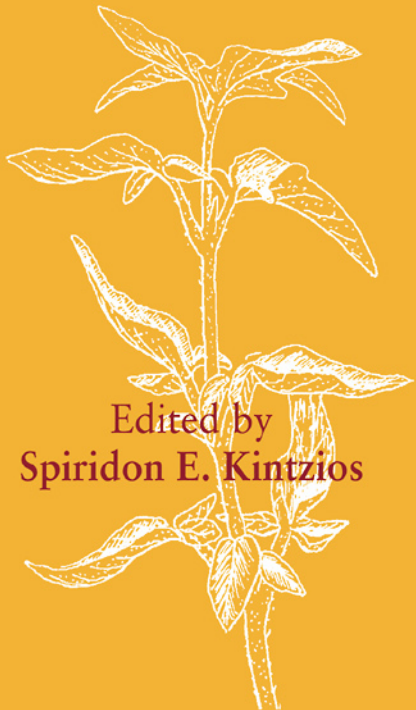
SAGE
The Genus *Salvia*



Edited by
Spiridon E. Kintzios

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PREFACE TO THE SERIES

There is increasing interest in industry, academia and the health sciences in medi cinal and aromatic plants. In passing from plant production to the eventual product used by the public, many sciences are involved. This series brings together informa tion which is currently scattered through an ever increasing number of journals. Each volume gives an in-depth look at one plant genus, about which an area special ist has assembled information ranging from the production of the plant to market trends and quality control.

Many industries are involved such as forestry, agriculture, chemical, food, flavour, beverage, pharmaceutical, cosmetic and fragrance. The plant raw materials are roots, rhizomes, bulbs, leaves, stems, barks, wood, flowers, fruits and seeds. These yield gums, resins, essential (volatile) oils, fixed oils, waxes, juices, extracts and spices for medicinal and aromatic purposes. All these commodities are traded world wide. A dealer's market report for an item may say "Drought in the country of origin has forced up prices".

Natural products do not mean safe products and account of this has to be taken by the above industries, which are subject to regulation. For example, a number of plants which are approved for use in medicine must not be used in cosmetic products.

The assessment of safe to use starts with the harvested plant material which has to comply with an official monograph. This may require absence of, or prescribed limits of, radioactive material, heavy metals, aflatoxins, pesticide residue, as well as the required level of active principle. This analytical control is costly and tends to exclude small batches of plant material. Large scale contracted mechanised cultiva tion with designated seed or plantlets is now preferable.

Today, plant selection is not only for the yield of active principle, but for the plant's ability to overcome disease, climatic stress and the hazards caused by mankind. Such methods as *in vitro* fertilisation, meristem cultures and somatic embryogenesis are used. The transfer of sections of DNA is giving rise to contro versy in the case of some end-uses of the plant material.

Some suppliers of plant raw material are now able to certify that they are supply ing organically-farmed medicinal plants, herbs and spices. The Economic Union directive (CVO/EU No 2092/91) details the specifications for the obligatory quality controls to be carried out at all stages of production and processing of organic products.

Fascinating plant folklore and ethnopharmacology leads to medicinal potential. Examples are the muscle relaxants based on the arrow poison, curare, from species of *Chondrodendron,* and the antimalarials derived from species of *Cinchona* and *Artemisia*. The methods of detection of pharmacological activity have become increasingly reliable and specific, frequently involving enzymes in bioassays and avoiding the use of laboratory animals. By using bioassay linked fractionation of crude plant juices or extracts, compounds can be specifically targeted which, for example, inhibit blood platelet aggregation, or have antitumour, or antiviral, or any other required activity. With the assistance of robotic devices, all the members of a genus may be readily screened. However, the plant material must be **fully** authen ticated by a specialist.

The medicinal traditions of ancient civilisations such as those of China and India have a large armamentarium of plants in their pharmacopoeias which are used throughout South East Asia. A similar situation exists in Africa and South America. Thus, a very high percentage of the world's population relies on medicinal and aromatic plants for their medicine. Western medicine is also responding. Already in Germany all medical practitioners have to pass an examination in phytotherapy before being allowed to practise. It is noticeable that throughout Europe and the USA, medical, pharmacy and health related schools are increasingly offering training in phytotherapy.

Multinational pharmaceutical companies have become less enamoured of the single compound magic bullet cure. The high costs of such ventures and the endless competition from too many compounds from rival companies often discourage the attempt. Independent phytomedicine companies have been very strong in Germany. However, by the end of 1995, eleven (almost all) had been acquired by the multi national pharmaceutical firms, acknowledging the lay public's growing demand for phytomedicines in the Western World.

The business of dietary supplements in the Western World has expanded from the Health Store to the pharmacy. Alternative medicine includes plant based products. Appropriate measures to ensure the quality, safety and efficacy of these either already exist or are being answered by greater legislative control by such bodies as the Food and Drug Administration of the USA and the recently created European Agency for the Evaluation of Medicinal Products, based in London.

In the USA, the Dietary Supplement and Health Education Act of 1994 recognised the class of phytotherapeutic agents derived from medicinal and aromatic plants. Furthermore, under public pressure, the US Congress set up an Office of Alternative Medicine and this office in 1994 assisted the filing of several Investigational New Drug (IND) applications, required for clinical trials of some Chinese herbal prepa rations. The significance of these applications was that each Chinese preparation involved several plants and yet was handled as a single IND. A demonstration of the contribution to efficacy, of each ingredient of each plant, was not required. This was a major step forward towards more sensible regulations in regard to phytomedicines.

My thanks are due to the staff of Harwood Academic Publishers who have made this series possible and especially to the volume editors and their chapter contrib utors for the authoritative information.

Roland Hardman

PREFACE

Salvia is a fascinating plant genus. One of the widest-spread members of the Labiatae family, it features prominently in the pharmacopoeias of many countries throughout the world. From the Far East, through Europe and across to the New World several of the almost 1000 *Salvia* species have been used in many ways, e.g. essential oils used in perfumery, the flowers used as rouge, the leaves used for varicose veins, the seed oil as an emollient, the roots as a tranquiliser. The range of traditional applications of the herb in domestic medicine seems to be endless: it has been used as a medication against perspiration and fever; as a carminative; a spas molytic; an antiseptic/bactericidal; an astringent; as a gargle or mouthwash against the inflammation of the mouth, tongue and throat; a wound-healing agent; in skin and hair care; and against rheumatism and sexual debility in treating mental and nervous conditions as well as an insecticidal.

This book begins with the presentation of the (approximately 400) most known *Salvia* species (Chapter One, A.C.Dweck), their pharmacopoeial status, their history and distribution, traditional uses as a food source and in domestic medicine, as well as general information on the chemical composition of prominent *Salvia* species, such as *S. officinalis, S. bowleyana, S. coccinea, S. columbariae, S. digitaloides, S. divinorum, S. hispanica, S. horminum, S. lavandulaefolia, S. miltiorrbiza, S. plebeia, S. pomifera, S. repens, S. rugosa, S. runcinata, S. sisymbrifolia, S. sclarea, S. erotina, S. verbenaca* and *S. yunnanensis.* Analytical dosing instructions are given for each area of applica tion.

The botany and the distribution—both global and regional—of the genus is presented along with taxonomical, chemotaxonomical, genetical and phylogenical aspects. In Chapter Two (R.Karousou *et al.*) detailed information is provided on sage species growing in Greece and the *ad hoc* main centre of origin and native distribution, the Mediterranean region. Emphasis is given on the three main species endemic in the region, namely *S. officinalis* ('Dalmatian or Garden Sage'), *S. fruticosa* ('Greek Sage') and *S. pomifera* ('Cretan Sage'), providing detailed information on their geographic distribution, morphology and essential oil composi tion. These species are remarkably variable and there is a vivid presentation of the climatically (temperature- and precipitation-) related high variation of the leaf mor phology and the qualitative and quantitative essential oil content (due, for example, to xerophytic adaptation). On the opposite side of the globe, Southern Africa, where traditional medicine plays a very important role in health care, is home to 30 species of the genus *Salvia*. In

Chapter Three (A.K.Jäger and J.van Staden) we learn about the botany, the distribution in different climatic regions, the traditional usages and the chemistry of representative *Salvia* species, like *S. africana, S. chamelaeagmea* and *S. stenophylla,* the latter species being one of the few known sources of epi-α-bisabolol, a potent anti-inflammatory agent.

An unusually large number of useful secondary metabolites, belonging to various chemical groups, have been isolated from *Salvia* species. These include various phenolic acids (such as caffeic, chlorogenic, ellagic, ferulic and gallic acid), tannins and volatile substances. Chapters 4–6 provide detailed information on the extrac tion, isolation and characterization of those components to which the biological properties of sage can be attributed: terpenoid compounds, essential oils in general and phenolic derivatives like salvianolic acids (including rosmarinic acid and lithospermic acid). In Chapter Four (A.Ulubelen), the presence of terpenoids (except of monoterpenoids) in *Salvia* species is thoroughly discussed. The chemical structure and botanical distribution and, in certain cases, structure-related bioactive properties of a total of 111 terpenoids is discussed, including various groups of diterpenoids (abietane, clerodane, pimarane and labdane-type), triterpenoids, sesquiterpenoids and sesterterpenoids. Cumulative data on the seasonal and intraspecific variation of essential oils are also included (Chapter Five, A.L. Giannouli and S.E.Kintzios), indicating that it may be possible to manipulate essen tial oil content in such a way that heavy investment of time and resources in selec tion and breeding can be avoided. In Chapter Six (Lian-Niang Li) the chemistry of the bioactive polyphenolic acids of various *Salvia* species, in particular *S. miltior rhiza,* is presented. These substances are commonly known as rosmarinic acid, litho spermic acid, salvianolic acids (A-J) and related compounds. Detailed information is provided on their chemical structure, extraction and isolation methods, UV-, MS- and NMR-spectra and chemical transformation.

The optimization of tillage, harvest and dry process technologies, as well as the proper application of fertilizers and pesticides largely improved the quality of the raw material. Chapter Seven (A.J.Karamanos) constitutes an in-depth review of virtually every aspect concerning the cultivation technology of sage, such as propa gation, land preparation, irrigation, fertilizer, growth regulator and herbicide application, harvest and postharvest treatment. A special reference is made to the ecophysiology of the genus in respect of its response to abiotic and biotic stress factors (drought, heavy metals, light, temperature, allelopathy, etc.) and their effect on biomass production and product yield and quality (e.g. essential oil composi tion) (Chapter Nine, E.Panagiotopoulos *et al.*).

Regarding optimization of the cultivation of the species for appropriate plant material, initially only indigenous local or introduced populations were used with moderate efficacy. To provide the basis for economical production, the breeding work especially on *S. sclarea* and *S. fficinalis* became more intensive. Breeding work on the genus is currently done in some countries (mainly Eastern European ones) to obtain varieties with improved characteristics, in their agricultural behav iour as well as in their chemical composition. In Chapter Eight (J.Bernáth and É.Németh) we see how various selection goals are approached by different strate gies and methods country by country, depending on the local tradition and experi ences. The high morphological and chemical diversities of the species are utilised, even if the plant is growing wild locally, or the indigenous populations had been introduced from exterior habitats. In particular there is extensive reference to the utilization of morphological and chemical diversity of indigenous populations as a background for genetic improvement, the improvement of populations by selection, the creation of new cultivars by hybridisation, the construction of polyploid forms and mutation breeding. A continuous breeding effort, incorporating both classical and modern, unconventional methods, led to the creation of new productive vari eties (such as 'Extrakta', a *S. officinalis* cultivar which is particularly rich in essential oil). Breeding new sage varieties requires substantial investment in terms of skill, labour, material resources and money and may take years. An efficient protection of the intellectual property should enhance the breeding work on the *Salvia* genus. The 1991 Act of the UPOV Convention and the 1994 TRIP'S Agreement provide for the possibility of protecting all genera and species in many countries. Hence, this gives a new opportunity to breeders of ornamental, medicinal and aromatic plants and in particular to *Salvia* breeders. The current situation of protection with a detailed explanation of the UPOV plant protection system and its main dispositions are given in Chapter Ten (B.Le Buanec).

The biological effects of plant extracts and/or essential oils and other important compounds of various species of the genus *Salvia* have been acknowledged over the centuries. Besides *S. officinalis,* which is additionally referred to as having anti biotic properties, other species also contain compounds with important pharmaco logical activities. In Chapter Eleven (D.Baricevic and T.Bartol), the bioactive/ pharmacological properties of the genus are quite extensively reviewed, including antimicrobial, antiviral, cardiovascular, renal, antioxidative, anti-inflammatory, tumorigenesis-preventing, antimutagenic, peptic-antiulcer, antispasmodic, hypo glycemic and hepatoprotective activities, as well as documented toxic effects. Extension of the use of sage as a food additive or a herbal medicine has been pre vented mostly due to the toxic effects of the ketone terpenoids in the volatile oil, namely camphor and thujone. A separate section of this chapter is devoted to the description of the pest-toxic and repellent activities of the genus.

Because of the unknown effect of synthetic antioxidants like butylated hydroxy anethole [BHA] and butylated hydroxytoluene [BHT] on human cancer risk the interest in preparing antioxidants from natural sources with minimal processing has considerably increased in recent years. Sage and related species are an important source of antioxidants used in the food industry and have wider implications for the dietary intake of natural antioxidants. *Salvia* is one of the favourite candidate species as a source of natural antioxidants in health care products. In Chapter Twelve (S.G.Deans and E.J.M.Simpson) the chemical structure, isolation and activity of the major antioxidant compounds of sage, mainly rosmarinic acid, carnosol, carnosic acid, rosmadial, rosmanol, epirosmanol and methyl carnosate, are presented. Aspects of essential oil variability and herbal material purity due to geographic location and drying temperature are investigated, along with a short description of assays for the determination of antioxidant activity. There is an analytical reference to studies inves tigating the relationship between leaf senescence and the oxidative defense system of sage, as well as the activity of the antioxidants in improving the responsiveness of the human immune system and reducing the free radical damage.

Dan-Shen extracts, derived from the roots of *S. miltiorrhiza,* have traditionally been used to treat haematological abnormalities and cardiovascular diseases in China. Along with tanshinone IIA sodium sulfonate, magnesium lithospermate B (a tetramer of caffeic acid) is an important constituent with antihypertensive proper ties. In Chapter Thirteen (T.Yokozawa) the structure and activity of this and related compounds is evaluated in detail, presenting its effects on blood flow and renal func tion as a result of the interaction with the secretion of prostaglandin E_2 and kallikrein activation.

Sage is also renowned for its effects on the central nervous system. Various anxi olytic and sedative, memory-enhancing, antidepressive and hallucinogenic activities have been ascribed to the genus (Chapter Fourteen, N.Perry *et al.*), thus making it a promising ingredient in the future treatment of CNS-related ailments.

Biotechnological techniques have been recently reported to significantly facilitate plant propagation and production of some important bioactive compounds of the genus *Salvia*. A special chapter of the book (Chapter Fifteen, O.Makri) is devoted to reviewing the biotechnology research that has been done in various other species of the Labiatae family, such as *Mentha, Origanum, Thymus, Lavantula, Ocimum, Hyssopus* and *Coleus,* whose antioxidant activity is valuable for the food, cosmetic and pharmaceutical industries.

Rosmarinic acid can be produced by cell suspension cultures of sage. The growth and production of rosmarinic acid by sage cells is modified by the type of culture medium used (Chapter Sixteen, I.Hippolyte). Rosmarinic acid production is increased 10-fold to attain 6.4 gL^{-1} (or 36% of the dry weight) under optimal condi tions. Investigation of cell growth kinetics showed that a change in the medium caused shifts in peaks of growth and rosmarinic acid production, and modifications in cellular metabolism. By changing the composition of the culture medium it is pos sible to manipulate rosmarinic acid production to coincide with cell growth or to begin only when growth had stopped.

There is an increasing interest in the development of efficient protocols for the tissue culture and micropropagation of certain *Salvia* species, in order to establish a relatively fast system for producing disease-free and true-to-type clonal (and there fore uniform) plants from outstanding genotypes. Progress in somatic embryogenesis and recent research on the technology of synthetic seeds, along with other advanced aspects of tissue culture (e.g. protoplast culture and fusion, creation of auto tetraploid lines) could offer a significant involvement of biotechnology in the propa gation and breeding of the genus *Salvia.*

Chapter Seventeen (S.E.Kintzios) offers a concise presentation of the various methods developed for the induction of callus, organogenesis and somatic embryo genesis as well as plant regeneration for micropropagation and breeding purposes of some *Salvia* species. Furthermore, the accumulation of secondary metabolites (in particular rosmarinic and lithospermic acid) in *in vitro* differentiated tissues is reviewed.

Biotechnology opens new perspectives for an automated, scaled-up and cost-efficient production of useful compounds from *Salvia* spp. Cell suspensions, immob ilized cell and hairy root cultures have been established from *S. officinalis, S. miltiorrhiza, S. fruticosa* and *S. sclarea* and used for the production of various secondary metabolites, such as rosmarinic acid, cryptotanshinone, ferruginol (achieving a yield of 29, 101 and 254 g/1, respectively) and (commercially) sclareol. Scale-up and immobilization techniques for *Salvia* liquid cell culture are the focus of Chapter Eighteen (E.Panagiotopoulos *et al.*), where updated information on the *in vitro* secondary metabolism of various important compounds can also be found.

It is hard to describe sage as an industrial crop, since its worldwide production is less than 25 000 kg per year. There is, however, a steady upward trend in the export of essential oil from various sage species, for use as products in the aromatherapy and natural cosmetics market. Commercial sage species include *S. officinalis, S. fruticosa, S. lavandulaefolia, S. verbenaca, S. sclarea* and *S. tomentosa.* In Chapter Nineteen (K.H.C.Baser) the actual situation of sage oil production and export (mainly in Mediterranean countries) is presented. In Turkey alone, approximately 500 kg of leaf oil from *S. triloba (S. fruticosa)* is annually produced and 600 tonnes of sage leaves worth more than 1.5 million US$ is exported. There is, in addition, an increasing demand for herbal tea from organically grown sage.

In the age of information technology a researcher is facing an accelerating growth of all kinds of scientific and technical data. The average yearly growth of *Salvia*-related publications is 2.2%. This rate is slight but persistent and shows a con tinuing presence of interest in the field. In an exhaustive analysis (Chapter Twenty, T.Bartol and D.Baricevic) most major bibliographic life-sciences databases are identified and assessed as pertinent sources for information on the genus *Salvia.* Using the example of *Salvia,* the degree of overlap across databases is observed and the annual trend of publishing for this genus and major journals where *Salvia*-related articles have been published is identified. An investigation of these databases and their differences in relation to keyword or classification representation of the topics is conducted. Finally, the most appropriate search technique in order to maxi mize the recall and optimize the precision is selected and presented.

Spiridon E.Kintzios

Dedicated to Katia

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I.

INTRODUCTION

1.
THE FOLKLORE AND COSMETIC USE OF VARIOUS *SALVIA* SPECIES

ANTHONY C.DWECK

Peter Black Medicare Ltd., White Horse Business Park, Aintree Avenue, Trowbridge, Wiltshire, BA14 OXB UK

SALVIA SPECIES

Salvia acetabulosa

Salvia acinos

Salvia acuminata Ruiz & Pav.

Salvia acutifolia Ruiz & Pav.

Salvia adenoclada Briq.=*Salvia striata* Benth.

Salvia aegyptiaca

Salvia aegyptiaca

Salvia aethiopis L.

Salvia alata Epling

Salvia albimaculata

Salvia albo-caerulea

Salvia alborosea Epling & Jativa

Salvia amarissima

Salvia amethystina

Salvia amplexicaulis

Salvia apiana

Salvia arabica

Salvia areysiana

Salvia argentea L.

Salvia arisanensis

Salvia arizonica Arizona sage

Salvia aspera

Salvia atrocalyx Epling

Salvia aucheri

Salvia austriaca Jacq.

Salvia axillaris

Salvia ayavacensis Kunth [Syn. *Salvia ayavacensis* Epling]

Salvia aytachii

Salvia azurea Azure Sage

Salvia azurea var. *grandiflora*

Salvia ballotaeflora

Salvia ballotiflora

Salvia bariensis

Salvia biflora Ruiz & Pav.=*Salvia tubiflora* Ruiz & Pav.

Salvia biflora var. *glabrata* Benth.=*Salvia tubiflora* Ruiz & Pav.

Salvia blancoana

Salvia blodgettii

Salvia bodinieri Vaniot

Salvia bogotensis

Salvia booleana

Salvia bowleyana Dunn

Salvia brandegei

Salvia breviflora

Salvia broussonettii

Salvia bucharica

Salvia bullulata Benth. [Syn: *Salvia bullulata* Benth.]

Salvia cadmica

Salvia caespitosa Montbret et Aucher ex Benth.

Salvia calocalicina Briq.=*Salvia paudserrata* subsp. *calocalicina* (Briq.)

Salvia calycina

Salvia camporum Epling

Salvia canariensis L.

Salvia candelabrum Spanish Sage

Salvia candica

Salvia candicans

Salvia candidissima

Salvia cardiophylla

Salvia carduacea

Salvia carnea

Salvia carnosa

Salvia cavalerici

Salvia cbapmanii

Salvia chia

Salvia chicamochae

Salvia chinensis

Salvia claytoni

Salvia clevelandii (Gray) Greene Blue Sage

Salvia clevelandii Fragrant Sage

Salvia coccinea Blood Sage, Tropical Sage

Salvia coccinea Buc'hoz ex Etlinger

Salvia coccinea var. *pseudococcinea* (Jacq.) A.Gray

Salvia columbariae Benth. California sage

Salvia columbariae Chia, Golden Chia

Salvia compressa

Salvia confertiflora

Salvia consobrina Epling

Salvia corrugata Vahl

Salvia cruikshanksii Benth.

Salvia cryptantha Montbret et Aucher ex Benth

Salvia cupheifolia Kunth=*Salvia oppositiflora* Ruiz & Pav.

Salvia cuspidata Ruiz & Pav.

Salvia cyanicalyx Epling

Salvia cylindriflora Epling

Salvia cypria Cyprus Sage

Salvia dazlyi

Salvia deserta

Salvia desoleana

Salvia digitaloides Diels

Salvia discolor Kunth

Salvia divaricata

Salvia divinorum Epling et Jativa Mexican Mint, Pipilzintzintli, Holy Sage

Salvia dombeyi Epling [Syn: *Salvia dombeyi* R. & P.]

Salvia dominica

Salvia dorisiana

Salvia dorrii Gray Ball Sage

Salvia dorrii ssp. *argentea*

Salvia dorrii ssp. *carnosa*

Salvia dorrii ssp. *dorrii* Gray Ball Sage

Salvia dorrii ssp. *gilmanii*

Salvia dorrii var. *carnosa*

Salvia dracocephaloides

Salvia elegans Pineapple Sage

Salvia eremostachya

Salvia ermenekensis

Salvia esquirolii Lévl.

Salvia euphratica

Salvia excisa Ruiz & Pav.=*Salvia tubiflora* Ruiz & Pav.

Salvia falcata

Salvia farinacea Mealy-Cup Sage

Salvia flava

Salvia flocculosa Epling & Mathias=*Scutellaria flocculosa* Epling & Mathias

Salvia florida Benth.

Salvia fluviatilis

Salvia formosa L'Heritier [Syn: *Salvia formosa* Gloxin]

Salvia formosa L'Heritier [Syn. *Salvia formosa* Ruiz & Pav.]

Salvia forskahlei

Salvia fruticosa Miller

Salvia fruticulosa

Salvia fulgens Mexican Red Sage

Salvia funerea Death Valley Sage

Salvia garedzhi

Salvia gilliessi or *gilliesii*

Salvia glabricaulis

Salvia glutinosa Hardy Sage

Salvia glutinosa Jupiter's Distaff

Salvia glutinosa Yellow Sage, Hardy Sage

Salvia glutinosa L.

Salvia grahamii

Salvia grandiflora Balsamic Sage, Broad-leafed Sage

Salvia grata M.Vahl=*Salvia oppositiflora* Ruiz & Pav.

Salvia gravida

Salvia greatae

Salvia greggii Autumn Sage

Salvia grisea Epling & Mathias

Salvia griseifolia Epling [Syn: *Salvia griseifolia* C.Presl ex Benth.]

Salvia guaranitica

Salvia haenkei Benth.

Salvia hapalophylla Epling

Salvia hastaefolia Epling=*Salvia rhodostephana* Epling

Salvia hayatana

Salvia heerii Regel

Salvia henryi Crimson Sage

Salvia herrerae Epling

Salvia hians

Salvia hidalgensis

Salvia hirta Kunth

Salvia hispanica L.Chia

Salvia horminum Red Topped Sage

Salvia hualiensis

Salvia hypargeia

Salvia hypoleuca

Salvia hyptoides

Salvia incurvata Ruiz & Pav.

Salvia indica

Salvia innoxia Epling & Mathias

Salvia integrifolia Ruiz & Pav.

Salvia jaimehintoniana=Salvia azura var. *mexicana*

Salvia japonica

Salvia jorgehintoniana

Salvia jurisicii Kosanin

Salvia keerlii

Salvia kietaoensis

Salvia korolkovii

Salvia lachnostoma Epling

Salvia lanata

Salvia lanceolata

Salvia lanicaulis Epling & Jativa

Salvia lanigera

Salvia lavandulae

Salvia lavandulifolia Spanish Sage

Salvia lavanduloides

Salvia lemmonii Lemmon's sage

Salvia leonuroides Gloxin=*Salvia formosa* L'Heritier

Salvia leucantha Mexican Bush Sage

Salvia leucoclada Benth.=*Salvia cruikshanksii* Benth.

Salvia leucophylla Greene

Salvia limbata

Salvia lobbii Epling

Salvia longiflora R. & P.=*Salvia dombeyi* Epling

Salvia longipedicellata

Salvia longispicata

Salvia longistyla

Salvia lupulina

Salvia lycioides Canyon sage

Salvia lyrata Lyre-leaf sage, Wild Sage, Cancerweed, Lyre Leaf Sage, Kasvaa Pohjois-Amerikassa

Salvia macbridei Epling=*Salvia revoluta* Ruiz & Pav.

Salvia macrophylla Benth. [Syn: *Salvia macrophylla* Benth.]

Salvia macrophylla var. *malacophylla* Benth.

= *Salvia macrophylla* Benth.

Salvia macrosiphon

Salvia madrensis

Salvia major

Salvia malacophylla Benth.

Salvia mathewsii Benth.=*Salvia speciosa* C.Presl ex Benth.

Salvia medusa Epling & Jativa

Salvia melaleuca

Salvia mellifera Black Sage

Salvia mellifera Greene California Black Sage

Salvia merjamie

Salvia mexicana

Salvia micrantha

Salvia microphylla

Salvia microstegia

Salvia miltiorrhiza Bunge Danchen, Danshen, Tan Shen, Tan Zhen, Astral Sage

Salvia miltiorrhiza Bunge [Syn. *Salvia tanshen* Max.]

Salvia miltiorrhiza Bunge [Syn. *Salvia pogonocalyx* Hance]

Salvia mirzayani

Salvia misella Kunth [Syn: *Salvia misella* Kunth]

Salvia mitis Ruiz & Pav.=*Salvia punctata* Ruiz & Pav.

Salvia mohavensis

Salvia montebrettii

Salvia moorcroftiana

Salvia moschata

Salvia mucidistachys Epling=*Salvia ayavacensis* Kunth

Salvia munzii

Salvia myuzii or mynzii

Salvia nemorosa Woodland sage

Salvia nemorosa L.

Salvia neurepia

Salvia nicolsoniana

Salvia nipponica

Salvia nodosa Ruiz & Pav.=*Salvia formosa* L'Heritier

Salvia nubigena

Salvia nutans L.

Salvia obumbrata Epling [Syn: *Salvia obumbrata* Epling]

Salvia occidentalis West Indian sage

Salvia occidentalis Sw. [Syn: *Salvia occidentalis* Ruiz & Pav.]

Salvia ocbrantha Epling

Salvia officinalis L.Sage, Salvia, Broadleaf Sage, Common Sage, Dalmatian Sage, Garden Sage, Ryytisalvia

Salvia officinalis var. *rubia* Broad-Leafed Sage, Dalmatian Sage, Garden Sage, Red Sage, Sawge, True Sage

Salvia oppositiflora Ruiz & Pav. [Syn. *Salvia oppositiflora* Kunth]

Salvia oppositiflora Ruiz & Pav. [Syn. *Salvia oppositiflora* M.Vahl]

Salvia oppositiflora Ruiz & Pav. [Syn: *Salvia oppositiflora* Hooker]

Salvia oxyodon

Salvia pachypbylla Rose Sage

Salvia palaefolia

Salvia palaestina

Salvia paposana Philippi [Syn. *Salvia paposana* Benth.]

Salvia paryskii

Salvia patens Gentian Sage

Salvia patens Cav.

Salvia pauciserrata Benth.

Salvia pauciserrata subsp. *calocalicina* (Briq.) J.R.I.Wood & Harley

[Syn: *Salvia pauciserrata calocalicina* Briq.]

Salvia pauciserrata var. *pauciserrata*

Salvia pavonii Benth.

Salvia penduliflora Epling

Salvia perlucida Epling

Salvia persipolitana