

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 local government area 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 questionnaire. Proximate nutrients were determined by standardized methods.

Results: The difference in proximate nutrients, except for ash content was not significantly different ($P>0.05$) between ripe and unripe samples. 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 basic food crops and cheap source of energy in Nigeria [1,2]. Several food consumption surveys in Nigeria identified plantain and banana among the major starchy staples [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 scarce on the consumption pattern and nutritive composition of these available new varieties of cooking-banana.

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

2. MATERIALS AND METHODS

2.1 Samples

Three plantain [Ebegegghi-Ejima (P1), Ebegegghi Nwankiri (P2), Ebegegghi-Obulabo (P3)] and two cooking-banana samples [Unere-Nwankita (Cb1), Unere-Mkpumkpu (Cb2)] were selected for this study. These samples were identified based on the

focus-group discussion with members of the four communities in Ikwuano, Abia state, Nigeria.

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

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

2.2 Proximate analysis

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

2.3 Consumption Pattern

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

2.4 Statistical analysis:

Percentage and frequency were used for analyzing data on consumption pattern. The differences in proximate composition between ripe and unripe stages of samples were determined by one way analysis of variance (ANOVA) followed by Fisher's least significant-difference (LSD) test. The level of significance was set at $p < 0.05$. Results were expressed as mean $\pm$ standard deviation. Statistical software used was SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).

3. RESULT AND DISCUSSION

The proximate composition (% dry matter) of samples at ripe and unripe stages is presented in Table 1. Proximate nutrients of unripe samples except for ash content were not significantly different from its respective ripen portion ($P>0.05$).

The protein and fat contents among samples ranged between 4.76 to 6.52 % and 0.25 to 0.70 %, respectively. These values are consistent with literature data [10, 15, 17, 18]. Fagbemi [15] reported similar value of protein (3.51 %) in unripe raw plantain flour as compared to ripe sample (3.50 %).

Ash content showed significantly increase with ripeness ($P<0.05$) 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 had statistically similar concentration of carbohydrate ($P<0.05$). Higher levels of carbohydrate content at ripe stage were found only in samples P1 and P3. The study by Baiyeri *et al.* [10] reported 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.

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

Samples	Protein %	Fat %	Ash %*	CHO %
P1 unripe	5.18±0.29	0.51±0.02	2.33±0.01	91.96±0.26
P1 ripe	5.13±0.40	0.53±0.02	2.16±0.04	92.18±0.33
P2 unripe	5.15±0.03	0.62±0.01	2.03±0.03	92.18±0.07
P2 ripe	5.01±0.43	0.55±0.03	2.34±0.01	92.09±0.40
P3 unripe	5.09±0.15	0.47±0.01	2.13±0.02	92.31±0.18
P3 ripe	4.76±0.13	0.25±0.28	2.27±0.05	92.70±0.37
Cb1 unripe	5.69±0.09	0.41±0.01	2.58±0.03	91.30±0.07
Cb1 ripe	5.82±0.14	0.35±0.02	2.85±0.07	90.97±0.23
Cb2 unripe	6.47±0.12	0.70±0.01	3.16±0.05	89.66±0.05
Cb2 ripe	6.52±0.12	0.65±0.03	3.44±0.01	89.37±0.10

129 * Mean ± standard deviation values between ripe and unripe stages of samples are
 130 significantly different (p<0.05)

131 CHO=Carbohydrate; P1=Ebegegghi-Ejima (Plantain); P2= Ebegegghi
 132 Nwankiri(Plantain); P3= Ebegegghi-Obulabo (Plantain);
 133 Cb1=Unere-Nwankita (cooking-banana); Cb2=Unere-Mkpumkpu(cooking-banana)

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

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149 **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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151 Consumption pattern of plantain and cooking-banana is shown in Table 3. The
 152 highest consumption frequency for plantain was reported on weekly basis (79.3%)
 153 while cooking-banana was on monthly basis (80 %). This implies lower consumption
 154 rate of cooking-banana than plantain among the study population.

155 The preference for unripe plantain consumption was more (62.3 %) compared to the
 156 ripe stage (37.7 %). On the other hand, cooking-banana had higher preference for
 157 ripe sample (83.3 %). The medical benefits linked to the consumption of the unripe
 158 samples included high affirmation that unripe plantain (63 %) and unripe cooking-

159 banana (74 %) are good for diabetes mellitus. This finding is consistent with previous
160 reports on preference for unripe plantain dishes among diabetics [13, 9]. Traditional
161 folklore and mythology have associated the utilization of plantain to management of
162 diseases like diabetes, ulcer and wound healing due to its hypoglycaemic, anti-
163 ulcerogenic and analgesic properties [21]. Agama-Acevedo et al. [22] related the
164 health beneficial effect of unripe bananas to its indigestible components such as
165 resistant starch.

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

168 The methods of food preparation included boiling, frying and roasting. However,
169 boiled plantain (66.7 %) and fried cooking-banana (73 %) had highest preference.
170 There was high preference (75.7 %) for cooked plantain in combination with other
171 staples whereas very few subjects (26.7 %) reported preference for preparation of
172 cooking-banana in combination with other staples.

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

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190 **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-Ebegegghi Ejima	P1-Ebegegghi Ejima
	
P2-Ebegegghi Nwankiri	P2- Ebegegghi Nwankiri
	
P3-Ebegegghi Obulabo	P3-Ebegegghi Obulabo
	

COOKING-BANANA SPECIES (MUSA Spp)	
Unripe stage	Ripe stage
Cb1-Unere Nwankita	Cb1-Unere Nwankita
	
Cb2- Unere mkpumkpu	Cb2- Unere mkumkpu
	

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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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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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