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Nutritional profiling of diploid (AA & AB) banana genotypes

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Abstract
An experiment was conducted at ICAR-AICRP on Fruits, K.R.C. College of Horticulture, Arabhavi to study the nutritional profiling of triploid (AAB) banana genotypes during 2018-19. The results revealed that, The nitrogen content of fruit sample ranged from 126.00 mg/100 g (Anaikomban) to 515.00 mg/100 g (Pisang Lilin) with a mean value of 272.00 in AA group. In AB group it was ranged from 123.00 mg/100 g (Aktoman) to 287.00 mg/100 g (Kodappanilla) with a mean value of 147.75 mg/100 g. potassium content of banana varieties ranged between 568.00 mg/100 g (Kadali) to 1142.00 mg/100 g (1142.00 mg/100 g) with mean value of 794.00 mg/100 g among AA group. Among AB group, the potassium content ranged from 698.00 mg/100 g (Aktoman) to 1532.00 mg/100 g (Ney Poovan) with a mean value of 797.00 mg/100 g. AA group depicted that, the iron content was ranged from 1.77-2.08 mg/100 g with a mean value of 1.91 mg/100 g and statistically analysed, it was noticed that, Namarai (2.08 mg/100 g) contained high amount of iron followed by Anaikomban (1.97 mg/100 g) while less iron content was observed in Kadali (1.77 mg/100 g).

Keywords: Nutrition profiling, diploid banana genotypes, potassium, magnesium, calcium

Introduction
Banana plants are the world's foremost herbs and it's grown in several countries. However, Bananas and plantains are the world 4th prominent agricultural crop after rice, wheat, and maize. (Ganapathi *et al.*, 1999) [13] and considered to be one of the most important sources of energy and starchy staple food for the people of tropical humid regions (Onwuka and Onwuka, 2005) [26]. Furthermore, bananas and plantains are rich in nutrients, starch, sugar and vitamins A and C, potassium, calcium, sodium and magnesium, Doymaz (2010) [9]. Plantains are nutritionally low protein food material but relatively high in carbohydrates, vitamins and minerals. During the recent past, there is a great interest among nutritionists in studying the role of fruits and vegetables in prevention of several life style diseases. Beneficial effects of consumption of banana is mainly prevention of constipation, hypertension, cancer, *etc*., due to high level of fruit fibres, phytochemicals (carotenoids, anthocyanins, antioxidants) and vitamins and hence are considered as functional food (Yoseph *et al.*, 2014) [36]. Banana is also rich source of minerals like potassium, phosphorus, calcium, magnesium, zinc and iron.

Plate 1: Banana power for estimation for mineral composition

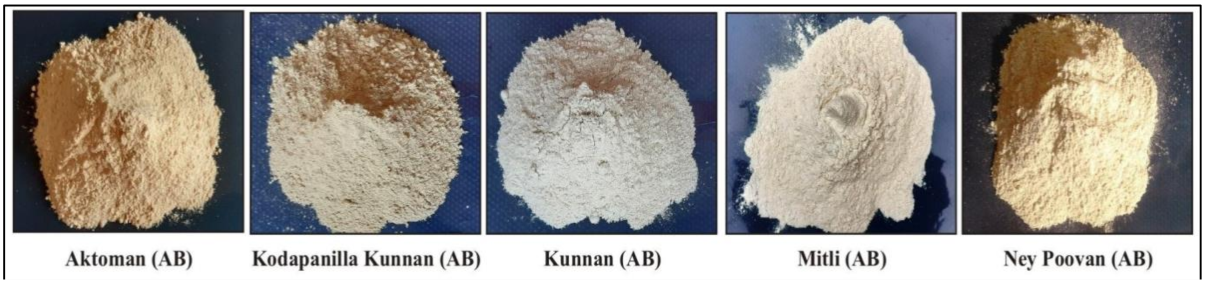

Plate 2: Banana power for estimation for mineral composition

The present investigation on "Nutritional profiling of triploid (AAB) banana genotypes" was conducted at ICAR-All India Coordinated Research Project (ICAR-AICRP) on Fruits, Kittur Rani Channamma College of Horticulture, Arabhavi (University of Horticultural Sciences, Bagalkot) Karnataka during 2018-19 and 2019-20. Four genotypes belonging to AA group *viz*., Anaikomban, Kadali, Namarai and Pisang Lilin and Five genotypes belonging to AB group *viz*., Aktoman, Kodappanilla Kunnan, Kunnan, Mitli and Ney Poovan were used for the study. The experiment was laid out in Complete Randomized Design (CRD) with six replications. Three hands are picked from each cultivar; ten uniform size and shape fingers are selected from the lot and sliced into round disks using a kitchen knife. These slices are dried in an hot air oven at 65±3°C for 8 hours. The dried slices were grind into fine powder using a laboratory mixer/grinder. The flour is then used for estimation of minerals (Narayana *et al*., 2017) [24]. The nitrogen content in these genotypes were analyzed by Kjeldahl methodas outlined by Piper (1966) [28] and the values were expressed in mg/100 g. The phosphorus content in these genotypes were analyzed by Vanadomolybdate method (Piper, 1966) [28] and the values were expressed in mg/100 g. The potassium content in these cultivars was estimated using flame photometer by the method outlined by Jackson (1973) [15] and the values were expressed in mg/100 g and magnesium, calcium and micronutrients were analyzed by using atomic absorption Spectrometer and the values were expressed in mg/100 g.

Statistical analysis

Completely Randomized Design (CRD) with one way ANOVA, utilizing the Web Agri Stat Package (WASP) version 2 (Jangam and Thali, 2010) [16] was used to examine the data on the nutritional profiling of triploid (AAB) banana genotypes. p=0.01 was the significance level applied to the tests. The tests used a significance level of p=0.01. Critical difference values were calculated when the F-test indicated significance.

Results and discussion

Nitrogen (mg/100 g)

The nitrogen content of fruit sample ranged from 126.00 mg/100 g (Anaikomban) to 515.00 mg/100 g (Pisang Lilin) with a mean value of 272.00 in AA group. In AB group it was ranged from 123.00 mg/100 g (Aktoman) to 287.00 mg/100 g (Kodappanilla) with a mean value of 147.75 mg/100 g (Table 1 & Fig 1). This may be due to high level of nitrogen uptake (both through soil and bunch spray) as reported earlier by Kotur and Murthy, (2011) [20], Yang *et al.* (2013) [35]. These results are also in accordance with Narayana *et al*. (2017) [24] who has reported that, the cultivar Karpuravalli (Pisang Awak, ABB) had significantly higher levels of nitrogen (0.58%) and least was in Poovan (0.29%).

Phosphorus (mg/100 g)

Phosphorus helps plants to store and use energy from photosynthesis, develop roots, speed up the maturity and resist stresses. In the present study (Table 1 & Fig 1), significantly genotype Kadali (60.00 mg/100 g) contained maximum phosphorus followed by Pisang Lilin (50.00 mg/100 g) while, minimum was noticed in Anaikomban (30.00 mg/100 g) among AA group. Among AB group, it was ranged between 30.00 mg/100 g (Kodappanilla) to 50.00 mg/100 g (Aktoman & Mitli) with a mean value of 30.00 mg/100 g. This is in conformity with previous findings of Sulaiman *et al.* (2011) [33] who studied the phosphorus content of banana cultivar grown in Malaysia. Kookal and Thimmaiah (2018) [19] have reported that, the phosphorus content was highest in ripened Njali Poovan banana fruits (81.25 mg/100 g). The similar findings were also noticed in Auta and Kumurya (2015) [4], Narayana *et al.* (2015) [24], Suriyavathana and Jeevitha (2011) [34], Anhwange, (2008) [2] and Do *et al.* (2015) [8] in banana peel.

Potassium (mg/100 g)

Among fruits, banana is valued for potassium content, because of its role in maintaining the body's blood pressure. A single banana provides 23 percent of the potassium needed on a daily basis. It also reduces the risk of stroke (Sampath *et al*., 2012) [29]. In the present findings, potassium content of banana varieties ranged between 568.00 mg/100 g (Kadali) to 1142.00 mg/100 g (1142.00 mg/100 g) with mean value of 794.00 mg/100 g among AA group (Table 1 & Fig 1). Among AB group, the potassium content ranged from 698.00 mg/100 g (Aktoman) to 1532.00 mg/100 g (Ney Poovan) with a mean value of 797.00 mg/100 g. Besides genomic status, the soil and climatic conditions also play an important role in nutrient uptake and there by the difference in the potassium content in the different banana genotypes (Narayana *et al.*, 2017) [24]. In comparison with the mineral elements composition of apple, banana and plantain contain higher amounts of potassium than apple. This shows that banana and plantain may have the tendency to lower blood pressure, aid in RBC's formation and also aid in the transmission of nerve impulse due to their high potassium contents (Auta and Kumurya2015) [5]. The results are in close agreement with the findings of Jyothirmayi and Rao (2015) [17] and Sampath *et al.* (2012) [29] who had also reported potassium content of 358.00 mg/100 g and 467.00 mg/100 g respectively of banana studied.

Contrary to the present findings, Sreedevi (2013) [32] found that the potassium content of organically cultivated samples of Nendran, Palayankodan and Rasakadali was 86.5 mg, 80.76 mg and 79.4 mg respectively. Average potassium content of Hawaii's banana (Dwarf Brazilian and Williams) was 330.6 mg/100 g (Marisa, 2006) [22]. Similar results were also reported by Leterme *et al.* (2006) [21]. Bernstein *et al.* (2011) [5] found that potassium increases protein, starch and soluble solid content in plants and improves colour and taste. Smitha *et al.* (2015) [31] showed potassium content in the range of 285.34to 397.01 mg per 100 g of fresh sample and among the varieties high content of potassium was found in variety Cavendish (397.01 mg/100 g) under Karnataka condition. These findings were also in agreement with Coulibaly *et al.* (2007) [6], Kiin-Kabari and Agoha (2018) [18], Do *et al.* (2015) [8] in banana peel. Sheng *et al.* (2010) [30] in banana flower.

Magnesium (mg/100 g)

In the present investigation, magnesium content was ranged from 321.00-464.00 mg/100 g with a mean value 396.25 mg/100 g in AA group (Table 1 & Fig 1). When the data was analyzed, it was found that significant difference was found to exist between the varieties, significantly higher magnesium content was recorded in PisangLilin (464.00 mg/100 g) followed by Namarai (455.00 mg/100 g) and genotype Kadali (321.00 mg/100 g)recorded less amount of magnesium. Among AB group, it was ranged from 258.00-397.00 mg/100 g with a mean value of 258.00 mg/100 g. When the data was statistically analyzed, it was found that genotype Kunnan (397.00 mg/100 g) and Kodappanilla Kunnan (377.00 mg/100 g) have shown significantly higher magnesium content while, Aktoman (258.00 mg/100 g) have shown minimum amount of magnesium. This was demonstrated in other research works by Coulibaly *et al.* (2007) [6], Auta and Kumurya (2015) [4], Do *et al.*, (2015) [8], Kiin-Kabari and Agoha (2018) [18]. Contrary to the findings of Sulaiman *et al.* (2011) [33], the level of magnesium in genotypes of ABB and AAB genomic group was lower than those of AAA or AB group.

Calcium (mg/100 g)

Calcium is an essential macronutrient for humans, which represents approximately 2% of body weight in an adult person. It is necessary for building strong bones, cell adhesiveness, mitosis, blood coagulation, muscle contraction and glandular secretion (Petrovich *et al.*, 2007) [27]. The findings of present study revealed that, calcium content was ranged from 25.00-57.00 mg/100 g with a mean value of 41.00 mg/100 g (Table 1 & Fig 1). Statistically it was noted that, there was a significant difference between genotypes, Pisang Lilin (57.00 mg/100 g) contained higher amount of calcium followed by Anaikomban (45.00 mg/100 g) while, Kadali (25.00 mg/100 g) has recorded least calcium among AA group. In AB group,it was depicted that, the mean value of calcium was 26.40 mg/100 g with value ranging between 13.00-92.00 mg/100 g and when it was statistically analysed, significantly genotype Ney Poovan (92.00 mg/100 g) contained maximum calcium followed by Mitli (40.00 mg/100 g) while, least was observed in Kunnan (13.00 mg/100 g). Similar results were found in Suriyavathana and Jeevitha (2011) [34], Florenta *et al.* (2015) [11] in banana blossoms.

Iron (mg/100 g)

Iron is another mineral which is essential for the formation of certain enzymes. The dietary iron is of two forms haeme and non-haeme. While the haeme iron is derived from meet and fish and non-haeme iron is derived from tropical fruits (Das, 2010) [7]. In the present investigation, AA group depicted that (Table 2),, the iron content was ranged from 1.77-2.08 mg/100 g with a mean value of 1.91 mg/100 g and statistically analysed, it was noticed that, Namarai (2.08 mg/100 g) contained high amount of iron followed by Anaikomban (1.97 mg/100 g) while less iron content was observed in Kadali (1.77 mg/100 g). The mean value was 1.05 mg/100 g with a values ranging between 1.06-1.93 mg/100 g. Genotype Kodappanilla Kunnan (1.93 mg/100 g) has recorded maximum iron content followed by Aktoman (1.76 mg/100 g) while, Ney Poovan (1.06 mg/100 g) contained less iron among AB group (Table 35). These findings are in conformity with reports of earlier workers (Sulaiman *et al.*, 2011) [33], Englberger *et al.* **(**2003) [10], Kiin-Kabariand Agoha(2018) [18], Narayan *et al.*, 2017[24], Fungo *et al.*, 2010) [12], Hapsari and Lestari (2016) [14] and Ashokkumar *et al.* (2018) [3] reported the iron concentration ranged from 1.42 mg/100 g in Saba to 0.063 mg/100 g in Kikundi. Kookal and Thimmaiah (2018) [19] also studied content of iron in unripe and ripened banana fruits of Nendran and Robusta genotypes.

Manganese (mg/100 g)

In the present study, manganese content was ranged from 0.82 mg/100 g (Anaikomban) to 1.36 mg/100 g (Pisang Lilin) with a grand mean value of1.36 mg/100 gsignificantly different from the other varieties among AA group (Table 2). Among AB group, it was observed that, manganese content was ranged between 0.48-0.73 mg/100 g with a mean value of 0.46 mg/100 g. Significant differences were noticed between genotypes, like Kunnan (0.73 mg/100 g) has shown maximum and on par with Aktoman (0.73 mg/100 g) while, Kdappanila Kunnan (0.48 mg/100 g) has recorded minimum manganese content. Narayan *et al.* (2017) [24] revealed that, manganese was in the range of 12.00 to 26.00 ppm, with the highest in Ney Poovan (AB-diploid), and triploids did not vary significantly in their manganese content.

Zinc (mg1100 g)

Significant differences ($p < 0.01$) were seen among the banana genotypes in terms of the zinc content (Table 2). The results revealed that, the range of zinc was between 0.33 mg/100 g (Anaikomban) to Namarai(0.58 mg/100 g) with a mean value of 0.46 mg/100 g in AA group. Among AB group (Table 2), the mean value of zinc was 0.32 mg/100 g with values ranging from 0.32 mg/100 g (Aktoman) to 0.56 mg/100 g (Ney Poovan). The genomic influence on the zinc content could not be related (Narayana *et al.*, 2017) [24], the similar findings were noticed in Ashokkumar *et al.* (2018) [3], Englberger *et al.* **(**2003) [10], Adenji *et al.* (2007) [1]. In another study, Fungo *et al.* (2010) [12] revealed that, zinc content of 17 banana genotypes were ranged from 0.063 to 0.608 mg/100 g.

Copper (mg/100 g)

With regard to copper, non significant difference was observed between genotypes with respect to copper content in AA group however, it was ranged from 0.23 mg/100 g (Kadali) to Namarai (0.38 mg/100 g) with a mean value of 0.30 mg/100 g (Table 2). Among AB group, significant difference was noticed between genotypes interms of copper content and it was ranged from 0.23 mg/100 g (Aktoman) to Ney Poovan (0.28 mg/100 g) with a mean value of 0.20

mg/100 g. Obiageli *et al.* (2016) [25] reported that, copper was seen to be higher in Saba banana (0.49mg/100 g) than in banana (0.26 mg/100 g) and plantain (0.20 mg/100 g).

Table 1: Mineral composition of N, P, K, Mg and Ca (mg/100 g) of different genomic subgroup of banana genotypes

Genomic group	Genotypes	Macronutrients (mg/100 g)				
		N	P	K	Mg	Ca
AA	Anaikomban	126.00	30.00	856.00	345.00	45.00
	Kadali	221.00	60.00	568.00	321.00	25.00
	Namarai	228.00	50.00	1142.00	455.00	37.00
	Pisang Lilin	515.00	50.00	610.00	464.00	57.00
	Mean	272.50	47.50	794.00	396.25	41.00
	Range	126.00-515.00	30.00-60.00	568.00-1142.00	321.00-464.00	25.00-57.00
	S.Em±	0.51	0.37	0.39	0.36	0.35
	C.D @ 1%	2.05	1.54	1.60	1.49	1.44
	C.V.	0.41	1.76	0.11	0.20	1.90
AB	Aktoman	123.00	50.00	698.00	258.00	16.00
	Kodappanilla Kunnan	287.00	30.00	1027.00	377.00	15.00
	Kunnan	249.00	30.00	1077.00	397.00	13.00
	Mitli	168.00	50.00	984.00	348.00	40.00
	Ney Poovan	158.00	40.00	1532.00	340.00	92.00
	Mean	147.75	30.00	797.70	258.00	26.40
	Range	123.00-287.00	30.00-50.00	698.00-1532.00	258.00-397.00	13.00-92.00
	S.Em±	0.58	0.45	0.50	0.53	0.46
	C.D @ 1%	2.43	1.86	2.06	2.21	1.91
	C.V.	0.79	2.97	0.12	0.41	3.47

Table 2: Mineral composition of Fe, Mn, Zn and Cu (mg/100 g) of different genomic sub group of banana genotypes

Genomic group	Genotypes	Micronutrients (mg/100 g)			
		Fe	Mn	Zn	Cu
AA	Anaikomban	1.97	0.82	0.33	0.26
	Kadali	1.77	1.03	0.42	0.23
	Namarai	2.08	1.26	0.58	0.38
	Pisang Lilin	1.82	1.36	0.50	0.33
	Mean	1.91	1.12	0.46	0.30
	Range	1.77-2.08	0.82-1.36	0.33-0.58	0.23-0.38
	S.Em±	0.15	0.03	0.03	0.04
	C.D @ 1%	0.61	0.13	0.16	NS
	C.V.	17.22	6.20	15.99	27.05
AB	Aktoman	1.76	0.72	0.32	0.23
	Kodappanilla Kunnan	1.93	0.48	0.42	0.26
	Kunnan	1.11	0.73	0.43	0.27
	Mitli	1.16	0.53	0.43	0.26
	Ney Poovan	1.06	0.59	0.56	0.28
	Mean	1.05	0.46	0.32	0.20
	Range	1.06-1.93	0.48-0.73	0.32-0.56	0.23-0.28
	S.Em±	0.04	0.05	0.05	0.04
	C.D @ 1%	0.15	0.22	0.20	0.17
	C.V.	6.98	23.22	30.22	42.41

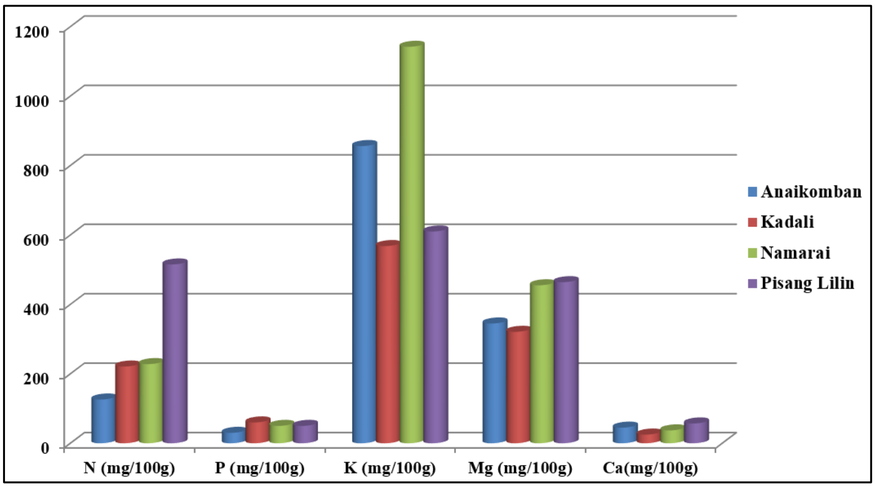

Fig 1: Mineral composition of AA genomic subgroup of banana genotypes

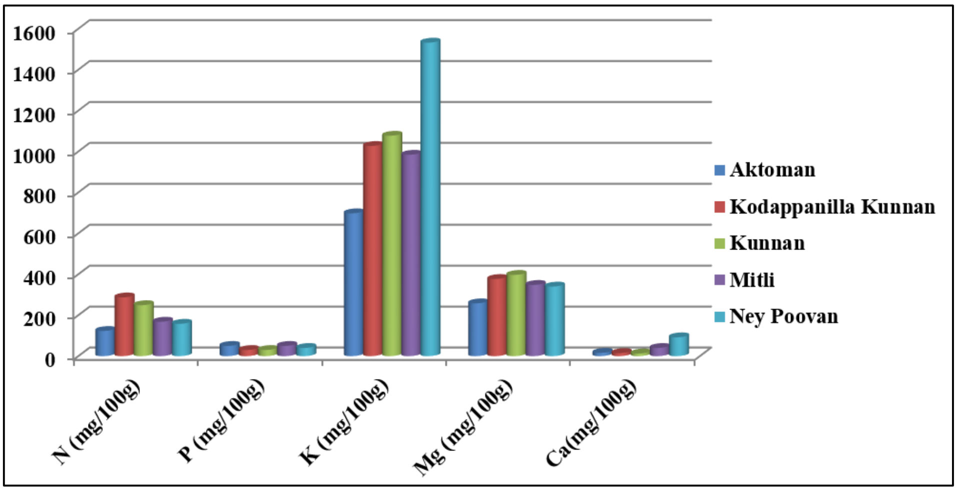

Fig 1: Mineral composition of AB genomic subgroup of banana genotypes

Conclusion

From the present study, it would be concluded that the genotypes, Pisang Lilin(AA), Kodapanilla Kunnan (AB) had shown maximum nitrogen content and Kadali (AA), Aktoman (AB), Mitli (AB)have contain maximum phosphorus. The genotypes like, Namarai (AA), Ney Poovan (AB) and Kunnan (AB) recorded higher amount of potassium and maximum content of magnesium was noticed in Pisang Lilin (AA), Kunnan and Kodappanilla (AB). With respect to calcium, the genotypes Pisang Lilin (AA) and Ney Poovan (AB) had shown maximum results. Namarai (AA) and Kodappanilla Kunnan (AB) have shown higher amount of iron content and Pisang Lilin (AA) and Kunnan (AB) noticed maximum content of manganese. With respect to zinc content, Namarai (AA) and Ney Poovan (AB) was found best. Namarai (AA) and Ney Poovan (AB), contained maximum amount of copper in green fruits.

However, the mineral contents in the bananas may vary from sample to sample due to different factors. The change could have been attributed by sampling measurement errors, changes in cultivation or agricultural methods (Mayer, 1997) [23]. Soil conditions including fertilizer application and storage and marketing conditions also influence mineral contents of bananas (Sreedevi *et al.*, 2015) [32]. The plant state of maturation, genetic variance and environmental factors were also the possible explanation for discrepancies observed.

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Reference

1. Adeniji TA, Sanni LO, Barimala IS, Hart AD. Nutritional composition of five new Nigerian *Musa* hybrid cultivars: Implications for adoption in human nutrition. Fruits. 2007;62(3):121-126.
2. Anhwange BA. Chemical composition of *Musa sapientum* (banana) peels. Journal of Food Technology. 2008;6(6):263-266.
3. Ashokkumar A, Eayabalan S, Shobana VG, Sivakumar P, Pandiyan M. Nutritional value of cultivars of banana (*Musa* spp.) and its future prospects. Journal of Pharmacognosy and Phytochemistry. 2018;7(3):2972-2977.
4. Auta SA, Kumurya AS. Comparative proximate, mineral elements and anti-nutrients composition between *Musa sapientum* (banana) and *Musa paradisiaca* (plantain) pulp flour. Sky Journal of Biochemistry Research. 2015;4(4):25-30.
5. Bernstein N, Loffe M, Luria G, Bruner M, Nishri Y, Philosoph HS. Effects of K and N nutrition on function and production of *Ranunculus asiaticus*. Pedosphere. 2011;21(3):288-301.
6. Coulibaly S, Nemlin GJ, Kamenan A. Chemical composition, nutritive and energetic value of plantain (*Musa* spp.) hybrids CRBP 14, CRBP 39, FHIA 17, FHIA 21 and Orishele variety. Tropicultura. 2007;25(1):2-6.
7. Das JL. Medicinal and nutritional values of banana cv. Nendran. Asian Journal of Horticulture. 2010;5(1):11-14.
8. Do O, Eleazu CE, Nwosu P. Nutrient and heavy metal composition of plantain (*Musa paradisiaca* L.) and banana (*Musa paradisiaca*) peels. Journal of Nutrition and Food Science. 2015;5(3):1-3.
9. Doymaz I. Evaluation of mathematical models for prediction of thin layer drying of banana slices. International Journal of Food Properties. 2010;13(3):486-497.
10. Englberger L, Aalbersberg W, Praveen R, Bonnin E, Marks GC, Fitzgerald MH, Elymore J. Further analysis on Micronesian banana, taro, breadfruit and other foods for provitamin A and minerals. Journal of Food Composition and Analysis. 2003;16:219-236.
11. Florenta AW, Loha AMB, Thomas HE. Nutritive value of three varieties of banana and plantain blossoms from Cameroon. Greener Journal of Agricultural Sciences. 2015;5(2):52-61.
12. Fungo R, Kikafunda JK, Pillay M. β-Carotene, iron and zinc content in Papua New Guinea and East African highland bananas. African Journal of Food Agriculture and Nutrition Development. 2010;10(6):2629-2644.
13. Ganapathi TR, Suprasanna PS, Bapat VA, Kulkarni VM, Rao PS. Somatic embryogenesis and plant

regeneration from male flower buds of banana. Current Science. 1999;76:1128-1131.
14. Hapsari L, Lestari DA. Fruit characteristic and nutrient values of four Indonesian banana cultivars (*Musa* spp.) at different genomic groups. Agrivita Journal of Agricultural Sciences. 2016;38(3):303-311.
15. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India Private Ltd.; 1973. p. 521.
16. Jangam AK, Thali P. ICAR Research Complex, Goa, Old Goa, Goa (India). 2010;402-403.
17. Jyothirmayi N, Rao NM. Banana. Medicinal uses. Journal of Medical Science and Technology. 2015;2:152-160.
18. Kiin-Kabari DB, Agoha A. Bioaccessibility of minerals in some plantain and banana hybrids grown in Nigeria. International Journal of Food Science and Nutrition. 2018;3(1):154-157.
19. Kookal SK, Thimmaiah A. Nutritional composition of staple food bananas of three cultivars in India. American Journal of Plant Science. 2018;9:2480-2493.
20. Kotur SC, Murthy KSV. Enhancing the fruit yield of Robusta banana (*Musa paradisiaca* L.) by de-vavelling and feeding nitrogen, potassium and sulphur through the distal stalk end of bunch. Indian Journal of Agricultural Science. 2011;78(2):15-19.
21. Leterme P, Bulgen A, Estrada F, Londono AM. Mineral content of tropical fruits and unconventional foods of the Andes and rain forest of Colombia. Food Chemistry. 2006;95(4):644-652.
22. Marisa MW. Ascorbic acid, vitamin A and mineral composition of banana (*Musa* sp.) and papaya (*Carica papaya*) cultivars grown in Hawaii. Journal of Food Composition and Analysis. 2006;19(4):434-445.
23. Mayer AM. Nutritional composition of staple food bananas of three cultivars in India. British Food Journal. 1997;99(6):207-210.
24. Narayana CK, Jeyabaskaran KJ, Mustaffa MM. Chemical and mineral composition of four cultivars of banana (*Musa* sp.) belonging to different genomic groups grown in India. International Journal of Current Microbiology and Applied Sciences. 2017;6(9):2862-2867.
25. Obiageli AO, Izundu AI, Ngozi MM, Helen ON. Mineral compositions of three *Musa* species at three stages of development. IOSR Journal of Dental and Medical Sciences. 2016;15(6):118-125.
26. Onwuka GI, Onwuka ND. The effects of ripening on the functional properties of plantain and plantain-based cake. International Journal of Food Properties. 2005;8(2):347-353.
27. Petrovich MB, Filho VRA, Neto JAG. Direct determination of calcium in milk by atomic absorption spectrometry using flow-injection analysis. Eclética Química. 2007;32(3):25-30.
28. Piper CS. Soil and plant analysis. Bombay: Hans Publishers; 1966.
29. Sampath K, Debjit B, Duraivel S, Umadevi M. Traditional and medicinal uses of banana. Journal of Pharmacognosy and Phytochemistry. 2012;1(3):51-63.
30. Sheng ZW, Ma WH, Jin ZQ, Bi Y, Sun ZG, Dou HT, Gao JH, Li JY, Han LN. Investigation of dietary fiber, protein, vitamin E and other nutritional compounds of banana flower of two cultivars grown in China. African Journal of Biotechnology. 2010;9(25):3888-3895.
31. Smitha K, Prabhu BR, Samshuddin S, Kamath SD. A comparative study of mineral contents in variety of bananas grown in coastal belt of Karnataka. Asian Journal of Plant Science and Research. 2015;5(8):51-54.
32. Sreedevi L. Quality evaluation of organic ripe banana [M.Sc. thesis]. Thrissur: Kerala Agricultural University; 2013. p. 41-46.
33. Sulaiman SF, Adlin Md Y, Eldeen IM, Eng MS, Azliana ABS, Supriatna KLO. Correlation between total phenolic and mineral contents with antioxidant activity of eight Malaysian bananas (*Musa* sp.). Journal of Food Composition and Analysis. 2011;24:1-10.
34. Suriyavathana M, Jeevitha M. Biochemical characterization of three species of banana (*Musa paradisiaca*) growing in Kanjamalai. Journal of Dairying, Foods & Home Sciences. 2011;30(3):206-208.
35. Yang PS, Chen YY, Li GH, Zhong SX. Analysis on the development of banana industry in China. Journal of Fruit Science. 2013;20:415-420.
36. Yoseph T, Shiferaw W, Sorsa Z, Simon T, Shumbullo A, Solomon W. Adaptability study of banana (*Musa paradisiaca* var. *sapientum*) varieties at Jinka, southern Ethiopia. American Journal of Agriculture and Forestry. 2014;2(6):250-256.