

## Glycoside, Moisture and Dry Matter Compositions of Fruits of Three *Musa* Species at Three Stages of Development

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**Abstract:** This was designed to evaluate the glycoside, moisture and dry matter compositions of fruits of three *Musa* species at three stages of development. Spectrophotometric method was used for the study. The results of the percentage moisture and dry matter composition of the fruit of banana, plantain and Saba banana revealed some increase in moisture content with ripening or development. The moisture content of banana (71.37%) at the immature stage was observed to be higher than the moisture content of Saba banana (66.19%) followed by plantain (60.44%). The results of the glycoside compositions of the three *Musa* species revealed that glycoside content was highest in Saba banana (0.811mg/100g) obtained at different levels of development followed by alkaloids. The quantity of glycosides was observed to be highest at the ripe stages of development of the three *Musa* species. This indicates that *Musa* species is a good source of these parameters especially at a ripped stage and should be used as a supplement in our diet.

**Keywords:** Glycosides, Moisture, Dry matter and *Musa* species

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### 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 overripe) 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 [7]. 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 week 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.

Glycosides in general, are defined as the condensation products of sugars (including polysaccharides) with a host of different varieties of organic hydroxy (occasionally thiol) compounds (invariably monohydrate in character), in such a manner that the hemiacetal entity of the carbohydrate must essentially take part in the condensation. Glycosides are colorless, crystalline carbon, hydrogen and oxygen-containing (some contain nitrogen and sulfur) water-soluble phytoconstituents, found in the cell sap. Chemically, glycosides contain a carbohydrate (glucose) and a non-carbohydrate part (aglycone or genin) [22 and 23]. Alcohol, glycerol or phenol represents aglycones. Glycosides are neutral in reaction and can be readily hydrolyzed into its components with ferments or mineral acids.

Glycosides are purely bitter principles that are commonly found in plants of the Genitaceae family and though they are chemically unrelated but possess the common property of an intensely bitter taste. The bitters act on gustatory nerves, which results in increased flow of saliva and gastric juices. Chemically, the bitter principles contain the lactone group that may be diterpene lactones (e.g. andrographolide) or triterpenoids (e.g. amarogentin).

## II. Aims And Objectives

This was designed to evaluates the Glycoside, Moisture and Dry Matter Compositions of Fruits 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 2a 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

### III. 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 State Nigeria. 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 [24]. Immature, green mature and ripe fruits were collected for the analyses (Plate 1<sup>a-c</sup>, 2<sup>a-c</sup> and 3<sup>a-c</sup>). 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.

### Test for Glycosides

Few drops of ferric chloride and concentrated sulphuric acid were added to a solution of the plant extract in glacial acetic acid. A reddish brown coloration at the junction of two layers and the bluish green colour in the upper layer indicated the presence of glycosides [25].

### Moisture Content

Moisture content was determined by the gravimetric method as described by [26]. One gram of the sample was weighed into a Petri dish and weighed before being put into the oven to dry for 1hr at 105°C. The weight was also noted after oven drying. The drying continued until a constant weight was achieved.

% MOISTURE CONTENT

CALCULATION

A. Weight of Petri dish + sample before oven drying =  $W_1$

B. Weight of Petri dish + sample after drying =  $W_2$

% moisture content =  $(W_1 - W_2) / 1 * 100$

$W_1 - W_2$  = Moisture loss.

### Determination of Dry Matter

Percentage dry matter was estimated as the difference of percent moisture content in 100% as described by [26]

## IV. Results

### Results of Percentage Moisture and Dry Matter Contents of fruits of Three *Musa* Species at Three Stages of Development

The results of the percentage moisture and dry matter composition of the fruit of banana, plantain and Saba banana showed some increase in moisture content with ripening or development (Table 1). The moisture content of banana (71.37%) at the immature stage was observed to be higher than the moisture content of Saba banana (66.19%) followed by plantain (60.44%) (Table 1).

**Table 1:** Percentage Moisture and Dry Matter Contents of fruits of Three *Musa* Species at Three Stages of Development

Plant Type	Developmental Stage	Composition (%)	
		Moisture	Dry Matter
Banana	Immature	71.37 ± 0.015 <sup>d</sup>	28.63 ± 0.015 <sup>e</sup>
	Green Mature	73.66 ± 0.005 <sup>c</sup>	26.34 ± 0.005 <sup>f</sup>
	Ripe	81.68 ± 0.010 <sup>a</sup>	18.32 ± 0.004 <sup>h</sup>
Plantain	Immature	60.44 ± 0.005 <sup>i</sup>	39.56 ± 0.022 <sup>a</sup>
	Green Mature	62.63 ± 0.185 <sup>h</sup>	37.37 ± 0.005 <sup>b</sup>
	Ripe	67.45 ± 0.025 <sup>f</sup>	32.55 ± 0.004 <sup>c</sup>
Saba Banana	Immature	66.19 ± 0.005 <sup>e</sup>	28.62 ± 0.004 <sup>e</sup>
	Green Mature	74.57 ± 0.220 <sup>b</sup>	25.43 ± 0.015 <sup>g</sup>
	Ripe	70.31 ± 0.005 <sup>e</sup>	29.69 ± 0.015 <sup>d</sup>

Values are in mean ± Standard error. Means ± Standard Error followed by the same letter(s) in a column are not significant.

### Results of Glycoside Compositions of fruits of Three *Musa* Species at Three Stages of Development

The results of the glycoside compositions of the three *Musa* species showed that glycoside content was highest in Saba banana (0.811mg/100g) obtained at different levels of development followed by alkaloids. The quantity of glycosides was observed to be highest at the ripe stages of development of the three *Musa* species (Table 2).

**Table 2:** Glycoside Compositions of fruits of Three *Musa* Species at Three Stages of Development

Phytochemical component	Plant Type	Phytochemical composition mg/100g		
		Immature	Green mature	Ripe
Glycoside	Banana	0.261 ± 0.001 <sup>g</sup>	0.764 ± 0.002 <sup>b</sup>	0.769 ± 0.002 <sup>b</sup>
	Plantain	0.352 ± 0.003 <sup>f</sup>	0.351 ± 0.001 <sup>f</sup>	0.602 ± 0.004 <sup>c</sup>
	Saba Banana	0.746 ± 0.001 <sup>c</sup>	0.498 ± 0.003 <sup>f</sup>	0.811 ± 0.004 <sup>a</sup>

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

## V. Discussion

The analysis of the fruits of banana, plantain and Saba banana revealed that the moisture content increased with ripening or development. This increase in moisture content as fruit developed is in agreement with the reports of [27 and 28]. This increase in moisture content as development progressed may be attributed to the moisture transfer from the peel to the pulp [29]. The high moisture content was an indication that the fruit cannot be stored for a long period. The moisture content of Banana increased from 71.37% to 81.68%. Also that of Saba banana increased from 66.19% to 70.31% as development progressed.

The Glycoside content showed significant difference between Plantain and Saba banana but no significant difference between plantain and banana and also between banana and saba banana.

This indicates that the fruit can be used as a major energy source in our daily supplement.

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