

Proximate composition and consumption pattern of plantain and cooking Banana

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ABSTRACT (ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)

Aims: To examine the proximate composition and consumption pattern of commonly available plantain and cooking-banana in Ikwuano L.G.A. of Abia state, Nigeria.

Methodology: Identification of samples and data collection on consumption pattern were achieved through focused group discussion, market survey and self-administered structured questionnaire. Proximate nutrients were determined by standardized methods.

Results: The contents of moisture, ash and carbohydrate were significantly influenced by ripeness ($P < 0.05$), whereas protein and fat were not affected by ripening. Ripe samples had higher ash content. Cooking-banana showed higher protein (5.69-6.52 vs. 4.76-5.18 %), lower carbohydrate (89.37-91.30 vs. 91.96-

92.70 %) and higher ash (2.56-3.44 vs. 2.03-2.34 %) than plantain samples, respectively. Consumption pattern indicated higher frequency of unripe plantain intake which was linked to health benefits such as diabetes mellitus management.

Conclusion: This study buttresses the nutritional value of locally available plantain and cooking-banana varieties at both ripe and unripe stages. There is need for intensified nutrition education to improve the poor preference for cooking-bananas.

Keywords: Plantain; cooking-banana; unripe and ripe stages; food consumption; proximate composition

1. INTRODUCTION

Bananas and plantains are among the most important starchy staples and cheap source of energy in Nigeria [1,2]. Several food consumption surveys in Nigeria identified plantain and banana among the major source of energy [3-6].

Plantain (*Musa paradisiacal normalis*) and cooking-bananas (*Musa acuminata*) differ from the regular dessert bananas (*M. Cavendish AAA*) by composition of more starchy pulp than sugary pulp in dessert banana [7].

Cooking-banana which can also be referred to as plantain-banana are consumed necessarily cooked, both in unripe and ripe stage unlike dessert bananas which are conventionally, consumed in their ripe stage [8].

Previous study on consumption pattern reported that plantain and banana are consumed in different forms including boiling, roasting, frying, as well as in combination with other staples [9]. Nutritive value of plantains and banana depends on their ripeness, variety, climatic conditions and soil of crop production [10, 11]. Baiyeri *et al.*, [10] reported increased ash and carbohydrate contents with ripeness, whereas at unripe stages fat, protein and dry matter were relatively higher.

There is literature documentation on high consumption pattern of unripe plantain among people suffering from diabetes mellitus [3, 12-15].

Published data is limited on the consumption pattern and nutritive composition of the available new varieties of cooking -banana in the community.

52 This study therefore aimed at providing data on proximate composition and
53 consumption pattern of the commonly available cooking-banana and plantain at ripe
54 and unripe stages.

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56 **2. MATERIALS AND METHODS**

57 **2.1 Samples**

58 Three plantain [Ebegegghi-Ejima (P1), Ebegegghi Nwankiri (P2), Ebegegghi-Obulabo
59 (P3)] and two cooking-banana samples [Unere-Nwankita (Cb1), Unere-Mkpumkpu
60 (Cb2)] were selected for this study. These samples were identified based on the
61 focus-group discussion with members of the four communities in Ikwuano, Abia
62 state, Nigeria.

63 Samples of the identified species were collected from different markets and
64 households within the studied communities at unripe stage (green). Samples were
65 randomly collected from different heads of the bunch separated into two portions;
66 unripe (stage 1) and ripe (stage 5). The two stages selected for our study was
67 based on United Fruit Sales Corporation description: unripe stage 1 represented
68 sample with green color peel, while ripe stage 5 represented sample with more
69 yellowish peel than greenish [15].

70 Samples were dried in Gallenkamp air oven at 60 °C for 24 h, and then stored in
71 polypropylene plastic bags at room temperature before transportation to McGill
72 University, Canada for analysis.

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74 **2.2 Proximate analysis**

75 Dried samples were ground using a coffee grinder (SUMEET Multi Grind, India) and
76 passed through a 0.5 mm sieve (CE Tyler, Ontario, Canada) for proximate analysis.
77 The proximate composition was determined by standard methods of the Association
78 of the Official Analytical Chemists [16].

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80 **2.3 Consumption Pattern**

81 Data on consumption pattern were obtained by self-administered questionnaire on
82 three hundred (300) subjects in the study communities.

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2.4 Statistical analysis:

Percentage and frequency were used for analyzing data on consumption pattern. Data on proximate composition were subjected to a one way analysis of variance (ANOVA) followed by Duncan's multiple range test ($P<0.05$) to determine the differences in proximate composition among samples. Results were expressed as mean $\pm$ standard deviation. Statistical software used was SAS version 4.3 (SAS Institute Inc., 2010, Cary, NC, USA).

3. RESULT AND DISCUSSION

The proximate composition of samples at ripe and unripe stages is presented in % dry matter on Table 1. There was statistical significant difference between unripe and its respective ripen portion in ash, carbohydrate and moisture contents whereas the protein and fat content were similar ($P>0.05$).

The protein and fat contents among samples ranged between 4.76 to 6.52 % and 0.25 to 0.70 %, respectively. The values of protein and fat are consistent with literature data [10, 15, 17, 18]. Protein and fat content were not significantly affected by ripening process. This observation is consistent with a previous study by Fagbemi [15] who reported similar value of protein (3.51 %) in unripe raw plantain flour as compared to the ripe sample (3.50 %).

Ash content showed a significantly increase with ripeness except for sample P1 which had higher ash in unripe sample (2.16 %) than ripe sample (2.33 %).

Baiyeri *et al.* [10] reported similar finding of higher ash content in ripe samples compared to unripe samples which was attributed to the bioavailability of minerals during ripening process.

The level of carbohydrate among samples, varied between 89.37 to 92.70 %. This result is comparable with literature data [19, 10, 15, 18]. The ripe and unripe samples showed statistically similar ($P<0.05$) concentration of carbohydrate. The study by Baiyeri *et al.* [10] observed higher carbohydrate concentration with ripeness. The comparison of proximate nutrients among samples indicated that cooking-banana had higher protein (5.69-6.52 vs. 4.76-5.18 %), higher ash (2.58-3.44 vs. 2.03-2.34 %) and lower carbohydrate (89.37-91.30 vs. 91.96-92.70 %) than plantain samples.

116 **Table 1: Proximate composition of plantain and cooking-banana flour at ripe**
 117 **and unripe stages (% dry basis).**

Samples	Protein %	Fat %	Ash %	CHO %
P1 unripe	5.18±0.29 ^{cd}	0.51±0.02 ^{abc}	2.33±0.01 ^e	91.96±0.26 ^b
P1 ripe	5.1±0.40 ^d	0.53±0.02 ^{abc}	2.16±0.04 ^f	92.18±0.33 ^{ab}
P2 unripe	5.15±0.03 ^{cd}	0.62±0.01 ^{ab}	2.03±0.03 ^g	92.18±0.07 ^{ab}
P2 ripe	5.01±0.43 ^d	0.55±0.03 ^{abc}	2.34±0.01 ^e	92.09±0.09 ^{ab}
P3 unripe	5.09±0.15 ^d	0.47±0.01 ^{bcd}	2.13±0.02 ^f	92.31±0.01 ^{ab}
P3 ripe	4.76±0.13 ^d	0.25±0.28 ^d	2.27±0.05 ^e	92.70±0.37 ^a
Cb1 unripe	5.69±0.09 ^{bc}	0.41±0.01 ^{bcd}	2.58±0.03 ^d	91.30±0.07 ^c
Cb1 ripe	5.82±0.14 ^b	0.35±0.02 ^{cd}	2.85±0.07 ^c	90.97±0.02 ^c
Cb2 unripe	6.47±0.12 ^a	0.70±0.01 ^a	3.16±0.05 ^b	89.66±0.05 ^d
Cb2 ripe	6.52±0.12 ^a	0.65±0.03 ^a	3.44±0.01 ^a	89.37±0.10 ^d

118 Mean±SD values within same column followed by same letters are not significantly
 119 different (P>0.05). CHO = Carbohydrate
 120 P1= Ebegegghi-Ejima (Plantain); P2= Ebegegghi Nwankiri(Plantain);
 121 P3= Ebegegghi-Obulabo(Plantain); Cb1=Unere-Nwankita(cooking-banana);
 122 Cb2=Unere-Mkpumkpu(cooking-banana)

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 127 Table 2 indicated that 50.3 % of respondents were males and 49.7 %, females. The
 128 respondents had varied occupation but majority were farmers (42.7%). Data on
 129 educational background showed that 91 % of subjects involved in this survey did not
 130 have post-secondary education. Most of the subjects (43 %) had no formal
 131 education. This finding is not surprising because the survey is conducted in a rural
 132 setting. Educational status has been described as one of the major factors
 133 influencing the adoption of cooking banana processing and utilisation methods in
 134 Nigeria [20].

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Table 2: Socio-Economic Characteristics of Respondents

Variables	Frequency	%
Sex		
Male	151	50.3
Female	149	49.7
Age		
10-29	86	30.0
30-49	107	35.7
>50	107	34.3
Occupation		
Civil/Public Servant	65	11.7
Farmer	128	42.7
Trader	85	18.3
Clergy	22	7.3
Artisan	60	2.0
Educational Status		
No formal education	129	43
Primary education	107	35.7
Secondary education	37	12.3
Tertiary education	27	9.0

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139 Consumption pattern for plantain and cooking-banana is shown in Table 3. The
 140 highest consumption frequency for plantain was reported on weekly basis (79.3%)
 141 while cooking-banana was on monthly basis (80 %). This implies low consumption
 142 rate of cooking-banana and plantain in the study population.

143 The preference for unripe plantain consumption was more (62.3 %) compared to the
 144 ripe stage (37.7 %). On the other hand, cooking-banana had higher preference for
 145 ripe sample (83.3 %). The medical benefits linked to the consumption of these
 146 samples included high affirmation that unripe plantain (63 %) and unripe cooking-
 147 banana (74 %) are good for diabetes mellitus. This finding is consistent with
 148 previous reports on the preference for unripe plantain dishes among diabetics [13,
 149 9]. Traditional folklore and mythology have associated the utilization of plantain to

150 management of diseases like diabetes, ulcer and wound healing due to its
151 hypoglycaemic, anti-ulcerogenic and analgesic properties (Adamson & Ganiyu;
152 Bischoff, 1994). Agama-Acevedo et al. (2012) related the health beneficial effect of
153 unripe bananas to its indigestible components such as resistant starch.

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155 In this present study, the subjects also associated the intake of roasted plantain (74
156 %) and roasted cooking-banana (26 %) to cure for diarrhea.

157 The method of food preparation included boiling, frying and roasting. However,
158 boiled plantain (66.7 %) and fried cooking-banana (73 %) showed highest
159 preference. There was high preference (75.7 %) for cooked plantain in combination
160 with other staples whereas very low subjects (26.7 %) like eating cooking-banana in
161 combination with other staples.

162 The overall preference of plantain as meal was reportedly higher (55.3 %) compared
163 to cooking-banana (45.7 %). The educational background of these subjects could
164 have contributed to low preference of cooking-banana. Lemchi et al. [20] identified
165 poor knowledge and poor market value among the major factors hindering adoption
166 of cooking banana processing and utilisation methods in Nigeria. However, the
167 selling prices of cooking banana and plantain samples were not ascertained in this
168 present survey.

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182 **Table 3: Consumption pattern of plantain and cooking-banana**

Pattern of food intake	Plantain		Cooking-banana	
Frequency of food intake	Response	%	Response	%
Daily	14	4.7	15	5.0
Weekly	238	79.3	38	10.0
Monthly	33	11.0	240	80.0
Rarely	15	5.0	15	5.0
Total	300	100	300	100
Preference at stages of ripeness				
Unripe	187	62.3	50	16.7
Ripe	113	37.7	250	83.3
Total	300	100	300	100
Overall preference as meal/snack				
Yes	166	55.3	134	45.7
Occasionally	134	45.7	166	55.3
Total	300	100	300	100
Preferred form of consumption				
Boiling	200	66.7	37	12.3
Frying	78	26.0	219	73.0
Roasting	22	7.3	44	14.7
Combination with other staples	227	75.7	80	26.7
Attitude towards food consumption				
Unripe stage is good for diabetes mellitus	189	63.0	222	74.0
Roasted form cures diarrhea	222	74.0	78	26.0
Diabetic should avoid intake of ripe stage	101	33.7	101	33.7

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PLANTAIN SPECIES (MUSA Spp)

Unripe stage

Ripe stage

P1-Ebegeghi Ejima

P1-Ebegeghi Ejima



P2-Ebegeghi Nwankiri

P2- Ebegeghi Nwankiri



P3-Ebegeghi Obulabo

P3-Ebegeghi Obulabo



COOKING-BANANA SPECIES (MUSA Spp)

Unripe stage

Ripe stage

Cb1-Unere Nwankita

Cb1-Unere Nwankita



Cb2- Unere mkpumkpu

Cb2- Unere mkumkpu



4. CONCLUSION

This study buttresses the nutritive value of locally available plantain and cooking-banana varieties at both ripe and unripe stages. The two stages of ripeness showed similar nutrient content except for ash, which was higher in ripe samples. Cooking-banana portrayed higher nutritional value than plantain samples.

The low preference for cooking banana with regards to the poor educational background suggests the need for intensified nutrition education on newly released cooking-banana and plantain varieties for overall food and nutrition security.

5. ACKNOWLEDGEMENT

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1. Competing interests

Authors declared no competing interests.

AUTHORS' CONTRIBUTIONS

Odenigbo, Amaka managed the chemical analysis and final manuscript preparation. All other authors contributed in literature, sample and data collection. All authors read and approved the final manuscript."

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