-Red_yeast_rice.jpg
Pelargonium graveolens - Laitche 800px-Rose_Geranium.jpg
Salvia miltiorrhiza - Oswald Engelhardt 428px-Wiesensalbei_1.jpg
Schisandra chinensis - Doronenko 398px-Schisandra_sinensis.jpg
Sophora alopecuroides - Forest & Kim Starr 450px-Starr_081014-0282_Sophora_chrysophylla.jpg
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Andrographis paniculata - JM Garg Andrographis_paniculata_(Kalpa)_in_Narshapur_forest,_AP_W2_IMG_0867.jpg
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Cucumis melo - Seth Vidal 800px-Muskmelon.jpg
Fagopyrum dibotrys _ Stanislav Doronenko 800px-Fagopyrum_cymosum.jpg
Gingko biloba - Claude Meisch 436px-GINKGOBAUM-2.jpg
Panax ginseng - US FWS 800px-Panax_quinquefolius.jpg
Panax quinquefolium - Jacob Bigelow 405px-Panax_quinquefolius00.jpg
Scutellaria spp - Alpsdake 448px-Scutellaria_pekinensis_Yamatatsunamisou_in_Ibukiyama_2002-6-9.jpg
Clematis armandii - A Barra Clematis_armandii_RJB.jpg
Glycyrrhiz auralensis - Stickpen 473px-Glycyrrhizauralensis.jpg
Ledebouriella divaricata - DC Houtt a4bf426a-85be-4fd9-b8f8-11001506c635.photonormal
Lophatherum gracile - Keisotyo 450px-Lophatherum_gracile_sasakusa01.JPG
Paeonia sp. - Ulf Eliasson 450px-Lactiflora1b.UME.jpg
Potentilla chinensis - KENPEI 800px-Potentilla_chinensis2.jpg
Rehmannia glutinosa - Shizhao 417px-Rehmannia.JPG
Schizonepeta tenuifolia - Doronenko Schizonepeta_multifida_1.jpg
Tribulus terrestris Forest & Kim Starr 800px-Starr_030612-0063_Tribulus_terrestris.jpg

8: Traditional Knowledge

8.1 Summary:

This section forms part of a wider review of *UK Patent Activity for Genetic Resources and Traditional Knowledge.* The section presents the results of a review of international patent activity by UK applicants involving references to traditional knowledge at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty between 1976 and 2010. The aim of the review is to improve transparency about the utilization of genetic resources and associated traditional knowledge in UK patent activity.

This section discusses UK patent activity in relation to traditional knowledge. The discussion is based on a review of search terms linked to traditional knowledge in 19,760 UK first filings of patent applications at the major patent offices. Our review revealed 56 examples of references to traditional knowledge or indigenous peoples and local communities. We identify two categories of traditional knowledge: a) Traditional knowledge pertaining to indigenous peoples and local communities, and; b) Written traditional knowledge that may be regarded as national heritage by states.

We identified specific references to written traditional knowledge from India and China in UK patent data and provide a list of 43 examples below. These documents represent 0.21% per cent of 19,760 UK first filings.

In the case of the knowledge, innovations and practices of indigenous peoples and local communities we identified two clear and unambiguous cases from Guyana. The cases are previously known in the wider literature and a newspaper report from the Guardian in 2000.[52] We would note that because of a degree of uncertainty about the terms applicants might use in the case of indigenous peoples and local communities it is likely that other examples may emerge. Furthermore, our data is confined to those cases where applicants disclose that their inventions are informed by traditional knowledge. However, on the balance of the available evidence we expect additional cases to be limited in number.

We therefore conclude that patent activity involving traditional knowledge constituted a very limited percentage of UK international patent activity involving genetic resources in the period between 1976-2010. We recognise that, due to the difficulty of data retrieval, additional examples may exist. Nevertheless, when combined with the finding that only 299 UK first filings are coded for traditional medicines from plants in International Patent Classification, in our view traditional knowledge related activity in UK data will remain small. This does not mean that traditional knowledge is unimportant. Rather, it signifies that in the specific case of the UK it is of limited relevance to patent activity involving genetic resources.

However, the provisions of the Nagoya Protocol with respect to traditional knowledge will require UK patent applicants to pay greater attention to this subject. In the case of the field collection and documentation of the knowledge, innovations and practices of indigenous peoples and local communities we suggest that UK applicants (notably research organisations) will need to pay particular attention to ethical codes of conduct and the provisions of the Nagoya Protocol with respect to prior informed consent and mutually agreed terms on benefit-sharing with indigenous peoples and local communities. In the case of traditional knowledge arising from historic written traditions (i.e. Traditional

Chinese Medicine or Indian Ayurvedic medicine) issues relating to intellectual property are likely to be addressed in debates at the World Intellectual Property Organization. Given that countries may introduce access and benefit-sharing legislation that addresses traditional knowledge, including historic written traditions, we suggest close attention to the national legislation and regulations for implementation of the Nagoya Protocol. International debates on traditional knowledge are continuing at the World Intellectual Property Organization.

8.2 Introduction:

This section discusses issues involving traditional knowledge in UK patent data for genetic resources. Traditional knowledge has become an important international focus of attention over the last decade in debates under the Convention on Biological Diversity and at the World Intellectual Property Organization (WIPO). Traditional knowledge is also an extensive focus of debate in the wider scientific literature.

This section reviews available UK patent data involving traditional knowledge. It begins by discussing the concept of traditional knowledge and identifies two basic categories of traditional knowledge:

1. The knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles.
2. Knowledge codified in literature in forms such as Ayurvedic medicine in India and Traditional Chinese Medicine (TCM) that may be regarded by states as national heritage.

The analysis is based on a review of 128 documents containing search terms of relevance to indigenous peoples and traditional knowledge in 19,760 UK first filings. We would note that the data may be limited by the search terms used and it does not include the names of indigenous peoples (i.e. Wapishana etc.) that might yield additional data. Based on the results of the searches we find:

1. Very limited evidence of direct collection of field samples and associated traditional knowledge among indigenous peoples and local communities. The available evidence suggests that direct field collection among such communities is very rare in UK Research and Development.
2. General and direct references to Indian traditional medicine and Traditional Chinese Medicine (TCM) in UK patent activity. Evidence for direct collection of genetic material and associated traditional knowledge in India and China is also very limited. The exception to this observation is Unilever UK which commonly submits patent applications as a co-applicant with Hindustan Unilever in India.

This leads to the conclusion that UK patent activity involving traditional knowledge is very limited. Patent activity involving indigenous peoples and local communities and traditional knowledge is an exception when viewed in terms of overall UK patent activity. While limited in nature, existing UK activity suggests that UK patent applicants will need to take account of traditional knowledge as part of the due diligence process when sourcing materials and preparing patent applications.

8.3 Understanding Traditional Knowledge:

There is no internationally accepted definition of what traditional knowledge is. In the context of intellectual property it can generally be described as knowledge of the uses of plants and other organisms, for a range of purposes, that is transmitted between people across generations through language and, in some cases, written texts. However, on a broader level traditional knowledge is grounded in the cosmologies, ontologies and epistemologies of indigenous societies around the world and informs their understandings of, and interactions with, the natural world. In short, traditional knowledge cannot simply be understood in utilitarian terms but speaks instead to the diversity of human cultures, understandings of the world, and cultural and spiritual values. This diversity is not easy for the intellectual property system to accommodate or for policy makers and patent applicants to appreciate.

Within international policy debates the best known description of traditional knowledge is provided by Article 8(j) of the Convention on Biological Diversity that refers to the "knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles". This phrase is now routinely abbreviated to traditional knowledge.

The definition in Article 8(j) focuses our attention on "indigenous and local communities embodying traditional lifestyles". As such, it focuses our attention on people who are members of particular types of communities. In international policy debates this is commonly associated with members of societies who describe themselves as indigenous peoples through the reference to *embodying traditional lifestyles*. However, this category also applies to those communities, such as *cablocos* in the Brazilian Amazon and Afro-Caribbean communities, who can be said to embody a traditional lifestyle. This description is also often applied to indigenous communities with tribal affiliations in African countries where it is commonly argued that everyone is indigenous in comparison with countries such as Australia, New Zealand and the Americas. For example, in the African case, this would encompass tribal peoples such as the Masai, the !Kung San, the Baka (Cameroon and Gabon) and the Twa forest peoples of Central Africa among others. In contrast, the term is not commonly understood to include crofters or other rural dwellers in developed countries. As this makes clear, the category is not precise.

Existing research reveals that members of these peoples and communities frequently belong to language groups with 10,000 speakers or less.[53] They are also frequently regarded as vulnerable populations from a human rights perspective due to external pressures on their environments and livelihoods within their home countries. They are a particular focus of international attention across a spectrum of policy fields ranging from human rights to the environment and development. The 2007 *United Nations Declaration on the Rights of Indigenous Peoples* represents an important milestone in international recognition of indigenous peoples and the application of existing human rights norms established in the International Covenants and related instruments to indigenous peoples.[54] Three aspects of the United Nations Declaration (UNDRIP) are particularly relevant to genetic resources and traditional knowledge. With respect to intellectual property Article 31 of the Declaration specifies that:

> Article 31.1 Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and

> traditional games and visual and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions.

This article establishes that indigenous peoples have rights in relation to intellectual property that extend to genetic resources, seeds, medicines and knowledge. Article 32 is of relevance to projects that take place on indigenous lands or territories or involving the resources therein:

> Article 32. 1. Indigenous peoples have the right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources.
>
> Article 32. 2. States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources.

This article is particularly relevant for those organisations that might consider developing or participating in projects on indigenous peoples' lands. Finally:

> Article 11. 2. States shall provide redress through effective mechanisms, which may include restitution, developed in conjunction with indigenous peoples, with respect to their cultural, intellectual, religious and spiritual property taken without their free, prior and informed consent or in violation of their laws, traditions and customs.

This article establishes the principle of redress and extends to intellectual property taken without the free prior informed consent of the indigenous peoples involved.

These and other articles of the UN Declaration are directed towards states. However, the Declaration provides useful guidance for research organisations or companies on the issues involved in engaging in projects that may involve or affect indigenous peoples. Other guidance is also available including discussion of best practice in research with indigenous peoples and local communities.[55]

The Nagoya Protocol makes extensive references to indigenous and local communities and to traditional knowledge. The preamble to the Protocol contains recognition that indigenous and local communities will identify the rightful holders of traditional knowledge within their communities, notes the UN Declaration on the rights of indigenous peoples, and affirms that nothing in the Protocol shall be construed as diminishing or extinguishing the existing rights of indigenous and local communities. The core provisions of the Nagoya Protocol with respect to traditional knowledge will now be briefly summarised.

Article 3 of the Protocol establishes that it applies to traditional knowledge associated with genetic resources within the scope of the Convention and to benefit-sharing. Article 5.2 on benefit-sharing establishes that each Party shall take action:

> "...with the aim of ensuring that benefits arising from the utilization of genetic resources that are held by indigenous and local communities... are shared in a fair and equitable way with the communities concerned, based on mutually agreed terms."

Article 6 make a variety of references to measures to be taken by Parties, in accordance with domestic law, to secure the prior informed consent of indigenous and local communities notably where the communities have rights over genetic resources. Article 7 specifically addresses access to traditional knowledge associated with genetic resources while Article 12 elaborates the terms and conditions of access and introduces concepts such as community protocols. Article 13 establishes that national focal points will provide information to applicants for access on procedures for obtaining prior informed consent from indigenous and local communities while Article 14 references competent authorities of indigenous and local communities. These provisions can perhaps be readily summarised as: inform, secure prior informed consent, and establish mutual agreement on benefit-sharing with competent indigenous and local community authorities.

Article 16.1 on compliance establishes that Parties will take effective measures to ensure that:

> "...traditional knowledge associated with genetic resources utilized within their jurisdiction has been accessed in accordance with prior informed consent or approval and involvement of indigenous and local communities and that mutually agreed terms have been established, as required by domestic access and benefit-sharing legislation or regulatory requirements of the other Party where such indigenous and local communities are located."

This signifies that Parties (such as the UK) should take such action in circumstances where another relevant Party has established access and benefit-sharing legislation. Traditional knowledge and indigenous and local communities are not mentioned in requirements for monitoring under Article 17 of the Protocol. Other relevant provisions include codes of conduct and best practices/standards under Article 20 and Article 22 on capacity building. The Annex to the Protocol provides a helpful indicative list of Monetary and Non-Monetary Benefits.

A second category of traditional knowledge focuses on countries with written historical medical traditions. Examples include Traditional Chinese Medicine (TCM) in China and Ayurveda and other medical traditions (such as Unani) in India. This category of traditional knowledge differs from community focused traditional knowledge in that it has been codified and transmitted in written form across generations. As a written tradition it can in some respects be considered to be "self standing". However, in reality this category of traditional knowledge may be deeply embedded in, and meaningful to, indigenous communities and communities of practitioners. The Nagoya Protocol is effectively silent on this category of traditional knowledge except in three main places. The following section of the preamble reads as follows:

> "*Further recognizing* the unique circumstances where traditional knowledge associated with genetic resources is held in countries, which may be oral, documented or in other forms, reflecting a rich cultural heritage relevant for conservation and sustainable use of biological diversity."

This language was inserted at the request of China and India towards the end of the negotiation of the Nagoya Protocol. A second stand alone reference to traditional knowledge is found in Article 10 of the Protocol on the Global Multilateral Benefit Sharing Mechanism specifying that Parties will consider the need for a mechanism:

> "....to address the fair and equitable sharing of benefits derived from the utilization of genetic resources and traditional knowledge associated with genetic resources that occur in transboundary situations or for which it is not possible to grant or obtain prior informed consent."

A second stand alone reference to traditional knowledge is found in Article 18 with reference to encouraging the inclusion of dispute resolution in mutually agreed terms. Finally, Article 21(g) on Awareness Raising refers to: "Education and training of users and providers of genetic resources and traditional knowledge associated with genetic resources about their access and benefit-sharing obligations."

As this makes clear, the core obligations under the Protocol are directed to the traditional knowledge of indigenous and local communities in circumstances where it is associated with a genetic resource and those circumstances where indigenous and local community rights over genetic resources are recognised.

These distinctions matter in international policy debates for two reasons. The first category focuses on people living in communities as the subject matter of debates on protection. These debates are grounded in approaches that focus on the realisation of existing human rights and actions that may be necessary to promote the realisation of human rights for peoples and communities who do not presently enjoy the same level of respect for human rights as other members of society. In short, the protection and promotion of the rights of vulnerable peoples and communities.

In contrast, the second category of traditional knowledge focuses on particular traditions. In practice, this can involve claims to rights by states on behalf of their citizens. As we will see below this is the most significant category of UK patent activity involving traditional knowledge.

8.4 Methods:

We conducted searches on key words within 19,760 UK first filings. By focusing on first filings we aimed to avoid repetitions of terms in equivalent documents (copies) published in the three jurisdictions. In developing the search queries we chose terms that were likely to be used by patent applicants including historic or archaic forms that would be considered derogatory in the 21st Century.

Search Terms and Search Results in UK First Filings (19,760 documents)

Search Terms	First Filings	Notes
1. "chinese medicine" or "ayurveda" or "ayurvedic" or "indian medicine" or "chinese traditional medicine" or "chinese herbal medicine" or "indian traditional medicine" or "traditional medicine in India" or "traditional medicine in china" or "indian herbal medicine" or "traditional chinese medicine" or "traditional indian medicine"	45	See examples
2. "indigenous people" or "indigenous peoples" or "indigenous population" or "indigenous populations" or "tribal population" or "tribal populations"	1	Oxitec refers to release of sterile insects into an indigenous population of insects (WO2004098278A1)
3. “indigenous community” or “indigenous communities”	1	Refers to a microbial community. (US20100227380A1)
3. "aborigine" or "aborigines" or "aboriginal" or "aboriginals"	4	Passing references and literature references.
2. "amazonian" or "amerindian" or “amerindians” or "south american indian" or "south american indians" or "andean" or "andes"	22	See examples
5. "native american" or "native americans" or "american indian" or "american indians" or "indian tribe" or "indian tribes" or "indigenous tribe" or "indigenous tribes" or "native tribe" or "native tribes"	10	See examples
“native people” or “native peoples” or “natives”	0	See examples

Search Terms	First Filings	Notes
"tribe" or "tribal" 40	40	The majority of references refer to a biological tribe (i.e. of plants). Two instances of use as a surname and one of a chemical tribe. One reference to the Wapishana of Guyana (US6048867A) and the ancient Hindu/Aryan use of Soma (EP2090315A1).
"primitive tribe" or "primitive tribes"	0	No data
“tribal people” or “tribal peoples”	0	No data
Total Documents	129	combination of all search terms in 19,760 UK first filings.

The following sections provide a selection of detailed examples. In reading the texts note that text rendering from the original documents in .pdf format is sometimes affected by random characters introduced during machine translation. We have retained the texts as is.

In some cases references to Traditional Chinese Medicine and traditional knowledge from India appear in the same document. The relevant segments of these documents are reproduced in the sub-sections on traditional knowledge from China and India.

8.5 Traditional Chinese Medicine:

We identified 28 examples of UK documents that refer to Traditional Chinese Medicines or equivalent terms. The following examples provide a summary of the results including the Abstract, relevant segments of the patent document and the first claim. The aim of these examples is to provide the reader with detailed but concise information on references to Traditional Chinese Medicines in the UK data.

TK1. US20040101581A1 Chinese herbs extract
Phytotech Limited.

Abstract: “This application relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising the following Chinese herbs: Radix Ledebouriella, Fructus Tribuli, Herba Potentilla chinensis, Caulis Clematis armandii, Radix Rehmannia, Radix Glycyrrhiza, Radix Paeonia rubra, Cortex Dictamni radicis, Herba Lopatheri, Spica Schizonepetae. The material comprises one or more of those components present in the freeze-dried decoction which run with Rf values in the ranges 0.00 to 0.100, 0.167 to 0.300, 0.400 to 0.533, 0.700 to 0.833 or 0.900 to 0.967 if the freeze-dried decoction is diluted in aqueous solution and subjected to chromatography on a Whatman 2 cmsÃ—55 cmsÃ—3 mm cellulose strip for 10 hours using a solvent mixture of butanol, ethanol and water in the proportions 4:1:1. “

Segment: “This application relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising the following Chinese herbs: Radix Ledebouriella, Fructus Tribuli, Herba Potentilla chinensis, Caulis Clematis armandii, Radix Rehmannia, Radix Glycyrrhiza, Radix Paeonia rubra, Cortex Dictamni radicis, Herba Lopatheri, Spica Schizonepetae. The material comprises one or more of those components present in the freeze-dried decoction which run with Rf values in the ranges 0.00 to 0.100, 0.167 to 0.300, 0.400 to 0.533, 0.700 to 0.833 or 0.900 to 0.967 if the freeze-dried decoction is diluted in aqueous solution and subjected to chromatography on a Whatman 2 cmsÃ—55 cmsÃ—3 mm cellulose strip for 10 hours using a solvent mixture of butanol, ethanol and water in the proportions 4:1:1.

[0001] The invention relates to materials derived from traditional Chinese herbs and to pharmaceutical compositions containing them which are useful in the treatment of atopic disease, in particular atopic eczema, and in treatment of other skin disorders such as non-atopic eczema and psoriasis.

[0002] It is to be understood that by the term Chinese herb is meant any herb which is used by traditional medicine practitioners, usually, but not exclusively, Chinese.

[0003] Practitioners of traditional Chinese medicine treat diseases using a system of anatomy and diagnosis totally different from that used in the west. The remedies prescribed are usually a plurality of Chinese herbs which are prepared for administration by the traditional method of decoction i.e. boiling the herbs in water. The herbs are removed and the water maintained for oral, parenteral or topical administration to the patient as appropriate.

[0004] Prescriptions for use in this kind of therapy may call for the use of ten or more herbs in combination and traditional Chinese medicine teaches that all of the herbs are

necessary to achieve a balanced prescription. A prescription is seen as a balanced whole containing the hierarchy of herbs to which are attributed different functions in treating different manifestations and symptoms of disease." (US20040101581A120040527: 7-12)

Illustrative Claims: "1. A composition for the treatment of a disease selected from the group consisting of atopic disease, non-atopic eczema and psoriasis, which comprises a decoction or extract obtained from a subset of the set of herbs consisting of: Radix Ledebouriella Fructus Tribuli Herba Potentilla Chinensis Caulis Clematis Armandii Radix Rehmannia Radix Glycyrrhiza Radix Paeonia Rubra Cortex Dictamni Radicis Herba Lopatheri Spika Schizonepetae in the substantial absence of any other herb; said decoction or extract comprising one or more of those components present in fractions which run with rf values in the ranges: 0.00 to 0.100; 0.167 to 0.300; 0.400 to 0.533; 0.700 to 0.833; or 0.900 to 0.967 if an aqueous solution of a freeze-dried decoction of said set of herbs is subjected to chromatography on a Whatman 2 cmÃ—55 cm 3 MM cellulose strip for 10 hours using a solvent mixture of butanol, ethanol and water in the proportions 4:1:1."

TK2. US20060198900A1 Bioactive Agent Compositions for Repair of Cell Injuries Nutritional Bioscience Ltd.

Abstract: "A method for prophylactically treating a gastrointestinal disorder or skin ailment in a mammal through the administration of an enhanced bioactive agent composition comprising a bioactive agent and at least one of a soy product, licorice product, or sodium bicarbonate (depending upon the indication to be treated) is provided according to the invention. The bioactive agent preferably is bovine colostrum. The effective amount of enhanced bioactive agent composition to be used will depend upon such factors as the age and weight of the mammal, the bioactivity level of the bioactive agent, the gastrointestinal disorder or skin ailment at issue, and whether treatment of existing symptoms of the gastrointestinal disorder or skin ailment, or prevention of the onset of such symptoms is desired. A medicament comprising an enhanced bioactive agent composition for prophylactically treating a gastrointestinal disorder or skin ailment in a mammal is also provided according to the invention."

Segment: "In addition to soybean-based products, another potential source of bioactive compounds is licorice root (Glycyrrhiza radix). Licorice root is one of the oldest and most frequently employed botanicals in Chinese medicine. In the U.S., licorice products are usually used as flavoring and sweetening agents in food products. Constituents of licorice include triterpenoids, such as glycyrrhizin and its aglycone glycyrrhizic acid, various polyphenols, and polysaccharides. Various chemical modifications of glycyrrhizic acid have also been produced such as the salts, amides, and glycopeptides derivatives." (US20060198900A120060907: 31)

Illustrative Claims: "1. A method of using a medicament comprising an enhanced bioactive agent composition for the prophylactic treatment of a gastrointestinal disorder or skin ailment in a mammal, wherein the enhanced bioactive agent composition comprises colostrum and at least one bioactivity enhancing additive selected from the group consisting of a soybean product, licorice product, and sodium bicarbonate."

TK3. US20100028262A1 3,4-METHYLENEDIOXY-SUBSTITUTED CHALCONES AS THERAPEUTIC AGENTS
Spear Therapeutics Ltd.

Abstract: “The present invention pertains to the use of a compounds for the manufacture of a medicament for use in the treatment of a proliferative condition, wherein the compounds have the following formula: ...” (continues).

Segment: “Many clinically successful anticancer drugs are themselves either natural products or have been developed from naturally occurring lead compounds. Great interest is currently being paid to drugs isolated from natural resources which have already been used as a medicine. The dried whole plant of Scutellaria barbata D. Don (Labiatae) is used in Traditional Chinese Medicine as an anti-inflammatory, an antitumour agent, and a diuretic. The α,β-unsaturated ketone, (E)-1-(4’-hydroxyphenyl) but-1-en-3-one has been isolated from this plant and found to have moderate antitumour activity (IC50 of 60 Î¼M for K562).” (US20100028262A120100204: 15)

Illustrative Claims: “1. A method of treating a proliferative condition characterized by cells which express CYP1B1 in a patient comprising administering to said patient a therapeutically-effective amount of a compound having the formula: wherein: each of RB2, RB3, RB4, and RB5 is independently -H, -OH, or -OMe; each of R1 and R2 is independently: -H, optionally substituted C1-4alkyl, or optionally substituted C5-20aryl; RA3 is -H, -OH, -OC(=O)RE, -OS(=O)2OH, or -OP(=O)(OH)2; and RE is: -H,optionally substituted C1-6alkyl, optionally substituted C3-20heterocyclyl, or optionally substituted C5-20aryl; or a pharmaceutically acceptable salt, solvate, amide, ester, ether, chemically protected form, or prodrug thereof.”

TK4. US5466452A Pharmaceutical compositions for the treatment of skin disorders
Phytopharm Ltd.

Abstract: “A process is provided which is suitable for the preparation of herbal compositions for the treatment of skin disorders such as eczema and psoriasis. The process comprises preparing an extract or extracts of herbs which provide an anti-inflammatory agent, an adrenocortical stimulant and a cortisol protecting agent by steam distillation and decoction and then treating the extracts to reduce the polysaccharide and/or sugar content.”

Segment: “Practitioners in traditional Chinese medicine however use decoctions of herbs for oral and topical treatment of dermatological conditions including eczema and psoriasis. A wide variety of agents have been used and in traditional Chinese medicine it is conventional to use a compound prescription which is designed by the practitioner after careful examination of the individual patient. It has been found by clinical experimentation that mixtures of certain herbs can be used to provide a composition which is effective in a large proportion of patients suffering from eczema and psoriasis, without recourse to individualisation of treatment. Different formulae have been devised for dry, weeping, infected and lichenified eczema although the mode of action of traditional Chinese medicines is not fully understood.” (US5466452A_19951114: 13)

“It is possible that some of the herbs in the mixtures are necessary in order to increase the solubility of some of the active constituents in water since the traditional method of preparing extracts is by decoction i.e. boiling in water. In traditional Chinese medicine some herbs are included in prescriptions because they act as demulcents i.e. agents

which have a soothing effect on the gastrointestinal tract and facilitate patient acceptance. It is firmly believed by traditional Chinese practitioners that the toxicity of mixtures of herbs is less than that of the herbs given in isolation. Although this has yet to be rigorously proved in controlled clinical trials, conventional wisdom indicates that some of the herbal components have biological activities which summate, and others antagonise the toxic effect of active components. Until the active components have been identified with certainty it has proved prudent to use a decoction, extract or fractionated extract of a plurality of herbs. To be useful in practice it is necessary to have one or more fixed composition mixtures. Surprisingly, it has been found that fixed combinations of specific herbs can be used to treat different types of eczema and psoriasis." (US5466452A_19951114: 15)

"Chinese medicine teaches that substantially all of the herbs in a composition are necessary for activity and that the herbs are best given in extemporaneously prepared decoction. However it has now surprisingly been found that the anti-eczema activity of the composite herbal preparation resides mainly, if not exclusively in a restricted number of herbs. It is therefore possible to reduce the amount of unnecessary material from the composition by limiting the number of herbs used, and to then further reduce the quantity of material given by preparing a composition in concentrated form in accordance with the invention wherein extraneous materials are removed.

Herbs selected from the list in Table I are suitable for use in the invention and a particularly preferred composition is one containing extracts from Rehmannia glutinosa, Dictamnus augustifolia, Glycyrrhiza uralensis and either Ledebouriella sesloides or Schizonepeta tenuifolia. Optionally Tribulus terrestris can be included. Another preferred composition is one containing the first 10 herbs listed in Table I.

It is preferable if one of the herbs included in the mixture provides an anti-pruritic (anti-itching) agent. As some of the herbs may have a bitter taste it is also preferable to add a sweetening agent for oral compositions." (US5466452A_19951114: 37-39)

Illustrative Claims: "1. A process to make a composition for treating eczema, psoriasis, pruritis and inflammatory reactions of the skin which comprises:

(a) subjecting a plurality of herbs having anti-inflammatory activity, adrenocortical stimulating activity and corticosol-protecting activity to steam distillation and decoction, to produce an extract of the herbs;

(b) reducing the amount of polysaccharides and/or sugars, in the extract to less than 5% by weight under conditions which do not substantially reduce the content of glycosides which are present in said material by one or more of:

(i) fermenting with barley malt or with a microorganism which produces amylase and/or saccharolytic enzymes or by using isolated amyolytic or saccharolytic enzymes,

(ii) extracting with a solvent having a polarity in the range EÂ° 0.4 to 0.99, or a mixture of solvents at least one of which has a polarity within said range,

(iii) precipitating the polysaccharide and/or sugar with an inorganic compound; and

(c) concentrating the active agents present in the extracted material by further extracting with a solvent having a polarity in the range EÂ° 0.4 to 0.99, or a mixture of solvents, at least one of which has a polarity within said range, wherein the herbs are selected from the group consisting of Potentilla chinensis (Bai Tai Weng), Rehmannia glutinosa (Dihuang), Radix paeoniae lactiflorae/veitchii (Chi Shao), Dictamnus augustifolia (Bai Xan Pi), Glycyrrhiza uralensis (Gan Cao), Ledebouriella sesloides (Fang Feng),

Tribulus terrestris (Ci Ji Li), Lopatheri gracile (Dan Zhu Ye), Schizonepeta tenuifolia (Jing Jie Sui), and Akebia trifoliata (Mu Tong)."

TK5. US6280751B1 Essential oil composition
UK Individual

Abstract: "The application relates to new medicinal and cosmetic compositions comprising essential oils in combination with herbs and/or spices. The compositions may be used orally or topically."

Segment: "Chinese herbal medicine has been known in China for several thousands of years. Only recently, however, has it become recognised in the West that Chinese herbs may be used to treat medical conditions.The inventors have unexpectedly found that it is possible to combine essential oils with naturally occurring spices and/or herbs to produce medicinal compositions which may be taken orally or which may be directly absorbed through the skin. Compositions of the invention may be used to treat a surprising range of illnesses. Such compositions are especially important with the move by many members of the public towards more "natural" treatments, which do not use artificial medicines." (US6280751B120010828: 31-33)

Illustrative Claims: "What is claimed is: 1. A medicinal or cosmetic composition for oral administration comprising at least one essential oil in combination with at least one spice selected from the group consisting of asapoetidia, coconut, coriander, fenugreek and horseradish; at least one herb selected from the group consisting of Acacia Catechu, Acanthopanax Gracilistylus, Cacsalpinia Sappan, Epimedium Spinosa, Paeonia lactiflora, Paeonia obovata, Atractylodes macrocephala, Glycyrrhiza uralexisis, Glycyrrhiza glabra, Lycium chinense, Nauclea rhyncholphylla, Cinnainomum cassia, Astragalus membranaceus, Scutellaria baicalensis, Schizonepeta tenuifolia, Ephedra sinica, Ophiopogon japonicus, Paeonia suffruticosa, Artemisia annua, Aretemisia apiacea, Panax notoginseng, Cornus officinalis, Acorius gramineus, Reluhania glutinosa, Gastrodia elata, Asparagus cochiichinensis, Cuscuta chinensis, Schizandra chinensis, Schizandra spenanthera, Magnolia liliflora, Epimedium brevicomum, Epimedium grandiflorun, Epimedium sagittatum, Houttuynia cordata, Polygala tenuifolia; and Perilla frutescens, and an Aloe Vera extract."

TK6. WO2000002544A2 TREATMENT OF SKIN DISORDERS
BTG International Ltd.

Abstract: "The present invention provides piperine and analogues or derivatives thereof for re-pigmenting post traumatised de-pigmented skin and for the treatment of skin conditions such as vitiligo. The piperine and analogues or derivatives thereof may also be used to cosmetically promote or enhance the natural colouration of the skin."

Segment: "Certain plant remedies, usually administered as mixtures of herbs or extracts, particularly those used in traditional Chinese medicine and Indian Ayurvedic medicine, have been employed for the treatment of vitiligo for a long time and in many cases have given positive results in small scale studies. Herbs such as Psoralea corylifiblia L. and Vernonia anthelmintica Willd. (=Centratherum anthelminticum Kuntze) are well known for their use in this disease. Psoralens, which are employed in the modern PUVA and khellin in KUVA therapy were originally derived from plant sources (Psoralea corylifolia L and Ammi visnaga respectively) used in traditional remedies for vitiligo. However these

therapies rely on the use of UV irradiation for their efficacy, which is associated with the aetiology of skin cancer." (WO2000002544A220000120: 12)

Illustrative Claims: "1. Use of piperine or an active analogue or derivative thereof for stimulating the proliferation of melanocytes. 2. Use of piperine or an active analogue or derivative thereof in the preparation of a medicament for re-pigmenting de-pigmented skin."

TK7. WO2000047992A1 PROCESS FOR QUALITY CONTROL AND STANDARDISATION OF MEDICINAL PLANT PRODUCTS
Oxford Natural Products PLC.

Abstract: "A process for establishing a standard specification for a medicinal plant material comprises: (i) preparing a test solution or test extract of a sample of the medicinal plant material which is known to possess the or each property required for the standard; (ii) submitting the said solution or extract to two or more analytical methods including (a) a combination of NMR spectroscopy and a computer-based pattern recognition technique, and (b) one or more biological profiling techniques; (iii) obtaining results from the analytical methods used in step (ii); and (iv) establishing a standard specification for the said plant material on the basis of the results obtained in step (iii). Candidate samples of the medicinal plant material may subsequently be tested for compliance with the standard. They can be accepted or rejected depending on whether they give analytical results which fall within or outside either part or all of the specification established in step (iv). This approach to standardisation and quality control is particularly applicable to mixtures of medicinal plant materials."

Segment: "The materials used in herbal and plant based medicine are usually whole plants, parts of plants or extracts of plants or fungi. Since plant and fungal materials contain many different chemical components the materials are, by definition, complex mixtures. This makes it very difficult to standardize and control the quality of the materials. Many of the remedies employed in traditional Chinese medicine and Ayurvedic medicine mentioned above are mixtures of two or more plant-based components. They are therefore effectively mixtures of mixtures and thus even more difficult to analyse than herbal remedies based on a single plant material." (WO2000047992A120000817: 15)

"An important application of the process of the present invention is in the standardisation of mixtures of plant materials. Examples of such mixtures include remedies from Traditional Chinese Medicine as discussed above. These are typically mixtures of several different plants and fungi prepared in accordance with recipes that may be many hundreds of years old. To date there has been no analytical technique by which producers of such materials could reliably and consistently differentiate their products from ostensibly identical products sold by competitors under the same name. It has now surprisingly been found that the NMR spectroscopy/pattern recognition technique used in the present invention can provide clear differentiation between samples of a given mixture of plant materials which are supposed to be identical but are obtained from different sources. This is illustrated in Example 5 and accompanying Figure 7. The process of the invention therefore allows mixtures of plant materials to be differentiated and standardised." (WO2000047992A120000817: 61)

"Figure 7 is a PCA score plot of factor 2 (y axis) against factor I (x axis) for the Traditional Chinese Medicine remedy analysed in Example 5. The symbols used for each sample are

as follows: = supplier 1; = supplier 2; and + = supplier 3." (WO2000047992A120000817: 89)

"Example 5: Use of NMR Spectroscopy and Multivariate Analysis to distinguish between samples of a mixture of plant materials The Traditional Chinese Medicine remedy known as Liu Wei Huang Wan, which contains six plant ingredients, was obtained from three different suppliers (denoted 1, 2 and 3)." (WO2000047992A120000817: 120)

Illustrative Claims: "1. A process for establishing a standard specification for a medicinal plant material, the process comprising: (i) preparing a test solution or test extract of a sample of the medicinal plant material which is known to possess the or each property required for the standard: (ii) submitting the said solution or extract to two or more analytical methods including (a) a combination of NMR spectroscopy and a computer-based pattern recognition technique, and (b) one or more biological profiling techniques; (iii) obtaining results from the analytical methods used in step (ii); and (iv) defining a standard specification for the said plant material on the basis of the results obtained in step (iii)."

TK8. WO2001043753A2 COMBINATION OF GINSENG AND GINKGO TO IMPROVE COGNITIVE SKILLS
Boehringer Ingelheim Pharmation (CH) with UK individual co-applicant & Inventor.

Abstract: "A dietary supplement consisting essentially of a combination of Ginseng and Ginkgo to improve the speed of memory and memory quality in normal, healthy subjects and to prevent deterioration of the speed of memory in people with decreased cognitive functions, and to counteract cognitive fatigue."

Segment: "SUMMARY OF THE INVENTION Unexpectedly, it was found in cognitive tests that administering a combination of extracts of the root of Panax ginseng C.A. Meyer and of the leaves of Ginkgo biloba to humans positively effects cognitive skills, for example such as the speed and quality of memory in normal, healthy subjects. Both Panax ginseng and Ginkgo biloba have been extensively used for various indications in Chinese medicine and are described in the traditional Chinese Pharmacopoeia. Ginkgo extracts and Ginseng extracts are known to have effects on cognitive functions, yet the effects produced by the combination are of a novel type. Therefore the present invention is directed to a method to enhance the speed of memory and memory quality in normal, healthy subjects which comprises the administration of a medication and / or a dietary supplement containing a combination of Ginseng and Ginkgo. Further, the combination may be used to prevent deterioration of the speed of memory in people with decreased cognitive functions and to counteract cognitive fatigue. Specifically, the composition of the present invention consists of herbal ingredients for example derived by an extraction from Ginseng roots and Ginkgo leaves. Another aspect of the present invention is a method for the enhancement of the mental effort and/or cognitive performance, in particular of children or young adults, said method comprises co-administration of synergistically enhancing amounts of the plant Panax ginseng, extracts thereof and/or the principle active substances thereof and the plant Ginkgo hiloba, extracts thereof and/or the principle active substances thereof to the persons being in acute in need of such a treatment."
(WO2001043753A220010621: 18)

Illustrative Claims: "1 A method to improve the speed of memory and memory quality in normal, healthy persons by co-administration of or a combination-administration of (1) the plant Panax ginseng, extracts thereof and or the principal active substances thereof, and

(11) the plant Ginkgo biloba, extracts thereof and or the principal active substances thereof."

TK9. WO2002057260A1 COMPOUNDS FOR USE IN THE TREATMENT OF SKIN CONDITIONS
BTG International Ltd.

Abstract: "The present invention provides compounds of formula (I) and analogues or derivatives thereof for the treatment of skin conditions, such as Vitiligo, which are treatable by the stimulation of melanocyte proliferation and also for treating skin cancer. The compounds may also be used to cosmetically enhance the natural coloration of the skin."

Segment: "Certain plant remedies, usually administered as mixtures of herbs or extracts, particularly those used in traditional Chinese medicine and Indian Ayurvedic medicine, have been employed for the treatment of vitiligo for a long time and in many cases have given positive results in small scale studies. Herbs such as Psoralea corylifolia L. and Vernonia a7 thelmi77tica Willd. (=Centratherum anthelminticum Kur tze) are well known for the use in this disease. Psoralens, which are employed in the modern PWA and khellin in KWA therapy were originally derived from plant sources (Psoralea corylifolia L and Ammi visnaga respectively) used in traditional remedies for vitiligo. However these therapies rely on the use of W irradiation for their efficacy, which is associated with the aetiology of skin cancer."

"The fruit of black pepper (Piper nigrum L.) and long pepper (Piper lo' gum L.) are both important medicinal herbs in Ayurvedic and Unani (traditional Indian) medicine systems, in which remedies generally consist of mixtures of herbs. A wide range of the medicinal uses of black pepper have been documented by Kirtikar and Basu (dian Medicinal Plants, 2nd Edition, Vol. 3, (1935) pages 2128-2135), including its use in the treatment of leucoderma." (WO2002057260A120020725: 15-16)

Illustrative Claims: "1. A compound of formula (1) for use in the treatment of a skin condition (R)m+;:;;: t) in which 5 mis2 n is O or 1 p is O or 1 q is O or 1 the two Ri groups together represent a 3',4'-methylene methylenedioxy group, 10 R2 is hydrogen; R3 and R4 represent hydrogen atoms or together represent a carbon to carbon double bond; R5 and R6 represent hydrogen atoms or together represent a carbon to carbon double bond; R7 and R8 represent hydrogen atoms or together represent a carbon to carbon double 15 bond..." (continues).

TK10. WO2003029176A1 4-C2-6ALKOXY-SUBSTITUTED CHALCONES AS THERAPEUTIC AGENTS
Cancer Research Technology Ltd.

Abstract: "The present invention pertains to compounds of the following formula: (1) wherein: R ALK is primary or secondary aliphatic saturated C2-6alkyl; each of RB2, RB3, RB4, and RB5 is independently-H,-OH, or-OMe; each of R1 and R2 is independently:-H, optionally substituted C1-4alkyl, or optionally substituted C5-20aryl; RA3 is-H,-OH,-OC(=O)RE,-OS(=O)2OH, or-OP(=O)(OH)2; RE is :-H, optionally substituted C1-6alkyl, optionally substituted C3-20 heterocyclyl, or optionally substituted C5-20aryl; or a pharmaceutically acceptable salt, solvate, amide, ester, ether, chemically protected form, or prodrug thereof. The present invention also pertains to pharmaceutical compositions comprising such compounds, and the use of such compounds and compositions, both in

vitro and in vivo, for both diagnosis and treatment of, for example, proliferative conditions, such as cancer, and inflammatory conditions."

Segment: "Great interest is currently being paid to drugs isolated from natural resources which have already been used as a medicine. The dried whole plant of Scutellaria barbata D. Don (Labiatae) is used in Traditional Chinese Medicine as an anti-inflammatory, an antitumour agent, and a diuretic. The a,,0-unsaturated ketone, (E)-1-(4'-hydroxyphenyl)but-1-en-3-one has been isolated from this plant 30 and found to have moderate antitumour activity (ICED of 60 hum for K562)." (WO2003029176A120030410: 17)

Illustrative Claims: "1. A compound of the following formula: RACK, I jig R (1) RA3 RBS wherein: 5 RANK is primary or secondary aliphatic saturated C2 6alkyl; f RB2 RB3 RB4 and RB5 is independently-H.-OH, or-OM; each of Rut and R2 is independently:-H. optionally substituted C, 4alkyl, or 10 optionally substituted C5 20aryl; RA3 is-H.-OH,-OC(=O)RE,-OS(=O)2OH, or-OP(=O) (OH)2; RE is:-H. optionally substituted Cal 6alkyl, 15 optionally substituted C3 20heterocyclyl, or optionally substituted C5 20aryl; or a pharmaceutically acceptable salt, solvate, amide, ester, ether, chemically protected form, or prodrug thereof."

TK11.WO2003105877A1 PHARMACEUTICAL COMPOSITIONS
Medipearl PTE Ltd. (Singapore) with UK individual co-applicant & inventor

Abstract: "Compositions have been obtained by extracting rhizomes of Fagopyrum dibotrys with alcohol and concentrating the extract to a powder or syrup, optionally followed by fractionation. The extract is demonstrated to be a potent anti-cancer agent. Its activity at the gene level was analysed."

Segment: "Technical Field - The present invention concerns compounds and 5 compositions which are therapeutically active, e.g. against some types of cancer. Thus it provides compounds, compositions, methods of manufacturing compositions and methods of treatment. It is primarily concerned with pharmaceuticals derived from Fagopyrum dibotrys (or Fagopyrum cymosum meisen) (golden buckwheat; jinqiaomai)."

"Background Art: Fagopyrum dibotrys is one of the innumerable plants used in Chinese traditional medicine. The whole plant, particularly the rhizome, is used as a medicament, allegedly having a wide range of beneficial effects, including antitumour activity." (WO2003105877A120031224: 12-13)

Illustrative Claims: "A method of preparing a pharmaceutical composition comprising (a) comminuting rhizomes of Fagopyrum 5 dibotrysi (b) extracting the comminuted material with a solvent comprising a Cl-C4 alcohol to produce a liquid extract) and (c) removing solvent from the liquid extract to produce a dried or concentrated material) and optionally (d) fractionating the dried or concentrated 10 material."

TK12. WO2005082388A1 EXTRACTS OF SCUTELLARIA FOR THE TREATMENT OF SARS
Phynova Ltd.

Abstract: "The present invention relates to pharmaceutical compositions having antiviral activity against Coronavirus, and more particularly against those viruses responsible for Severe Acute Respiratory Syndrome (SARS). In a preferred embodiment it comprises a total standardised extract of a Scutellariae spp."

Segment: "In spite of the above, the finding that PYN5C showed activity against SARS-CoV was unexpected, as generally speaking the plant is used in Chinese medicine for it's antibacterial activity and is furthermore typically used in combination with several other plant species. Indeed the applicant was surprised that this single plant extract showed activity although they hoped a combination comprising, for example, extracts of three herbs Radix Scutellariae, Fructus Forsythiae and Flos Lonicerae, a composition not dissimilar to a licensed Chinese medicine Shang Huang Lian (SHL) might prove to be effective against SAIlS-CoV Thus, according to third aspect of the present invention there is provided the use of one or more botanical raw materials (BRM), one or more botanical drug substances (BDS), or one or more botanical ingredients obtainable from a species of the genus: a) Scutellaria b) Lonicera; c) Forsythia; or d) Rabdosia in the manufacture of a botanical drug (BD), or dietary supplement for the treatment of a patient infected with SARS-CoV." (WO2005082388A120050909: 58)

"The claimed invention is based on the finding that PYN 5C, a lyophilised 70% ethanolic extract of a Scutellaria spp inhibited SARS-CoV in cell culture.

By reference to what is known about: i) the composition of SHL and similar herbal combinations; ii) the presumed actives of Scutellaria spp, Lonicera spp, Forsythia spp and Rabdosia spp; and iii) alternative Chinese herbs providing similar medicinal effects in Traditional Chinese Medicine the applicant, by way of extrapolation, proposes that in addition to their, Scutellaria extract different extracts to the one they have initially tested, as well as alternative herbal materials or their identifiable botanical ingredients or active constituents, may be responsible for the SARS-CoV inhibitory activity and may additionally prove useful in treating other viral infections, particularly RNA viruses and more particularly positive RNA stranded viruses including, for example, RSV, influenza and Avian Flu.

Thus, for example, in US 6,083,921, the contents of which document is incorporated by reference, it is suggested that: a) Baicalin isolated from Radix Scutellariae; b) Chlorogenic acid isolated from Flos Lonicerae and c) Forsythiaside isolated Tom Fructus Forsythiae I are the active components of SHL." (WO2005082388A120050909: 83-85)

Illustrative Claims: "1. The use of a single botanical drug substance (BDS) or one or more botanical ingredients, obtained from a species of the genus Scutellaria selected from the group consisting of Scutellaria baicalensis, S. amoeba, S. barbata, S. discolor, S. hypericifolia, S. iambics, S. Iikiangensis, S. orthocalyx, S. rehderiana, S. scssiliflora and S. viscidula in the manufacture of a medicament for the treatment of a patient with a SARS-CoV infection."

TK13. WO2005104871A1 COMPOSITION COMPRISING STATINS
Unilever (Netherlands, UK, India)

Abstract: "A composition comprising statin wherein the composition is a flour comprising less than 10 wt.% of fat and the use of the composition comprising statin in the preparation a food product is disclosed. The process for the preparation of the composition comprising statin comprises the steps of fermenting a substrate with a statin producing fungus and of extracting the substrate."

Segment: "As a food product, rice fermented with a red Monascus fungus (red rice) has been known and used for hundreds of years in China. Red rice was used and still is used in wine making, as a food-colouring agent and as drug in traditional Chinese medicine. Most red rice available on the market contains no statins or statins in very low amounts. The Food and Drug Administration has concluded that red yeast rice available in the market does not contain significant amounts of lovastatin (FDA, Docket No. 97-044 1, Final Decision)." (WO2005104871A120051110: 59)

Illustrative Claims: "1. Composition comprising statin characterized in that the composition is a flour comprising less than 10 wt.% of fat. 12. Process for the preparation of composition comprising statin wherein the composition is a flour comprising less than 10 wt.% of fat, and wherein the process comprises the steps of fermenting a substrate with a statin producing fungus, grounding the substrate, extracting the substrate, and recovering the extracted substrate, whereby the extracted substrate results in a flour comprising statin with less than 10 wt.% of fat. 15. Process according to any of the claims 12 to 14 wherein the statin producing fungus is a Monascus fungus."

TK14. WO2006056317A1 COSMETIC COMPOSITIONS CONTAINING SOPHORA ALOPECUROIDES L. EXTRACTS
Unilever UK, India (Hindustan Lever), Netherlands

Abstract: "Disclosed are extracts of Sophora alopecuroides L. as cosmetic skin lightening agents alone or in combination with other skin benefit agents and together with a cosmetic vehicle. Also disclosed are active ingredients in the extracts, including alopecurone A, alopecurone B, sophoraflavone-G, sophoraflavone-I, sophoraflavone-K, and mixtures thereof. The inventive extracts, compositions and methods have effective skin lightening properties, may be easier to deliver to the skin and are available in nature."

Segment: "Ku Gan Cao (Chinese pinyin) is a traditional medicine in China, which is the root of the plant Sophora alopecuroides L. This plant is a shrub, growing wild in fields, along river banks and in meadows, and widely available in Inner Mongolia, Xin Jiang autonomous region and Tibet in China, among other places. In traditional Chinese medicine, the cut pieces of the root are used as a fever reducer, as a pain reliever, and as an antibacterial agent.

A different name, Ku Dou Geng, is also commonly used in the traditional Chinese medicine market.

Seven alopecurones (alopecurone A-G) have been previously isolated from Sophora alopecuroides and identified by Iinuma, et al., "Six Flavonostilbenes and a Flavanone in Roots of Sophora Alopecuroides," Phytochemistry, 38 (2) : 519-525 (1995) The present invention is based at least in part on the discovery that extracts of the plant Sophora alopecuroides L. and/or its active components, such as alopecurone A, alopecurone B and

newly identified components, have at least comparable and/or demonstrably better skin lightening activity than known skin lightening agents. The use of Sophora alopecuroides L. and/or its active components for cosmetic skin lightening applications has not heretofore been known.

Summary of the Invention

The present invention alleviates the deficiencies of the prior art and includes, in part, a novel composition for skin lightening containing cosmetically acceptable carrier and an organic solvent extract of Sophora alopecuroides L and method for skin lightening by applying the inventive composition." (WO2006056317A120060601: 19-23)

"This example illustrates in vitro tyrosinase inhibition activity of the inventive plant extracts of Sophora alopecuroides L. Original root freshly collected in the County of Ding Bian, ShanXi province, China, obtained via a local agency, Xin Zheng, which deals in raw materials of Traditional Chinese Medicine, was used." (WO2006056317A120060601: 96)

Illustrative Claims: "1. A cosmetic method of skin lightening comprising applying to the skin a composition comprising: a. 0.000001 wt% to 50 wt% of a Sophora alopecuroides extract; and b. a cosmetically acceptable carrier."

TK15. WO2007020382A2 FURTHER MEDICAL USE OF A BOTANICAL DRUG OR DIETARY SUPPLEMENT
Phynova Ltd.

Abstract: "The present invention relates to further medical uses for a botanical drug or dietary supplement consisting essentially of four botanical drug substances, optionally formulated with excipients. The botanical raw materials, botanical drug substances or botanical ingredients used are from a species of each of the genera: (a) Silybum; (b) Astragalus or Hedysarum; (c) Salvia; and (d) Schisandra."

Segment: "The composition of the present invention is unusual in that it comprises a combination of a Western herb and a small number (only three) Chinese herbs.

In Traditional Chinese Medicine (TCM), HCV infection is regarded as causing the following pathological changes in the body: - accumulation of toxin and heat in the blood;-consumption of vital energy and body fluid;-stagnation of blood; and-injury of liver and spleen function." (WO2007020382A220070222: 38-39)

"In Chinese medicine it is usual to use a relatively large number of herbs. Thus typical of the art are: CN l,071,581A, which describes an anti hepatic including seven herbs including salvia inhltiorrhiza, astragalus rnenbranaceus and magnolia vine."
(WO2007020382A220070222: 48)

Illustrative Claims: "1. The use of a botanical drug or dietary supplement consisting essentially of botanical raw materials, botanical drug substances or botanical ingredients from each of: (a)The fruit of Silybum marianum; (b) The root of Asiragalus membranaceus var rnongholicus or Hedysaruin polybotrys; (c) The root of Salvia miltiorrhiza, Salvia bowleyana or Salviaprzewalskii; and (d) The fruit of Schisandra chinensis or Schisandra sphenanthera in the manufacture of a medicament for use in the treatment or prevention of one or more of the following: i) Liver inflammation associated with hepatitis B virus; ii) Liver inflammation associated with alcohol abuse; iii) Metabolic disorders associated with

the liver, including for example, diabetes and metabolic syndrome X; iv) Fatty liver; v) Treating patients who are non responsive to imniuno-modulatory! antiviral combination therapies such as, interferon /ribovarin; vi) As an adjunct therapy to combination therapies such as, interferon /ribovarin vii) HCV associated liver disease; viii) Hepatitis; fibrosis, cirrhosis or hepatocellular carcinoma ix) Treatment to reduce raised liver enzyme levels associated with chemotherapy."

TK16. WO2007049089A1 USE OF GA AND NIF TO TREAT ISCHEMIC OR DAMAGED TISSUES
Lead Billion Ltd. (China) with UK individual co-applicant and inventor

Abstract: "After myocardial infarction, the myocardium is incapable of regenerating new cardiomyocytes to replace the lost muscle cells. Scar tissues, which replace the necrosed myocardium, cause further deterioration in cardiac function. There was no effective medicine that can stimulate the growth of new blood vessels (angiogenesis) at early stage. An organic extract of Gum Japonicum Thumb variant is known to stimule growth of functional blood vessels and/or regenerate myocardium in damaged tissues, particularly damaged heart tissues. However, the exact compounds responsible for these functions are not known. This invention identifies two compounds, Gemin A and Niga-ichigoside Fi, that are responsible for stimulating growth of funtional blood vessels and/or regeneration of myocardium in damaged tissues."

Segment: "Examples Example 1 During the course of screening for angiogenic reagents from Chinese herbal medicine, the methanol extract of Geum Japonicum thunb var (EGJ) has been identified that showed potent dual effects on stimulating early growth of new vessels both in ischemic heart muscles and infarcted heart muscles (< 48 hours), and on triggering myocardial regeneration in myocardial infarction.

The whole plant of Geum Japonicum Geum Japonicum collected from Guizhou Province of China in August was dried and percolated with Methanol at room temperature for 7 days. The extract is then dried under reduced pressure to yield a powder residue. The dried powder was suspended in H2O and successively partitioned with hexane, ethylacetate and n-butanol respectively. All hexane, ethylacetate and n-butanol soluble fractions were filtered and evaporated under reduced pressure (500C) yielding three different fractions, which were tested for their ability to stimulate angiogenesis and myogenesis in cell culture and in both muscle injury and myocardial infarction animal models. It was shown that n-butanol soluble fraction could enhance the proliferation of C2C12 myoblasts (ATCC) and HCAECs human coronary artery endothelial cells (Clonetics, Inc.) and promote early revascularization within 24 hours or 48 hours, and muscle fiber regeneration or myocardial regeneration in severe muscle injury or myocardial infarction animal models." (WO2007049089A120070503: 39-40)

Illustrative Claims: "1. The use of a compound having the formula: in at least one of the functions of stimulating growth of functional blood vessels, regeneration of myocytes or myocardium, and promoting cardiac differentiation of bone marrow mesenchymal stem cells into myocytes in ischemic or damaged tissues of a subject."

TK17. WO2007107914A1 COSMETIC COMPOSITION COMPRISING GINGKO BILOBA AND SUNSCREEN AGENTS
Proctor & Gamble US with UK individual co-applicant and inventor

Abstract: "A cosmetic composition is provided comprising a Gingko biloba extract, an alkyl Î²,Î²- diphenylacrylate and/or Î±-cyano Î²,Î²-diphenylacrylate derivative, and a dibenzoyl methane derivative. A cosmetic use of that composition is also provided for preventing sun damage and photo ageing."

Segment: "Gingko Biloba is a large, bold-textured, urban-tolerant shade tree and it is known as a living fossil. That plant is widely used in traditional Chinese medicine and from the late 1950s, its medicinal and cosmetical properties have been studied. Extracts of Gingko Biloba, preferably leaf extracts, are already used in cosmetic compositions. In fact, Gingko biloba is known for preventing and/or treating acne and dermatitis, exhibiting high skin moisture-keeping effect, reducing excess fat, preventing and/or treating scalp conditions, etc." (WO2007107914A120070927: 21)

Illustrative Claims: "1. Cosmetic composition comprising a Gingko biloba extract, an alkyl Î²,Î²- diphenylacrylate and/or Î±-cyano Î²,Î²-diphenylacrylate derivative, and a dibenzoyl methane derivative."

TK18. WO2008038030A2 DISPIRO TETRAOXANE COMPOUNDS
University of Liverpool, Liverpool School of Tropical Medicine

Abstract: "A compound having the formula (I) wherein ring A represents a substituted or unsubstituted monocyclic or multicyclic ring; m=any positive integer; n=0-5; X=CH and Y=-C(O)NR 1R2, -NR1R2 or -S(O)2R4, where R1, R2 and R4 are each individually selected from the group consisting of H, substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted amine, substituted or unsubstituted carbocyclic ring, substituted or unsubstituted heterocyclic ring, or any combination thereof, or R1 and R2 are linked so as to form part of a substituted or unsubstituted heterocyclic ring, or X=N and Y=-S(O)2R3 or -C(O)R3, where R3 is selected from the group consisting of H, substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted amine, substituted or unsubstituted carbocyclic ring, substituted or unsubstituted heterocyclic ring or any combination thereof."

Segment: "The present invention relates to dispiro tetraoxane compounds, particularly but not exclusively, for use in the treatment of malaria and/or cancer, and methods for producing such compounds.

The discovery of artemisinin and the establishment that the peroxide pharmacophore is important for antimalarial activity has seen many attempts by chemists to synthesise simple but effective synthetic or semi-synthetic endoperoxides.

Artemisinin (2) is a naturally occurring endoperoxide sesquiterpene lactone compound of Artemisia annua, an herbal remedy used in Chinese medicine."
(WO2008038030A220080403: 11-13)

Illustrative Claims: "1. A compound having the formula (I) (I) wherein ring A represents a substituted or unsubstituted monocyclic or multicyclic ring; m=any positive integer; n=0-5; X=CH and Y=^C(O)NR1R2,-NR 1R2 or -S(O) 2R4, where R1, R2 and R4 are each individually selected from the group consisting of H, substituted or unsubstiruted alkyl,

substituted or unsubstituted aryl, substituted or unsubstituted amine, substituted or unsubstituted carbocyclic ring, substituted or unsubstituted heterocyclic ring, or any combination thereof, or R and R are linked so as to form part of a substituted or unsubstituted heterocyclic ring, or X=N and Y^S(O) 2R3 or -C(O)R 3, where R3 is selected from the group consisting of H, substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted amine, substituted or unsubstituted carbocyclic ring, substituted or unsubstituted heterocyclic ring or any combination thereof."

TK19. WO2008071968A1 CUCURBITACIN B AND USES THEREOF
Ultra Biotech Ltd. Isle of Man, UK

Abstract: "The present invention relates to uses of cucurbitacins and compositions comprising cucurbitacin B. The present invention also relates to methods for preventing or treating various diseases and disorders by administering to a subject in need thereof cucurbitacin B. The invention also encompass methods of developing a therapeutic that comprises a cucurbitacin using the signaling molecules in the Ras-Raf-Mek-Elk-STAT3 pathway."

Segment: "Cancer is the second leading cause of death in the United States. In the US, cancer accounts for 1 in every 4 deaths. The American Cancer Society estimated that in 2007, there would be 1.44 million new cases of cancer and that cancer would cause 560,000 deaths. Current cancer therapy involves surgery, chemotherapy and/or radiation treatment to eradicate neoplastic cells in a patient (see, for example, Stockdale, 1998, "Principles of Cancer Patient Management", in Scientific American: Medicine vol. 3, Rubenstein and Federman, eds., Chapter 12, Sections IV and X). All of these approaches pose significant drawbacks for the patient. Almost all chemotherapeutic agents are toxic, and chemotherapy can cause significant, and often dangerous, side effects, including severe nausea, bone marrow depression, immunosuppression, etc. Additionally, many tumor cells are resistant or develop resistance to chemotherapeutic agents through multi-drug resistance. Therefore, there is a significant need for novel compounds and methods that are useful for treating cancer with increased specificity and reduced side effects.

[0003] Natural cucurbitacins are predominantly found in the family Cucurbitaceae which contain some 900 species in about 100 genera, many familiar as the wild gourds, squash, cucumbers, and melons of Cucurblta, Cucumis, Citrullus, Marah, Echinocystis, Lagenaria, Scyos, Ecballium, and Bryonia. At least 100 species in 30 genera have been shown to contain cucurbitacins - a group of oxygenated tetracyclic triterpenes that are responsible for the characteristic bitter taste of most wild Cucurbitaceae.

[0004] Cucurbitacin B can be extracted from a traditional Chinese medicine, namely the stem-end of Cucumis melo L. It is used traditionally to treat hepatitis and liver cancer. Recent findings also indicated that cucurbitacin B protects against CC14-induced hepatotoxicity (Agil et al., Planta Med. 1999;65:673-5) and bear anti-cancer and anti-inflammatory activities (Jayaprakasam et al., Cancer Lett. 2003; 189: 11-6)."
(WO2008071968A120080619: 14-16)

Illustrative Claims: "1. A method of inducing a cytostatic effect on cancer cells in a subject, comprising: administering an effective amount of an isolated cucurbitacin to said subject, to induce said cytostatic effect in said cancer cells."

TK20. WO2009050451A1 ANTIBACTERIAL COMPOSITION COMPRISING SALVIA EXTRACTS
Botanic Century Beijing Co Ltd (China) with UK co-applicant and inventor

Abstract: “The present invention relates to a selectively purified tanshinone compounds containing extract from the root of a Salvia spp comprising Cryptotanshinone, Dihydrotanshinone, Tanshinone I, and Tanshinone IIA. It comprises at least 15%, by weight of the said identified tanshinone compounds and at least 4% by weight, of cryptotanshinone. The extract and formulations thereof have been found to exhibit excellent anti-microbial properties against, in particular MRSA.”

Segment: “The extract exhibiting these beneficial properties is derived from the root and rhizome of Salvia miltiorrhiza Bunge, a perennial herb from the Labiatae family. In Traditional Chinese Medicine (TCM) it is also referred to as Danshen.

Danshen was recorded as a top-grade herbal medicine in Shennong's Classic of Materia Medica, as well as in Compendium of Materia Medica and Annotations to the Divine Husbandman's Classic of Materia Medica.

It has broad clinical applications.

In the medical monographs of Coverage of the Materia Medica, Compendium of Materia Medica and Renewal of Herbal, Danshen is said to evacuate puss with de- toxication, a reference to its anti-bacterial and anti-inflammatory effects.

It should be noted that in TCM whole extracts, usually obtained as decoctions, are typically used in combination with a number of other herbs.

Modern scientific research on Danshen started in 1930's.

The chemical constituents of Danshen can be divided into two main categories of chemicals: â€¢ lipid-soluble, and â€¢ water-soluble.

Earlier studies on "active" compounds of Danshen have mainly been concentrated on the lipid-soluble compounds, where around 40 compounds have been found so far.

These can be further divided into two groups: â€¢ Tanshinones (o-quinone structure) and â€¢ Rosiglitazones (o-hydroxy rosiglitazone, paraquinoid structure).

Most of the tanshinone compounds are diterpenes, of which they are mainly diterpene quinones.” (WO2009050451A120090423: 15-25)

Illustrative Claims: “1. A selectively purified tanshinone compounds containing extract from the root of a Salvia spp comprising o Cryptotanshinone, o Dihydrotanshinone, o Tanshinone I, and o Tanshinone ILA, characterized in that the above identified tanshinone compounds comprise at least 15%, by weight, of the selectively purified extract and the cryptotanshinone comprises at least 4% by weight, of the selectively purified extract.”

TK21. WO2009068872A1 ANTIVIRAL
Phynova Ltd.

Abstract: “The present invention relates to a novel antiviral product and its use in the treatment of the flaviviridae family of viruses including the genus flavivirus, particularly Dengue.”

Segment: “The plant which exhibits the activity is a member of the Leguminosae family, more particularly Huang Qi: Pharmaceutical name: Radix Astragali Membranaceous; Botanical name: Astragalus membranaceus (Fisch) Bge. or Astragalus membranaceus Bge var. Mongholicus Hsiao (hereafter Astragalus).

The plant may be referred to as Milkvetch in Europe and it is the root which is used.

In traditional Chinese herbal medicine a dosage (based on dry raw material) of 9-3Og and occasionally up to 6Og is used. Typically it is taken as a decoction. According to Pharmacopoeia of the People's Republic of China (English Edition 2000) Vol I a cold water extraction method gives a water soluable extract of not less than 17%.

According to Chinese Herbal Medicine, Materia Medica, Revised edition, chemically the root of Astragalus membranaceus is known to contain, as major ingredients, D-Î² asparagine, 2'4'-dihydroxy-5, 6-dimethoxyisoflavane, calycosin, formononetin, cycloastragenol, astragalosides, choline, betaine, kumatakenin, sucrose, glucuronic acid and Î²-sitosterol.” (WO2009068872A120090604: 25-28)

Illustrative Claims: “1. An Astragalus extract or an active fraction thereof or an active compound isolated therefrom, for use in the manufacture of a medicament for the treatment of a disease caused by a genus of the flaviviridae family selected from: â€¢ the genus - Flavivirus, (Table 1.1); â€¢ the genus - Pestivirus, (Table 1.2); â€¢ the genus â €”Unassigned Flaviviradae (Table 1.3) or â€¢ tentative Species in the Genus HCV (Table 1.4).”

TK22. WO2009077187A2 COMPOSITON FOR ENHANCING IMMUNITY
Unilever PLC. Unilever Netherlands, Unilever Hindustan

Abstract: “Disclosed is an edible composition for enhanced immunity comprising theanine or a source of theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof.”

Segment: “However, in general, people do not prefer medicinal solutions to solving the problem of reduced immunity. This is because, although medicinal solutions are believed to be effective, they are believed to cause undesirable side-effects. Thus, there is a continuing demand for "natural" solutions to such problems. The science of herbal medicine is one of the ancient sciences, which finds place in modern medical research. Examples of herbal medicine include Ayurveda in India and Traditonal Chinese Medicine in China.

The present inventors have been working on the problem of providing enhanced immunity for individuals using herbs, herbal extracts and other natural materials. One of the problems faced is that although scores of herbs are cited in traditional medicinal system for boosting immunity, there is often a lack of scientific evidence for their efficacy.

Further, a large number of combinations of herbs and natural materials have been formulated to form traditional herbal recipes that have been consumed by people over the centuries for various health benefits.

The present inventors have worked extensively to verify the efficacy of the health benefits claimed in the individual herbs and the combination of herbs used in the traditional recipes. During the course of these extensive studies the present inventors determined that a combination of a naturally occurring material usually present in tea viz. theanine when combined with certain herbs viz. shankhpushpi and/or shatavari provides for synergistic benefits in providing immunity. While a large number of combinations were tried by the inventors, it was only these combinations where synergy was observed while combination of theanine with a host of other herbs either provided merely additive benefits or there was antagonistic interaction." (WO2009077187A220090625: 14-17)

Illustrative Claims: "1. An edible composition for enhanced immunity comprising theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof."

TK23. WO2009120774A2 METHOD OF PREPARING HUPERZINE A AND DERIVATIVES THEREOF
Debiopharm SA (Switzerland) with individual UK co-applicant and inventor

Abstract: "The present invention is related to the synthesis of huperzine A. The synthesis includes a variety of process steps that increase productivity, reduce safety concerns, and allow for increasing production of compounds of desired optical isomer. The inventive methods may encompass a single improved reaction step that may be incorporated into a known reaction process for synthesizing huperzine A or a derivative thereof to improve the overall reaction. The inventive methods also encompass complete synthesis methods for preparing huperzine A or a derivative thereof."

Segment: "The present invention is directed to methods for the synthesis of huperzine A, as well as analogs and derivatives thereof.

BACKGROUND Huperzine A is a plant alkaloid derived from the Chinese club moss plant, Huperzia serrata, which is a member of the Lycopodium species. Huperzia serrata has been used for centuries in Chinese medicine for the treatment of many conditions, including fevers, blood disorders, and inflammation.

In addition to these historical uses, huperzine A has more recently been found to exhibit useful neuroprotective effects. In particular, clinical trials have shown huperzine A to have acetylcholinesterase activity making it useful for increasing acetylcholine levels in the brain following administration. It also increases norepinephrine and dopamine levels, but not serotonin levels. In light of its neuroprotective effects, particularly its ability to affect acetylcholine levels, huperzine A is currently being investigated as a possible treatment for diseases characterized by neurodegeneration, including myasthenia gravis, senile memory loss, and Alzheimer's disease." (WO2009120774A220091001: 13-16)

"Huperzine A is a compound having the structure illustrated in Formula (12) and is also known as HUP, hup A, selagine and, in Chinese medicine, Chien Tseng Ta and shuangyiping." (WO2009120774A220091001: 30)

Illustrative Claims: "1. A method of preparing huperzine A of a derivative thereof, the method comprising the following steps: A) reacting the compound of Formula (1) with

methyl propiolate to form the compound of Formula (2) B) methylating the compound of Formula (2) to form the compound of Formula (3) C) performing acid hydrolysis on the compound of Formula (3) using aqueous phosphoric acid to form the compound of Formula (4) (4); D) performing carboxymethylation on the compound of Formula (4) to form the compound of Formula (5) (5); E) performing annulation on the compound of Formula (5) using acetone as the reaction solvent to form the compound of Formula (6) and performing isomerization on the compound of Formula (6) using ethylene dichloride as the reaction solvent to form the compound of Formula (7) F) performing Wittig coupling on the compound of Formula (7) to form the compound of Formula (8) G) performing isomerization on the compound of Formula (8) to form the compound of Formula (9) (9); H) performing base hydrolysis on the compound of Formula (9) to form the compound of Formula (10)."

TK24. US20040101581A1 Chinese herbs extract
Phytotech Ltd.

Abstract: "This application relates to a material which is suitable for the treatment of atopic disease, non-atopic eczema or psoriasis. The material can be extracted from a freeze-dried decoction of a mixture comprising the following Chinese herbs: Radix Ledebouriella, Fructus Tribuli, Herba Potentilla chinensis, Caulis Clematis armandii, Radix Rehmannia, Radix Glycyrrhiza, Radix Paeonia rubra, Cortex Dictamni radicis, Herba Lopatheri, Spica Schizonepetae. The material comprises one or more of those components present in the freeze-dried decoction which run with Rf values in the ranges 0.00 to 0.100, 0.167 to 0.300, 0.400 to 0.533, 0.700 to 0.833 or 0.900 to 0.967 if the freeze-dried decoction is diluted in aqueous solution and subjected to chromatography on a Whatman 2 cmsÃ—55 cmsÃ—3 mm cellulose strip for 10 hours using a solvent mixture of butanol, ethanol and water in the proportions 4:1:1."

Segment: [0008] "While a decoction of the above-described 10 herbs is known to be effective, the use of a complex prescription containing a plurality of herbs is expensive and it is therefore desirable to simplify the prescription if this can be done without compromising activity and/or safety. It would also be preferable to limit any prescription to herbs which might be grown in the UK or Europe rather than relying on import from China. Thus many attempts have been made to identify the active principle or principles in prescriptions of traditional Chinese medicines. In the case of eczema however this has proved difficult because hitherto there has been no validated animal or in vitro model for the disease which could be used to identify clinical activity in fractions or pure substances prepared from the crude herbs.

[0009] Now however an in vitro assay has been developed which appears to be predictive of clinical efficacy in atopic eczema and other atopic diseases and this has allowed the present inventors to detect active components in freeze-dried decoctions (hereinafter referred to as PSE222) of the 10 herbs listed above." (US20040101581A120040527: 16-17)

Illustrative Claims: "1. A composition for the treatment of a disease selected from the group consisting of atopic disease, non-atopic eczema and psoriasis, which comprises a decoction or extract obtained from a subset of the set of herbs consisting of: Radix Ledebouriella Fructus Tribuli Herba Potentilla Chinensis Caulis Clematis Armandii Radix Rehmannia Radix Glycyrrhiza Radix Paeonia Rubra Cortex Dictamni Radicis Herba Lopatheri Spika Schizonepetae in the substantial absence of any other herb; said decoction or extract comprising one or more of those components present in fractions

which run with rf values in the ranges: 0.00 to 0.100; 0.167 to 0.300; 0.400 to 0.533; 0.700 to 0.833; or 0.900 to 0.967 if an aqueous solution of a freeze-dried decoction of said set of herbs is subjected to chromatography on a Whatman 2 cmÃ—55 cm 3 MM cellulose strip for 10 hours using a solvent mixture of butanol, ethanol and water in the proportions 4:1:1."

TK25. US20070160693A1 Plant-based medicament for the treatment of hepatitis c Phynva Ltd. (for Phynova Ltd.)

Abstract: "The present invention relates to a botanical drug or dietary supplement for use in the treatment of patients suffering from Hepatitis C virus infection. More particularly, it relates to a botanical drug consisting essentially of four botanical drug substances, optionally formulated with excipients, for use either in alleviating the symptoms of Hepatitis, particularly chronic Hepatitis C, and/or inhibiting the activity of the causative Hepatitis C virus. The botanical raw-materials, botanical drug substances or botanical ingredients used are from a species of each of the genera: (a) Silybum; (b) Astragalus or Hedysarum; (c) Salvia; and (d) Schisandra."

Segment: "In Traditional Chinese Medicine (TCM), HCV infection is regarded as causing the following pathological changes in the body:

* accumulation of toxin and heat in the blood;
* consumption of vital energy and body fluid;
* stagnation of blood; and
* injury of liver and spleen function.

In order to address these different aspects existing TCM plant based formulations for HCV treatment usually contain many ingredients, typically ten or more. For practical purposes it would clearly be desirable and advantageous to minimise the number of botanical ingredients or botanical drug substances without in any way compromising therapeutic efficacy.

Surprisingly the applicant has found that a combination of only four plant species demonstrates activity against Hepatitis C virus.

DISCLOSURE OF THE INVENTION According to a first aspect of the present invention there is provided a botanical drug or dietary supplement, for the treatment of or for use in patients with Hepatitis C infection, consisting essentially of botanical raw materials, botanical drug substances or botanical ingredients from a species of each of the genera:

* (a) Silybum;
* (b) Astragalus or Hedysarum;
* (c) Salvia; and
* (d) Schisandra." (US20070160693A120070712: 36-48)

Illustrative Claims: "1. A botanical drug or dietary supplement, for the treatment of or for use in patients with Hepatitis C infection, comprising botanical raw materials, botanical drug substances or botanical ingredients from each of the following plant sources:
(a) The fruit of Silybum marianum;
(b) The root of Astragalus membranaceus var mongholicus or Hedysarum polybotrys;
(c) The root of Salvia miltiorrhiza, Salvia bowleyana or Salvia przewalskii; and
(d) The fruit of Schisandra chinensis or Schisandra sphenanthera."

TK26. US5466452A Pharmaceutical compositions for the treatment of skin disorders Phytopharm Ltd.

Abstract: “A process is provided which is suitable for the preparation of herbal compositions for the treatment of skin disorders such as eczema and psoriasis. The process comprises preparing an extract or extracts of herbs which provide an anti-inflammatory agent, an adrenocortical stimulant and a cortisol protecting agent by steam distillation and decoction and then treating the extracts to reduce the polysaccharide and/or sugar content. This is achieved by fermentation or enzymic action or by extraction with a solvent having a polarity in the range EÂ° 0.4 to 0.95 or by precipitation with an inorganic compound and/or colloid or by a combination of two or more of the above. As a final concentration step, the material is further purified by extraction with a solvent having a polarity in the range mentioned above. The reduction of the sugar/polysaccharide content greatly improves the handling characteristics of the extract which can be dried to a free flowing powder. Tablets and capsules for oral administration can be prepared from the extract and it is also suitable for the preparation of topical compositions.”

Segment: “Practitioners in traditional Chinese medicine however use decoctions of herbs for oral and topical treatment of dermatological conditions including eczema and psoriasis. A wide variety of agents have been used and in traditional Chinese medicine it is conventional to use a compound prescription which is designed by the practitioner after careful examination of the individual patient. It has been found by clinical experimentation that mixtures of certain herbs can be used to provide a composition which is effective in a large proportion of patients suffering from eczema and psoriasis, without recourse to individualisation of treatment. Different formulae have been devised for dry, weeping, infected and lichenified eczema although the mode of action of traditional Chinese medicines is not fully understood.

Table I shows a number of Chinese herbs which are traditionally used for the treatment of skin disorders together with the principle constituents and their pharmacological actions (Chang and But; Pharmacology and Applications of Chinese Materia Media. World Scientific Publishing 1986, Volumes I and II) . The table shows that many of the agents traditionally used have pharmacological properties which are appropriate for the treatment of symptoms of eczema and psoriasis, namely anti-inflammatory, analgesic, anti-pyretic, anti-pruritic, anti-bacterial and immune suppressent activity. Some of the agents listed may stimulate the adrenal cortex to produce endogenous corticosteroids and others may inhibit the breakdown of cortisol in certain tissues such as the skin and lung. The combination of herbs to provide a combined attack on the symptoms of eczema and psoriasis are therefore rational even though at present it is not known exactly which of the constituents are responsible for the beneficial therapeutic effects of the mixtures.

It is possible that some of the herbs in the mixtures are necessary in order to increase the solubility of some of the active constituents in water since the traditional method of preparing extracts is by decoction i.e. boiling in water. In traditional Chinese medicine some herbs are included in prescriptions because they act as demulcents i. e. agents which have a soothing effect on the gastrointestinal tract and facilitate patient acceptance. It is firmly believed by traditional Chinese practitioners that the toxicity of mixtures of herbs is less than that of the herbs given in isolation. Although this has yet to be rigorously proved in controlled clinical trials, conventional wisdom indicates that some of the herbal components have biological activities which summate, and others antagonise the toxic effect of active components. Until the active components have been identified with certainty it has proved prudent to use a decoction, extract or fractionated extract of a

plurality of herbs. To be useful in practice it is necessary to have one or more fixed composition mixtures. Surprisingly, it has been found that fixed combinations of specific herbs can be used to treat different types of eczema and psoriasis."
(US5466452A_19951114: 13-15)

"Many clinically successful anticancer drugs are themselves either natural products or have been developed from naturally occurring lead compounds. Great interest is currently being paid to drugs isolated from natural resources which have already been used as a medicine. The dried whole plant of Scutellaria barbata D. Don (Labiatae) is used in Traditional Chinese Medicine as an anti-inflammatory, an antitumour agent, and a diuretic. The Î±,Î²-unsaturated ketone, (E)-1-(4â€²-hydroxyphenyl)but-1-en-3-one has been isolated from this plant and found to have moderate antitumour activity (IC50 of 60 Î¼M for K562)." (US20100028262A120100204: 15)

Illustrative Claims: "1. A process to make a composition for treating eczema, psoriasis, pruritis and inflammatory reactions of the skin which comprises:
(a) subjecting a plurality of herbs having anti-inflammatory activity, adrenocortical stimulating activity and corticosol-protecting activity to steam distillation and decoction, to produce an extract of the herbs;
(b) reducing the amount of polysaccharides and/or sugars, in the extract to less than 5% by weight under conditions which do not substantially reduce the content of glycosides which are present in said material by one or more of:

(i) fermenting with barley malt or with a microorganism which produces amylase and/or saccharolytic enzymes or by using isolated amyolytic or saccharolytic enzymes,

(ii) extracting with a solvent having a polarity in the range EÂ° 0.4 to 0.99, or a mixture of solvents at least one of which has a polarity within said range,

(iii) precipitating the polysaccharide and/or sugar with an inorganic compound; and

(c) concentrating the active agents present in the extracted material by further extracting with a solvent having a polarity in the range EÂ° 0.4 to 0.99, or a mixture of solvents, at least one of which has a polarity within said range, wherein the herbs are selected from the group consisting of Potentilla chinensis (Bai Tai Weng), Rehmannia glutinosa (Dihuang), Radix paeoniae lactiflorae/veitchii (Chi Shao), Dictamnus augustifolia (Bai Xan Pi), Glycyrrhiza uralensis (Gan Cao), Ledebouriella sesloides (Fang Feng), Tribulus terrestris (Ci Ji Li), Lopatheri gracile (Dan Zhu Ye), Schizonepeta tenuifolia (Jing Jie Sui), and Akebia trifoliata (Mu Tong)."

TK27. WO2000002544A2 TREATMENT OF SKIN DISORDERS
BTG International Ltd.

Abstract: "The present invention provides piperine and analogues or derivatives thereof for re-pigmenting post traumatised de-pigmented skin and for the treatment of skin conditions such as vitiligo. The piperine and analogues or derivatives thereof may also be used to cosmetically promote or enhance the natural colouration of the skin."

Segment: "Certain plant remedies, usually administered as mixtures of herbs or extracts, particularly those used in traditional Chinese medicine and Indian Ayurvedic medicine, have been employed for the treatment of vitiligo for a long time and in many cases have given positive results in small scale studies. Herbs such as Psoralea corylifiblia L. and Vernonia anthelmintica Willd. (=Centratherum anthelminticum Kuntze) are well known for their use in this disease. Psoralens, which are employed in the modern PUVA and khellin in KUVA therapy were originally derived from plant sources (Psoralea corylifolia L and

Ammi visnaga respectively) used in traditional remedies for vitiligo. However these therapies rely on the use of UV irradiation for their efficacy, which is associated with the aetiology of skin cancer." (WO2000002544A220000120: 12)

Illustrative Claims: "1. Use of piperine or an active analogue or derivative thereof for stimulating the proliferation of melanocytes. 2. Use of piperine or an active analogue or derivative thereof in the preparation of a medicament for re-pigmenting de-pigmented skin."

TK28. WO2002057260A1 COMPOUNDS FOR USE IN THE TREATMENT OF SKIN CONDITIONS
BTG International Ltd.

Abstract: "The present invention provides compounds of formula (I) and analogues or derivatives thereof for the treatment of skin conditions, such as Vitiligo, which are treatable by the stimulation of melanocyte proliferation and also for treating skin cancer. The compounds may also be used to cosmetically enhance the natural coloration of the skin."

Segment: "Certain plant remedies, usually administered as mixtures of herbs or extracts, particularly those used in traditional Chinese medicine and Indian Ayurvedic medicine, have been employed for the treatment of vitiligo for a long time and in many cases have given positive results in small scale studies. Herbs such as Psoralea corylifolia L. and Vernonia a7 thelmi77tica Willd. (=Centratherum anthelminticum Kur tze) are well known for the* use in this disease. Psoralens, which are employed in the modern PWA and khellin in KWA therapy were originally derived from plant sources (Psoralea corylifolia L and Ammi visnaga respectively) used in traditional remedies for vitiligo. However these therapies rely on the use of W irradiation for their efficacy, which is associated with the aetiology of skin cancer." (WO2002057260A120020725: 15)

Illustrative Claims: "1. A compound of formula (1) for use in the treatment of a skin condition (R)m+;:;;: t) in which 5 mis2 n is O or 1 p is O or 1 q is O or 1 the two Ri groups together represent a 3',4'-methylene methylenedioxy group, 10 R2 is hydrogen; R3 and R4 represent hydrogen atoms or together represent a carbon to carbon double bond; R5 and R6 represent hydrogen atoms or together represent a carbon to carbon double bond; R7 and R8 represent hydrogen atoms or together represent a carbon to carbon double 15 bond; and R9 represents piperidino, morpholino, cyclohexylamino, methylamino, ethylamino, isopropylamino, isopropoxy, propoxy and butoxy in any of its E,Z geometrically isomeric forms or an active analogue or derivative thereof or optionally when n is 1 R2 and R3 together represent a carbon to carbon double bond and one or more of R4 and Rs together, 20 Rs and R6 together, Rfi and R7 together or R7 and R8 together represent a carbon to carbon double bond the other of R4 to R8 representing hydrogen with the proviso that the compound is not piperine, 3,4-dihydropiperine; 1,2,3,4-tetrahydropyridine, Ilepeimide or piperettine."

8.6 Indian Traditional Medicine (Ayurvedic Medicine)

The following examples from UK patent data refer to traditional knowledge in India. Note that documents referring to traditional knowledge from India often also mention traditional knowledge from China.

TK29. EP2090315A1 Method and system for producing medicinal alcohol as a prophylatic or remedy for cancer, HIV, AIDS and autoimmune diseases
UK individuals

Abstract: “A method and system for producing a prophylatic or a remedy for both solid and blood Cancer, HIV, AIDS, and AutoImmune Diseases by means of a malic, latic acid naturally fermented pasteurised solution comprises the extract of mushrooms, fruits , fruit juices, seeds , beans, various aruvedic herbs and flowers which can be taken as a dietary supplement, in both a non-toxic or a toxic variety.”

Segment: “An English Translation of, The Rig Veda (the Earliest of the Holy Books of the Hindus the last tribe to still observe some of the Aryran Traditions) which describes a ceremony in which self sacrifice was carried out. The Aryrans drank Soma were intoxicated and felt at one with the Gods.” (EP2090315A1: 17)

Illustrative Claims: “1. A method for producing, administrating a prophylactic or remedy for Cancer, HIV, AIDS and autoimmune diseases the method comprising pasteurising mushrooms, vegetables , herbs, seeds, roots, grasses , flowers, tree bark , leaves and ayurvedic medicines in natural organic and fruit juices to extract nutrients to produce a slightly alcoholic drink for consumption.” (EP2090315A120090819: 213)

TK30. US20100028262A1 3,4-METHYLENEDIOXY-SUBSTITUTED CHALCONES AS THERAPEUTIC AGENTS
Spear Therapeutics Ltd.

Abstract: “The present invention pertains to the use of a compounds for the manufacture of a medicament for use in the treatment of a proliferative condition, wherein the compounds have the following formula...” (continues).

Segment: “Many clinically successful anticancer drugs are themselves either natural products or have been developed from naturally occurring lead compounds. Great interest is currently being paid to drugs isolated from natural resources which have already been used as a medicine. The dried whole plant of Scutellaria barbata D. Don (Labiatae) is used in Traditional Chinese Medicine as an anti-inflammatory, an antitumour agent, and a diuretic. The Î±,Î²-unsaturated ketone, (E)-1-(4â€²-hydroxyphenyl)but-1-en-3-one has been isolated from this plant and found to have moderate antitumour activity (IC50 of 60 Î¼M for K562).” (US20100028262A120100204: 15)

Illustrative Claims: “1. A method of treating a proliferative condition characterized by cells which express CYP1B1 in a patient comprising administering to said patient a therapeutically-effective amount of a compound having the formula...” (continues).

TK31. WO2000002544A2 TREATMENT OF SKIN DISORDERS
BTG International Ltd.

Abstract: "The present invention provides piperine and analogues or derivatives thereof for re-pigmenting post traumatised de-pigmented skin and for the treatment of skin conditions such as vitiligo. The piperine and analogues or derivatives thereof may also be used to cosmetically promote or enhance the natural colouration of the skin."

Segment: "Certain plant remedies, usually administered as mixtures of herbs or extracts, particularly those used in traditional Chinese medicine and Indian Ayurvedic medicine, have been employed for the treatment of vitiligo for a long time and in many cases have given positive results in small scale studies. Herbs such as Psoralea corylifiblia L. and Vernonia anthelmintica Willd. (=Centratherum anthelminticum Kuntze) are well known for their use in this disease. Psoralens, which are employed in the modern PUVA and khellin in KUVA therapy were originally derived from plant sources (Psoralea corylifolia L and Ammi visnaga respectively) used in traditional remedies for vitiligo. However these therapies rely on the use of UV irradiation for their efficacy, which is associated with the aetiology of skin cancer." (WO2000002544A220000120: 12)

"The fruit of black pepper (Piper nigrum L.) and long pepper (Piper longum L.) are both important medicinal herbs in Ayurvedic and Unani (traditional Indian) medicine systems, in which remedies generally consist of mixtures of herbs. A wide range of the medicinal uses of black pepper have been documented by Kirtikar and Basu (Indiarn Medicinal Plants, 2 d Edition, Vol. 3, (1935) pages 2128-2135), including its use in the treatment of leucoderma. Black pepper has also been implicated as a possible adjunct to Vernonia anthelmintica in the treatment of leucoderma (Indian Medicinal Journal, Vol. 1, 3d Edition, (1982) 1267-1270). These two herbs are employed as a constituent in many traditional herbal preparations for a variety of uses, including gastro-intestinal and skin ailments. Compositions comprising black pepper, ginger and pipali have been used in the treatment of vitiligo (Ancient Science of Life, Vol. IX. No. 4 (1990) 202-206); however, the specific therapeutic action of black pepper in this orally administered composition has not been established." (WO2000002544A220000120: 13)

Illustrative Claims: "1. Use of piperine or an active analogue or derivative thereof for stimulating the proliferation of melanocytes."

TK32. WO2000047992A1 PROCESS FOR QUALITY CONTROL AND STANDARDISATION OF MEDICINAL PLANT PRODUCTS
Oxford Natural Products PLC.

Abstract: **"**A process for establishing a standard specification for a medicinal plant material comprises: (i) preparing a test solution or test extract of a sample of the medicinal plant material which is known to possess the or each property required for the standard; (ii) submitting the said solution or extract to two or more analytical methods including (a) a combination of NMR spectroscopy and a computer-based pattern recognition technique, and (b) one or more biological profiling techniques; (iii) obtaining results from the analytical methods used in step (ii); and (iv) establishing a standard specification for the said plant material on the basis of the results obtained in step (iii). Candidate samples of the medicinal plant material may subsequently be tested for compliance with the standard. They can be accepted or rejected depending on whether they give analytical results which fall within or outside either part or all of the specification established in step (iv). This

approach to standardisation and quality control is particularly applicable to mixtures of medicinal plant materials."

Segment: "The present invention relates to further medical uses for a botanical drug or dietary supplement consisting essentially of four botanical drug substances, optionally formulated with excipients. The botanical raw materials, botanical drug substances or botanical ingredients used are from a species of each of the genera: (a) Silybum; (b) Astragalus or Hedysarum; (c) Salvia; and (d) Schisandra."

Illustrative Claims: "1. A process for establishing a standard specification for a medicinal plant material, the process comprising: (i) preparing a test solution or test extract of a sample of the medicinal plant material which is known to possess the or each property required for the standard: (ii) submitting the said solution or extract to two or more analytical methods including (a) a combination of NMR spectroscopy and a computer-based pattern recognition technique, and (b) one or more biological profiling techniques; (iii) obtaining results from the analytical methods used in step (ii); and (iv) defining a standard specification for the said plant material on the basis of the results obtained in step (iii).

15. A process according to claim 14 wherein the system of traditional medicine is Traditional Chinese Medicine or Ayurvedic Medicine." (WO2000047992A120000817: 174)

TK33. WO2007098597A1 GLYCOSIDASE INHIBITORS AND METHODS OF SYNTHESIZING SAME
Univ Fraser Simon with UK individual co-applicant and inventor

Abstract: "Methods for synthesizing Salacinol, its stereoisomers, and analogues, homologues and other derivatives thereof potentially useful as glycosidase inhibitors are described. In some embodiments the compounds of the invention may have the general formula (I) or (II)..." (continues).

Segment: "Some naturally-occurring glucosidase inhibitors have been isolated from Salacia reticulata, a plant native to submontane forests in Sri Lanka and parts of India (known as "Kotala himbutu" in Singhalese). Salacia reticulata is a woody climbing plant which has been used in the Ayurvedic system of Indian medicine in the treatment of diabetes. Traditionally, Ayurvedic medicine advised that a person suffering from diabetes should drink water left overnight in a mug carved from Kotala himbutu wood. In an article published in 1997, Yoshikawa et al. reported the isolation of the compound Salacinol from a water-soluble fraction derived from the dried roots and stems of Salacia reticulata} Yoshikawa et al. determined the structure of Salacinol, shown below, and demonstrated its efficacy as an Î±-glucosidase inhibitor." (WO2007098597A120070907: 15)

"Salacinol and Kotalanol may potentially have fewer long-term side effects than other existing oral antidiabetic agents. For example, oral administration of Acarbose in the treatment of Type II diabetes results in undesirable gastrointestinal side effects in some patients, most notably increased flatulence, diarrhoea and abdominal pain. As mentioned above, Salacinol has been used as a therapy for diabetes in the Ayurvedic system of traditional medicine for many years with no notable side effects reported. Further, recent animal studies have shown that the oral ingestion of an extractive from a Salacia reticulata trunk at a dose of 5,000 mg/kg had no serious acute toxicity or mutagenicity in rats.3 The Salacia reticulata plant is, however, in relatively small supply and is not readily available

outside of Sri Lanka and India. Accordingly, it would be desirable if Salicinol, Kotalanol and analogues thereof could be produced synthetically." (WO2007098597A120070907: 18)

Illustrative Claims: "1. A non-naturally occurring compound selected from the group consisting of compounds represented by the general formula (I) and stereoisomers and pharmaceutically acceptable salts thereof: (I) where X is selected from the group consisting of S, Se and NH; Ri, R , R3, R and R 5 are the same or different and are selected from the group consisting of H, OH, SH, NH , halogens and constituents of compounds selected from the group consisting of cyclopropanes, epoxides, aziridines and episulfides; and R is selected from the group consisting of H and optionally substituted straight chain, branched, or cyclic, saturated or unsaturated hydrocarbon radicals."

TK34. WO2008107296A1: TEA COMPOSITION
Unilever PLC, Unilever Netherlands, Unilever Hindustan (India)

Abstract: "Disclosed is a tea composition comprising tea and from 0.1 to 4.0 weight % Bacopa monnieri, its extracts or derivatives thereof.The tea composition may be used to provide enhanced mental healthof an individual, improved learning ability of an individual and/or improved memory of an individual whilst delivering the organoleptic properties of tea."

Segment: "Bacopa monnieri is also known as Bacopa monniera, water hyssop, or Herestis monniera. In India, this herb is known as Brahmi. The term Bacopa monnieri, Bacopa and Brahmi are used interchangeably throughout this specification and is meant to denote the same ingredient. Bacopa grows in damp, marshy areas and is under cultivation as a medicinal crop. The herb and extracts for ingestion purposes are known to be very bitter and pungent. Brahmi has been used in a wide variety of medicinal preparation in "Ayurveda" the traditional Indian system of medicine. In this system of medicine, Brahmi has been used as a brain tonic to enhance memory development, learning and concentration. Active compounds in Brahmi include alkaloids like Brahmine and herpestine; saponins like d-mannitol and hersaponin, acid A and monnierin; and sterols. Other active constituents include betulic acid, stigmastarol, beta-sitosterol and numerous bacosides and bacopasaponins. A preferred amount of Bacopa monnieri, extracts or derivatives thereof in the tea composition of the invention is at least 0.5% and utmost 2.0% by weight of the composition. An especially preferred form of Bacopa monnieri is an aqueous extract of the herb. The extract could be made from any part of the Bacopa plant, preferably the aerial part of the Bacopa plant including leaves, shoots, bark, flower, fruits, stem or a mixture thereof. It is especially preferred that the leaf and/or stem part is used. A preferred form of Bacopa to be added to the tea composition of the invention is the powder form." (WO2008107296A120080912: 39)

Illustrative Claims: "1. A tea composition comprising: (a) tea; and (b) from 0.1 to 4.0 weight % Bacopa monnieri, its extracts or derivatives thereof."

TK35. WO2009032887A1 METHODS OF TREATING OR PREVENTING RESPIRATORY TRACT INFECTION COMPRISING ADMINISTERING CHOLECALCIFEROL
Proctor and Gamble US with UK individual co-applicant and inventor

Abstract: "The present invention comprises an oral composition. More particularly to a method of treating and preventing a respiratory tract infection comprising: the steps of administering to a human a composition comprising from about 450 IU to about 500,000 IU of cholecalciferol, per dose of the composition."

Segment: "The composition may comprise an andrographis extract, an active component thereof, or mixtures thereof. As used herein, the andrographis is a plant of the genus Andrographis, having a limited number of species within this genus largely present in Asia. Only a few of the species are medicinal. In one embodiment, the plant is of the species Andrographispaniculata, which may be referenced as Kalmegh in Ayurvedic medicine.

Andrographis is typically standardized by quantifying the total amount of andrographolides, which often make up 5 to 20% of the extract." (WO2009032887A120090312: 75-77)

Illustrative Claims: "1. A method of treating and preventing a respiratory tract infection comprising: the steps of administering to a human a composition comprising from 450 to 500,000 IU of cholecalciferol, per dose of composition."

TK36. WO2009077187A2 COMPOSITON FOR ENHANCING IMMUNITY
Unilever PLC, Unilever Netherlands, Unilever Hindustan (India)

Abstract: "Disclosed is an edible composition for enhanced immunity comprising theanine or a source of theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof."

Segment: "However, in general, people do not prefer medicinal solutions to solving the problem of reduced immunity. This is because, although medicinal solutions are believed to be effective, they are believed to cause undesirable side-effects. Thus, there is a continuing demand for "natural" solutions to such problems. The science of herbal medicine is one of the ancient sciences, which finds place in modern medical research. Examples of herbal medicine include Ayurveda in India and Traditonal Chinese Medicine in China.

The present inventors have been working on the problem of providing enhanced immunity for individuals using herbs, herbal extracts and other natural materials. One of the problems faced is that although scores of herbs are cited in traditional medicinal system for boosting immunity, there is often a lack of scientific evidence for their efficacy.

Further, a large number of combinations of herbs and natural materials have been formulated to form traditional herbal recipes that have been consumed by people over the centuries for various health benefits.

The present inventors have worked extensively to verify the efficacy of the health benefits claimed in the individual herbs and the combination of herbs used in the traditional recipes. During the course of these extensive studies the present inventors determined that a combination of a naturally occurring material usually present in tea viz. theanine when combined with certain herbs viz. shankhpushpi and/or shatavari provides for synergistic benefits in providing immunity. While a large number of combinations were tried

by the inventors, it was only these combinations where synergy was observed while combination of theanine with a host of other herbs either provided merely additive benefits or there was antagonistic interaction." (WO2009077187A220090625: 14-17)

Illustrative Claims: "1. An edible composition for enhanced immunity comprising theanine and a herb selected from Shankhpushpi, Shatavari, or a mixture thereof."

TK37. WO2009077188A1 TEA COMPOSITION AND PROCESS FOR THE MANUFACTURE THEREOF
Unilever PLC, Unilever Netherlands, Unilever Hindustan (India)

Abstract: "A composition comprising tea, 0.1 to 15% by weight of herb selected from Shankhpushpi, Shatavari, Vidarikhand, Arogyapacha or a mixture thereof; and 0.01 to 0.5% by weight of a flavouring agent is disclosed. Also disclosed is a process for manufacturing the composition."

Segment: "However, in general, people do not prefer medicinal solutions to solving the problem of reduced immunity. This is because, although medicinal solutions are believed to be effective, they are believed to cause undesirable side-effects. Thus, there is a continuing demand for "natural" solutions to such problems. The science of herbal medicine is one of the ancient sciences, which finds place in modern medical research. Examples of herbal medicine include Ayurveda in India and Traditonal Chinese Medicine in China." (WO2009077188A120090625: 13)

Illustrative Claims: "1. A composition comprising: (a) tea; (b) 0.1 to 15% by weight of herb selected from Shankhpushpi, Shatavari, Vidarikhand, Arogyapacha or a mixture thereof; and (c) 0.01 to 0.5% by weight of a flavouring agent."

TK38. WO2009103953A1 TREATMENT OF ENERGY UTILIZATION DISEASE
Summit Corp PLC.

Abstract: "Described are compositions comprising imino sugar acids for the treatment of energy utilization disease (e.g.metabolic syndrome, including any disease or disorder associated therewith, for example central obesity, elevated levels of triglycerides and diabetes, including type 1 diabetes, type 2 diabetes and insulin resistance), processes for producing said compositions from various plant sources, together with various products, compounds, compositions, medical uses and methods based thereon."

Segment: "Example 1: Detection of the compound of formula (G2) in Gvmnema Gymnema sylvestre is a liana or climbing plant with stems up to 8 m in length. It grows in open woods and bushland at an altitude of 100-1000 m in India, China, Indonesia, Japan, Malaysia, Sri Lanka, Vietnam and South Africa: Both the leaf and root are used in Ayurvedic medicine. Because of its property of abolishing the taste of sugar it was given the Hindi names of Gurmar and Madhunashini meaning 'sugar destroying.' The herb is traditionally used for the treatment of metabolic syndrome and Gymnema extracts are sold in Japan for the control of obesity." (WO2009103953A120090827: 220)

Illustrative Claims: "1. An isolated imino sugar acid for the treatment of an energy utilization disease, wherein the imino sugar acid does not inhibit glucosidase (e.g. disaccharidase) activity. 2. A nutraceutical or pharmaceutical composition comprising an isolated imino sugar acid, wherein the imino sugar acid does not inhibit glucosidase (e.g. disaccharidase) activity."

TK39. WO2010046316A2 A TOPICAL COMPOSITION
Unilever Netherlands, Univlever PLC, Unilever Hindustan (India)

Abstract: "The invention relates to a topical composition and a method for reducing or preventing occurrence of acne on the skin. It is an object of the present invention to provide for a combination of herbal extracts that interact synergistically to provide a cosmetic composition for prevention, reduction or treatment of acne. The present invention provides for a topical composition comprising (i) an extract of a first active which is Azhadirachta indica; and (ii) an extract of a second active selected from Momordica charantia or Sesamum indicum."

Segment: "The present invention provides for a topical composition comprising a mixture of extracts of two herbal actives. The first active is the herb Azhadirachta indica. The second active is a herb selected from either Momordica charantia or Sesamum indicum. It is particularly preferred that the extract is a water extract.

Azadirachta indica, also known as Melia azadirachta, is a large evergreen tree which can grow up to a height of 18 meters and can have a girth of up to 2.4 meters. It grows in the wild throughout India and in similar tropical climatic countries. It is also cultivated widely in India. The tree is deeply associated with Indian culture and is known as Neem, Nim, Nimba, Nimb, Veppa, Bevinamara, Limba, Vembu etc. in different languages of India. Outside India, the tree is known as Indian Lilac, Margosa or Neem Tree. The extract of neem for use in the present invention is preferably from the leaves of the neem tree. Leaves of neem have been used in the traditional Indian medicinal system known as Ayurveda for treatment of various disorders. It has been reported to be used in treating various skin disorders, and for preventing wound infections. Decoction of the leaves is added to bath water to get rid of skin problems." (WO2010046316A220100429: 30-31)

"Ayurveda, the traditional Indian form of medicine, uses karela fruit as laxative, anti pyretic and as an appetizer. It is used in Ayurveda to improve liver functions and to purify the blood. Fruits are eaten as food and used in treatment of arthritis, gout, liver and spleen enlargement." (WO2010046316A220100429: 38)

Illustrative Claims: "1. A topical composition comprising (i) an extract of a first active which is Azhadirachta indica; and (ii) an extract of a second active selected from Momordica charantia or Sesamum indicum."

TK40. WO2010046710A1 THERAPEUTICS FOR NEUROLOGICAL DISORDERS
University of Sheffield

Abstract: "The present invention relates to therapeutic compounds that are Nrf2-ARE pathway activators suitable for the treatment of diseases known to be mediated by oxidative stress such as motor neurone disease. The invention also includes compounds identified by the methods of the invention for treatment of neurodegenerative diseases."

Segment: "We have shown Ebseien gives a robust concentration response curve in this assay. The calculated Z' score was 0.51 (Fig 2b) which is acceptable for library screening, In addition, signal to noise (S/N) and signal to background (S/B) ratios were acceptable at 12.8 and 2.9 respectively. The library was subsequently screened at a single concentration per compound of 10ÂμM. Drug library dilutions and plating were carried out by a Q-BOT liquid handling system and both the 4xARE-TK-GFP reporter cell line and TK-GFP control ceil line were tested for their response to the compounds. An example set of data for the

ARE-TK-GFP cell line from a single 384 well plate is shown in Figure 3. Hits were identified as having data points more than three standard deviations above the background level, which was the average value of 24 wells treated with vehicle (0.1% DMSO) only. Hit compounds were checked to see if they generated a response in the control cell line due to either non-specific activation of transcription or autofluorescence of the compounds. In addition, any compounds showing signs of toxicity by enhancing ethidium homodimer fluorescence were excluded. The library screen was repeated with the 4xARE -TK-CHO cell line only and compounds which emerged as hits from both screens were taken forward for further assessment. A total of 46 compounds were identified on this basis. The next step was to determine the compound concentration required to give a 50% response (ECS0) for these 46 hit compounds. Each compound was subjected to a 7 point concentration response curve in duplicate wel!s. Many compounds showed a beli shaped dose response curve simitar to that seen for standard ARE inducers such as tBHQ and EGCG1 due to toxicity at higher concentrations. Figure 4a shows all 46 dose response curves in the first assay. The majority of compounds exhibit a bell-shaped dose response curve with toxicity at higher concentrations and many also have a very narrow window of ARE induction. Figure 4b shows a set of compounds with enhancement of reporter expression over a broader concentration range (>1 log unit) or with minimal toxicity at higher concentrations. The concentration response curves for all 46 hits were repeated and the average EC50 and average maximum fold induction of GFP fluorescence measured. The lowest concentration which caused a toxic response was also noted and the data are summarised in Table 2 (presented herein after), together with a brief description of the known bioactivity of these compounds. The lowest dose at which toxicity was observed is also included in the table. Compounds are ranked according to activity in the reporter assay. The most potent ARE inducer was the natural product andrographolide, the only compound with a sub-micromo!ar EC50 (740 nM), this compound comes from the natural product AÏ€drographis paniculata, and is used widely in Chinese and Indian herbal medicine. Of the 26 other natural products, a further two have been used in man; securinine, a GABAA receptor antagonist and CNS stimulant and isoÏ‹quiritigenin, a component of liquorice root which is an aldose reductase inhibitor. The remaining 19 products were synthetic small molecules or derivatives and of these a total of six molecules were approved drugs. Two alkylating antineoplastic drugs (pipobroman and mechiorethamine) a dopamine agonist (apomorphine hydrochloride), a topical skin whitener (hydroquinone), a loop diuretic (ethacrynic acid) and a vasodilator (isoxsuprine hydrochloride). One of the synthetic small molecules had reached phase three clinical trials in stroke (Ebselen)." (WO2010046710A120100429: 94)

Illustrative Claims: "1. A therapeutic agent for the treatment of motor neurone disease, the therapeutic agent being a Nrf2-ARE pathway activator selected from the group comprising andrographolide and S [+] apomorphine."

TK41. WO2010049678A2 TREATMENT OF ENERGY UTILIZATION DISEASES
Summit Corp PLC

Abstract: "Described are various compounds, in particular iminosugars, for the treatment of energy utilization diseases, in particular diabetes (including type 1 diabetes, type 2 diabetes and insulin resistance) and metabolic syndrome (including any disease or disorder associated therewith, for example central obesity and elevated levels of triglycerides)."

Segment: "Table 3 Example 2: Detection of Cpd 7 in Gvmnema Gymnema sylvestre is a liana or climbing plant with stems up to 8 m in length. It grows in open woods and

bushland at an altitude of 100-1000 m in India, China, Indonesia, Japan, Malaysia, Sri Lanka, Vietnam and South Africa: Both the leaf and root are used in Ayurvedic medicine. Because of its property of abolishing the taste of sugar it was given the Hindi names of Gurmar and Madhunashini meaning 'sugar destroying.' The herb is traditionally used for the treatment of metabolic syndrome and Gymnema extracts are sold in Japan for the control of obesity." (WO2010049678A220100506: 397)

"Example 6: Properties of the Cpd 7 of the invention Chemical Properties Cpd 7 of the invention is an iminosugar acid of molecular weight 177. It is freely soluble in water. The compound is stable under all normal laboratory storage conditions.

Occurrence and Exposure Data The Cpd 7 is a natural product that occurs in polar extracts of a range of plants that are known in Ayurveda and the European plant pharmacopoeia. The present inventors have detected the compound at concentrations ca. 0.2 mg/mL in several herbal medicinal products used in the management of obesity and diabetes in humans. Such products are generally regarded as safe and, at typical doses, exposure to the Cpd 7 from their consumption is around 1 mg/day."
(WO2010049678A220100506: 410-411)

Illustrative Claims: "1. A compound of Formula (1) in which n represents an integer from 1 to 7, provided that where n>1 the ring may also contain at least one unsaturated C-C bond z represents an integer from 1 to (n+2) y represents 1 or 2 R1 represents H; C1-15 alkyl, C1-15 alkenyl or C1-15 alkynyl, optionally substituted with one or more R2; oxygen or an oxygen containing group such that the compound is an N-oxide..." (continues).

TK42. WO2010086716A1 ORGANIC BODY OIL COMPOSITIONS AND METHOD THEREOF
Himalaya Global Holding Ltd. (coded UK but registered in Grand Cayman)

Abstract: "Disclosed herein is an organic body oil composition comprising extracts of organically certified herbs and organic essential oils, wherein the extract is prepared by employing super critical fluid extraction."

Segment: "In accordance with another embodiment of the present invention, there is provided an organic body oil composition, wherein the extract of herbs is obtained from a blend of herbs selected from Withania somnifera, Sida cordifolia, Riibia cordifolia, Terminalia chebula, Terminalia bellerica and Phyllanthus emblica."
(WO2010086716A120100805: 22)

"Clinical trial to evaluate the safety and efficacy of Organic Rejuvenating massage oil: The study was conducted at Shubhdeep Ayurvedic Medical College and Hospital Indore, (MP), India. Introduction." (WO2010086716A120100805: 61)

Illustrative Claims: "1. An organic body oil composition comprising extracts of organically certified herbs and organic essential oils, wherein the extract is prepared employing a super critical fluid extraction."

TK43. WO2010119294A2 COMPOSITION
Ron Fields Nutrition

Abstract: “The invention provides a composition for oral administration comprising as active ingredient a combination of material derived from the plants Andrographis paniculata, Tinospora Cordifolia, Eclipta alba, Tephrosia purpurea, Vitex negundo, Zinzibar officinale, Terminaliai chebula and Withania somnifera. Methods for preparing such a composition and the use of such a composition in therapy of animals are also provided.”

Segment: “Background of the Invention

Compositions based on plants or plant materials have been used for treating a variety of conditions in humans and animals. Combinations of herbs have traditionally been used in Ayurvedic medicine, for example.

Various combinations of plants or plant materials have been advocated for use in a variety of conditions, such as treating disorders of the immune system, cardiovascular diseases and as hepatoprotective agents.

Commercially available products comprising combinations of herbal components of use in improving the general health of animals include anti-arthritic preparations such as Elastinâ„¢ feed supplement suitable for use with dogs, cats and horses which comprises a combination of Boswellia Serrate gum, Glycyrrhiza Glabro roots, Curcuma longa, Tinospora Cordifolia stems, Trigonella foerum-graecum seeds, Vitex negundo , Withania Somnifera, Zingibar Officinale and Phyllanthus embelica fruits and Hepasan â„¢ feed supplement , a liver tonic for dogs comprising a combination of Boehaaria diffusa, Terminalia arjuna, Eclipta alba, Terminalia chebula , Achyranthes aspera and Andrographis paniculata (all of which products are available from Ron Fields Nutrition, Hereford, UK) .

Although feed supplements based on such specific combinations of herbal components for use in treating specific ailments in specific animals are commercially available, there remains a continuing need for the development of animal health products with improved effectiveness and range of applicability. In particular, there remains a need for the development of improved compositions for treating ailments in animals such as cats for which it is often considered that effective and commercially viable treatments are not available.

Summary of the Invention

The present invention is concerned with compositions which are effective in improving the general health of animals including humans. In particular the compositions are effective in improving the health of domestic animals such as dogs and especially cats, as well as horses and cattle. The compositions are effective in improving liver function, as anti-arthritis agents in improving joint mobility and freedom of movement, and are also useful in protecting animals against infection.

In a first aspect, the invention provides a composition for oral administration comprising as active ingredient a combination of materials derived from the plants Andrographis paniculata, Tinospora Cordifolia, Eclipta alba, Tephrosia purpurea, Vitex negundo, Zinzibar officinale, Terminaliai chebula and Withania somnifera .

The invention also provides a method for preparing such a composition and the use of such a composition in therapy of animals, and in protecting animals against infection." (WO2010119294A220101021: 14-21)

"Andrographis paniculata, commonly known in Ayurvedic medicine as Kalmegh, is a herbaceous plant of the Acanthaceae family, which is well known for treating infections and as an immunostimulant agent amongst other pharmacological activities. In the active ingredient according to the present invention, the Andrographis paniculata is suitably present in an amount of from 10 to 20 % of the total weight of plant-derived material in the composition, for example 15% of the total weight of plant- derived material in the composition. " (WO2010119294A220101021: 34)

"Tephrosia purpurea, commonly known as Wild Indigo is used in Ayurvedic medicine for the treatment of a variety of disorders including rheumatism, asthma and urinary disorders. In the active ingredient according to the invention, the Tephrosia purpurea is suitably present in an amount of from 5 to 15 % of the total weight of plant-derived material in the composition, for example 10% of the total weight of plant-derived material in the composition." (WO2010119294A220101021: 37)

Illustrative Claims: "1. A composition for oral administration comprising as active ingredient a combination of materials derived from the plants Andrographis paniculata , Tinospora Cordi folia , Eclipta alba, Tephrosia purpurea , Vitex negundo, Zinzibar officinale , Terminaliai chebula and Withania somnifera .2. A composition according to claim 1 further comprising an additional active ingredient comprising material derived from one or more of the plants Phyllanthus embelica, Terminalia arjuna, Boswellia Serrate, Boehaaria diffusa and Achyranthes aspera."

8.7 Indigenous Peoples and Local Communities

The following examples provide information on references to indigenous peoples and local communities in UK patent data for genetic resources. We include examples that are not directly relevant to the Nagoya Protocol in order to provide an overview of the types of references that are encountered.

Amerindian/Amerindians:

TK44. US6048867A Biologically active rupununines
Conrad Gorinsky

Abstract: "A method of therapy wherein there is administered to a person in need of such therapy a pharmacologically effective amount of a rupununine having the formula: ##STR1##"

Segment: "The invention relates to alkaloids, and especially to bisbenzylisoquinoline alkaloids, and derivatives thereof.

It has been known for some time that Amerindian peoples of the Rupununi area of Guyana, South America chew the nuts of the greenheart tree (Ocotea rodiaei) as a crude form of contraception. Also, infusions of the bark of the greenheart tree have been used as a febrifuge and as an anti-periodic in fevers. Some bisbenzylisoquinoline alkaloids from other plants are known to have similar uses, and it was considered possible that the activity of the greenheart tree was attributable to a bisbenzylisoquinoline alkaloid. Although bisbenzylisoquinoline alkaloids have been extracted from the greenheart tree, no biological activity had previously been reported for such alkaloids.

We have now isolated an active bisbenzylisoquinoline alkaloid which we have named rupununine C.sub.37 H.sub.40 O.sub.6 N.sub.2 which has now been characterised, as in Formula 1. The isolated compound had OR. sub.1 and OR.sub.2 one as a hydroxy group the other as a methoxy group, not distinguished in the mass spectrograph."
(US6048867A: line 9-11)

"Although the greenheart tree (Octotea rodiaei) has been reported to be a source of d-curine, no biological activity has been reported of bisbenzylisoquinoline alkaloids from this plant. However it is known that amongst the Wapishana tribe of the Rupununi area of Guyana, the seeds (or fruits) of this tree have been used as a form of oral contraceptive. The fact that the alkaloids rodiasine, sepeerine, ocotine, ocotosine, demerarine, dirosine, norrodiasine and 2(+)-nortetrandrine have been isolated from the bark and seeds of this tree, brought speculation as to the possible biological properties existing in the plant."
(US6048867A: 14)

Illustrative Claims: "1. A method of treating lung tumors sensitive to rupununine wherein there is administered to a person in need of such therapy a pharmacologically effective amount of a rupununine having the formula: wherein R=â€"H or â€"CH3 and wherein one or both of the hydroxy groups may carry a substituent, the same or different, selected from the group consisting of alkyl, acyl and glycosidyl groups."

TK45. EP610059A1 Polyacetylenes
Conrad Gorinsky

Abstract: “A 2-(1-nonen-3,5,7-triynyl)3-hydroxy tetrahydropyran (cunaniol) particularly that having the formula:- or a corresponding anhydrocunaniol or cunanione, for use in therapy, especially as a reversible heart blocking agent or neuromuscular active or in neurofunction generally; or for use as a pesticide or mycobactericide. Derivatives are also referred to as are various methods, e.g. of treatment, using the cunaniol, anhydrocunaniol, cunanione or derivatives.”

Segment: “The invention relates to polyacetylene derivatives, and especially to the tetrahydro pyranol derivatives known as cunaniols, and their derivatives.

The term "cunani" has long been used by Amerindians for a group of fast acting fish poisons. Such fish poisons are generally derived from plants, and especially from the leaves thereof. South America probably possesses greater numbers of recorded fish poison plants than any other continent. For example, Guyana is thought to have about 40 such fish poison plants.

Effective fish poisons may be derived from the root of the Kurukuruwai plant, or from the sap, leaves or stems of the Kumarau plant. The fruit of the Sisal plant may be crushed in water and used as a fish poison.

The present invention however is concerned with a particular class of compounds which are polyacetylenes as set out in the claims herein, and their derivatives. These polyacetylenes include cunaniols of the following general formula:..” (continues). (EP610059A119940810: 10-13)

Illustrative Claims: “1. A 2-(1-nonen-3,5,7-triynyl)3-hydroxy tetrahydropyran (cunaniol), particularly that having the formula:- or a corresponding anhydrocunaniol or cunanione, for use in therapy, especially as a reversible heart blocking agent or neuromuscular active or in neurofunction generally; or for use as a pesticide or mycobactericide.”

American Indian:

References to American Indian in UK first filings exclusively refer to literature or to passing references as illustrated in the following examples:

TK46. WO1997020070A1 METHODS FOR SEPARATING AND/OR IDENTIFYING DNA MOLECULES
The Anthony Nolan Bone Marrow Trust

Segment: “Characterization of the HLA-A polymorphism by locus-specific polymerase chain reaction amplification and oligonucleotide hydridization. Human Immunology 1994: 41; 267-279 29.-A. Selvakumar, C. B. Granja, M. Salazar, S. M. Alosco, E. J. Yunis & B. Dupont. A novel subtype of A2 (A*0217) isolated from the South American Indian B-cell line AMALA. Tissue Antigens 1995: 45; 343-347 30.” (WO1997020070A119970605: 193-194)

TK47. WO1998047363A1 COMPOSITION FOR THE CONTROL OF CLAVICEPS AFRICANA
Imperial College

Segment: “Hassan et al (Proceedings XIII International Plant Protection Congress. The Hague. July 1995. Abstract 677) merely suggest that "a higher sugar content of exuded honeydew might suppress secondary conidiation. Such a strategy might be achieved by incorporation of a sweet sorghum character into the genome of the male-sterile line, if some sweet sorghums could be shown to support an altered parasitic behaviour of the pathogen". However, of note, these workers did not present any data showing that they had actually investigated such an approach, let alone had any test data for same. Aside from sorghum plants, ergots also infect other plants such as maize, rye and millet. Maize, the American Indian word for corn, means literally "that which sustains life".” (WO1998047363A1)

TK48. WO1999006388A2 PHARMACEUTICAL COMPOUNDS ISOLATED FROM ARISTOLOCHIA TALISCANA
Electrophoretics International

Segment: “Crude extracts from Aristolochia tafiscana have been known for many years to have certain medicinal properties. A book published in the 1800's, called "Las Plantas Medicinales de Mexico" (Medicinal Plants of Mexico) makes reference to the use of Aristolochia tafiscana extracts in the treatment of snake bites and it would appear that the native tribes in this region of Mexico have known about the uses of the extracts for many centuries.” (WO1999006388A2)

TK49. WO2002064795A2 ENZYMES
Incyte Genomics Inc (US) with UK co-applicant and inventor

Segment: “In addition, the mitochondrial enzyme aldehyde dehydrogenase 2 catalyzes the second step in ethanol utilization: Step 1: ethanol + NAD+ acetaldehyde + NADH (alcohol dehydrogenase) 25 Step 2: acetaldehyde + NAD+ acetic acid + NADH (aldehyde dehydrogenase) Defects in aldebyde dehydrogenase result in acute alcohol intoxication. This genetic defect is very common in South-east Asians and South American Indians, while less common in Caucasians. The inactive variant allele encodes a single amino acid exchange (Hsu, L.C. et al. (1988) Genomics 2:57-65).” (WO2002064795A2)

TK50. WO2004003220A2 METHODS AND COMPOSITIONS FOR ANALYZING COMPROMISED SAMPLES USING SINGLE NUCLEOTIDE POLYMORPHISM PANELS
Orchid Biosciences Inc. with UK individual co-applicant and inventor

Segment: “A compromised sample is "genetically related" to another compromised 15 sample or a reference sample if the samples can be said, to a degree of statistical certainty, to derive from a defined population of interest. By a "defined population of interest" is meant a group of individuals of interest that share certain features of their genomes in common, for example, family members, ethnic groups such as Asians, Africans, Native Americans, and the like. A " defined population of interest" may be 20 as small as a single individual, or as large a group as all females or all males in the human population. Thus, for example, a compromised sample derived from a male individual of Asian heritage may be "genetically related" to a female Asian sibling if the defined population of interest consists of all Asians, but would not be considered to be "genetically

related" in this sense if the defined population of interest consists of Asian males only." (WO2004003220A2)

TK51. WO2004006944A1 FLOWER ESSENCE-CONTAINING MEDICAMENTS
UK individual

Segment: "Various treatments are used to assist people suffering from stress, including 20 pharmaceutical drug therapy, relaxation techniques such as yoga and meditation, and aromatherapy. Aromatherapy involves a range of treatments using essential oils and flower essences that are extracted from plants. Essential oils are known to contain the plant actives that have a 25 beneficial effect of repairing the cellular structure ofthe skin and helping to stimulate the growth of new cells, flower essences, on the other hand, are known as the flowers liquid energy and have the extraordinary ability directly to enhance and alter our emotional response to ourselves and the world, bringing relief from unsettling moods and emotions such as fear, anxiety, guilt, anger and melancholy, and helping with the development of a 30 positive and stress-free attitude towards our life. It is well known that a happy self-image has a powerful physiological effect that adds to the inner glow of health and vitality. Many ancient civilizations, particularly the Chinese, documented the use of such materials in treating different disorders, and some aromatherapy treatments are known to have effect on stress-related conditions. Indeed, the Australian Aborigines practiced one of the most ancient forms of flower essence therapy. Around 10,000 years ago they were gathering dew-drenched flowers and either drinking the dew or placing the flowers in their mouths.

If the flowers were inedible, then they would simply sit among them. They found that the; 5 flowers could restore a person's mental attitude. If someone were afraid, they would gain courage, if angry they would find peace, if sick would become well again. It is believed I that Native Americans, Minoans and ancient Egyptians harnessed the healing powers of flowers in similar ways." (WO2004006944A1)

TK52. WO2005049086A1 YEAST COMPOSITIONS AND THEIR USES AS DIETARY SUPPLEMENT OR MEDICINE
Ultra Biotech Ltd.

Segment: "According to the Lupus Foundation of America, approximately 1.4 million Americans have LE. Although LE can affect both males and females at all ages, LE occurs 10 to 15 times more frequently among adult women than adult men. Also, LE is two to three times more common among African Americans, Hispanics, Asians and Native Americans." (WO2005049086A1)

TK53. WO2005094234A2 DIETARY SUPPLEMENT AND METHOD FOR TREATING DIGESTIVE SYSTEM-RELATED DISORDERS
Freedom Health LLC. with UK individual co-applicant and inventor

Segment: "[00 19] The third disorder in the second group is lactose intolerance, which is caused by a deficiency of lactase, an enzyme which is required to absorb and digest lactose (the sugar in milk and other dairy products). Undigested lactose in the digestive system lingers in the colon and ferments, causing abdominal pain, bloating, gas, and diarrhea. Over ten percent lo of Americans are lactose intolerant, and as many as 75 percent of people of African descent and Native Americans, and 90 percent of people of Asian descent are lactose intolerant. Lactose intolerance is primarily treated by diet, with

lactose intolerant 1 5 people simply avoiding dairy products. Lactase enzymes are also available in tablet or liquid form and may be ingested with the dairy products.**"** (WO2005094234A2)

TK54. WO2005071058A2 METHODS AND SYSTEMS FOR ANNOTATING BIOMOLECULAR SEQUENCES
Compugen Ltd. with UK co-applicant and inventor

Segment: "X-Lired Z40343 MIDI Opitz Syndrome, X-Linked HUM6PTHS PTS Pyrovoyltetrahydropterin Synthase Deficiency M62103 CIRH1A North American Indian Childhood Cirrhosis HSDHPR QDPR Dihydropteridine Reductase Deficiency (DHPR) T23665 FKRP Congenital Muscular Dystrophy Type 1C;Limb-Girdle Muscular Dystrophies, Autosomal Recessive T60498 LRPPRC Leigh Syndrome, French-Canadian Type HSACHRA CHRNA1 Congenital Myasthenic Syndromes HSACHRB CHRNB 1 Congenital Myasthenic Syndromes HSACHRG. . CHRND Congenital Myasthenic Syndromes HSACETR. . CHRNE Congenital Myasthenic Syndromes HSACRAP. RAPSN Congenital Myasthenic Syndromes M78334. COLQ Congenital Myasthenic Syndromes S56138. . CHAT. Congenital Myasthenic Syndromes D11584. SDHC Familial Nonchroman Paragangliomas HSPSTI." (WO2005071058A2)

Andean/Andes

We identified a reference to Andean potato, Andean potato mottle virus and the importation of a pest species into the UK from the Andean region. For Andes we identified a passing reference to Andes virus and as part of a species name.

One example of potential interest is provided below. However, note that this example refers to a species that *does not* occur in the Andes. The applicants in this case are a Colombian company (Ecopulpa) with a UK inventor as co-applicant and the first filing recorded in the UK.

TK55. US20100186912A1 PULP PRODUCTION
Ecopulpa Limitada (Colombia) with UK individual co-applicant and inventor

A process for the production of a paper pulp, comprising preparing the pulp from a raw material derived from a plant of the Araceae family. In this case the applicant is a Colombian company Ecopulpa with a UK inventor and first filing in the UK. However, in 2011 the UK family (equivalent) application was taken to be withdrawn or refused in the UK

Segment: "Plants of the Araceae family are widely distributed in the tropics; and are often cultivated as an ornamental plant and as a food source (Mayo, S. J., Bogner, S. & Boyce, P. C. 1997, The Genera of Araceae, Royal Botanic Gardens, Kew). When present, they are typically found in a large number of individual plants, which are often of climbing habit and have large leaves. Wherever there is woodland the Araceae are represented, but they are not frequent in the cloudy forest, on the sides of the coastal and Andean mountains and also in the rainforests of the lowlands. Some species however also occur in semi-deciduous woodland and in open areas with a marked dry season (Bunting, G. 1973, Synopsis of the Araceae in Venezuela, Agricultural Botany Institute, Faculty of Agriculture, Central University of Venezuela)." (US20100186912A120100729: 62)

"According to the present invention, the Aroideae are a preferred sub-family of plants within the Araceae family. More preferred are the Montrichardieae tribe and especially the Montrichardia genus. A most preferred member of the Araceae family is Montrichardia arborescens, commonly known as Arracacho, mocou mocou, or moko moko. M. arborescens has been reported in all countries from Guatemala to Panama, and in Puerto Rico and in the lesser Antilles, Guyana, Dutch Guyana, French Guyana, Venezuela and Northern Brazil (Bunting, 1973)." (US20100186912A120100729: 64)

Illustrative Claims: "1. A process for the production of a paper pulp, comprising preparing the pulp from a raw material derived from a plant of the Araceae family. 2. A process according to claim 1, wherein the plant is from the genus Montrichardia. 3. A process according to claim 2, wherein the plant is the species Montrichardia arborescens."

South American Indian

The results excluslvely refer to literature citations for human genetic studies as illustrated in this example

Segment: "Characterization of the HLA-A polymorphism by locus-specific polymerase chain reaction amplification and oligonucleotide hydridization. Human Immunology 1994: 41; 267-279 29.-A. Selvakumar, C. B. Granja, M. Salazar, S. M. Alosco, E. J. Yunis & B. Dupont. A novel subtype of A2 (A*0217) isolated from the South American Indian B-cell line AMALA." (WO1997020070A119970605: 193). Anthony Nolan Bone Marrow Trust UK.

Tribe/Native Tribe

The term tribe is typically used to refer to a species belonging to a particular tribe (i.e. plants of the tribe Stapelieae). The following example makes reference to native tribes in Mexico and the scientific literature but is not specific.

TK56. WO1999006388A2 PHARMACEUTICAL COMPOUNDS ISOLATED FROM ARISTOLOCHIA TALISCANA
Electrophoretics International PLC.

Abstract: "The invention relates to extracts from Aristolochia taliscana and their uses in medicine, and also to compounds, known and novel isolated from the extracts, and compositions containing the extracts and compounds. The extracts and compounds are useful inter aliaas anti-mutagens, antifungal agents and cytotoxic agents. The extracts and compositions of the invention can comprise at least 10 %, preferably at least 20 %, and more preferably at least 25 % by weight of a phenylbenzfuran."

Segment: "Crude extracts from Aristolochia tafiscana have been known for many years to have certain medicinal properties. A book published in the 1 800's, called "Las Plantas Medicinales de Mexico" (Medicinal Plants of Mexico) makes reference to the use of Aristolochia tafiscana extracts in the treatment of snake bites and it would appear that the native tribes in this region of Mexico have known about the uses of the extracts for many centuries." (WO1999006388A219990211: 20)

Endnotes:

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[52] http://www.theguardian.com/science/2000/nov/15/genetics2 and see also http://www.twnside.org.sg/title/bans.htm

[53] Maffi, L. & Woodley, E. (2010) *Biocultural diversity conservation : a global sourcebook.* London; Washington, D.C.: Earthscan. See also, Maffi, L (1999) 'Language and the Environment', in Posey, D (ed.) (1999) *Cultural and Spiritual Values of Biodiversity*. London: Intermediate Technology Publications. & Moseley C (2010) Atlas of the World's Languages in Danger. Paris: UNESCO

[54] Oldham P, Frank MA (2008) We the peoples: The United Nations Declaration on the Rights of Indigenous Peoples. Anthropology Today 24: 5-9.

[55] Laird, S. (ed.) (2002) *Biodiversity and Traditional Knowledge: Equitable Partnerships in Practice.* London: Routledge.

9: Marine Genetic Resources

9.1 Introduction:

This section forms part of a wider review of *UK Patent Activity for Genetic Resources and associated Traditional Knowledge.* The section presents the results of an exploratory review of international patent activity by UK applicants involving marine species at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty between 1976 and 2010.

The review is intended only to provide an initial overview or snapshot of UK patent activity involving marine species. For the purpose of the review we targeted a sample of documents that included a marine species in the claims section where a species is a focus of the claimed invention. In this section we provide a general overview of the marine organisms appearing in UK patent activity before providing a series of examples where a species appears in the claims section.

We identified an initial 624 marine species in UK patent documents at the major patent offices. This number includes species mentioned in the Title, Abstract, Description or Claims of a UK patent document. Of these species 225 were mentioned in the patent claims. Figure 9.1 breaks down these numbers by Kingdom. We then reviewed the twenty species most commonly mentioned in the claims. This included all species for which there were six or more mentions and is intended to provide an overview of the greatest levels of activity.

A small selection of additional documents were also examined. This selection was based on the casual observation that where a species was mentioned in a large number of documents but only a very low number of claims the species might still provide useful information on UK activity involving marine species.

One further habitat specific search was made to identify patent activity concerning species living in extreme environments, notably deep sea hydrothermal vents.

Kingdom	Number Of Species recorded in all patent documents	Number of Species mentioned in claims	Number of Species mentioned more than 6 times in claims
Protozoa	23	5	1
Plantae	78	20	3
Fungi	8	3	2
Chromista	41	19	2
Bacteria	16	5	1
Archaea	4	3	2
Animalia	454	170	11

Figure 9.1: The number of species included in all patent documents compared to the number that appear in patent claims.

Habitats

Patent activity appears to cover species from a very large number of habitats. The review has revealed species which are found in coastal lagoons, shallow seas, reefs, ocean coastlines and extreme habitats such as deep sea hydrothermal vents and acidic waters. The species have been recorded across the globe: The Atlantic, Indian, Pacific and Antarctic Oceans, The Caribbean and Mediterranean Seas and the seas of coastal New Zealand are all recorded. Given the restricted number of patents examined it is remarkable that such diversity of habitats and geographical locations were present.

Species

A broad range of species were identified across seven kingdoms. Micro algae, seaweeds, molluscs, corals, jellyfish, starfish, sea squirts, bony fish and microorganisms were all present in the list of most mentioned species. An interesting development during the review was the discovery that by searching patents for habitat types, notably extreme habitats such as deep sea hydrothermal vents, new species of microorganisms were identified that are not yet included in available marine species databases.

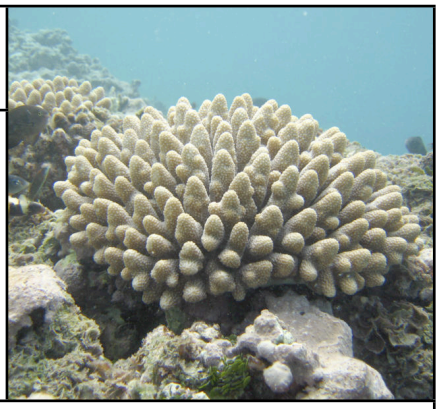
Products

It is clear that there are many products being developed from marine species, and that many species have properties that are unknown elsewhere in nature. For example, DHA omega-3 fatty acids can be extracted from algae, an important and essential element for human health. Useful fatty acids are also found in krill oils and are produced by a wide range of other maritime species. Alginates are produced from seaweeds which can absorb liquid and are used to aid sequestration of metals from fluids. Green fluorescent proteins from jellyfish are used extensively in molecular biology. Thermostable DNA polymerases from microorganisms living in extreme habitats are also used in molecular biology. Other extremophiles live in highly acidic conditions and provide new proteins. Marine products are used for anti-viral and anti-cancer compounds and have traditional medical uses such as the use of bladderwrack for treating thyroid disorders. Harvests of marine species are of significant commercial value as food. For this reason we also identified a number of patents that claim products such as vaccines for commercial fish stocks.

In the following section we provide examples of marine species that frequently appear in patent claims in UK patent data.

9.2 Marine species in Patent Claims:

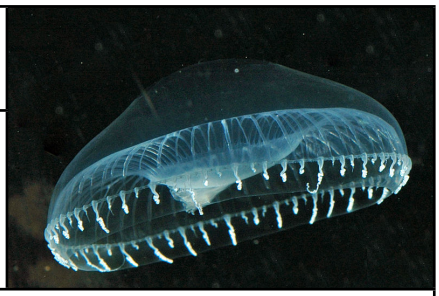
MGR1

Species Name: **Acropora aspera**	Kingdom: **Animalia**	
Brief Description of the species: A coral listed on the IUCN red list as vulnerable. It is particularly susceptible to bleaching, disease, crown-of-thorns starfish predation, trade, and extensive reduction of coral reef habitat due to a combination of threats. It is found in shallow water in the Indian Ocean and Western Pacific.		
Occurrences in claims: 6	No of documents: 1	
WO2002070703A2 - Molecular biology - A nucleic acid molecule which imparts an altered visual characteristic to said cell when visualized by a human eye.		

MGR2

Species Name: **Acropora nobilis**	Kingdom: **Animalia**	
Brief Description of the species: A coral of deep sandy lagoons to upper reef slopes in Indian Ocean and western Pacific. Regarded as being of least concern by IUCN.		
Occurrences in claims: 6	No of documents: 1	
WO2002070703A2 - Molecular biology - A nucleic acid molecule which imparts an altered visual characteristic to said cell when visualized by a human eye.		

MGR3

Species Name: **Aequorea victoria**	Kingdom: **Animalia**	
Brief Description of the species: A bioluminescent jellyfish found along the western coast of north America. A species most noted for the production of Green Fluorescent Protein.		
Occurrences: 12	No of documents: 178	
WO1996027675A1 - The primary source of GFP. This species is referred to in many patents concerning cell and molecular biology in which GFP is used as a reporter of expression.		

MGR4

Species Name: **Anemonia sulcata**	Kingdom: **Animalia**	
Brief Description of the species: The snakelock anemone found in NE Atlantic and Mediterranean. Has symbiotic relationship with algae living in tentacles. Eaten in Spain.		
Occurrences in claims: 6	No of documents:9	
WO2002070703A2 - Molecular and cell biology - A nucleic acid molecule which imparts an altered visual characteristic to said cell when visualized by a human eye. WO2008085502A2 -An invention providing a new fluorescent protein, engineered to facilitate release from self-cleaving peptides.		

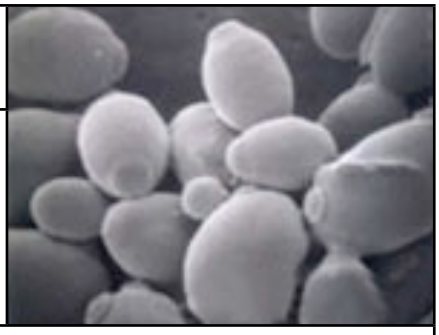
MGR5

Species Name: **Ascophyllum nodosum**	Kingdom: **Chromista**	
Brief Description of the species: A common brown seaweed of the North Atlantic Ocean coastal areas. It is commonly used as a source of alginate which has pharmaceutical and dietary uses due to its water absorbing properties. Additionally it is harvested for use as fertilisers.		
Occurrences in claims: 32	No of documents: 38	
WO2002009513A2 - A new agricultural composition and a method for protecting and enhancing the resistance of plants to infections by plant pathogens.		

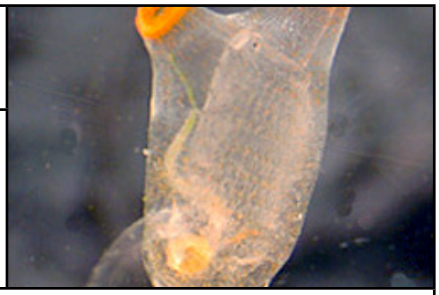
MGR6

Species Name: **Crypthecodinium cohnii**	Kingdom: **Protozoa**	
Brief Description of the species: Cohnii is a dinoflagellate micro-alga species; a microscopic, unicellular, flagellated, photosynthetic protist. It is used for the commercial production of docosahexaenoic acid (DHA) which is an omega-3 fatty acid which plays an essential role in human brain development and health.		
Occurrences in claims: 61	No of documents: 29	
WO2010143974A1 - Looking for fish-free sources of DHA for future food and pharmaceuticals. WO2005007845A2 - Cells Expressing Proteins Involved in Fatty Acid Biosynthesis.		

MGR7

Species Name: **Debaryomyces hansenii**	Kingdom: **Fungi**	
Brief Description of the species: Debaryomyces hansenii is a hemiascomycetous yeast commonly found in natural substrates. It is an alkane-assimilating yeast and one of the most frequent yeast species to be associated with chilled food.		
Occurrences in claims: 7	No of documents: 48	
EP0371568A1 - A process for producing gamma-lactones using a micro-organism cultured in a culture medium containing a suitable substrate for producing gamma-hydroxy-alkanoic acids. US6001615A - Processes relating to the reduction of ketone groups.		

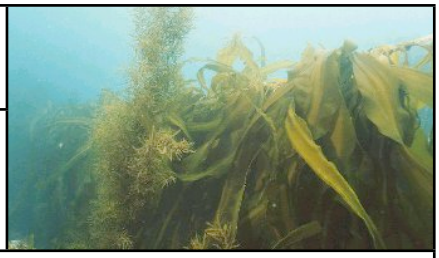
MGR8

Species Name: **Ecteinascidia turbinata**	Kingdom: **Animalia**	
Brief Description of the species: A sea squirt from which the cancer drug Trabectedin is isolated. The species is found in shallow seas most notably in the Caribbean and the Mediterranean		
Occurrences in claims: 5	No of documents: 23	
EP1716853A2 - Use of agents in treatment of cancer. US7309601B2 - rDNA corresponding to an endosymbiotic bacteria associated with Ecteinascidia turbinata has been identified & deposited in GeneBank with the accession number AY054370.		

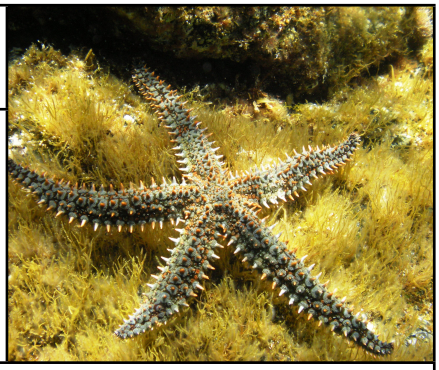
MGR9

Species Name: **Fucus vesiculosus**	Kingdom: **Chromista**	
Brief Description of the species: Commonly known as bladderwrack, it contains many chemicals and minerals. Bladderwrack has been used in the treatment of under active thyroid glands.		
Occurrences in claims: 12	No of documents: 16	
WO1992011020A1 - A seaweed derived composition for treating herpes simplex virus type 1 and type 2 using one or more seaweeds in a gel.		

MGR10

Species Name: **Laminaria japonica**	Kingdom: **Chromista**	
Brief Description of the species: A commercially important kelp species from Japan, China and Korea.		
Occurrences in claims: 1	No of documents: 30	
EP1618149B1- Source of alginates for thickeners. WO2001021536A1- Source of alginate to sequester metals from solution.		

MGR11

Species Name: **Marthasterias glacialis**	Kingdom: **Animalia**	
Brief Description of the species: A starfish of 30 to 40 cm in diameter but it may be up to 80 cm. Its surface is covered by linear papillae from which arise large conical spines. It lives on rocky bottoms from surface to depths up to 180 m and can cause damage to mussel and oyster farm stock.		
Occurrences in claims: 7	No of documents: 6	
US6991810B1, WO2000075183A1 - An invention relating to a product with anti-fouling properties, anti-adhesive properties, and anti-inflammatory properties that is obtainable from starfish.		

MGR12

Species Name: **Oncorhynchus mykiss**	Kingdom: **Animalia**	
Brief Description of the species: The rainbow trout, a salmonid species introduced to most parts of the world, originally a Pacific species.		
Occurrences in claims: 1	No of documents: 36	
EP1597359B1 - A vaccine for nodavirus in marine fish. US2009229532A1 - An apparatus to affect fish behaviour.		

MGR13

Species Name: **Palaeococcus ferrophilus**	Kingdom: **Archaea**	No Image Available
Brief Description of the species: A hyperthermophilic archaeon isolated from deep sea hypothermal vents.		
Occurrences in claims: 2	No of documents: 2	
US2011014660A1, WO2009112867A1- A novel thermostable DNA polymerase for use in reactions requiring DNA polymerase activity such as nucleic acid amplification reactions.		

MGR14

Species Name: **Palaeococcus helgesonii**	Kingdom: **Archaea**	No Image Available
Brief Description of the species: A hyperthermophilic archaeon isolated from a shallow geothermal well that taps marine waters on the Island of Vulcano in the southern Tyrrhenian Sea, Italy.		
Occurrences in claims: 0	No of documents: -	
WO2009112867A1 WO2009112868A1 - Thermostable DNA polymerase isolated from this species.		

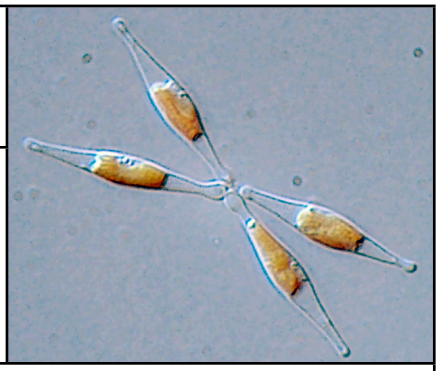
MGR15

Species Name: **Palmaria palmata**	Kingdom: **Plantae**	
Brief Description of the species: Also known as dulse. This red seaweed grows on northern coasts of the Atlantic and Pacific Oceans. It has been a food in Iceland where it has been eaten for centuries. A good source of vitamins and trace elements.		
Occurrences in claims: 20	No of documents: 4	
US2005095260A1 - A water-soluble anti-viral extract of Palmaria palmata for use in the therapeutic or prophylactic treatment of a range of viral infections, particularly viruses of the Herpes family. WO2000059524A1- An antiviral composition containing a water soluble extract of Palmaria palmata.		

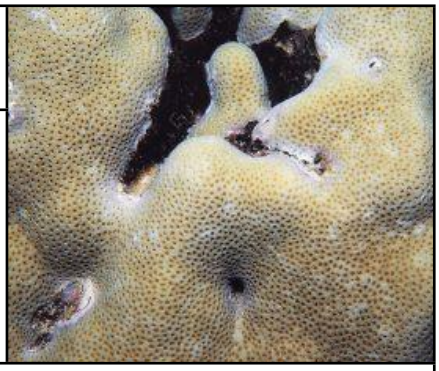
MGR16

Species Name: **Perna canaliculus**	Kingdom: **Animalia**	
Brief Description of the species: The New Zealand Green-Lipped Mussel is of economic importance to New Zealand where is is farmed. The industry produces 140,000 tones per year. Wild mussel seed known as spat is collected from seaweed to supply the aquaculture industry.		
Occurrences in claims: 25	No of documents: 17	
WO2005112910A1 - A pharmaceutical or veterinary composition which includes fatty acids from Perna canaliculus. WO1999008535A1 - A purification method for microbially contaminated fluids using an active protein, isolated from mussels.		

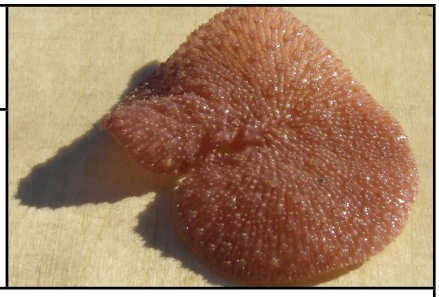
MGR17

Species Name: **Phaeodactylum tricornutum**	Kingdom: **Plantae**	
Brief Description of the species: Phaeodactylum tricornutum is one of two diatoms to have its genome sequenced. It has been found in several locations around the world, typically in coastal areas with wide fluctuations in salinity.		
Occurrences in claims: 6	No of documents: 39	
EP1373519B1, US7714185B2, US2011023185A1 Polyunsaturated fatty acids are produced from such algae in patents for novel PUFAs.		

MGR18

Species Name: **Porites murrayensis**	Kingdom: **Animalia**	
Brief Description of the species: Stoney coral. Widely distributed throughout the Indo-Pacific, from the Maldives to Okinawa and French Polynesia. Usually found in shallow reef environments, especially reef flats with clear water.		
Occurrences in claims: 6	No of documents: 1	
WO2002070703A2 - Molecular biology - A nucleic acid molecule which imparts an altered visual characteristic to said cell when visualized by a human eye.		

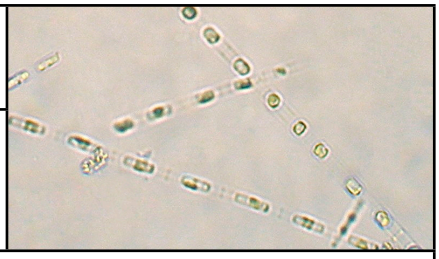
MGR19

Species Name: **Renilla reniformis**	Kingdom: **Animalia**	
Brief Description of the species: Sea pansy. A collection of polyps which have bioluminescent properties due to luciferase and Green Fluorescent Protein (GFP).		
Occurrences in claims: 4	No of documents: 79	
Cited within the descriptions of many patents as a source of Green Fluorescent Protein. WO2000049416A2 claims an assay system involving a reporter protein from Renilla reniformis.		

MGR20

Species Name: **Salmo salar**	Kingdom: **Animalia**	
Brief Description of the species: The Atlantic Salmon. Economically important as a recreational fish and as a farmed food product. A major controversy with this species has been the escape of farmed animals which then breed with wild populations.		
Occurrences in claims: 7	No of documents: 53	
US2008161243A1 - The present invention encompasses albumin fusion proteins selected from salmon.		

MGR21

Species Name: **Skeletonema costatum**	Kingdom: **Chromista**	
Brief Description of the species: A common Atlantic diatom. Used in aquaculture as food for other species.		
Occurrences in claims: 5	No of documents: 30	
US2003039672A1 - A source of high quality fatty acids for cosmetics. WO2006037947A1 - Microbiology - Isolation of nucleic acid molecules from algae.		

MGR22

Species Name: **Stenopus hispidus**	Kingdom: **Animalia**	
Brief Description of the species: A shrimp like crustacean. It has a pan-tropical distribution extending into some temperate areas.		
Occurrences in claims: 1	No of documents: 1	
WO2009034315A2 -A vaccine against Aeromonas hydrophila for use especially in fish.		

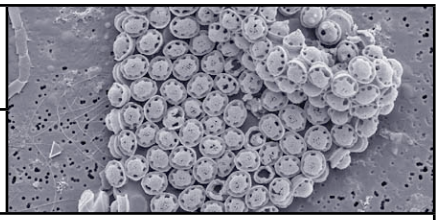
MGR23

Species Name: **Sulfolobus solfataricus**	Kingdom: **Archaea**	No Image Available
Brief Description of the species: A microorganism which grows in volcanic springs, first isolated in the Solfatara volcano. Sulfolobus proteins are of interest for biotechnology and industrial use due to their thermostable nature.		
Occurrences in claims: 23	No of documents: 86	
WO2000075306A2 - Highly technical genome technology patent. US2004091474A1 - A method for inactivating a transmissible spongiform encephalopathy (TSE) agent by exposing to a thermostable proteolytic enzyme.		

MGR24

Species Name: **Symploca hydnoides**	Kingdom: **Bacteria**	
Brief Description of the species: A marine cyanobacterium from which metabolites with possible anti-cancer uses have been isolated.		
Occurrences in claims: 1	No of documents: 1	
WO2003033523A2 - New dolastatin derivatives prepared by extraction from Symploca hydnoides for the treatment of cancer.		

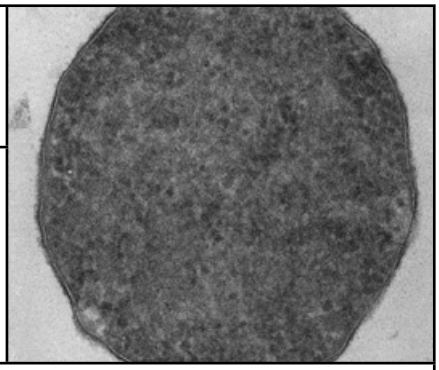
MGR25

Species Name: **Syracosphaera pulchra**	Kingdom: **Chromista**	
Brief Description of the species: A carbon sequestering coccolithophorid algae.		
Occurrences in claims: 1	No of documents: 1	
WO2010049687A1 - A method of sequestration of carbon dioxide from the atmosphere into solid form, the method comprising culturing coccolithophorid algae in seawater.		

MGR26

Species Name: **Thermodesulfatator indicus**	Kingdom: **Bacteria**	No Image
Brief Description of the species: A thermophilic, marine, anaerobic, chemolithoautotrophic, sulfate-reducing bacterium isolated from a deep-sea hydrothermal vent site at the Kairei vent field on the Central Indian Ridge.		
Occurrences in claims: 2	No of documents: 2	
US2011008848A1 WO2009106795A1 - Molecular biology - A polypeptide having thermostable DNA polymerase activity.		

MGR27

Species Name: **Thermoplasma acidophilum**	Kingdom: **Archaea**	
Brief Description of the species: A microorganism which is among the most acidophilic organism known. They grow at 55-60°C and favor a range pH of 0.5-4. Scientists are particularly interested in the protein these organism have.		
Occurrences in claims: 10	No of documents: 16	
US2003039985A1 - Invention relates to modification of ribonucleic acid (RNA) to form oligo- and polynucleotides.		

An additional selection of marine patents of interest

MGR28

Patent ref: WO2010142522A2	Species: **Phaeodactylum tricornutum**	Kingdom: **Plantae**
Species Description:	Phaeodactylum tricornutum is one of two diatoms to have its genome sequenced. It has been found in several locations around the world, typically in coastal areas with wide fluctuations in salinity.	
Nature of Patent:	The invention provides isolated nucleic acid molecules which encodes a novel fatty acid nECR.	
Evidence of species usage: (Description)	A polynucleotide encoding a polypeptide having a nECR activity as specified above has been obtained in accordance with the present invention, preferably, from Thalassiosira pseudonana or Phaeodactylum tricornutum.	

MGR29

Patent ref: WO2010128312A	Species: **Coregonus lavaretus**	Kingdom: **Animalia**
Species Description:	A widespread species of freshwater whitefish.	
Nature of Patent:	A method for the prevention or amelioration of plant-induced enteritis in fish is provided which comprises feeding to said fish a biomass derived from a culture of methanotrophic bacteria.	
Evidence of species usage: (Description)	...the present invention is directed particularly at carnivorous fish, especially salmonids ... e.g. Atlantic salmon (Salmo salar)... whitefish, e.g. common whitefish (Coregonus lavaretus).	

MGR30

Patent ref: WO2010115472A	Species: **Cochlodinium polykrikoides**	Kingdom: **Protozoa**
Species Description:	An unarmoured, marine, planktonic dinoflagellate species with a distinctive spiral-shaped cingulum. It is associated with fish kills in Japan and Korea.	
Nature of Patent:	The invention provides compositions and methods for treating or preventing harmful algal blooms such as red tides.	
Evidence of species usage: (Claim)	A method for treating or preventing harmful algal bloom, which comprises applying to the affected or susceptible waters a composition comprising powdered dried plant material... wherein the harmful algal bloom comprises Cochlodinium polykrikoides.	

MGR31

Patent ref: WO2009077577A	Species: **Piscirickettsia salmonis**	Kingdom: **Bacteria**
Species Description:	Piscirickettsia salmonis is the first Gram-negative, intracellular bacterial pathogen isolated from fish and is a significant cause of mortality in salmonid fish.	
Nature of Patent:	...novel proteins, e.g., antigens, from Piscirickettsia salmonis... vaccines that can be used to protect fish from Piscirickettsia salmonis, as well as other pathogens.	
Evidence of species usage: (Description)	The present invention relates to novel proteins from Piscirickettsia salmonis.	

MGR32

Patent ref: WO2009034315A	Species: **Acipenser naccarii, cyprinus carpio, Oncorhynchus kisutch and others.**	Kingdom: **Animalia**
Species Description:	The Adriatic Sturgeon. Critically endangered on the IUCN Red List	
Nature of Patent:	A vaccine against Aeromonas hydrophila for use especially in fish.	
Evidence of species usage: (Claim)	A protein of approximately 50 kDa from the S-layer of A. hydrophila... for... raising an immune response in Abalone *Haliotis discus hanna*i, Adriatic sturgeon *Acipenser naccarii.*	

MGR33

Patent ref: WO2008117062A	Species: **Euphausia superba.**	Kingdom: **Animalia**
Species Description:	Antarctic Krill	
Nature of Patent:	This invention discloses new krill oil compositions characterized by having high amounts of phospholipids, astaxanthin esters and/or omega-3 contents.	
Evidence of species usage: (Claim)	A composition comprising: from about 3% to 10% ether phospholipids on a w/w basis... wherein said composition comprises a blend of lipid fractions obtained from Euphausia superba.	

MGR34

Patent ref: WO2008085502A	Species: **Corynactis viridis**	Kingdom: **Animalia**
Species Description:	Jewel Anemone. Lives on rocks, occurring in shaded places low on the shore, or sublittorally down to about 50m, always in strong wave action or tidal streams. It occurs in Mediterranean Sea and around west Europe.	
Nature of Patent:	The present invention provides a new fluorescent protein, engineered to facilitate release from self-cleaving peptides.	
Evidence of species usage: (Claim)	...cDNA sequence (SEQ ID NO:5) encoding a fluorescent protein (FP) from Corynactis viridis... Corynactis viridis specimens were collected off the French Atlantic coast (Arcachon Bay, France).	

MGR35

Patent ref: WO2007135392A	Species: **Amphiroa ephedraea** **Corallina officinalis**	Kingdom: **Plantae**
Species Description:	Red seaweeds. (A. ephedraea. Sometimes known as the horsetail algae.)	
Nature of Patent:	A process for preparing hydroxylapatite from a calcium carbonate- containing algae. This has medical uses for bone repair.	
Evidence of species usage: (Claim)	Corallina officinalis and Amphiroa ephedraea were collected from County Donegal, Ireland.	

Image Credits:

Acropora aspera - NOAA 800px-Acropora_coral_ffs.jpg
Acropora nobilis - Doug Fenner 0052_C1_03.jpg
Aequorea victoria - Sierra Blakely 800px-Aequorea4.jpg
Anemonia sulcata - Que2 800px-Snakelocks_anemone.jpg
Ascophyllum nodosum - The Dozens 381px-Ascophyllum_nodosum.jpg
Crypthecodinium cohnii - La Molina bigredalgae.jpg
Debaryomyces hansenii - diARK Debaryomyces_hansenii_CBS767
Ecteinascidia turbinata - Kathy Hill Ectein_turbin_organs.jpg
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Oncorhynchus mykiss - Andreas Praefcke 800px-Oncorhynchus_mykiss_mid_res_150dpi.jpg
Palmaria palmata - Emőke Dénes Palmaria_palmata_-_Broadstairs,_UK_1.jpg
Perna canaliculus - Hans Jørn Storgaard Andersen 720px-Muslinger-mad.jpg
Phaeodactylium tricornutum - Alessandra de Martino and Chris Bowler 637px-Phaeodactylum_tricornutum.png
Porites murrayensis - Charlie Veron 0322_C1_01.jpg
Renilla reniformis - Job 800px-Sea_pansy.png
Salmo salar - NOAA Salmo_salar_GLERL_1.jpg
Skeletonema costatum - Minami Himemiya 800px-Skeletonema_costatum.jpg
Stenopus hispidus - Richard Ling 800px-Stenopus_hispidus_1.jpg
Symploca hydnoides - Cassidy/Reef Watch Waikiki img_0965.jpg
Syracosphaera pulchra - Jeremy Young NHM vaulot_127-09_20070419130514_w.jpg
Thermoplasma acidophilum - Linda Stannard Thermoplasma.jpg

10: Antarctica

10.1 Introduction:

This section forms part of a wider review of *UK Patent Activity for Genetic Resources and Traditional Knowledge.* The section presents the results of a review of international patent activity by UK applicants involving species from Antarctica at the European Patent Office, the United States Patent and Trademark Office and the Patent Cooperation Treaty between 1976 and 2010.

We reviewed 208 UK patent documents featuring species with distribution in Antarctica. The review was not extensive and is intended to provide an initial overview or snapshot of patent activity involving species from Antarctica in UK patent data. In undertaking this review we identified a number of documents where a species is the focus of an invention and which is likely to have been acquired from Antarctica based on distribution, or where it is explicitly stated that Antarctica is the source.

104 Antarctic species were recorded in the patent data. This number includes species mentioned in any part of the document including the Title, Abstract, Description or Claims. Of these species 46 were mentioned in the claims of patents. Figure 10.1 breaks down these numbers by kingdom.

Kingdom	Number Of Species recorded in all patent documents	Number of Species mentioned in claims
Protozoa	1	1
Plantae	19	7
Fungi (incl. Lichens)	43	19
Chromista	5	3
Bacteria	13	9
Animalia	23	7

Figure 10.1: The number of species included in all patent documents compared with the number which appear in patent claims.

Species identified as having potentially originated from Antarctica include representatives from four kingdoms: animals, plants, fungi (as part of a lichen organism) and bacteria. The inventions where these species are utilized cover a number of technologies. Principal among these is the use of anti-freeze proteins found in plants and lichens that enable these species to survive in extremely low temperatures. The most notable examples include EP0959689B1(Unilever) and US6096867A (the Unilever subsidiary Good Humor-Breyers Ice Cream) where proteins from a number of species are incorporated in a frozen food product. EP1049713B1 and US6774210B1 by the same applicants takes this same property and focuses on one species of lichen - *Umbilicaria antarctica.*

The Antarctic krill *Euphausia superba,* the most abundant species on Earth by biomass, is found in two inventions. WO2009027692A2 involves Aker Biomarine ASA et. al. - a Norwegian company focusing on Antarctic krill products - and lists a UK individual as a co-applicant and inventor. The patent claims a method for producing krill meal. Patent application WO2008117062A1 by the same applicants claims a krill oil composition.

Finally, the bacteria *Pseudomonas synxantha* is used as a source of antifreeze peptides which can be incorporated into a number of frozen foods. These claims are made by Good Humor-Breyers Ice Cream et. al. (US6887984B2 and US2002072108A1) and Unilever (WO2001044275A2).

Summary

It can be seen from this brief overview that species with properties that enable them to survive in extremely low temperatures are of significant interest, in particular for manufacturers of frozen food stuffs. Patents involving krill products reveal the commercial importance of the krill industry which supplies fish feed and human food supplements.

There are many more species with distribution in Antarctica that appear in the patent landscape than have been identified in this study as having likely Antarctic origin. The reason for this is that many of these species are cosmopolitan and have distribution ranges extending beyond Antarctica.

10.2 Summary Tables of Species originating from Antarctica

AQ1

<table>
<tr><td>Species name:
Caloplaca regalis</td><td>Kingdom: Fungi/Lichen</td><td rowspan="2">  </td></tr>
<tr><td colspan="2">Brief description of species:
Caloplaca is a lichen genus, composed of a number of distinct species. The distribution of this lichen genus is worldwide.</td></tr>
<tr><td colspan="2">Distribution: Cosmopolitan</td><td>No of documents: 2</td></tr>
<tr><td colspan="3">EP0959689B1 US6096867A</td></tr>
<tr><td colspan="3">Detail: EP0959689B1 US6096867A: Plant anti-freeze proteins incorporated into frozen confectionery products, provided they have the capability of limiting the growth of ice crystals.</td></tr>
</table>

AQ2

Species name: *Chorisodontium aciphyllum*	Kingdom: Plantae	No Image Available
Brief description of species: A species of moss.		
Distribution: Cosmopolitan	No of documents: 2	
EP0959689B1 US6096867A		
Detail: EP0959689B1 US6096867A: Plant anti-freeze proteins incorporated into frozen confectionery products, provided they have the capability of limiting the growth of ice crystals.		

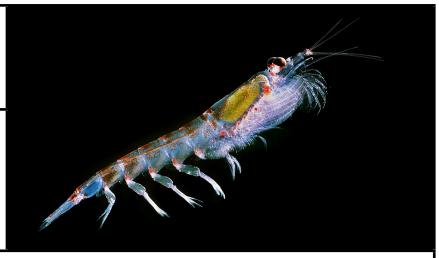
AQ3

Species name: *Colobanthus quitensis*	Kingdom: Plantae	
Brief description of species: Antarctic pearlwort is one of the two flowering plants found in the Antarctic region.		
Distribution: Cosmopolitan	No of documents: 2	
EP0959689B1 US6096867A		
Detail: EP0959689B1 US6096867A: Plant anti-freeze proteins incorporated into frozen confectionery products, provided they have the capability of limiting the growth of ice crystals.		

AQ4

Species name: *Deschampsia antarctica*	Kingdom: Plantae	
Brief description of species: Antarctic hair grass is one of two flowering plants native to Antarctica.		
Distribution: Cosmopolitan	No of documents: 2	
EP0959689B1 US6096867A		
Detail: EP0959689B1 US6096867A: Plant anti-freeze proteins incorporated into frozen confectionery products, provided they have the capability of limiting the growth of ice crystals.		

AQ5

Species name: *Euphausia superba*	Kingdom: Animalia	
Brief description of species: Antarctic Krill. The species of krill living in the southern oceans.		
Distribution: Cosmopolitan	No of documents: 2	
WO2009027692A2 WO2008117062A1		
Detail: WO2009027692A2: A new method for krill meal production using a two step cooking process that creates a krill meal product with superior nutritional properties. WO2008117062A1: New krill oil composition characterized by having high amounts of phospholipids, astaxanthin esters and/or omega-3 contents.		

AQ6

Species name: *Himantormia lugubris*	Kingdom: Fungi/Lichen	
Brief description of species: H. lugubris, an Antarctic endemic, is distributed on the islands of the northern maritime Antarctic and along the Antarctic Peninsula.		
Distribution: Cosmopolitan	No of documents: 2	
EP0959689B1 US6096867A		
Detail: EP0959689B1 US6096867A: Plant anti-freeze proteins incorporated into frozen confectionery products, provided they have the capability of limiting the growth of ice crystals.		

AQ7

Species name: *Pseudomonas synxantha*	Kingdom: Bacteria	No Image Available
Brief description of species: Pseudomonas synxantha is a fluorescent rhizosphere bacterium with nematicidal properties which lives in a low temperature environment.		
Distribution: Cosmopolitan	No of documents: 3	
US6887984B2 US2002072108A1 WO2001044275A2		
Detail: US6887984B2 US2002072108A1 WO2001044275A2: A process for preparing a novel anti-freeze peptide and to the peptides obtained from bacteria from an aqueous low-temperature environment.		

AQ8

Species name: *Stereocaulon glabrum*	Kingdom: Fungi/Lichen	
Brief description of species: Family of lichen with global distribution, sometimes known as snow lichen.		
Distribution: Cosmopolitan	No of documents: 2	
EP0959689B1 US6096867A		
Detail: EP0959689B1 US6096867A: Plant anti-freeze proteins incorporated into frozen confectionery products, provided they have the capability of limiting the growth of ice crystals.		

AQ9

Species name: *Umbilicaria antarctica*	Kingdom: Fungi/Lichen	No Image Available
Brief description of species: One of eleven Umbilicaria lichen species found in Antarctica.		
Distribution: Cosmopolitan	No of documents: 4	
EP0959689B1 US6096867A US6774210B1 EP1049713B1		
Detail: EP0959689B1 US6096867A: Plant anti-freeze proteins incorporated into frozen confectionery products, provided they have the capability of limiting the growth of ice crystals. US6774210B1 EP1049713B1: Anti-freeze protein which can be derived from Lichen.		

Image Credits:

Caloplaca regalis - Christina Carvalho 3903655.jpg
Colobanthus quitensis - Liam Quinn 800px-Antarctic_Pearlwort.jpg
Deschampsia antarctica - Lomvi2 800px-Deschampsia_antarctica.jpg
Euphausia superba - Uwe Kils 800px-Antarctic_krill_(Euphausia_superba).jpg
Himantormia lugubris - Andre Aptroot hypogymnia-lugubris-taiwan.jpg
Stereocaulon glabrum - Stephen Sharnoff stereocaulon_alpinum_2.jpg