



Research Article

## Comparative nutritional composition study of local banana cultivars

Dawodu Olufunke Grace\*<sup>1</sup> , Adegbeye Oluwatosin<sup>1</sup> and Adenekan Sunday<sup>2</sup>

1. Department of Science Laboratory Technology, Federal Polytechnic Ede, Osun State, Nigeria.
2. Department of Biochemistry, College of Medicine University of Lagos, Akoka, Nigeria.

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### Corresponding Author

Prof. Dr. Dawodu Olufunke  
Grace  
E-mail: dawgrace@yahoo.com  
Tel: +234-8037382417.

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### Abstract

Banana is a fruit that is consumed worldwide because of its sweetness and it comes in different varieties. The essence of this work was to compare the nutritional value of different varieties of banana; (Plantain banana, lakantan, maoli, red banana, cavendish, burro, manzano and nino banana). The cultivars were purchased from Oje market, the peel and pulp were separated and dried, grounded to powder form. The proximate, mineral, and vitamin analyses were carried out according to standardized methods. The pulp of the banana cultivars gave the following nutritional composition values, showed the highest and lowest values (Maoli gave 58.6% and Burro 31.6% of CHO content). Lakantan gave 24.59%, Nino 12.50% of protein content, Plantain 8.17% and Burro 3.31% of crude fat. Cavendish 13.08% and Nino 3.83% of moisture content. Nino 9.82% and Maoli 4.31% of ash content. Burro 30.71% and Maoli 10.99% of crude fibre, while the peel values gave the following: Nino 48.01% and Burro 22.02% of carbohydrate content. Lakantan 24.62% and Nino 13.68% of protein content. Burro 6.65% and Plantain 3.35% of crude fat. Cavendish 13.59% and Plantain 9.44% of moisture content. Cavendish 12.37% and Lakantan 4.97% of ash content. Burro 24.36% and Cavendish 15.18% of crude fibre. From this study, it showed that the different cultivars of bananas (local to Nigeria) contain distinct nutritional compositional values.

## 1. Introduction

Bananas belong to the family of Musaceae and the genus *Musa*, which develops in a series of clusters or bunches whose weight can reach up to 50 kg. Banana is a perennial herbaceous plant [1-2] that grows from the underground rhizome. It flourishes well under tropical, moisture-rich, humid, low-lying farmlands. Banana is the largest herbaceous plant in the world [3]. Banana is a known major food crop cultivated globally and consumed in over 100 countries throughout the tropics and sub-tropics [4-6]. In developing countries, they are the fourth most important food crop after rice, wheat and maize [4, 7-8]. Worldwide, over 1,000 banana cultivars or landraces are recognized [9] and some countries have

as many as 200-300 cultivars grown in them [10-11]. Banana as a plant is described as a tall arborescent monocotyledon having a pseudo-stem or stem made up of leaf sheaths and a corm (underground true stem) having the ability to produce vegetative through suckers (CPSC116 - Banana - Properties of Banana (google.com)). Each pseudostem of the banana plant produces a single inflorescence, the female flowers which give rise (either parthenocarpically or following fertilization) to the banana fruits. Bananas as fruit are quite well balanced in nutrient composition, with a number of minerals, vitamins, large amount of carbohydrates, with small amounts of oil and protein, it is regarded as a complete fruit [8,

12-16]. Banana fruits are usually eaten raw as desert fruits [17]. Dessert bananas are consumed usually as ripe fruits, whereas ripe and unripe plantain fruits are usually consumed boiled, roasted or fried [18]. Plantain (*Musa paradisiaca*) is a staple food grown throughout the tropical and subtropical regions of the world. It is one of the major sources of carbohydrate for millions of people in Africa [19-20]. It ranks third, after yam and cassava, for sustainability in Nigeria [21] and Nigeria is known to be the largest producer of plantain in West Africa [22]. Bananas are a favorite food for everyone from infants to elders. They could not be more convenient to enjoy, and they are a good source of vitamins and minerals, as well as fiber. Bananas are considered nutritious with a high content of vitamins A, B complex and C [1, 7, 23-28]. Provitamin A (B-carotene) has been found in banana in appreciable quantities and at different levels in cultivars [29,30]. Generally, bananas contain a considerable amount of mineral elements and could therefore serve as a good source of mineral supplements in human/animal diets [31-32,11]. Banana fruit is a rich source of potassium, an essential mineral known for maintaining normal blood pressure and heart function ([www.archanaskitchen.com/kachcha-kela-masala-sabzi-recipe-raw-banana-with-tomat-oes-spices](http://www.archanaskitchen.com/kachcha-kela-masala-sabzi-recipe-raw-banana-with-tomat-oes-spices)). Banana nutrient composition changes considerably, especially during the process of ripening [31,33]. Many studies have been done on cultivars of different countries or even specific states or locations on nutrient composition, mineral and assessment, phenolic compounds and antioxidant ability of bananas [3, 10-11, 34-37,], to mention a few, but here in Nigeria specifically not many studies have looked at the different cultivars and their nutritional implications, especially citing a state or a region. In fact, the plantain variety is the most studied of all the banana cultivars. The aim of this study is to analyze comparative nutritional composition of cultivars of unripe bananas local to Ede, Osun State, Nigeria.

## 2. Materials and methods

### 2.1 Materials

#### 2.1.1 Apparatus and equipment

Water bath, centrifuge, measuring cylinder, test tubes, conical flasks, ultra turrax mixer, Pasteur pipette, round bottom flasks, filter paper, desiccators,

weighing balance, muffle furnace, oven, Porcelain crucible, fume cupboard, Kjeldahl distillation, digestion flask, cathode lamp, mortar and pestle cheese cloth, volumetric flask.

#### 2.1.2 Reagents

2.5 N HCl anthrone reagent, H<sub>2</sub>SO<sub>4</sub>, sodium carbonate, methanol, chloroform, distilled water, sodium hydroxide, selenium catalyst, nitric acid, perchloric acid, iodine solution, potassium iodide.

#### 2.1.3 Sample collection

Different varieties of banana cultivars were obtained from the local market (Oja Oje) in Ede, Osun State, Nigeria. National Horticultural Research Institute, International Institute of Tropical Agriculture (NIHORT and IITA) and from local fruit sellers. These cultivars are shown in Fig. 1

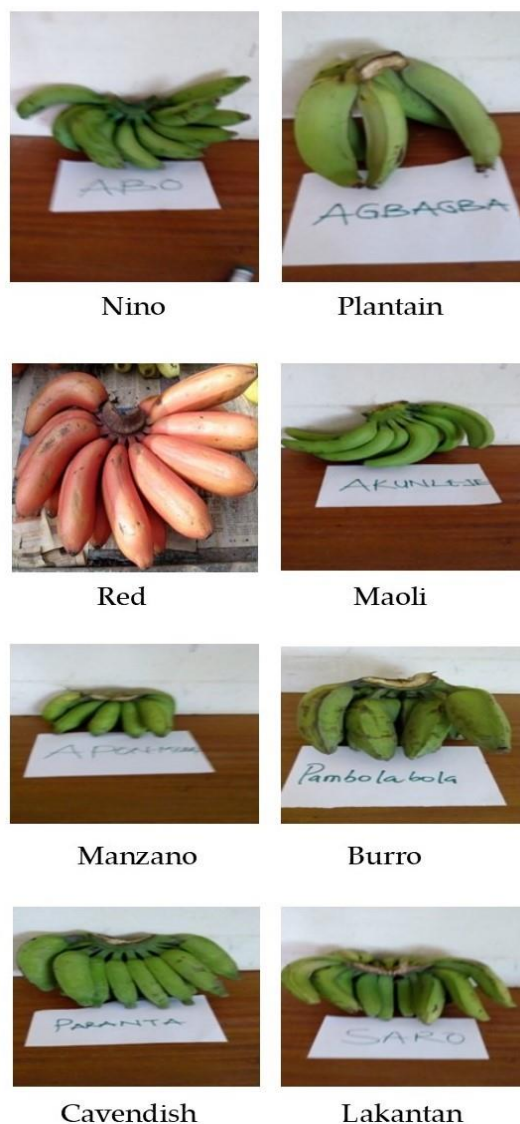


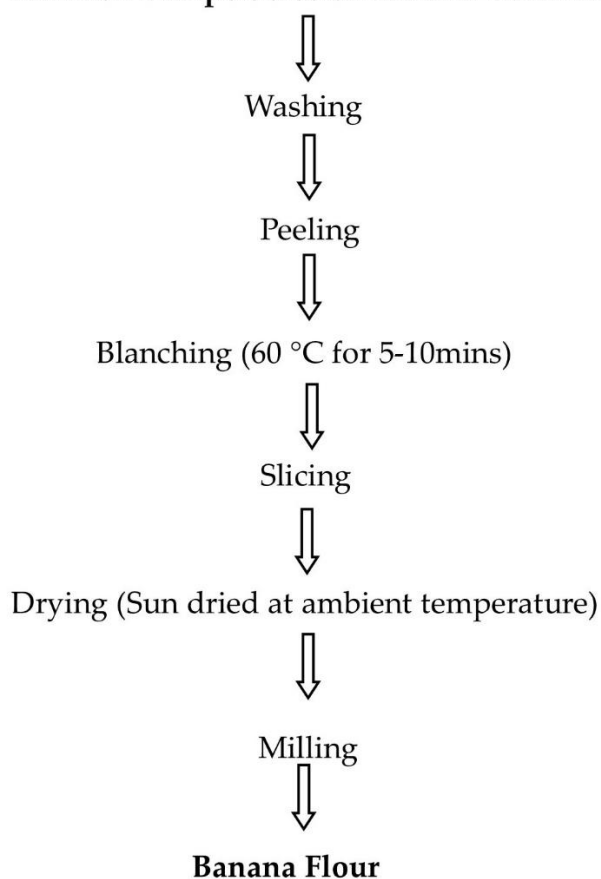
Figure 1. Local cultivars of bananas in Ede, Osun state.

2.2 Methods

2.2.1 Preparation of the sample

The banana pulp and peel samples were sliced and dried in a tray drier separately for quick drying, using sun drying methods, respectively. The dried fruit was grounded, using a household mixer grinder to powder forms. The dried sample of banana was grounded to powder form as described in Fig. 2 in the flow chart below. The fine powder was sieved and stored in an air-tight container for further analysis.

**Matured Unripe Selected Banana Cultivars**



**Figure 2.** Flowchart for the production of banana flour [38].

2.2.2 Proximate analysis of varieties of banana

Proximate analysis was determined according to AOAC [39], vitamin C content [40-41], vitamin A [42], and mineral content was done using AAS as described by the method of Wall [31].

2.3 Statistical analysis

All measurements were carried out in triplicates for each of the cultivars and Graphpad Prism 7.0 (Chicago, U.S.A) and SPSS v. 24.0 were used for the

computation of results obtained from this study. Data are presented as mean ± standard deviation (M ± SD).

**3. Results and discussion**

Tables 1 and 2 show the proximate compositions of different parts of the eight cultivars of banana pulp and peel. While the most studies reveal different nutritional constituents in the pulp and peels, surprisingly they are very close in terms of nutritional composition.

With respect to what people eat most in bananas which is the pulp, Maoli pulp had the highest carbohydrate value of (58.29%) followed by Nino (52.19%) and Cavendish (47.41%), while Burro had the lowest value of 31.60%, Aurora et al, [7] reported that a variety called ‘Karporavalli’ was found to be rich in carbohydrate content of the peels as compared to the pulp, which had about 1/3<sup>rd</sup> of the % of the peels. In the same study, Hill and Moorish varieties had almost 50-50% content of peel to pulp in their carbohydrate/starch content. These later findings were almost in line with the results of this study.

The protein content was low in Nino (12.50%) and Plantain (15.04%) while Lakantan banana protein content was (24.59%) followed by Manzano (18.79%), showing that banana though low in protein is consumed, basically for its carbohydrate, fiber and mineral contents. The Cavendish variety was found to be of high protein content when compared with other varieties [43-44]. Although from this study the Lakantan variety gave the highest protein value.

Plantain banana crude fat content was 8.17% followed by Manzano (5.98%), while the moisture content of Cavendish was 13.08% and Nino is 3.83%. This low moisture content makes it a more preservable variety. The ash content of all cultivars showed moderate value (4.97%-12.3%), which suggests that it may provide essential minerals.

Table 3 shows the mineral analysis for the pulp. The eight cultivars were rich in the following mineral elements: iron, cadium, magnesium, copper, sodium, manganese, zinc, potassium, phosphorus, calcium [45,46]. Cavendish peel and pulp was rich in calcium, potassium, magnesium, and sodium, lead and nickel were not detected in all the samples, this was in accordance with the work of Gbolahan [47].

The daily mineral requirement the human body needs

**Table 1.** Proximate composition of banana cultivars (pulp)

Banana Cultivars	CHO (%)	Protein (%)	Crude fat (%)	Moisture (%)	Ash (%)	Crude fibre (%)
Plantain/Agbagba	43.86 ± 0.43	15.04 ± 0.09	8.17 ± 0.04	7.38 ± 0.05	9.00 ± 0.08	16.87 ± 0.04
Lakanta/Saro	35.22 ± 0.02	24.59 ± 0.04	4.69 ± 0.04	11.64 ± 0.06	4.97 ± 0.14	18.87 ± 0.04
Maoli/Akunleje	58.29 ± 0.05	15.59 ± 0.03	4.19 ± 0.04	6.63 ± 0.06	4.31 ± 0.04	10.99 ± 0.06
Redbanana/Enubabanseje	40.21 ± 0.06	18.39 ± 0.04	4.26 ± 0.02	12.74 ± 0.03	7.81 ± 0.04	16.61 ± 0.04
Cavendish/Paranta	47.41 ± 0.02	17.17 ± 0.04	4.69 ± 0.03	13.08 ± 0.05	5.63 ± 0.21	12.04 ± 0.15
Burro/Pambolabola	31.60 ± 0.02	17.74 ± 0.00	3.31 ± 0.03	8.83 ± 0.05	7.78 ± 0.12	30.71 ± 0.18
Manzano/Yoyo/Aponmade	40.46 ± 0.05	18.79 ± 0.04	5.98 ± 0.03	6.27 ± 0.04	7.34 ± 0.05	17.64 ± 4.94
Nino/ Abo	52.19 ± 0.04	12.5 ± 0.04	6.09 ± 0.04	3.83 ± 0.05	9.82 ± 0.08	15.56 ± 0.08

Data represented as M ± S.D for triplicate observations

**Table 2.** Proximate composition of banana cultivars (peels)

Banana cultivars	CHO (%)	Protein (%)	Crude fat (%)	Moisture (%)	Ash (%)	Crude fibre (%)
Plantain/Agbagba	38.51 ± 0.40	19.32 ± 0.05	3.35 ± 0.03	9.44 ± 0.04	8.05 ± 0.09	21.40 ± 0.01
Lakantan/Saro	35.00 ± 0.00	24.62 ± 0.00	4.69 ± 0.04	11.65 ± 0.06	4.97 ± 0.14	18.88 ± 0.22
Maoli/Akunleje	35.00 ± 0.04	20.99 ± 0.06	5.32 ± 0.01	11.96 ± 0.05	8.05 ± 0.11	18.44 ± 0.15
Redbanana/Enubabanseje	35.00 ± 0.00	20.99 ± 0.06	5.32 ± 0.01	11.96 ± 0.05	7.9 ± 0.09	18.44 ± 0.15
Cavendish/Paranta	36.00 ± 0.04	17.57 ± 0.00	4.67 ± 0.00	13.59 ± 0.70	12.37 ± 0.09	15.18 ± 0.16
Burro/Pambolabola	22.02 ± 0.04	22.62 ± 0.02	6.65 ± 0.04	13.12 ± 0.03	8.39 ± 0.09	24.36 ± 0.36
Manzano/Yoyo/Aponmade	38.72 ± 0.04	23.36 ± 0.04	5.65 ± 0.03	9.56 ± 0.06	9.49 ± 0.03	17.64 ± 0.24
Nino/ Abo	48.01 ± 0.90	13.68 ± 0.04	5.36 ± 0.04	10.61 ± 0.03	6.67 ± 0.05	15.67 ± 0.13

Data represented as mean ± S.D for triplicate observations.

**Table 3.** Mineral content (mg/100g) of banana cultivars

Banana cultivars	Fe	Cd	Mn	Cu	Na	Pb	Mg	Zn	K	P	Ni	Ca
Plantain	7.65	0.03	1.38	2.14	55.83	ND	8.42	1.03	20.88	33.27	ND	56.39
Lakantan	6.85	0.03	0.24	2.60	42.00	ND	7.22	12.76	30.93	35.09	ND	47.89
Maoli	6.25	0.01	0.34	3.65	46.26	ND	7.55	ND	28.90	34.62	ND	52.73
Red Banana	5.34	0.02	0.71	2.87	45.18	ND	8.74	ND	21.26	41.72	ND	36.93
Cavendish	7.23	0.01	0.03	3.96	64.67	ND	6.80	0.93	24.77	36.55	ND	73.73
Burro	11.03	0.02	0.77	3.52	36.57	ND	6.81	ND	23.82	28.73	ND	32.02
Manzano	9.66	0.01	0.50	4.44	28.09	ND	7.50	ND	18.57	33.94	ND	51.50
Nino	10.77	0.01	0.39	4.95	40.02	ND	7.26	0.14	14.13	31.64	ND	45.60

Key: ND ----Not Detected, Fe- iron, Cd-Cadmium, Mn-manganese, Cu-copper, Na- sodium, Pb-lead, Mg-magnesium, Zn-zinc, K-potassium, P-phosphorus, Ni-nickel, Ca-calcium.

is of crucial importance, since fruits tend to be cheap worldwide, any fruit that has this is a welcome addition to the diet [48-50]. Banana is such a fruit, potassium is found in copious amounts in banana, and this mineral is necessary for bone growth and development. Banana as a fruit comes in varieties that is cultivars and unfortunately, mineral composition differs amongst cultivars and even geographical location, cultivation is a response of the land, hence sometimes the mineral differences in cultivars [51,48-49]. The eight cultivars used in this study contained these minerals in different concentrations, this was

also reported in the study of Ogunlade et al., [50]. Iron was present in all the eight cultivars of banana used in this study, with Burro banana having the highest value of 11.03mg/100g and red banana having the least value of 5.34mg/100g. Iron as a microelement is a known energizer of the body but excess consumption can cause fatigue but this hardly happens if taken from natural sources [47]. Since these fruits contain these elements in different concentrations, the quantity and the type of fruit to be taken will depend on the individual's needs so as to achieve maximal benefits, especially in terms of

mineral requirements [37, 52].

Table 4 gave the beta carotene (Pro Vit A) and vitamin C contents of the eight cultivars of banana, with manzano i.e. yoyo banana having the highest levels (1.37µg/10g) and red banana (enubabaseje) having the least beta carotene (0.13µg/10g) and maoli banana having the least vitamin C content (0.03mg/100g) respectively. The ripe banana can be considered as a moderate source of provitamin A, i.e. beta carotene because it contained this vitamin in moderate amounts, which was in support with the findings of Chandrika et al., [53]. Vitamin C content of banana cultivars has also been found from different studies to be varied [31-33]. Seymour [54], found that the pro vit A content varies when ripening is considered as a factor [30].

**Table 4.** Vitamin A (beta carotene) and vitamin C content of banana cultivars

Banana Cultivars	Beta carotene (µg/10g)	Vitamin C (mg/100g)
Lakantan/Saro	0.85±0.01	0.04±0.01
Maoli/Akunleje	0.45±0.02	0.03±0.10
Redbanana/Enubabaseje	0.13±0.02	0.04±0.00
Cavendish/Paranta	0.24±0.01	0.06±0.01
Burro/Pambolabola	0.19±0.01	0.08±0.01
Manzano/Yoyo/Aponmade	1.37±0.00	0.15±0.01
Nino/ Abo	0.16±0.00	0.60±0.01

Data represented as M ± S.D for triplicate observations.

#### 4. Conclusions

It can be concluded from the study that the cultivars of banana are a rich source of nutrients. For example, the Maoli variety had a carbohydrate content of 58.29%, Lakantan variety, 24.59% of protein, Cavendish contained 13.08% of crude fibre of pulp. The peels, Nino variety gave 48.01% of carbohydrate, Lakantan, 24.62% of protein and Burro, 6.65% of crude fibre. Each cultivar however had its own advantage in terms of nutritional composition over the other. The reason why cultivars differ in nutrient composition is based on the cultivars response to the land, geographical location and some other factors which are sometimes countries or continent specific. It is recommended that cultivars of banana should be consumed at all times, taking cognizance of its nutritional composition to suit body needs. The rich

nutritive quality of these cultivars further emphasizes their utilization in other products like flour and even baby food. These products could enhance the economic value of the crop since it grows very well in Nigeria.

#### Authors' contributions

Conceptualization, O.D.; Methodology, O.D., S.A.; Formal analyses, O.A., S.A.; Investigation, S.A., O.A.; Resources, O.D., O.A.; Writing-original draft preparation, O.A.; Writing-review and editing, O.D.; Supervision, O.D.

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#### Availability of data and materials

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#### Conflicts of interest

The authors declare that there are no conflicts of interest as regards the publication of this article.

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