

- 1 **Research paper**
- 2 **Proximate composition and consumption pattern of plantain and cooking-**
- 3 **banana**
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ABSTRACT

The proximate composition and consumption pattern of commonly available plantain and cooking-banana in Ikwuano L.G.A. of Abia state, Nigeria were examined. Identification of samples and data collection on consumption pattern were achieved through focused group discussion, market survey and self administered structured questionnaire. Proximate composition was determined using standardized methods. 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 and moisture contents with decrease carbohydrate content. Cooking-banana was found with higher protein (5.14-5.93 Vs 4.35-4.71 %), lower carbohydrate (78.35-82.37 Vs 80.22-83.63 %) and higher ash (2.33-3.02 Vs 1.84-2.12 %) than the plantain samples respectively.

Data on consumption pattern showed that plantain was consumed more frequently than cooking-banana consumption. Subjects' preference for unripe stage was mostly among plantain varieties (62.3 %) whereas, cooking-banana had higher preference for the ripe stage (83.3 %). The main reason for consuming the unripe food was linked to diabetes mellitus management.

This study buttresses the nutritive value of locally available plantain and cooking-banana varieties at both ripe and unripe stages for appropriate food choices and healthy consumption pattern.

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

41 INTRODUCTION

42 Bananas and plantains are among the most important starchy staples in Nigeria, with
 43 frequent consumption (Adeniyi *et al.*, 2006). Plantain (*Musa paradisiacal normalis*)
 44 and cooking-bananas (*Musa acuminata*) differ from the regular dessert bananas (*M.*
 45 *Cavendish AAA*) by composition of more starchy pulp than sugary pulp in dessert
 46 banana (Happi Emaga *et al.*, 2007).

47 Cooking-banana which can also be referred to as plantain banana are consumed
 48 necessarily cooked, both in unripe and ripe stage unlike dessert bananas which are
 49 conventionally, consumed in their ripe stage (Aurore *et al.*, 2009).

50 The study on consumption pattern of plantain and banana in Nigeria reported that
 51 these foods are consumed in different forms such as boiling, roasting, frying, as well
 52 as in combination with other staples (Ajayi and Aneke, 2002).

53 Nutritive value of plantains and banana depends on their ripeness, variety, climatic
 54 conditions and soil of crop production (Baiyeri *et al.*, 2011; Ogazi, 1996). Baiyeri *et*
 55 *al.*, (2011) reported increased ash and carbohydrate contents with ripeness, whereas
 56 at unripe stages fat, protein and dry matter were relatively higher.

57 There is paucity of published data on the consumption pattern and nutritive
 58 composition of the available new varieties of cooking -banana in the community.

59 This study aimed at providing data on the proximate composition and pattern of
 60 consuming the commonly available cooking-banana and plantain at ripe and unripe
 61 stages.

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MATERIALS AND METHODS

Samples

Three plantain [Ebegeghi-Ejima (P1), Ebegeghi Nwankiri (P2), Ebegeghi-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 L.G A of 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 is based on United Fruit Sales Corporation description: unripe stage 1 is when colour of peel is mainly green, while ripe stage 5 is more yellow colour than green (Fagbemi, 1999).

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.

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 (AOAC, 2000): moisture by drying in an oven at 105 °C until constant weight; ash contents by combustion of sample at temperature of 550 °C in muffle furnace; Protein by nitrogen determination using Leco Nitrogen Analyzer (N x 6.25) while fat determination was by Soxhlet extraction using petroleum ether as solvent. The total carbohydrate content was determined by difference using the following formula: 100 - (weight in grams [protein + fat + water + ash] in 100 g sample).

Consumption Pattern

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

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).

Result and Discussion

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

Samples	Protein %	Fat %	Ash %	CHO %	Moisture %
P1 unripe	4.71 $\pm$ 0.26 ^{cd}	0.47 $\pm$ 0.01 ^{abc}	2.12 $\pm$ 0.01 ^e	83.51 $\pm$ 0.22 ^a	9.19 $\pm$ 0.03 ^g
P1 ripe	4.61 $\pm$ 0.37 ^d	0.48 $\pm$ 0.02 ^{abc}	1.94 $\pm$ 0.04 ^f	82.79 $\pm$ 0.33 ^b	10.18 $\pm$ 0.06 ^e
P2 unripe	4.68 $\pm$ 0.03 ^{cd}	0.57 $\pm$ 0.00 ^{ab}	1.84 $\pm$ 0.03 ^g	83.63 $\pm$ 0.16 ^a	9.28 $\pm$ 0.10 ^{fg}
P2 ripe	4.37 $\pm$ 0.37 ^d	0.48 $\pm$ 0.03 ^{abc}	2.05 $\pm$ 0.01 ^e	80.22 $\pm$ 0.44 ^e	12.88 $\pm$ 0.10 ^a
P3 unripe	4.55 $\pm$ 0.14 ^d	0.43 $\pm$ 0.01 ^{bcd}	1.90 $\pm$ 0.02 ^{fg}	82.49 $\pm$ 0.01 ^{bc}	10.63 $\pm$ 0.18 ^d
P3 ripe	4.35 $\pm$ 0.13 ^d	0.23 $\pm$ 0.26 ^d	2.07 $\pm$ 0.04 ^e	81.86 $\pm$ 0.13 ^d	11.24 $\pm$ 0.23 ^c
Cb1 unripe	5.14 $\pm$ 0.08 ^{bc}	0.37 $\pm$ 0.01 ^{bcd}	2.33 $\pm$ 0.03 ^d	82.37 $\pm$ 0.08 ^{bc}	9.79 $\pm$ 0.02 ^f
Cb1 ripe	5.22 $\pm$ 0.12 ^b	0.32 $\pm$ 0.02 ^{cd}	2.56 $\pm$ 0.06 ^c	81.54 $\pm$ 0.02 ^d	10.36 $\pm$ 0.03 ^{de}
Cb2 unripe	5.93 $\pm$ 0.10 ^a	0.64 $\pm$ 0.01 ^a	2.89 $\pm$ 0.05 ^b	82.07 $\pm$ 0.01 ^c	8.47 $\pm$ 0.04 ^h
Cb2 ripe	5.72 $\pm$ 0.11 ^a	0.58 $\pm$ 0.03 ^{ab}	3.02 $\pm$ 0.01 ^a	78.35 $\pm$ 0.00 ^f	12.33 $\pm$ 0.10 ^b

Mean $\pm$ SD values within same column followed by same letters are not significantly different ($P>0.05$). CHO = Carbohydrate

P1= Ebegegghi-Ejima (Plantain); P2= Ebegegghi Nwankiri(Plantain);

P3= Ebegegghi-Obulabo(Plantain); Cb1=Unere-Nwankita(cooking-banana);

Cb2=Unere-Mkpumpkpu(cooking-banana)

The proximate composition of samples at ripe and unripe stages is presented in 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 among samples ranged between 4.35 to 5.93% and 0.23 to 0.64 % respectively. The values of protein and fat are consistent with literature data (Menezes *et al.*, 2011; Baiyeri *et al.*, 2011; Fagbemi, 1999; Kettiku, 1973). The protein and fat content were not significantly affected by ripening process. This observation agrees with the previous report by Fagbemi (1999).

Ash content showed a significant increase with ripeness except in sample P1 which had higher ash in unripe sample (2.12 %) than ripe sample (1.94 %).

Baiyeri *et al.* (2011) reported similar finding of higher ash content in ripe samples compared to unripe samples. Their studies indicated the bioavailability of minerals during ripening stage.

Samples in our study had ranges of carbohydrate and moisture between 78.35-83.63 and 8.47 - 12.88 % respectively. These observed values are in agreement with literature data (Baiyeri *et al.*, 2011; Fagbemi, 1999; Kettiku, 1973).

The carbohydrate content of the unripe samples were generally higher ($P<0.05$) than their respective ripe samples. This result is similar to the finding of lower starch content in ripe samples of plantain and cooking-banana reported by Sakyi-Dawson *et al.* (2008) and Onwuka and Onwuka (2005). Although, the study by Baiyeri *et al.* (2011) had a contrary observation of higher carbohydrate contents with ripeness. The observation of higher moisture among the ripe samples in this study agrees with previous studies (Sakyi-Dawson *et al.*, 2008; Onwuka and Onwuka, 2005; Fagbemi, 1999). Fagbemi (1999) demonstrated that moisture moves from peel to the pulp during ripening stage while the study by Sakyi-Dawson *et al.* (2008) reported decreased dry matter with progress in ripening of plantain and cooking-banana.

The comparison of proximate parameters between cooking-banana and plantain samples indicated higher protein (5.14-5.93 vs 4.35-4.71 %), lower carbohydrate (78.35-82.37 vs 80.22-83.63 %) and higher ash (2.33-3.02 vs 1.84-2.12 %) respectively. This finding demonstrated higher nutritive intake in the consumption of cooking-banana than plantain.

165 **Table 2: 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
No response				
Total	300	100	300	100
Preferred form of consumption				
Boiling/porridge	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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167 The Consumption pattern for plantain and cooking-banana is shown in Table 2. The

168 frequency of consumption was reported mostly on weekly basis for plantain (79.3%)

169 and monthly basis for cooking-banana (80 %). Only few subjected responded to daily

170 intake of plantain (4.7 %) and cooking-banana (5 %). This implies lower consumption

171 rate of cooking-banana and could be attributed to its less popularity and selling price.

Ajayi and Aneke (2002) associated higher consumption rate of dessert banana than plantain to the higher selling price of plantain.

The preference for unripe plantain consumption was more (62.3 %) compared to the ripe stage (37.7 %). On the other hand, cooking-banana had higher preference for ripe sample (83.3 %).

The medical benefits associated to the consumption of these samples included high affirmation that unripe plantain (63 %) and unripe cooking-banana (74 %) are good for diabetes mellitus. This finding agrees with previous reports on the preference for unripe plantain dishes (Ayodele and Erema, 2010; Ajayi and Aneke, 2002). Particularly, people suffering from diabetes mellitus are associated with unripe plantain and banana. Literature data showed that in Nigeria, plantains have been recognized as one of the commonest diets among diabetic patients (*Iya et al.*, 2006; Odenigbo, 2002).

Other medical therapy associated to the food consumption was cure for diarrhea by intake of roasted plantain (74 %) and roasted cooking-banana (26 %).

The method of food preparation varied but boiling and cooking in form of porridge was highly preferred for plantain (66.7 %). However, frying method showed the most preference (73 %) for cooking-banana. There was high preference (75.7 %) for cooked plantain in combination with other staples whereas very low subjects (26.7 %) like eating cooking-banana in combination with other staples.

The overall preference of plantain as meal and snack was reportedly higher (55.3 %) compared to cooking-banana (45.7 %). This could be explained by the popularity of plantain as against cooking-banana.

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 mkpumkpu 

Fig.1: Ripe and unripe samples of plantain and cooking-banana varieties.

Conclusion

This study buttresses the nutritive value of locally available plantain and cooking-banana varieties at both ripe and unripe stages for proper food choices and healthy consumption pattern.

Moreover there is need for nutrition education on the nutritional value of newly released cooking-banana varieties for overall food and nutrition security.

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