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Characterization and nutritional analysis of commonly cultivated banana varieties in Kerala

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Abstract
Banana is one of the most common and widely used food all over the universe from ancient time. In this work mainly the nutrition analysis of various commonly cultivated banana varieties in Kerala has been used such as Najalipoovan, Poovan, Etha, Palenkodan, Robesta, Chemkadali, Pachakadhali, Sundari and Kannan. The peel contain about 40% of weight of banana fruit, its nutrition analysis is been also done to analyse various contents of significance. Further there is chance of occurrence of nutrients in peel since banana fruit is rich in various nutrients. And the peel of banana, a biomass just discarded into nature can thus be converted to various value added products like drugs, soaps, animal feed etc. It is been observed that these peel is source of various natural antioxidants, dietary fibre, crude fat and crude protein. On analysis Pachakadali fruit has highest moisture content and moisture content of peel is highest for Etha. Crude protein content of fruit and peel is highest for Kannan. Crude fibre content of fruit is highest for Kannan and crude protein content of peel is highest for Sundari. Ether extract in fruit and peel is highest for Kannan. Total ash content of fruit is highest for Kannan and ash content of peel is more for Pachakadali. Gross energy of fruit is highest in case of Najalipoovan fruit and gross energy of peel is highest for Robesta. On comparing these varieties on the basis of test result Kannan is the most superior variety on the basis of nutritional quality. Further on analysing test results it has been found that the peel has superior nutrient and moisture content. So from the analysis it is revealed that one of the most useful part of a banana is it's peel. By the above analysis one can easily understand importance of many varieties of banana and further detailed researches can extend the scope of study.

Keywords: Banana, Crude ash, banana peel, crude protein, proximate analysis

1. Introduction
Bananas is one of the wide known and accepted food crop in the whole world (Bouis and Welch, 2010; May *et al*., 1995; Padam *et al*., 2014) [6, 24, 31]. It is one of the oldest food crop cultivated with evidence of cultivation dating 4000 BC in New Guinea (Lejju *et al*., 2006; Denham and Donohue, 2009; Kennedy, 2008; Denham *et al*., 2003, 2004) [23, 11]. Bananas are used in raw consumption as well as for making wide variety of dishes including deserts (Aurore *et al*., 2009; Kumar *et al*., 2012; Chandler, 1995) [2, 21, 9] and serves a good deal in daily diet and nutrition (Zhang *et al*., 2005; Menezes *et al*., 2011; Aurore *et al*., 2009; Vatanasuchart *et al*., 2012) [48, 25, 2, 46]. Banana is rich in carbohydrate, vitamins, protein, dietary fibre and iron (Kumar *et al*., 2012; Mohapatra *et al*., 2010; Aurore *et al*., 2009) [21, 26, 2]. Therefore it has great impact in maintain good digestion, immune tolerance, avoiding cancers, and maintains good levels of metabolism in body. India is the country with largest production of banana in the world, and Kerala one of India's major producers of banana (Nayar, 2010) [28]. The ideal tropical condition and good precipitation in Kerala aids good growth of banana. Many kinds of banana that differ from each other in colour, taste, shape, size are cultivated in Kerala (Devi *et al*., 1990; Norman and Radhakrishnan, 1990; Nair *et al*., 2005) [12, 29, 27]. The major common varieties include Njalipoovan, Poovan, Etha, Palenkodan, Robesta, Chemkadali, Pachakadhali, Sundari, Kannan etc (Jacob, 1952) [17]. Among this Eatha is considered as the biggest, popular and commonly available variety in Kerala. Palayankodan is one of the sweet banana available and is one of the cheapest variety among the small banana variety available. Robesta is a variety with increased yield, good aroma, and different taste compared too many common variety. Poovan has medium bunch size, and good disease resistance and good storage. Chemkadali has larger fruit size than Poovan but smaller than Eatha (Jacob, 1952) [17].

It is unique with its red violet colour, high levels of vitamin C, and good storage characters (Kaimal *et al*., 2010; Jacob, 1952) [18, 17]. Njalipoovan is another small variety of banana with good aroma and taste. The plant is medium sized and produce many suckers.

Not just fruit but the banana peel also contain many nutrient, dietary fibre, potassium, antioxidants (Kumar *et al*., 2012; Mohapatra *et al*., 2010) [21, 26]. The banana peel of these varieties aids in whitening of teeth, improves skin health by removing warts, pimples, wrinkles, and cures psoriasis (Chabuck *et al*., 2013; Kumar *et al*., 2012; Ehiowemwenguan *et al*., 2014) [8, 21, 13]. It help in pain relief of various body part, healing wound, reducing headache and also improve eye health such as UV protection, reduce dark circles (Kumar *et al*., 2012; Mohapatra *et al*., 2010) [21, 26]. Banana peel help in treating anaemia, improves mental health, lowers cholesterol levels, reduces weight, thus maintain good heart health. Further its use improves immunity and prevents occurrence of cancer (Someya *et al*., 2002; Anhwange *et al*., 2008) [41, 1].

1.1 Banana varieties and its characteristics

1.1.1 Dwarf Cavendish (AAA)

It is a popular commercial cultivar grown extensively for table and processing purpose in the states Maharashtra, Gujarat, Bihar and West Bengal. It is also popular in Tamil Nadu, Karnataka and Andhra Pradesh. 'Basrai' is the leading commercial variety of Cavendish group and is a leading commercial variety of Maharashtra. The plant stature is Dwarf making it less prone to wind damage. The bunch size, the fruit length and size is quite good though the keeping quality is rather poor. The average bunch weight with 6-7 hands and with about 13 fruits per hand is about 15-25 kg. The thick rind of the fruits retains to some extent the greenish colour even when the fruits are ripe. Gandevi selection known as 'Hanuman' or 'Padarre' is gaining importance in spite of its longer crop duration. The selection yields bunches weighing 55-60 kg. Performs well under light soils with high inputs. In combination with high-density planting and drip irrigation, Dwarf Cavendish is becoming a highly successful cultivar. It is highly susceptible to Sigatoka leaf spot disease in humid tropics restricting its commercial cultivation.

1.1.2 Robusta (AAA)

It is a semi-tall variety, grown mostly in Tamil Nadu and some parts of Karnataka for table purpose. Andhra Pradesh and Maharashtra. It is a high yielding and produces bunch of large size with well-developed fruits. Dark green fruits turn bright yellow upon ripening depending on ripening conditions. Fruit is very sweet with a good aroma. Bunch weighs about 25-30 kg. Requires propping. Fruit has a poor keeping quality leading to a quick breakdown of pulp after ripening, hence not suited for long distance transportation. Robusta is highly susceptible to Sigatoka leaf spot disease in humid tropics.

1.1.3 Rasthali (Silk AAB)

It is a medium tall variety commercially grown in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Bihar. Its unique fruit quality has made Rasthali popular and a highly prized cultivar for table purpose. Fruits are yellowish green throughout their development, but turn pale yellow to golden yellow after ripening. Fruit is very tasty with a good aroma. Longer crop duration, severe susceptibility to Fusarium wilt, requirement of bunch cover to protect fruits from sun cracking and formation of hard lumps in fruits make crop production more expensive.

1.1.4 Poovan (Mysore AAB)

It is a leading commercial cultivar grown throughout the country with location specific ecotypes like Palayankodan in Kerala, Poovan in Tamil Nadu, Karpura Chakkarakeli in Andhra Pradesh and Alpan in North Eastern Region. It is generally cultivated as a perennial crop. Tamil Nadu is the leading producer of Poovan cultivar owing to its climatic and marginal soil condition. Poovan is also commercially cultivated for leaf industry throughout Tamil Nadu and in certain parts of Kerala. Fruit is slightly acidic, firm and has typical sour-sweet aroma. Fruits turn to attractive golden yellow on ripening. Medium sized bunch, closely packed fruits, good keeping quality and resistant to fruit cracking is its plus points. But it is highly susceptible to Banana Bract Mosaic Viral (BBMV) disease and Banana Streak Virus (BSV), which cause considerable reduction in yield.

1.1.5 Nendran (AAB)

It is a popular variety in Kerala where it is relished as a fruit as well as used for processing. Commercial cultivation of Nendran (Eatha) has picked up rapidly in Tamil Nadu in the recent past. Nendran is known to display considerable diversity in plant stature, pseudostem colour, presence or absence of male axis, bunch size, etc. Bunch has 5-6 hands weighing about 12-15 kg. Fruits have a distinct neck with thick green skin turning buff yellow on ripening. Fruits remain as starchy even on ripening. Nendran is highly susceptible to BBMV, nematodes and borers.

1.1.6 Red Banana (AAA)

Red banana is the most relished and highly prized variety of Kerala and Tamil Nadu. Its commercial cultivation is prominent in Kanyakumari and Tirunelveli districts of Tamil Nadu. It is also popular in Karnataka, Andhra Pradesh and to some extent in Western and Central India. In Bihar and other regions, it is popular as Lal Velchi while in Karnataka as Chandra Bale. The colour of the pseudostem, petiole, and midrib and fruit rind is purplish red. It is a robust plant with bunches weighing 20-30 kg under good management practices. Fruits are sweet, orange yellow coloured and with a pleasant aroma. It is highly susceptible to bunchy top, fusarium wilt and nematodes.

1.1.7 Ney Poovan (AB)

Ney Poovan is the choicest diploid cultivar, which is under commercial mono cultivation on a large scale especially in Karnataka and Tamil Nadu. In Kerala It is grown in backyards and now shifting to large-scale cultivation. Ney Poovan is a slender plant bearing bunches of 15-30 kg after 12-14 months. Dark green fruits turn golden yellow with a very good keeping quality. Fruit is highly fragrant, tasty, powdery and firm. Ney Poovan is tolerant to leaf spot but susceptible to Fusarium wilt and banana bract mosaic virus.

1.1.8 Virupakashi (AAB)

It is an elite variety in South India especially grown for table purpose in Palani and Shevroy hills of Tamil Nadu under perennial cultivation. It is a vigorous and hardy variety though not a prolific one. Fruits show a typical curvature, possess a pleasant aroma and delightful taste. Virupakshi has the characteristic flavour only when they are cultivated in higher elevation. In the mixed cultivation it is well suited as a shade plant for young coffee. It has many ecotypes like 'Sirumalai' (grown on hills), 'Vannan', 'Kali' etc. well suited for cultivation in plains. Perennial system of cultivation aggravates Banana Bunchy Top Virus (BBTV).

1.1.9 Pachanadan (AAB)
It is a popular variety in Tamil Nadu grown especially for its cooling effects in hot tracts in summer. The variety comes up well in marginal soils without any yield reduction. It is well suited as an intercrop in coconut/areca nut garden. The bunch weight ranges from 12-15 kg (after 11-12 months). Pachanadan could be used in the Nendran plantations for gap filling as it comes up for harvest along with Nendran. This variety is tolerant to leaf spot and BBTV diseases, but susceptible to wilt disease.

1.1.10 Monthan (ABB)
It is a widely cultivated variety for processing. Monthan is a fairly tall and robust plant bearing bunches of 18-20 kg after 12 months. Fruits are bold, stocky, knobbed and pale green in colour. The skin is usually green. The new prolific 'Monthan' type clones of economic value namely 'Kanchi Vazhai' and 'Chakkia' are recently becoming popular in Tamil Nadu. Apart from its culinary use of fruits, pseudostem core is a highly relished vegetable with many medicinal properties. Monthan is also cultivated for production of leaves in Trichy and Tanjore districts of Tamil Nadu. It has many desirable qualities like immunity to BBTV diseases, salt tolerance and normal bunch mass even under marginal condition, but it is highly susceptible to Fusarium wilt disease.

1.1.11 Karpuravalli (ABB)
It is a popular variety grown for table purpose in medium rich soils. Its commercial cultivation is spread over in central and Southern districts of Tamil Nadu and Kerala. In Bihar, cultivation is in patches under the name 'Kanthali'. Karpuravalli is a tall, robust plant well suited to marginal lands and soils, produced under low input conditions. It is also the sweetest among Indian bananas. Karpuravalli is occasionally seeded depending on the seasonal variability. Its ash coated golden yellow and sweet fruits have good keeping quality. Karpuravalli is highly susceptible to wilt disease, tolerant to leaf spot disease and well suited for drought, salt affected areas and for low input conditions.

1.1.12 Safed Velchi Musa (A B Group)
This is considered a good quality fruit for table purpose and is cultivated in the Thane, Nasik districts of Maharashtra. It is grown under the shade of areca nut gardens in the South Kanara districts of Karnataka. This variety is medium sized with slender yellowish green pseudostem and can be recognised by the reddish petiole margin, large fruits, very thin and papery rind and white firm flesh that is very sweet. The average bunch weight is about 12 kg with about 150 fruits/bunch. The duration of the variety is about 13 months.

1.2 Objectives
The morphological and nutritional analysis of different varieties (fruit and peel) in Kerala are yet to be discovered. Based on this background the main objective of the study includes the identification of difference in terms of nutritional constituents of selected varieties.

1.3 Scope of the study
The study would enlighten the nutritional content of various cultivated banana varieties in Kerala and value addition of banana peel which could be further explored.

2. Review of literature
Many work relating to nutritional and morphological characterization of variety of banana (fruit and peel) had been done so far yet. Works on banana plant has been done on fields including phytochemical analysis, simple chemical analysis, nutrition management, physiological, morphological, genome analysis, and antioxidant profiling. Analysis of banana genome groups of wild and cultivated cultivars of Manipur, India using score card method (Singh *et al*., 2014) [40], phytochemical analysis of baby banana peels (*Musa acuminata*) in relation with a hyperpigmentation phenomenon (Benitez, 2015) [5], phytochemical analysis of selected banana varieties (Siji and Nandini, 2017a; Siji and Nandini, 2017b) [34, 35], phytochemical screening and antioxidant activity of banana peels (Velumani, 2016) [47], varietal impact on phytochemical contents and antioxidant properties of *Musa acuminata* (Babu *et al*., 2012) [3]. Majority of works done on this field is mainly focussed on qualities analysis of various parts and products of banana plant. But there is only few work done on quantitative analysis about nutritional value of banana. This work aims for the characterization of various common varieties of banana available in Kerala and its nutritional analysis.

2.1 Musa (Banana)
The bispecific origin of edible banana first mentioned by Kurz (1867) [22] and experimentally proved by Simmonds and Shepherd (1955) [38] by cross the two parent varieties; *Musa acuminate* and *Musa balbisiana*. Supported by morphological and cytological evidences, it was assumed that the edible bananas were evolved from the two ancestors in five main stages. The triploids were formed by the fertilization of diploid egg cell with haploid pollen leads to the formation of triploids as a main step in the banana evolution process. The triploids were popular among farmers and breeders due to many beneficial traits especially sturdiness, robustness and pulpiness. Parthenocarpy, sterility, polyploidy and vegetative propagation for perpetuation of useful traits has played a major role in the evolution of current banana varieties (Uma *et al*., 2005a; Uma *et al*., 2005b) [43, 44].
The generic name Musa is rooted in Sanskrit word Moca or may have derived from Arabic world Mauz, Mouz or Mauwz, which is used for banana (De Candolle, 1886; Nayar, 2010; Hakkinen *et al*., 2009) [7, 28, 15]. The Arabic name for banana ‘Mauz’ is also mentioned in Rheede’s ‘Hortus Malabaricus’.
The earliest scientific classification of banana was made by the famous taxonomist Linnaeus in 1783. According to his classification, all dessert banana were known as *Musa sapientium*; which is sweet during ripening and consumed fresh. The name *Musa paradisiaca* was assigned to the plantain group which are cooked and consumed while starchy. These two apparent species are not species at all, but considered to be closely related interspecific triploids hybrids of the AAB group. The modern method of classifying edible bananas was devised by Simmonds and Shepherd (1955) [38], most modern edible bananas originally come from two wild species, *Musa acuminate* Colla (A genome) and *Musa balbisiana* Colla (B genome). The classification proposed by Simmonds and Shepherd based on the relative contribution of the parent character to the constitution of the cultivar and to the ploidy or chromosome number of the cultivar. The original characters used by Simmonds and Shepherd (1955) [38] were amended and updated by many taxonomists (Purseglove, 1972; Stover and Simmonds, 1987; Valmayor *et al*., 2000) [32, 42, 45].
By using 15 separate characters, with strong diagnostic differences between the two ancestors, the contribution of the

two species could be clearly distinguished. For each character in which a cultivar agreed completely with wild acuminate, a score of 1 was given, and for each character in which the cultivar agreed with balbisiana, a score of 5 was given. The intermediate expression of the character were assigned as score of 2, 3 or 4, according to intensity.

Concerning ploidy, edible bananas belonging to the section Eumusa have 22, 33 or 44 chromosomes. The basic haploid number is 11, thus cultivars can only be diploid, triploid or tetraploid. Of the 200-300 clones which are thought to exist, more than half are triploids, with the remaining being mostly diploids. Tetraploid clones are very rare. The planted area of triploid bananas is more than 100 times greater than that of diploids. Triploids are hardier, more vigorous and easier to grow. Morphologically, triploids and tetraploids are larger and more robust than diploids. Also leaf thickness and cell size increases with increasing ploidy.

The scoring technique based on 15 plant characters allows for a range of total score from 15 (pure *Musa acuminate*) to 75 (pure *Musa balbisiana*). Scores in between would be based on the relative contribution of the two species plus the level of ploidy in the interspecific hybrid. Simmonds and Shepherd (1955) [38] and Stover and Simmonds (1987) [42] used the groups and scores to classify a range of edible bananas. Silayoi and Chomchalow (1987) [36] classified 137 accessions in the Thai banana gene bank on the same basis. Recognizing some deficiencies, they later modified the classification.

The main difference between these two classifications is the introduction of almost pure balbisiana clones in the Thai grouping, which did not appear in the original classification. Espino and Pimentel (1990) [14] used isozymes technology to differentiate clones of pure acuminate, pure balbisiana and their hybrids from one another. They found broad bands of malate dehydrogenease activity which were unique to pure balbisiana, and other bands which indicated an acuminate genome. They concluded that BB and BBB cultivars were unique and distinct from hybrid ABB clones. The cooking plantain Saba (BBB) is very close to pure balbisiana (73 to 75 points).

2.1.1 Taxonomical classification (*Musa acuminata*; banana)

Kingdom: Plantae-planta, plantes, and plants, vegetal
Subkingdom: Tracheobionta
Division: Magnoliophyta
Class: Liopsida
Order: Zingiberales
Family: Musaceae
Genus: Musa
Species: *Musa acuminata*

Table 1: Different vernacular names of *Musa paradisiaca* around the globe and India.

Language	Names
Scientific names	*Musa paradisiaca*
Name in various global languages	
French	Bananier
German	Banane
English	Banana
Name in various Indian languages	
Sanskrit	Kadali
Hindi	Kela
Urdu	Bonana
Marathi	Kela
Kannada	Baale
Gujarati	Kelphool
Malayalam	Vazha
Tamil	Vazhai

Table 2: Classification of edible bananas.

Genomic group	Score	References
AA diploid	15-23	Simmonds and Shepherd (1955); Stover and Simmonds (1987) [38, 42]
AAA triploid	15-23	
AAB triploid	24-46	
AB diploid	49	
ABB triploid	59-63	
ABBB tetraploid	67	
AA/AAA	15-25	Silayoi and Chomchalow (1987) [36]
AAB	26-46	
ABB	59-63	
ABBB	67-69	
BB/BBB	70-75	

Table 3: Important banana varieties cultivated in different states of India.

State	Varieties grown
Andhra Pradesh	Dwarf Cavendish, Robusta, Rasthali, Amritpant, Thellachakrakeli, Karpoora Poovan, Chakrakeli, Monthan and Yenagu Bontha
Assam	Jahaji (Dwarf Cavendish), Chini Champa, Malbhog, Borjahaji (Robusta), Honda, Manjahaji, Chinia (Manohar), Kanchkol, Bhimkol, Jatikol, Digjowa, Kulpait, Bharat Moni
Bihar	Dwarf Cavendish, Alpon, Chinia, Chini Champa, Malbhig, Muthia, Kothia, Gauria
Gujarat	Dwarf Cavendish, Lacatan, Harichal (Lokhandi), Gandevi Selection, Basrai, Robusta, G-9, Harichal, Shrimati
Jharkhand	Basrai, Singapuri
Karnataka	Dwarf Cavendish, Robusta, Rasthali, Poovan, Monthan, Elakkibale
Kerala	Nendran (Plantain), Palayankodan (Poovan), Rasthali, Monthan, Red Banana, Robusta
Madhya Pradesh	Basrai
Maharashtra	Dwarf Cavendish, Basrai, Robusta, Lal Velchi, Safed Velchi, Rajeli Nendran, Grand Naine, Shreemanti, Red Banana
Orissa	Dwarf Cavendish, Robusta, Champa, Patkapura (Rasthali)
Tamil Nadu	Virupakshi, Robusta, Rad Banana, Poovan, Rasthali, Nendran, Monthan, Karpuravalli, Sakkai, Peyan, Matti
West Bengal	Champa, Mortman, Dwarf Cavendish, Giant Governor, Kanthali, Singapuri

3. Hypothesis

The current research work is based on the following hypothesis

- The commonly cultivated banana varieties in Kerala shows a clear morphological difference among them.
- The nutritional quality of the fruit and peel of different commonly cultivated varieties also vary widely.
- The nutritional parameters of the peel is higher than the fruit among the selected cultivated varieties.

4. Materials and Methods

4.1 Study area

Kerala state covers an area of 38,863 km^2 with a population density of 859 per km^2 and spread across 14 districts. The climate is characterized by tropical wet and dry with average annual rainfall amounts to 2,817 ± 406 mm and mean annual temperature is 26.8 °C (averages from 1871-2005; Krishnakumar *et al*., 2009) [20]. Maximum rainfall occurs from June to September mainly due to South West Monsoon and temperatures are highest in May and November.

4.2 Sample collection

Nine various cultivated banana varieties were identified based on a baseline survey and selected for characterization and nutritional analysis from various districts across Kerala State, India. Mature fruits were collected from different varieties and the fruits were thoroughly cleaned using double distilled water and outer skin (peel) were separated. The samples were cut into small pieces and dried in hot air oven at 60 ºC for 48 hrs, powdered using a kitchen blender (Prestige Nakshatra plus, Prestige industries Mumbai) and later stored in air tight polyethylene zipper bag for analysis.

4.3 Varieties selected

4.3.1 Robusta (B1) *Musa acuminate* Colla (AAA)

These banana has high fibre content, but has low in calories. A high fibre intake has been linked to reduced body weight and a number of health benefits. Bananas also contain fibre, that will reduce blood sugar levels. A banana contains high fibre so that everyone, should eat banana to add dietary fibre due to its health benefits Vitamin B6 can also help protect against type 2 diabetes and aid in weight loss. Robesta too had good and different taste than other available varieties.

4.3.2 Etha (B2) *Musa* x *paradisiaca* (AAB)

Etha fruit helps in improving digestion. It has high fibre content so it prevents constipation. They are rich in calcium, phosphorus therefore it improve teeth and bone strength. Iron present in it reduces the chances of developing anaemia. Etha intake helps in controlling diabetics. It help to reduce weight due to high fibre content. It boost the memory and is also used to treat ulcer. The peel has been used to remove psoriasis and warts.

4.3.3 Poovan (B3) *Musa* x *paradisiaca* (AAB)

It lower Blood Pressure. It is used in the treatment of Asthma. The high fibre content in it help to cures Diabetes and also help in weight loss. It helps to have good memory and also help to boost mood. It is used in the treatment of anaemia. Eating this will strengthen bones. Poovan peel has good anti-inflammatory properties.

4.3.4 Sundari (B4) *Musa acuminate* Colla (AA)

Sundari has high levels of vitamin C and Manganese which is good for skin health. Potassium in bananas is good for heart health and blood pressure maintenance. Bananas can help in the digestion and help to cure gastrointestinal problems. It provide high levels of energy with no cholesterol and other unwanted contents. The peel is rich in crude fibre content.

4.3.5 Njalipoovan (B5) *Musa acuminate* Colla (AB)

Najalipoovan has ability to control high blood pressure. It promote weight loss. Eating Najalipoovan is good for pregnant women due to its high nutrition content. It boost energy and increase stamina. It keeps bones strong and healthy. It is used as a good food for athletes. Najalipoovan improves gut health and digestion. It can improves mood and mental health.

4.3.6 Palayamkodan (B6) *Musa* x *paradisiaca* (AAB)

It controls high blood pressure. It helps in promoting weight loss easily. It helps in improving energy and thus increases the stamina too. This help in keeping bone strong and healthy. It improves gut health and prevent stomach ulcers etc. It helps in improving memory and improving moods. It has less crude fibre content and less calorie value as compared to other varieties of banana.

4.3.7 Chemkadali (B7) *Musa acuminate* Colla (AAA)

Chemkadali is rich source of fibre and therefore help in weight loss. It is used to avoid kidney stones. It has high levels of vitamin c which improves health. It also help in improving the blood volume. Eating the fruit will reduce ageing of skin. It is used to relieve from heart burning effects.

4.3.8 Kannan (B8) *Musa acuminate* Colla (AAA)

Banana porridge prepared from natural Kannan kaya powder is believed to be an ideal food for the babies. Raw banana powder of this fruit is rich with carbohydrates, minerals and vitamins. It is a source of energy required for babies, toddlers and even adults. It is an instant source of energy. Kannan fruit has high crude protein content, crude fibre content and high levels of ether extract, and high levels of ash content.

4.3.9 Pachakadali (B9) *Musa acuminate* Colla (AAA)

It has high fibre content therefore is used in weight loss. It is used in treating kidney stone. Its regular intake will reduce ageing of skin. Pachakadali peel has high level of total ash content too. The fruit is used to treat heartburns.

4.4 Proximate analysis

The powdered banana samples were subjected various proximate analysis using standard protocols. The analysis includes estimation of dry matter and moisture content, estimation of crude protein, estimation of crude ash and insoluble ash, crude fat and determination of dietary fibre.

4.4.1 Estimation of dry matter and moisture

The dry matter (DM) is calculated using oven dry methods where fresh samples were kept hot air oven at 85 °C for 48 hrs. The values are calculated based on the initial and final weight of the samples using the equation given below

$$\% \text{ DM} = \frac{DM_1 \, XDM_2}{100}$$

4.4.2 Estimation of crude ash and insoluble ash

The weight of clean dry empty silica crucible is determined as 'W' gms approximately 3 gms of the dried powdered sample is weighed noting the exact weight of crucible + sample as W1. Ignite it in the muffle furnace at 600 °C for 3 hrs, allow to cool overnight. Take the weight of silica crucible + crude ash as W2. Digest the ash in the crucible with 25 ml of 5N HCl, boiling it for 10 minutes, cool, filter through Whatman no 42 ash less filter paper and make paper and crucible acid free. Transfer the paper with residue to respective crucible. Dry in hot air oven and ignite in the muffle furnace at 600 °C

for 3 hrs. Cool overnight and take the weight of the crucible 'W3'Gms, and acid insoluble ash is calculated as

$$\% \text{ crude ash (\% CA)} = \frac{W_2 - W}{W_1 - W} \times 100 \; ; \left[\frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100\right]$$

$$\% \text{ acid insoluble ash} = \frac{\text{Weight of AIA}}{\text{Weight of sample}} \times 100$$

$$= \frac{W_3 - W}{W_1 - W} \times 100$$

4.4.3 Estimation of crude fat

The crude fat is done using solvent extraction with petroleum ether. The extraction is done on soxtec fat analyser. Clean dry aluminium cups marked appropriately are weighed W1. Dry powdered sample are weighed approximately 3 Gms of sample, noting exact sample weight, W in marked thimbles. The thimbles are attached in correct order on the adaptors of soxtec extractor. 60 ml of petroleum ether is taken in the aluminium cups and assembled seeing that markings of thimble, cup and sample numbers tally. Condenser water supply is switched on. The heating bench is turned on using the 'power on' button on control unit of soxtec unit and when the temperature reaches 100 °C, the thimbles are dipped into boiling ether and boiling cycle is done for 15 minutes. The thimbles are raised and rinsed with condensed ether in the rinsing cycle for 30 minutes. This is followed by 10 minutes of recovery cycle where pure unsaturated ether is collected back and recovered. The fat containing cups with residual ether is then dried in hot air at 100 °C for 1hr, cooled in desiccators and weighed, W2 Gms. The crude fat is calculated as

$$\text{Crude fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100$$

$$= \frac{W2 - W1}{W} \times 100$$

4.4.4 Estimation of crude fibre

The thimbles containing fat free extract from the forgoing estimation are dried in hot air oven at 50 °C for overnight. Approximately 0.8 Gms of fat free sample is weighed exactly 'W' Gms into grouch crucibles provided with fibretec extraction assembly. They are set on the assembly and two digestions, acid & alkali digestions in 1.25% H_2SO_4 and 1.25% NaOH are done one after the other for 30 minutes. With draining of acid and alkali and flushing of hot distilled water done in between each digestion. The residue containing crucibles are removed, over dried at 60 °C for overnight, weighed 'W1'gms. They are ashed at 600 °C for 3 hours in muffle furnace overnight, cooled and weighed 'W2' Gms.

$$\text{Then \% crude fibre} = \frac{\text{Weight of crude fibre}}{\text{Weight of fat free extract}} \times 100$$

$$= \frac{(W_1 - W_2)}{W} \times 100$$

4.4.5 Estimation of crude protein

Estimation of crude protein consists of two parts: digestion and distillation. Weigh approximately 0.25 gm of dried powdered sample noting the exact weight, 'W' gms, into clean dry digestion tubes. Add approximately 1 gm of digestion mixture (potassium sulphate & copper sulphate, 9:1 by weight) into each tube. Add 12ml of con.H_2SO_4 into each tube, place on the digester (KJELTEC) assembly and digest at 400°C for 11 to 12 hrs. Cool down to room temperature.

Place on distillation unit (KJELTEC) and set the program (water-70 ml, alkali-70 ml, receiver-30 ml, tube drain) and distil it with steam in the unit. The instrument estimates the crude protein on entering the weight of sample W as

$$\% \text{ crude protein} = \frac{\text{volume of 0.1N HCl x 0.0014 x 6.25 x 100}}{W}$$

4.4.6 Estimation of nitrogen free extract

NFE or soluble carbohydrate is calculated based on difference

NFE = Dry matter-(crude protein + crude fat+ crude ash + crude fibre)

NFE = 100–(moisture + crude protein + crude fat + crude ash + crude fibre)

4.5 Statistical analysis

The results were analysed and descriptive statistics were done using SPSS 12.0 (SPSS Inc., an IBM Company, and Chicago, USA) and graphs were generated using Sigma Plot 7 (Systat Software Inc., Chicago, USA).

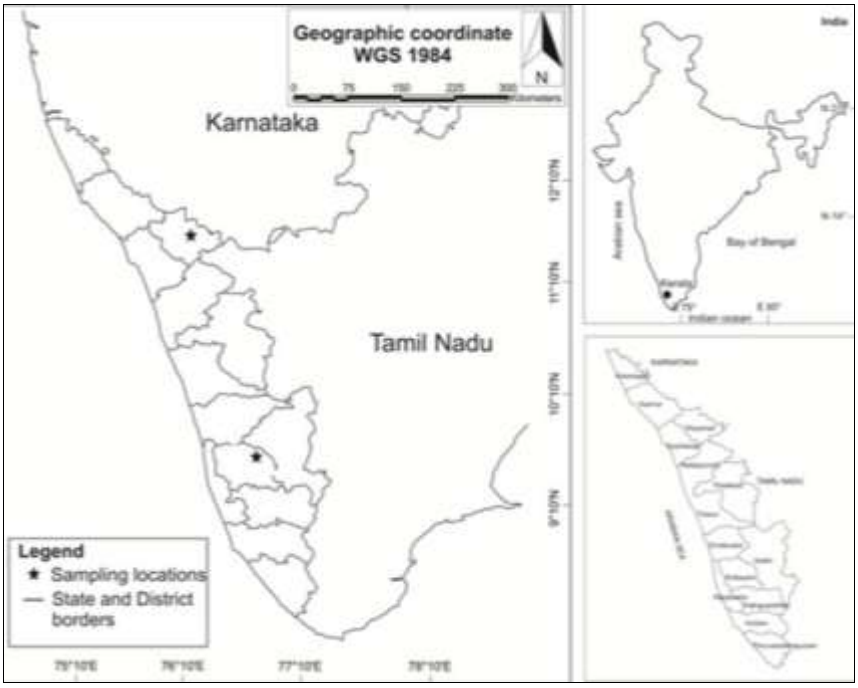

Fig 1: Map of Kerala showing the sample collection point.

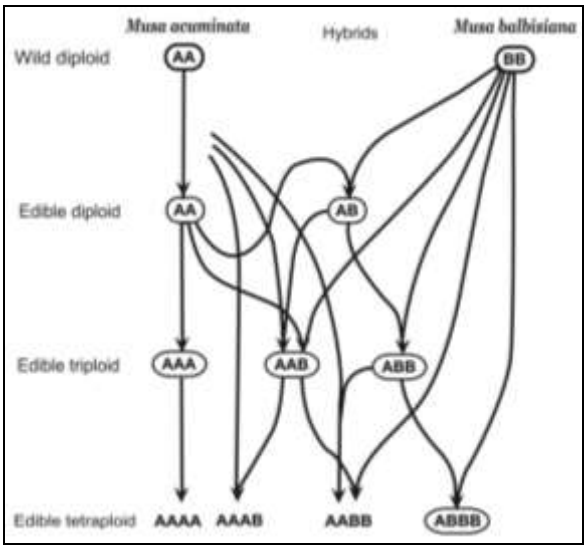

Fig 2: The evolution of the banana complex: A, *M. acuminata*; B, *M. balbisiana*. Genotypes known to occur naturally are encircled, those known only from experiment are not encircled (adopted from Simmonds and Shepherd, 1955) [38].

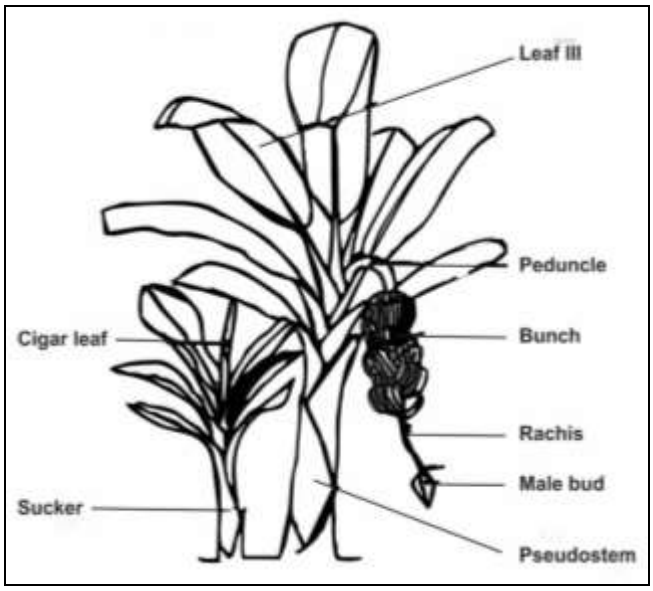

Fig 3: Description of pseudostem/suckers of banana. Modified after: IPGRI, 1984.

Fig 4: General morphology A) habitat (A1, suckers; A2, pseudostem; A3, petiole base; A4, inflorescence; A5, petiole; A6, leaf base; A7, 3rd leaf), B) inflorescence at early stages (B1, peduncle; B2, sterile bract; B3, female bud; B4, female flowers; B5, female bract), C) female flower (C1, ovary; C2, free tepal; C3, compound tepal; C4, stigma), D) compound tepal, E) free tepal, F) pistil with staminodes (F1, ovary; F2, staminodes; F3, style; F4, stigma), G) c.s of ovary, H) infructescence (H1, peduncle; H2, fruits; H3, rachis; H4, male bract; H5, male bud), I) male flower, J) rudimentary pistil with stamens (J1, rudimentary pistil; J2, stamens), K) fruit hand (K1, pedicel; K2, fruit; K3, fruit apex).

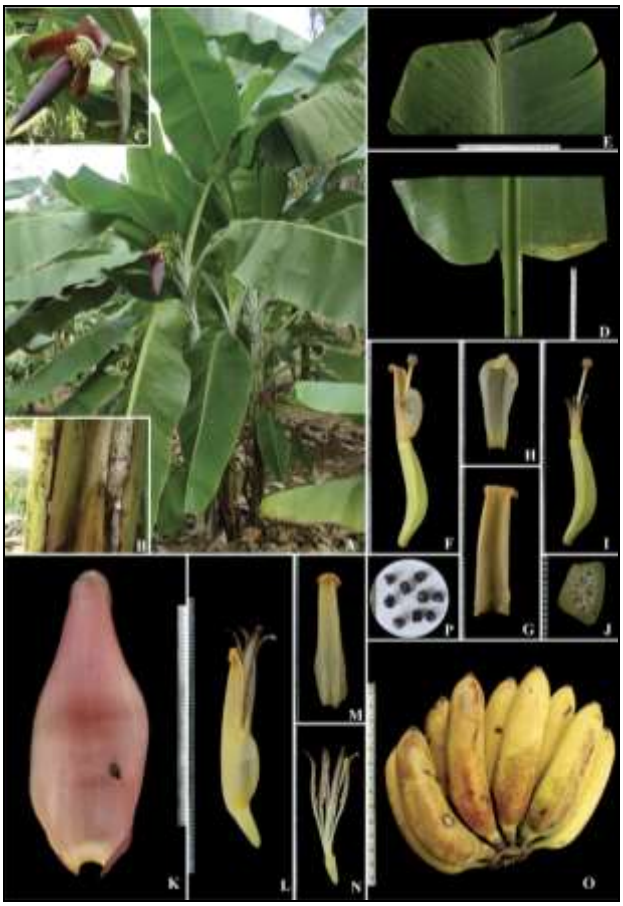

Fig 5: *Musa acuminata* Colla A) habitat, B) pseudostem coloration, C) inflorescence at early stage, D) leaf base, E) leaf apex, F) female flower, G) compound tepal, H) free tepal, I) pistil with staminodes, J) c.s of ovary, K) male bract abaxial surface, L) male flower, M) compound tepal, N) rudimentary pistil with stamens, O) ripened fruit hand, P) seeds.

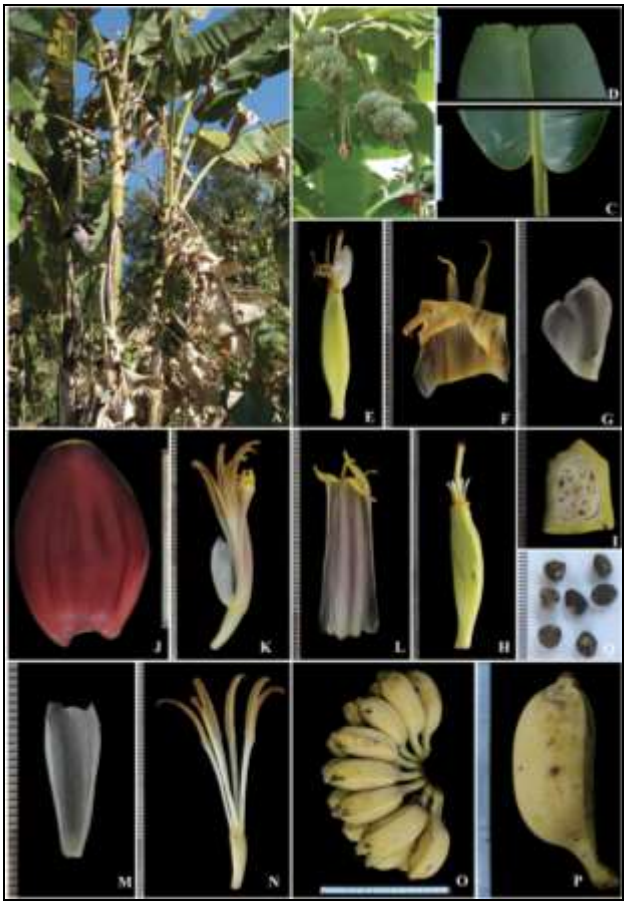

Fig 6: *Musa balbisiana* Colla A) habitat, B) infructescences with advanced stage of male bud, C) leaf base, D) leaf apex, E) female flower, F) compound tepal (female), G) free tepals (female), H) pistil with staminodes, I) c.s of ovary, J) male bract, K) female flower, L) compound tepal (male), M) free tepal (male), N) rudimentary pistil with stamen, O) ripened fruit hand, P) single fruit, Q) seeds.

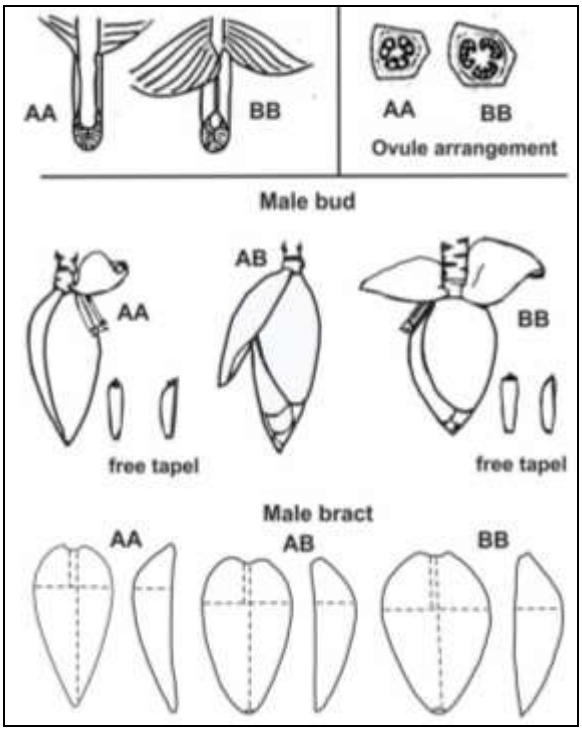

Fig 7: Important characters used in species and genome groups of edible banana. Modified after: IBPGR, 1984.

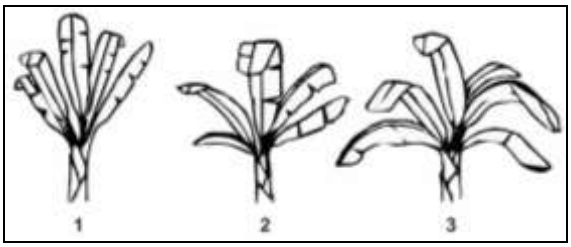

Fig 8: Different leaf habit of banana 1) Erect, 2) Intermediate, 3) Drooping. Modified after: IPGRI, 1984.

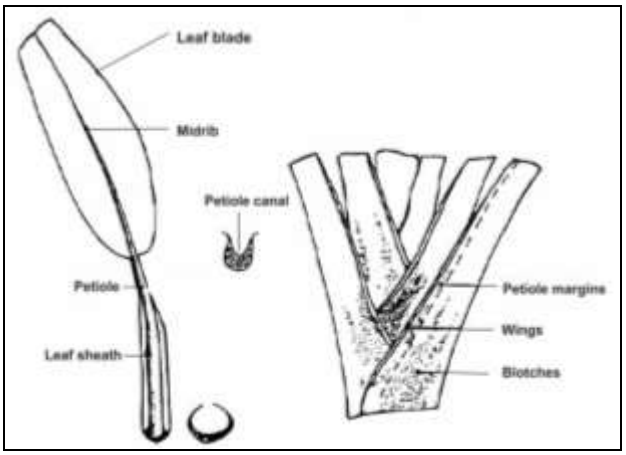

Fig 9: Petiole/midrib/leaf of banana. Modified after: IPGRI, 1984.

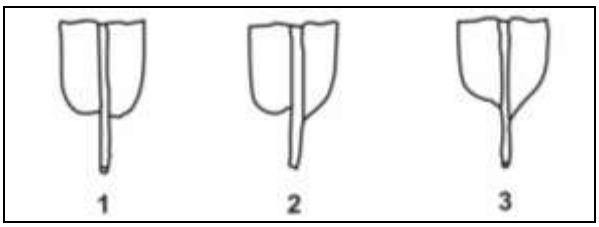

Fig 10: Shape of leaf blade base 1) both side rounded, 2) one side rounded, one pointed, 3) both side pointed. Modified after: IPGRI, 1984.

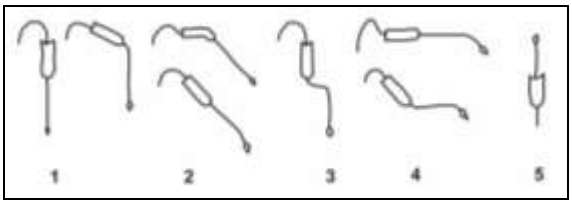

Fig 11: Rachis position 1) falling vertically, 2) at an angle, 3) with a curve, 4) horizontal, 5) erect. Modified after: IPGRI, 1984.

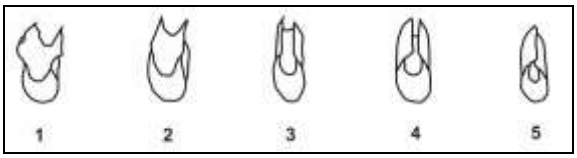

Fig 12: Petiole canal leaf III. Modified after: IPGRI, 1984.

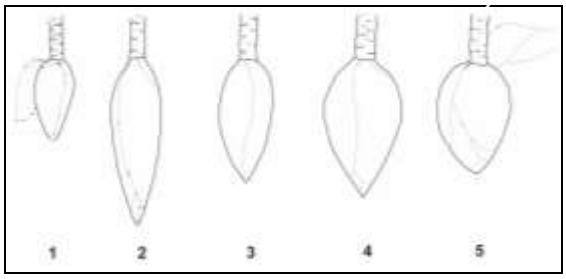

Fig 13: Male bud shape 1) like a top, 2) lanceolate, 3) intermediate, 4) ovoid, 5) rounded. Modified after: IPGRI, 1984.

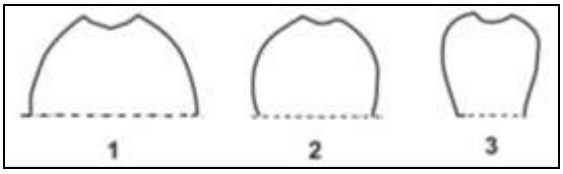

Fig 14: Bract base shape 1) small shoulder, 2) medium, 3) large shoulder. Modified after: IPGRI, 1984.

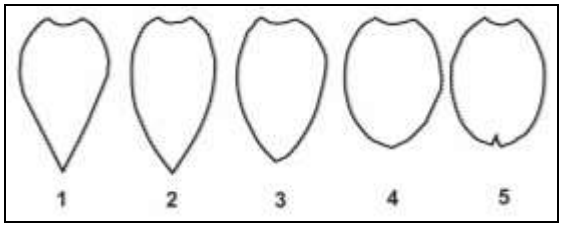

Fig 15. Bract apex shape 1) pointed, 2) slightly pointed, 3) intermediate, 4) obtuse, 5) obtuse and split. Modified after: IPGRI, 1984.

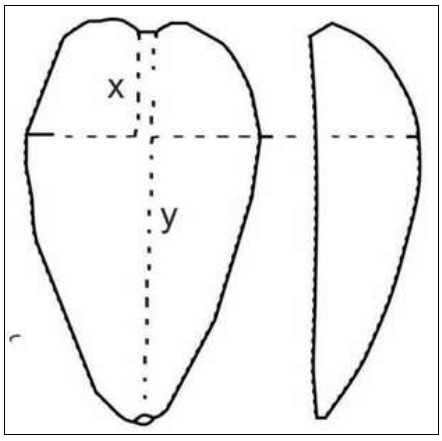

Fig 16: Male bract shape. Modified after: IPGRI, 1984.

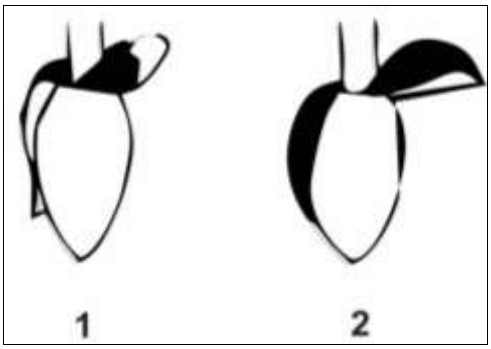

Fig 17: Bract behaviour before falling 1) revolute (rolling), 2) not revolute (not rolling). Modified after: IPGRI, 1984.

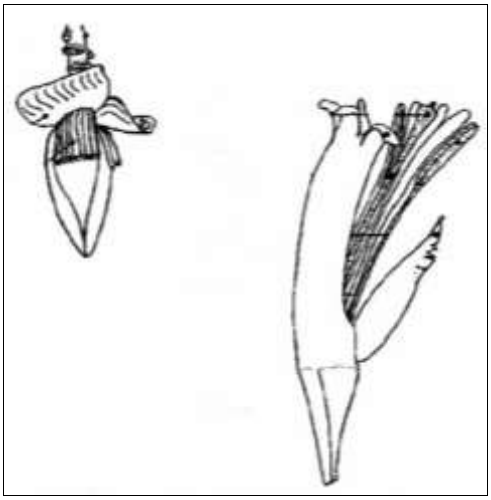

Fig 18: Male bud and flower. Modified after: IPGRI, 1984.

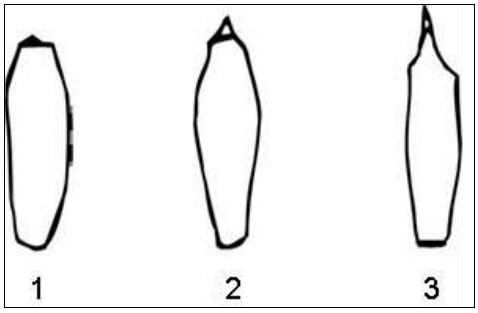

Fig 19: Free tepal apex development 1) little or no visible sign of development, 2) developed, 3) very developed. Modified after: IPGRI, 1984.

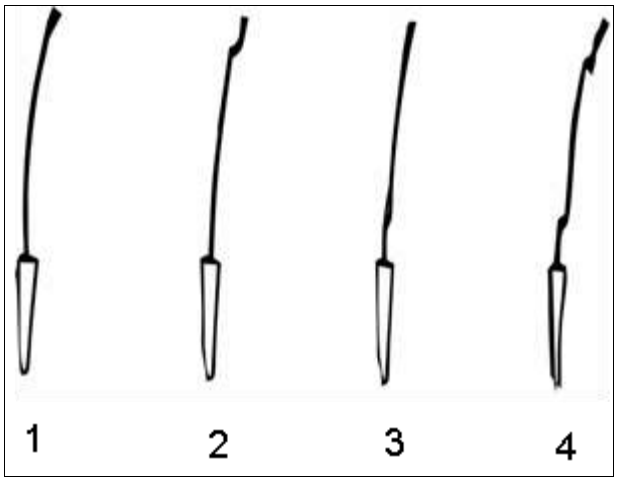

Fig 20. Style shape 1) straight, 2) curved under stigma, 3) curved at the base, 4) curved twice, 5) other. Modified after: IPGRI, 1984.

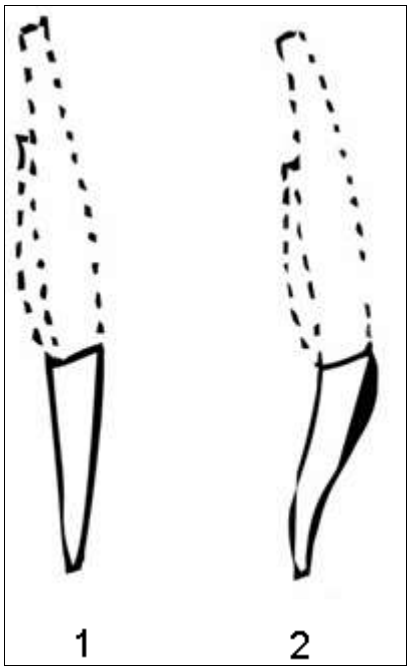

Fig 21: Ovary shape 1) straight, 2) arched. Modified after: IPGRI, 1984.

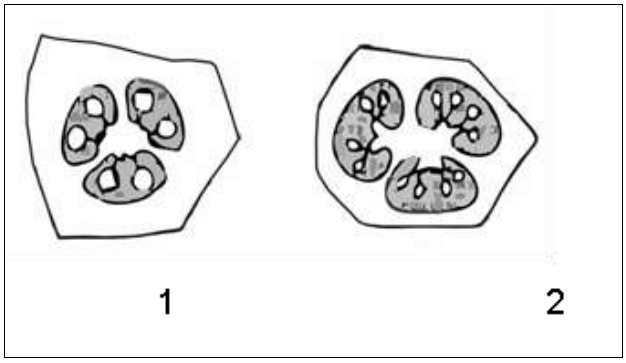

Fig 22. Arrangement of ovules 1) two rowed, 2) four rowed (more or less). Modified after: IPGRI, 1984.

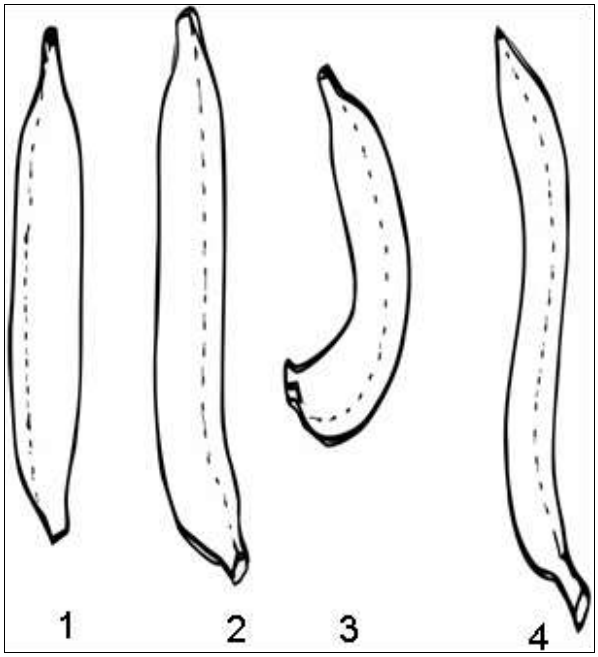

Fig 23: Fruit shape (longitudinal curvature) 1) straight (or slightly curved), 2) straight in the distal part, 3) curved (sharp curve), 4) curved in 'S' shape (double curvature, 5) other. Modified after: IPGRI, 1984.

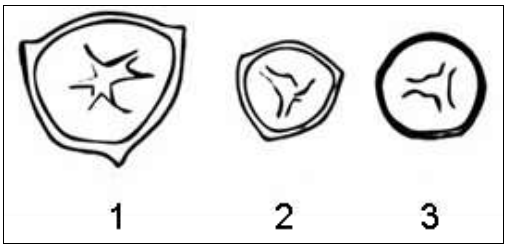

Fig 24: Transverse section of fruit 1) pronounced ridges, 2) slightly ridged, 3) rounded. Modified after: IPGRI, 1984.

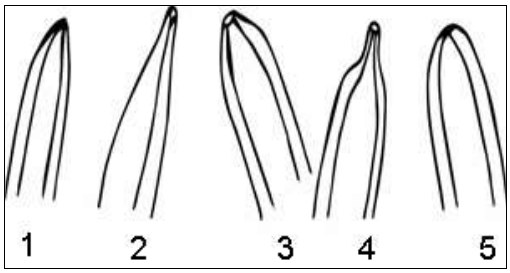

Fig 25: Fruit apex 1) pointed, 2) lengthily pointed, 3) blunt-tipped, 4) bottle-necked, 5) rounded. Modified after: IPGRI, 1984.

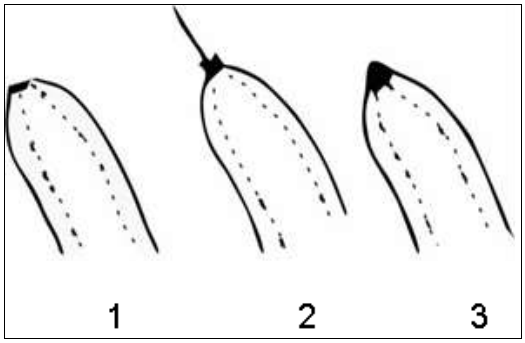

Fig 26: Remains of flower relicts at fruit apex 1) without any floral relicts, 2) persistent style, 3) base of the style prominent. Modified after: IPGRI, 1984.

Fig 27: Description of *Musa accuminata* Colla (AA) Pisang lilin/Sundari a) & b) fruit bunch, c) mature fruit skin peeled, d) mature fruit without skin, e) & g) fruit skin peel chopped into small pieces, f) & h) mature fruit cut into small slices.

Fig 28: Description of *Musa accuminata* Colla (AA) Pisang lilin/Sundari a) skin and fruit chopped into small pieces, b) fruit bunch c) sections of fruit, description of *Musa x paradisiaca* L. (AAB) Etha d) mature fruit, e) mature fruit without skin, f) fruit skin, g) mature fruit cut into small slices, h) skin chopped into small pieces.

Fig 29: Description of *Musa accuminata* Colla (AA) Poovan a) fruit bunch, b) mature fruit without skin, c) fruit skin d) mature fruit cut into small slices, e) skin cut into small pieces, f) fruit bunch, g) mature fruit without skin, h) fruit skin.

Fig 30: Description of *Musa accuminata* Colla (AA) Njalipoovan a) skin and fruit chopped into small pieces, b) fruit bunch c) sections of fruit, d) mature fruit, e) mature fruit without skin, f) mature fruit cut into small slices, g) fruit skin cut into small slices, h) fruit skin.

Fig 31: Description of *Musa accuminata* Colla (AA) Robusta a) fruit bunch, b) mature fruit without skin, c) fruit skin, d) mature fruit cut into small slices, e) d) mature fruit, e) fruit skin cut into small slices, f) description of *Musa x paradisiaca* L. (AAB) Chemkadali; fruit bunch, g) mature fruit cut into small slices, h) fruit skin.

Fig 32: Description of *Musa x paradisiaca* L. (AAB) Chemkadali a) fruit skin chopped into small pieces, b) fruit chopped into small pieces, c) description of *Musa accuminata* Colla (AA) Kanna; fruit bunch d) sections of fruit, d) mature fruit without skin, e) fruit skin, f) fruit chopped into small pieces, g) and h) fruit skin chopped into small pieces.

Fig 33: Description of *Musa accuminata* Colla (AA) Pachakadali a) fruit bunch, b) mature fruit without skin, c) fruit skin, d) mature fruit cut into small pieces, e) and f) fruit skin chopped into small pieces.

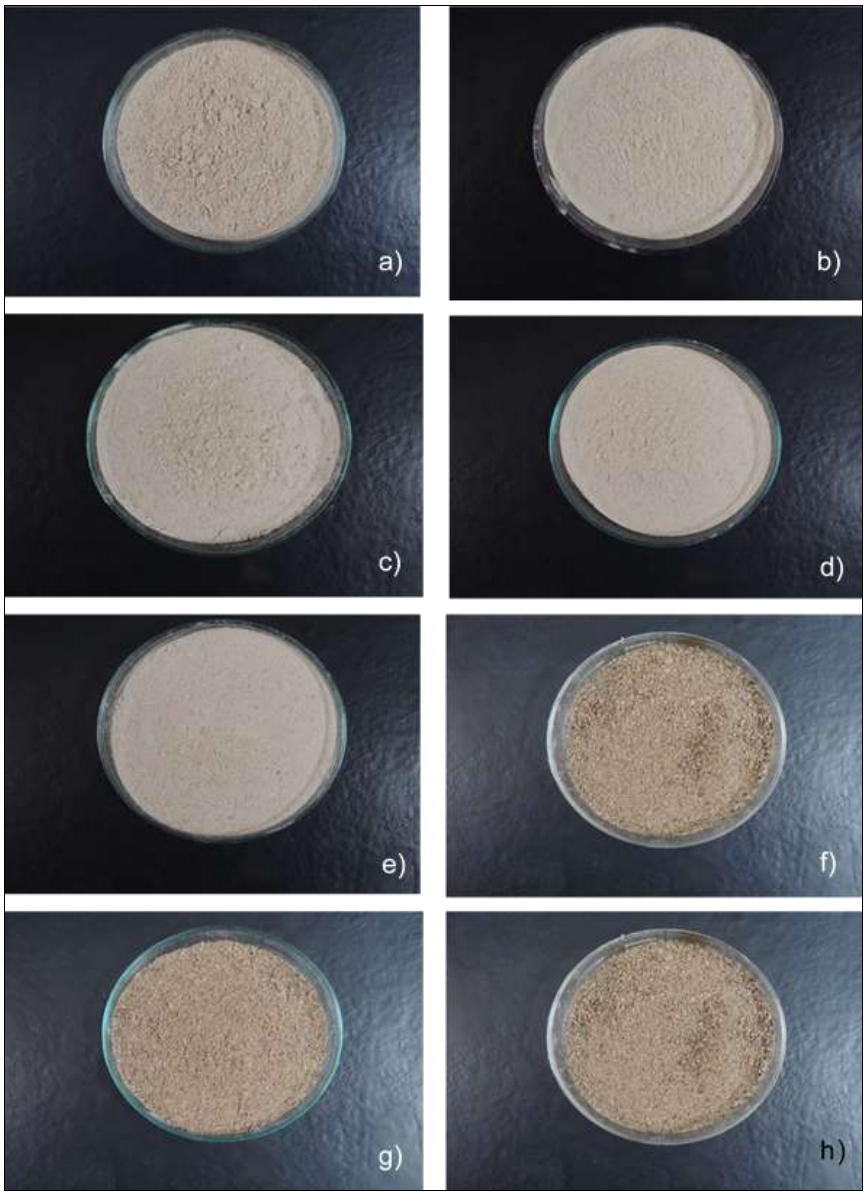

Fig 34: Description of fruit powder and peel of banana varieties a) Robusta fruit, b) Palayamkodan fruit, c) Njalipoovan fruit, d) Kannan fruit, e) Pachakadali fruit, f) Pachakadaki peel, g) Kannan peel, h) Sundari peel.

Table 4: Proximate analysis fruit and peel of Musa varieties (B1, B2, B3, B4, B5, B6, B7, B8, B9) in Kerala.

Sample	Moisture (%)	Crude protein (%)	Crude fibre (%)	Ether extract (%)	Total ash (%)	Gross energy (kcal/kg)
Robusta fruit (RF)	9.84 ± 0.34	6.12 ± 0.32	1.86 ± 0.28	1.17 ± 0.11	2.68 ± 0.24	3664 ± 121
Robusta peel (RP)	9.81 ± 0.22	7.85 ± 0.27	8.88 ± 0.21	4.05 ± 0.34	9.63 ± 0.34	4043 ± 58
Sundari fruit (SF)	10.61 ± 0.18	4.82 ± 23	1.2 ± 0.86	1.31 ± 0.22	2.84 ± 0.18	3612 ± 89
Sundari peel (SP)	9.68 ± 0.37	7.82 ± 0.35	6.43 ± 0.29	4.87 ± 0.32	8.67 ± 0.21	4005 ± 54
Etha fruit (EF)	8.98 ± 0.54	3.93 ± 0.46	1.05 ± 0.81	1.08 ± 0.17	2.28 ± 0.33	3673 ± 59
Etha peel (EP)	10.45 ± 0.88	8.28 ± 0.26	6.73 ± 0.39	4.87 ± 0.33	7.11 ± 0.11	3700 ± 75
Poovan fruit (PF)	11.52 ± 0.74	5.67 ± 0.21	1.36 ± 0.21	1.04 ± 0.45	2.51 ± 0.45	3589 ± 88
Poovan peel (PP)	10.03 ± 0.14	7.86 ± 0.19	7.36 ± 0.43	5.53 ± 0.35	7.08 ± 0.32	3747 ± 80
Najalipoovan fruit (NF)	6.95 ± 0.18	4.36 ± 0.23	1.22 ± 0.86	1.02 ± 0.22	2.35 ± 0.18	3756 ± 89
Najalipoovan peel (NP)	9.96 ± 0.37	8.3 ± 0.35	8.01 ± 0.29	6.45 ± 0.32	9.63 ± 0.21	3705 ± 54
Palayamkodan fruit (PaF)	9.71 ± 0.54	4.79 ± 0.46	1.02 ± 0.81	1.12 ± 0.17	3.21 ± 0.33	3623 ± 59
Palayamkodan peel (PaP)	9.48 ± 0.88	7.85 ± 0.26	8.5 ± 0.39	6.11 ± 0.33	9.98 ± 0.11	3684 ± 75
Chemkadali fruit (CF)	8.65 ± 0.74	4.36 ± 0.21	1.05 ± 0.21	1.35 ± 0.45	3.13 ± 0.45	3674 ± 88
Chemkadali peel (CP)	6.61 ± 0.14	4.36 ± 0.19	1.47 ± 0.43	1.13 ± 0.35	2.97 ± 0.32	3750 ± 80
Kannan fruit (KF)	8.13 ± 0.54	6.55 ± 0.46	8.02 ± 0.81	4.32 ± 0.17	10.22 ± 0.33	3610 ± 59
Kannan peel (KP)	7.85 ± 0.88	6.59 ± 0.26	5.78 ± 0.39	5.25 ± 0.33	8.44 ± 0.11	3992 ± 75
Kadali fruit (KaF)	12.1 ± 0.74	4.79 ± 0.21	1.11 ± 0.21	1.05 ± 0.45	2.31 ± 0.45	3560 ± 88
Kadali peel (KaP)	9.05 ± 0.14	6.87 ± 0.19	4.57 ± 0.43	5.30 ± 0.35	7.81 ± 0.32	3754 ± 80

B1; Robusta, B2; Sundari, B3; Etha, B4; Poovan, B5; Nalipoovan, B6; Palayamkodan, B7; Chemkadali, B8; Kannan, B9; Kadali
RF; Robusta fruit, RP; Robusta peel, SF; Sundari fruit, SP; Sundari peel; EF; Etha fruit, EP; Etha peel, PF; Poovan fruit, PP; Poovan peel, NF; Najalipoovan fruit, NP; Najalipoovan peel, PaF; Palayamkodan fruit, PaP; Palayamkodan peel, CF; Chemkadali fruit, CP; Chemkadali peel, KF; Kannan fruit, KP; Kannan peel, KaF; Kadali fruit, KaP; Kadali peel.
Numbers represent means ± one standard error (SE) of the mean

Table 5. Proximate analysis fruit and peel of Musa varieties (B1, B2, B3, B4, B5, B6, B7, B8, B9) in Kerala.

Sample	Moisture content (%)	Organic matter* (g)	Organic carbon* (g)	Crude ash* (g)	Acid insoluble ash* (g)	Acid soluble ash* (g)
Robusta fruit (RF)	7.54 ± 0.34	2.84 ± 0.38	1.65 ± 0.28	0.16 ± 0.12	0.11 ± 0.06	0.05 ± 0.01
Robusta peel (RP)	5.55 ± 0.29	2.42 ± 0.21	1.40 ± 0.21	0.58 ± 0.31	0.29 ± 0.11	0.29 ± 0.18
Sundari fruit (SF)	5.19 ± 0.22	2.80 ± 0.27	1.62 ± 0.20	0.20 ± 0.12	0.17 ± 0.04	0.03 ± 0.05
Sundari peel (SP)	8.56 ± 0.12	2.40 ± 0.15	1.39 ± 0.46	0.60 ± 0.11	0.37 ± 0.12	0.23 ± 0.09
Etha fruit (EF)	7.17 ± 0.31	2.71 ± 0.31	1.57 ± 0.23	0.29 ± 0.31	0.18 ± 0.23	0.11 ± 0.11
Etha peel (EP)	7.67 ± 0.37	2.28 ± 0.35	1.32 ± 0.25	0.72 ± 0.12	0.35 ± 0.09	0.37 ± 0.08
Poovan fruit (PF)	7.52 ± 0.51	2.05 ± 0.40	1.15 ± 0.43	0.95 ± 0.13	0.25 ± 0.05	0.70 ± 0.14
Poovan peel (PP)	4.15 ± 0.18	2.06 ± 0.20	1.19 ± 0.33	0.94 ± 0.31	0.49 ± 0.10	0.45 ± 0.08
Najalipoovan fruit (NF)	6.53 ± 0.28	2.06 ± 0.26	1.15 ± 0.31	0.94 ± 0.13	0.28 ± 0.06	0.66 ± 0.11
Najalipoovan peel (NP)	8.53 ± 0.24	2.51 ± 0.25	1.45 ± 0.23	0.49 ± 0.05	0.40 ± 0.03	0.09 ± 0.02
Palayamkodan fruit (PaF)	8.05 ± 0.17	2.73 ± 0.22	1.58 ± 0.33	0.27 ± 0.25	0.20 ± 0.12	0.07 ± 0.06
Palayamkodan peel (PaP)	6.52 ± 0.48	2.19 ± 0.19	1.27 ± 0.23	0.81 ± 0.09	0.47 ± 0.07	0.34 ± 0.10
Chemkadali fruit (CF)	4.15 ± 0.18	2.79 ± 0.20	1.62 ± 0.33	0.21 ± 0.31	0.15 ± 0.10	0.06 ± 0.08
Chemkadali peel (CP)	6.53 ± 0.28	2.49 ± 0.26	1.44 ± 0.31	0.51 ± 0.13	0.35 ± 0.11	0.40 ± 0.06
Kannan fruit (KF)	8.53 ± 0.24	2.76 ± 0.25	1.60 ± 0.23	0.24 ± 0.05	0.17 ± 0.03	0.07 ± 0.02
Kannan peel (KP)	8.05 ± 0.17	1.75 ± 0.22	1.01 ± 0.33	1.25 ± 0.25	0.50 ± 0.12	0.75 ± 0.06
Pachakadali fruit (PKaF)	6.52 ± 0.48	2.07 ± 0.19	1.20 ± 0.23	0.93 ± 0.09	0.19 ± 0.07	0.74 ± 0.10
Pachakadali peel (PKaP)	6.52 ± 0.48	1.75 ± 0.19	1.01 ± 0.23	1.25 ± 0.09	0.50 ± 0.07	0.75 ± 0.10

* Amount obtained for 3 g of dried plant samples
B1; Robusta, B2; Sundari, B3; Etha, B4; Poovan, B5; Najalipoovan, B6; Palayamkodan, B7; Chemkadali, B8; Kannan, B9; Kadali
RF; Robusta fruit, RP; Robusta peel, SF; Sundari fruit, SP; Sundari peel; EF; Etha fruit, EP; Etha peel, PF; Poovan fruit, PP; Poovan peel, NF; Najalipoovan fruit, NP; Najalipoovan peel, PaF; Palayamkodan fruit, PaP; Palayamkodan peel, CF; Chemkadali fruit, CP; Chemkadali peel, KF; Kannan fruit, KP; Kannan peel, PKaF; Pachakadali fruit, PKaP; Pachakadali peel.
Numbers represent means ± one standard error (SE) of the mean

5. Results and discussion

5.1 Proximate analysis

On comparing the proximate analysis of fruit and peel of Musa varieties in Kerala many factors such as moisture content, amount of crude protein and crude fibre, percentage of ether, ash percentage, gross energy was calculated. Here Pachakadali fruit has the largest moisture content of 12.1 ± 0.74% and Najalipoovan fruit has lowest moisture content of 6.98 ± 0.08%. Etha peel has largest moisture content of 10.45 ± 0.88% and Chemkadali peel has the lowest moisture content of 6.61 ± 0.14%.Crude protein content in fruit is largest for Kannan fruit with 6.55 ± 0.46% and lowest for Etha fruit of 3.93 ± 0.46%. Crude protein content in peel is more for Kannan peel with 16.59 ± 0.26% and lowest for Chemkadali peel of 4.36 ± 0.19%.Crude fibre content in fruit is more for Kannan fruit of 8.02 ± 0.81% and lowest for Palenkodan with 1.02 ± 0.81%. Crude fibre content in peel is largest for peel of Sundari with 28.43 ± 0.29% and lowest for Chemkadali of 1.47 ± 0.43%.Ether extract from fruit is largest in Kannan with 4.32 ± 0.17% and lowest for Najalipoovan with 1.02 ± 0.22%. Ether extract from peel is largest for Kannan with 8.25 ± 0.33% and lowest for Chemkadali with 1.13 ± 0.45. The total ash content in fruit is largest for Kannan fruit with10.22 ± 0.33% and lowest for Etha fruit with 2.28 ± 0.33%.Total ash content in peel is largest for Pachakadali with 11.81 ± 0.32% and lowest for Chemkadali with 2.97 ± 0.32%. The gross energy content of fruit is largest for Najalipoovan with 3756 ± 89kcal/kg and lowest for Pachakadali with 3560 ± 88 kcal/kg. The gross energy content of peel is largest for Robesta with 4043 ± 58 kcal/kg and lowest for Palenkodan with 3684 ± 75 kcal/kg respectively.

6. Conclusions

There is a clear variation that exists among the banana varieties in Kerala and the morphological characterization studies help in the better knowledge about the common varieties. Selected 9 different varieties of banana parts like fruits and peel were used to detect its nutritional qualities like moisture, crude protein, crude fibre, ether extract, and total ash and the test was based on the AOAC method. The banana peel could be also used for value addition especially making animal feeds.

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8. References

1. Anhwange BA, Ugye TJ, Nyiaatagher TD. Chemical composition of Musa sapientum (banana) peels. Journal of Food Technology. 2008;6(6):263-266.
2. Aurore G, Parfait B, Fahrasmane L. Bananas, raw materials for making processed food products. Trends in Food Science & Technology. 2009;20(2):78-91.
3. Babu MA, Suriyakala MA, Gothandam KM. Varietal impact on phytochemical contents and antioxidant properties of *Musa acuminata* (banana). Journal of Pharmaceutical Sciences and Research. 2012;4(10):1950-1955.
4. Bailey RC, Head G, Jenike M, Owen B, Rechtman R, Zechenter E. Hunting and gathering in tropical rain forest: Is it possible? American Anthropologist. 1989;91(1):59-82.
5. Benitez MC. Phytochemical analysis of Baby Banana peels (*Musa acuminata*) in relation with a hyperpigmentation phenomenon. Cuvillier Verlag, Germany. 2015.
6. Bouis HE, Welch RM. Biofortification-a sustainable agricultural strategy for reducing micronutrient malnutrition in the global south. Crop Science. 2010;50(Supplement):1S:20-32.
7. Candolle AD. Origin of cultivated plants. Reprint of second edition, International Scientific Series, NY, USA. 1886.
8. Chabuck ZAG, Al-Charrakh AH, Hindi NKK, Hindi SKK. Antimicrobial effect of aqueous banana peel

extract, Iraq. Research Gate: Pharmaceutical Sciences, 2013;1(1):73-75.
9. Chandler S. The nutritional value of bananas. In Bananas and plantains. Springer, Dordrecht, Germany. 1995, 468-480.
10. De Candolle A. Origin of cultivated plants reprint, Hafner Publishing Company, NY, USA. 1886-1964.
11. Denham T, Donohue M. Pre-Austronesian dispersal of banana cultivars West from New Guinea: linguistic relics from Eastern Indonesia. Archaeology in Oceania. 2009;44(1):18-28.
12. Devi PI, Thomas EK, Thomas JK. Growth and supply response of banana in Kerala. Agricultural Situation in India. 1990;45(4):239-242.
13. Ehiowemwenguan G, Emoghene AO, Inetianbor JE. Antibacterial and phytochemical analysis of Banana fruit peel. IOSR Journal of Pharmacy. 2014;4(8):18-25.
14. Espino RRC, Pimentel RB. Electrophoretic analysis of selected isozymes in BB cultivars of Philippine bananas. Identification of Genetic Diversity in the Genus Musa INIBAP, Los Banos, the Philippines. 1990.
15. Hakkinen M. Musa chunii Häkkinen, a new species (Musaceae) from Yunnan, China and taxonomic identity of Musa rubra. *Journal of Systematics and Evolution*. 2009;47(1):87-91.
16. Häkkinen M. Reappraisal of sectional taxonomy in Musa (Musaceae). Taxon. 2013;62(4):809-813.
17. Jacob K. Madras bananas: a monograph. Madras bananas: a monograph. 1952.
18. Kaimal S, Sujatha KS, George S. Hypolipidaemic and antioxidant effects of fruits of Musa AAA (Chenkadali) in alloxan induced diabetic rats. Indian Journal of Experimental Biology. 2010;48(2):165-173.
19. Kennedy J. Pacific Bananas: Complex Origins, Multiple Dispersals? Asian Perspectives. 2008;47(1):75-94.
20. Krishnakumar KN, Rao GP, Gopakumar CS. Rainfall trends in twentieth century over Kerala, India. Atmospheric Environment. 2009;43(11):1940-1944.
21. Kumar KS, Bhowmik D, Duraivel S, Umadevi M. Traditional and medicinal uses of banana. Journal of Pharmacognosy and Phytochemistry. 2012;1(3):51-63.
22. Kurz S. Note on the plantains of the Indian archipelago. Journal of Agricultural Society India. 1867;14(1):295-301.
23. Lejju BJ, Robertshaw P, Taylor D. Africa's earliest bananas? Journal of Archaeological Science. 2006;33(1):102-113.
24. May GD, Afza R, Mason HS, Wiecko A, Novak FJ, Arntzen CJ. Generation of transgenic banana (*Musa acuminata*) plants via Agrobacterium-mediated transformation. Biotechnology. 1995;13(5):486.
25. Menezes EW, Tadini CC, Tribess TB, Zuleta A, Binaghi J, Pak N, *et al*. Chemical composition and nutritional value of unripe banana flour (*Musa acuminata*, var. Nanicão). Plant Foods for Human Nutrition. 2011;66(3):231-237.
26. Mohapatra D, Mishra S, Sutar N. Banana and its by-product utilisation: an overview. Journal of Scientific and Industrial Research. 2010;69(1):323-329.
27. Nair AS, Teo CH, Schwarzacher T, Harrison PH. Genome classification of banana cultivars from South India using IRAP markers. Euphytica. 2005;144(3):285-290.
28. Nayar NM. 2 The Bananas: Botany, Origin, Dispersal. Horticultural Reviews. 2010;36:117-164.
29. Norman SJ, Radhakrishnan V. Marketing of banana in Kerala. Indian Journal of Horticulture. 1990;47(3):325-330.
30. Opara UL, Jacobson D, Al-Saady NA. Analysis of genetic diversity in banana cultivars (Musa cvs.) from the South of Oman using AFLP markers and classification by phylogenetic, hierarchical clustering and principal component analyses. Journal of Zhejiang University Science B. 2010;11(5):332-341.
31. Padam BS, Tin HS, Chye FY, Abdullah MI. Banana by-products: an under-utilized renewable food biomass with great potential. Journal of Food Science and Technology. 2014;51(12):3527-3545.
32. Purseglove JW. Tropical Crops. Monocotyledons. Longman, London, UK. 1972;1:2.
33. Robinson JC. Bananas and Plantains, Crop Production Science in Horticulture, CAB International, UK. 1996.
34. Siji S, Nandini PV. Chemical and Nutrient Composition of Selected Banana Varieties of Kerala. International Journal of Advanced Engineering, Management and Science. 2017a;3(4):401-404.
35. Siji S, Nandini PV. Antioxidants and antioxidant activity common eight banana varieties in Kerala. International Journal of Advanced Engineering Research and Science. 2017b;4(7):118-123.
36. Silayoi B, Chomchalow N. Cytotaxonomic and morphological studies of Thai banana cultivars. Proceedings of Banana and Plantain Breeding Strategies. 1987, 157-160.
37. Simmonds NW. The evolution of bananas. Tropical Science Series, Longmans, London, UK. 1962.
38. Simmonds NW, Shepherd K. The taxonomy and origins of the cultivated bananas. Botanical Journal of the Linnean Society. 1955;55(359):302-312.
39. Singh R, Ranvir S, Madan S. Comparative study of the properties of ripe banana flour, unripe banana flour and cooked banana flour aiming towards effective utilization of these flours. International Journal of Current Microbiology and Applied Science. 2017;6(8):2003-2015.
40. Singh WR, Singh SS, Karuna S. Analysis of banana genome groups of wild and cultivated cultivars of Manipur, India using sScore card method. Advances in Applied Science Research. 2014;5(1):35-38.
41. Someya S, Yoshiki Y, Okubo K. Antioxidant compounds from bananas (Musa Cavendish). Food Chemistry. 2002;79(3):351-354.
42. Stover RH, Simmonds NW. Bananas. Tropical agricultural series. John Wiley and Sons, Inc., NY. 1987;10:158-468.
43. Uma S, Kalpana S, Sathiamoorthy S, Kumar V. Evaluation of commercial cultivars of banana (Musa spp.) for their suitability for the fibre industry. Plant Genetic Resources Newsletter. 2005a;(142):29-35.
44. Uma S, Siva SA, Saraswathi MS, Durai P, Sharma TVRS, Selvarajan R, *et al*. Studies on the origin and diversification of Indian wild banana (*Musa balbisiana*) using arbitrarily amplified DNA markers. *The* Journal of Horticultural Science and Biotechnology. 2005b;80(5):575-580.
45. Valmayor RV, Jamaluddin SH, Silayoi B, Kusumo S, Danh LD, Pascua OC, *et al*. Banana cultivar names and synonyms in Southeast Asia. Advancing banana and plantain R & D in Asia and the Pacific. Proceedings of the 10th INIBAP-ASPNET Regional Advisory Committee

meeting held at Bangkok, Thailand. International Network for the improvement of Banana and Plantain - Asia and the Pacific Network, Los Baños, Laguna, Philippines. 2000.
46. Vatanasuchart N, Niyomwit B, Wongkrajang K. Resistant starch content, *in vitro* starch digestibility and physico-chemical properties of flour and starch from Thai bananas. Maejo. International Journal of Science and Technology. 2012;6(2):259-271.
47. Velumani S. Phytochemical screening and antioxidant activity of banana peel. IJARIIE. 2016;2(1):91-102.
48. Zhang P, Whistler RL, BeMiller JN, Hamaker BR. Banana starch: production, physicochemical properties, and digestibility-a review. Carbohydrate Polymers. 2005;59(4):443-458.