IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 10, Issue 6 Ver. III (Jun. 2016), PP 01-07
www.iosrjournals.org

Vitamin Compositions of Three *Musa* Species at Three Stages of Development

[1]Ogbonna Obiageli A., [2]Izundu A. I., [3]Okoye Nkechi Helen and [4]Mgbakor Miriam Ngozi

[1]*Department of Science Laboratory Technology Institute of Management and Technology Enugu, Nigeria.*
[2]*Department of Botany, Faculty of Biosciences Nnamdi Azikiwe University Awka, Nigeria.*
[3]*Department of Applied Chemistry Nnamdi Azikiwe University Awka, Nigeria.*
[4]*Department of Agricultural Economics Enugu state University of Science and Technology, Enugu*

Abtract: *This study was designed to evaluates the vitamin compositions of three Musa species at three stages of development. Spectrophotometric method was employed in the determination of vitamin contents. The vitamin compositions of the three Musa species at three stages of development revealed that vitamin A and vitamin C components of the samples were higher when compared with vitamin B1, B2 and B3 contents of all the samples at the different stages of development. The vitamin A components of Banana was higher than that of plantain. The results also showed that the vitamin contents increased as the fruits developed from immature to ripe stages. Although differences occurred among the different species and at different developmental stages, these differences are not significant. The Results of the vitamin composition of the three Musa species at the immature stages of development revealed that vitamins A, C, and B_3 content in plantain were higher than in Saba banana and also banana. The significantly higher constituents of some vitamins as vitamins A, B_3 and C identify the saba banana as a very good type for consumption especially during ripe stage.*

Key Words: *Vitamin, Musa species, Spectrophotometric, Fruits and Significant increase*

I. Introduction

Since the dawn of human civilization plants have made large contributions to facilitate human health and well being [1]. The stage of maturity of plants greatly affects the concentrations of nutrients in plants [2], thus it is very important to choose suitable stage of harvesting [3]. Medicinal potentials of most common plants have been extensively studied and compiled but the lack of information regarding the potential of these plants at varying stages of development makes these plants to be highly underutilized.

During the process of growth and development of fruit, series of developmental transitions are undergone. These processes involve coordinated changes in a number of catabolic and anabolic reactions [4], which leads to the synthesis or degradation of wide range of bioactive compounds. Hence, fruits at varying maturity levels may possess vivid bioactive compounds, which need to be studied so as to provide maturity indices for its usage as a source of food or medicine. It has also been proven that ethno-botanically derived compounds have potential bioactive compounds and they therefore provide greater potential for product development [5].

In Nigeria, fruits can be harvested at all stages of development (from immature to over ripe) and can be used as a source of food in one form or the other. Some fruits are picked when they are mature but not yet ripe [6]. According to [7], plantain fruits may be consumed unripe (green), yellow-green, or ripe.

The stage of maturation at which any fruit is harvested also influences the fruit's green-life or its ability to be stored for long periods [8]. Fruits harvested at an early stage of maturity are of poor quality upon ripening, despite having a long storage life [8]. Similarly, harvesting at an advanced stage of maturity is unsuitable for fruits intended for long distance shipment due to their shorter storage life. However according to [9], the appropriate time to harvest unripe plantain for maximum benefit is between the 12th and 14th week. This two weeks period provides enough time for harvest, distribution, marketing and utilization of the produce before ripening.

Increased vegetable utilization and consumption are critical to alleviate world-wide incidence of nutritional deficiencies. Investigations have shown that some plants contribute to increased intake of some essential nutrients and health-promoting phytochemicals. Phytochemicals are present in virtually all of the fruits, vegetables, legumes (beans and peas), and grains we eat, so it is quite easy for most people to include them in their diet.

Musa paradisiaca L is an herbaceous plant (up to 9 m long) with a robust treelike pseudostem, a crown of large elongated oval deep-green leaves (up to 365 cm in length and 61 cm in width) with a prominent midrib. Each plant produces a single inflorescence like drooping spike, and large bracts opening in succession, ovate, 15-20 cm long, concave, dark red in color and somewhat fleshy. Fruits are oblong, fleshy, 5-7cm long in wild

form and longer in the cultivated varieties. The ripe fruits are sweet and full of seeds and the peel is thicker than other banana. *Musa paradisiaca* is a type of plantain, which is normally cooked before it is eaten. It belongs to the AAB genomic group.

Musa sapientum L is a treelike perennial herb that grows 5 - 9 m in height, with tuberous rhizome, hard, long pseudostem. The inflorescence is big with a reddish brown bract and is eaten as vegetables. The banana plant grows up to 10 to 26 feet. Musa *sapientum* known as true banana or dessert banana is usually eaten raw at maturity. It belongs to the AAA genomic group.

Musa saba L is primarily a cooking banana although it can also be eaten raw. It is one of the most important banana varieties in Philippine cuisine. It is also known as the Cardaba banana or simply Saba banana. Saba bananas are part of the saba subgroup (ABB). Saba banana is a triploid (ABB) hybrid of the seeded banana *Musa balbisiana* and *Musa acuminata* [10]. It has predominant *Musa balbisiana* gene. It's also designated as *Musa acuminata* × *balbisiana* Colla (ABB Group) 'Saba'.

The fruits otherwise known as fingers are 8 to 13 cm long and 2.5 to 5.5 cm in diameter. Saba Bunches are big with 8 to 16 hands having 12 to 20 fingers per hand. The fruits are short and stubby and highly angular (plate 1b). Saba banana is a beautiful plant with an unusual bluish-green colored fruit. The pulp is white and starchy, making it ideal for cooking. The bright white interior contrasts with the outer peel. They are usually harvested while still green after about 150 to 180 days after planting [11]. The skin is thick and yellow when ripe (Plate 1c).

Saba banana has the largest and tallest stem attaining a height of four meters. It can grow to 25 feet and is very tolerant of cold and resistant to wind. The trunk can be as thick as 24 inches. Its leaves are dark green, and the banana is green skinned or green verging toward yellow. This plant is often grown for shade. The Saba plant's pseudo stem is robust and grows taller than the dessert cultivars, producing about 8 suckers per mat at harvest. Its fruit, however, has a longer gestation period at 150 to 180 days after flowering. The plant's potential yield is 26 to 28 kg per bunch with one bunch containing up to 16 hands, each hand having 12 to 20 fingers.

In Nigeria, *Musa saba* is available year round in Southern part of the country but highly underutilized. It is highly restricted in utilization to production of flour and fried chips, thereby predisposing it to rapid post harvest spoilage contributed by its physiological metabolic activities and high moisture content. It is relatively cheaper as compared to dessert bananas and plantains and has been reported to be rich in minerals, ash and ascorbic acid [12].

Banana and plantain fruits can be used industrially in the production of baby food and pastries [13 and 14]. The peels of plantain can be dried and made into meal which can be used to substitute up to 70 – 80% of the grain in pig and dairy diets with little change in performance [15]. The meals are also used in poultry diets but when in high level tends to depress growth and reduces feed efficiency. The leaves, sheaths and petioles are used in tying, roofing, wrapping, and packaging of food. Plantain and banana are also used in beer production. In Central and East Africa, the juice from the ripe fruits is fermented to make beer with low alcohol content [15 and 16].

Akpabio *et al* (2012), [17], also observed that green plantain and banana pseudo stems can be used in alcohol production, paper making and in the preparation of cellulose derivatives. Unripe plantain because of its starch content indicates wider utility in alcohol production, fuel and sugar industries, and as drug binder in pharmaceuticals.

Plantain and banana play important role in income generation for both large scale and small holders' farmers in the country, especially for those who produce them within their homestead or gardens [18].

Plantains and bananas are known to contain bioactive compounds (phytochemicals) such as alkaloids, flavonoids, tannins and phenolic compounds [19 and 20]. According to [21], knowledge of the chemical composition of a plant together with its antioxidants activity will give a fair estimate of its therapeutic potential furthermore.

From the ongoing it is clear that knowledge of the constituents of any plant at each usable stage of development is necessary for better understanding of when it will be used to achieve desired result. Information about the stages of development of banana and plantain used to realize certain objectives in literature are scanty. Since these plantation crops can be utilized at different stages of development there is therefore an increased need to reveal the constituents at possible usable stages.

Aims and objectives

This study was designed to evaluates the vitamin compositions of three *Musa* species at three stages of development

Plate 1a: Fruits of Saba Banana {*Musa acuminata x balbisiana* Colla (ABB Group) cv saba} at the Immature Stage**.**

Plate 1b: Fruits of Saba Banana {*Musa acuminata x balbisiana* (ABB Group) cv saba} at green Mature Stage

Plate 1c: Fruits of Saba Banana {Musa *acuminata x balbisiana* (ABB Group) CV Saba} at the Ripe Stage of Development.

Plate 2 a Fruits of Plantain (*Musa paradisiaca* L) at the Immature Stage

Plate 2b Fruits of Plantain (*Musa paradisiaca* L) at the green Mature Stage

Plate 2b Fruits of Plantain (*Musa paradisiaca* L) at the Ripe Stage

Plate 3a Fruits of Banana (*Musa sapientum* L) at the Immature Stage of Development

Plate 3b Fruits of Banana (*Musa sapientum* L) at the green Mature Stage

Plate 3c Fruits of Banana (*Musa sapientum* L) at the Ripe Stage of Development

II. Materials And Methods

Sources of Materials

Fresh plantain, banana and saba banana fruits used in this work were supplied through special arrangements with plantation farmers at Nike town in Enugu StateNigeria. The three *Musa* species used were *Musa paradisiaca* L, *Musa sapientum* L *and Musa saba* L. The species were identified and authenticated accordingly by Professor C. U. Okeke, a plant taxonomist of the Department of Botany Nnamdi Azikiwe University, Awka.

The fruits were collected fresh and used immediately in the analyses. The collection of the samples in these analyses was based on the rate of their development as recommended by [22]. Immature, green mature and ripe fruits were collected for the analyses (Plate $1a^{-c}$, 2^{a-c} and 3^{a-c}). Fruits at each these stages of development were aged 30 – 45 days following fruit set for immature; 70 – 90 days of fruit set for green mature: while the ripe stage were those whose peels were showing 50% or more visible xanthophylls exposures or yellowing.

Sample Preparation:

The samples were thoroughly washed under running water and the back removed exposing the pulp which was homogenized using a Kenwood warring blender and kept in the refrigerator until required for analysis.

Vitamin Content Determination

The spectrophotometric method by [23], was employed in the determination of vitamin contents.

Vitamin A

Five grams of the sample was weighed into a 250ml flask. Sixty five ml of 0.1M HCl was added and the mixture warmed in a water bath at 100^{o}C for 30mins. The mixture was allowed to cool and pH adjusted to 4.5 with NaOAc. To the mixture, 50mg of β amylase and50mg takadiastase and incubated at 37^{o}C oven for overnight. The mixture was then decanted quantitatively into a 100ml volumetric flask and volume adjusted with water, the supernatant was filtered and vitamin contents determined by liquid chromatogragraphy.

III. Results

Results of Vitamin Compositions of Three *Musa* Species at Three Stages of Development

The vitamin compositions of the three *Musa* species at three stages of development shows that vitamin A and vitamin C components of the samples were higher when compared with vitamin B1, vitamin B2 and vitamin B3 contents of all the samples at the different stages of development. The vitamin A components of Banana was higher than that of plantain. The results also showed that the vitamin contents increased as the fruits developed from immature to ripe stages (Table 1).

Although differences occurred among the different species and at different developmental stages, these differences are not significant (Table 1). The Results of the vitamin composition of the three *Musa* species at the immature stages of development showed that vitamins A, C, and B_3 content in plantain were higher than in Saba banana and also banana. (Table 1)

Table 1: Vitamin Compositions of Three *Musa* Species at Three Stages of Development

Vitamin	Developmental Stage	Vitamin Compositions mg/100g		
		Banana	Plantain	Saba Banana
Vit B1	Immature	0.06 ± 0.002 [a]	0.07 ±0.001 [a]	0.07 ± 0.001 [a]
	Green Mature	0.08 ± 0.001 [a]	0.07 ± 0.000	0.08 ± 0.001[a]
	Ripe	0.08 ± 0.001 [a]	0.08 ± 0.001 [a]	0.08 ± 0.002 [a]
Vit B2	Immature	0.05 ± 0.001 [a]	0.04 ± 0.001 [a]	0.04 ± 0.001 [a]
	Green Mature	0.05 ± 0.001 [a]	0.05 ± 0.001 [a]	0.05 ± 0.001 [a]
	Ripe	0.05 ±0.001 [a]	0.05 ± 0.001 [a]	0.05 ± 0.001 [a]
Vit B3	Immature	0.29 ± 0.008[d]	0.24 ± 0.008[e]	0.30 ±0.008[cd]
	Green Mature	0.27 ± 0.004[e]	0.26± 0.004[e]	0.30 ±0.012[c]
	Ripe	0.32 ± 0.008[b]	0.28 ± 0.118[d]	0.35 ± 0.012[a]
Vit A	Immature	2.86 ± 0.025[b]	2.63 ± 0.008[e]	2.75 ± 0.019[d]
	Green Mature	2.84 ±0.014[b]	2.76 ±0.062[d]	2.80 ± 0.061[c]
	Ripe	3.14 ± 0.008[a]	2.78 ±0.008[cd]	2.85 ±0.021[b]
Vit C	Immature	4.75 ± 0.008[f]	5.70 ± 0.012[b]	5.72 ±0.019[b]
	Green Mature	4.72 ±0.015[f]	5.15 ± 0.028[e]	5.54 ±0.016[d]
	Ripe	5.60 ± 0.008[c]	5.80 ± 0.016[a]	5.48 ± 0.008[d]

Results are in Means ± Standard Error. Means ± Standard Error followed by the same letter(s) are not significant

IV. Discussion

The vitamin compositions of the three *Musa* species at three stages of development revealed that vitamin A and vitamin C components of the samples were higher than vitamin B1, vitamin B2 and vitamin B3 contents of all the samples at the different stages of development. The vitamin compositions of the Three *Musa* species also revealed that there is significant difference between the vitamin A content of Banana and Plantain at the three stages of development. The vitamin A components of Banana is higher than that of plantain. The result equally revealed that there were significant differences in the vitamin A contents at the different stages of development. According to [2], total carotenoid contents (Vitamin A) in fruits and vegetables increases during ripening because the chlorophyll undergoes degradation and carotenogenesis takes place resulting in synthesis of carotenoid compound at Chromoplast rather than chloroplast. Vitamin C is an important water-soluble vitamin already implicated in most of the life processes but principally function as an antioxidant. It is present abundantly in fruits and vegetables where the common man in the developing countries receives most of their daily intake [18, 19, 24 and 25].

V. Conclusion

The significantly higher constituents of some vitamins as vitamins A, B_3 and C identify the saba banana as a very good type for consumption.

References

[1]. Singh, R., S.A. Dar and P. Sharma,(2012). Antibacterial activity and toxicological evaluation of semi purified hexane extract of *Urtica dioica* leaves. *Res. Journal of Medicinal Plant,* 66: 123-135.

[2]. Izonfuo W.A.L. and V.O.T. Omuaru (1988)," Effect of Ripening on the Chemical Composition of Plantain Peels and Pulps (*Musa paradisiaca*)", *Journal of the Science of Food and Agriculture* 45:333-336.

[3]. Yu, P., Christensen, D. A. and Mckinion, J. J (2004), In situ rumen degradation kinetics of timothy and alfalfa as affected by cultivar and stage of maturity, *Canadian Journal of Animal Science*, 84: 255- 263.

[4]. Duhan, A., B.M. Chauhan and D. Punia(1992), Nutritional value of some non-conventional plant food of India, *Plant Foods Human Nutrition*, 42: 193-200.

[5]. Chanda, S., Kaneria, M. and Nair, R (2011), Antibacterial activity of *Psoralea corylifolia* L. seed and aerial parts with various extraction methods, *Res. Journal of Microbiology*, 60: 124-131.

[6]. Sitti N. Mamogkat (2013). Maturity of fruits and vegetables and its effect on the finished product

[7]. Adeyemi, D. O., Komolafe, O. A., Adewole, O. S., Obuotor, E. M. and Adenowo, T. K. (2009), Antiglycemic activities of Annona muricata (Linn), African journal of Traditional, Complementary

[8]. Narayana C. K.and Mustaffa M.M (2007), Influence of maturity on shelf life and quality changes in banana during storage under ambient conditions, *Indian Journal of Horticulture* 64(1): 12- 16.

[9]. Onuegbu, N., Ubbaonu, C., Ajoku, N and Ihediohanma, N.(2011), "Effect of develelopmental stage on some maturity parameters of plantain", Nature and Science 9(9): 68.

[10]. Porcher, M. H. and Barlow, S. (2002), *Sorting Musa names*, The University of Melbourne

[11]. Solidum, J N (2011), Characterization of Saba peels, *International Journal of Chemical and Environmental Engineering* 2(3): 147-152.

[12]. Ayo-Omogie, H. N., Adeyemi, I. A. and Otunola, E. T.(2010), Effect of Ripening on Some Physicochemical Properties of Cooking Banana (*Musa* ABB Cardaba) Pulp and Flour, *International Journal of Food Science & Technology*, 45, (12): 2605-2611.

[13]. Ogazi P.O. (1996) Plantain: Production, Processing and Utilization. Paman and Associates ,Uku, Okigwe.

[14]. Akyempong, E. (1999), Plantain production, marketing and consumption in West and Central Africa, Proc. International Symposium on Banana and Food security.Douala, Cameroon10-14 , November pp 353- 359.

[15]. Sharrock, S. (1997) Uses of *Musa* in: International Networks for Improvement of Banana and Plantain INIBAP annual report (INIBAP: Montpellier France) 42-44.

[16]. Eleazu, C.O., Okafor, P. N., Aniago, J. Awa, E., Ikpeama, A. I and Eleazu K. C.,(2011),'' Chemical composition, antioxidant activity, functional properties and inhibitory action of unripe plantain(*Musa paradisiacal*) flour'', *African Journal of Biotechnolgy* 10(74): 16948- 16952.

[17]. Akpabio, U. D, Udiong, D G and Akpakpau, A E(2012), The Physico chemical characteristics of plantain and banana pseudostem wastes, *Advances in Natural and Applied Sciences* 6(2): 167- 172.

[18]. Falade, O.S., Dare A.F., Bello M.O., Osutogun, B.O., Adewusi, R .S .A (2004), "Varietal changes in proximate composition and effect of processing on the ascorbic content of Nigerian Vegetables", *Journal of Food Technology*, 2:103-108.

[19]. Atindehou, K.K., Kone, M., Terreaux, C., Traore, D., Hostettmann, K. and Dosso, M. (2002), Evaluation of the antimicrobial potential of medicinal plants from the Ivory Coast. *Phytotherapy Research 16* (5): 497- 502.

[20]. Edeoga, H.O., Okwu, D. E. and Mbaebie, B. O. (2003). Mineral and nutritive value of some Nigerian medicinal plants, *Journal of Medicinal and Aromatic Plant Science* 25: 689-694.

[21]. Akinmoladun, A. C., Ibukun, E. O., Afor, E, Akinrinlola, B. L., Onibon, T. R., Akinboboye, O. A., Obuotor, E. M. and Farombi, E. O. (2007). Chemical Constituents and Antioxidant Activitity of *Alstonia boonei*, *African Journal of Biotechnology* **6** (10): 1197-1201.

[22]. Duncan, B. D. (1955). Multiple ranges and multiple F Test, *Biometrics* 11: 1-7.

[23]. Onwuka, G.I. and Onwuka, N.D. (2005). The effects of ripening on the functional properties of plantain and plantain based cake, *International Journal of Food Properties* 8 (2), 347-353.

[24]. Offor, C.E., P. C. Ugwu Okechukwu and U. Alum Esther (2015). Determination of Ascorbic Acid Contents of Fruits and Vegetables. *International Journal of Pharmacy and Medical Sciences*, 5(1): 1-3.

[25]. Offor, C.E., Agidi, J.U., Egwu, C.O., Ezeani N. and Ugwu Okechukwu P.C. (2015). Vitamin and Mineral Contents of Gongronema latifolium leaves. *World Journal of Medical Sciences*, 12 (2): 189-191.