

Full Length Research Paper

Production, characterization and application of banana (*Musa* spp) flour in whole maize

Daramola, B.* and Osanyinlusi, S.A.

Department of Food Science and Technology, Federal Polytechnic, P.M.B. 5351, Ado Ekiti, Ekiti State, Nigeria.

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Pasting properties of flour from six varieties of matured green banana (*Musa* spp) fruits identified as Gross michel (GM), Dwarf Cavendish (DC), Cavendish (CA), Lacatan (LA), Poyo (PO) and Red skin (RS) were determined. Flour of CA, used in formulation of banana-whole maize meal was assessed organoleptically for binding and mouth feels qualities. Peak viscosity ranged from 434.75 – 837.17 RVU; break down viscosity, 115.42 – 487.92 RVU; final viscosity, 355.00 – 504.92 RVU; set back viscosity, 70.17 – 426.25 RVU; gelatinization time, 3.94 – 4.56 min; and gelatinization temperature, 64.35 – 67.55 °C. Statistical analysis ($P = 0.05$) of sensory scores of different formulations of flour-whole maize meal showed an improvement of binding property and mouth feel of the composite food product. This simple method of processing banana, its pasting profile and application in food product reported in this study will serve as a means of utilization and extension of shelf life of mature banana fruits.

Key words: Mature green, banana flour, pasting properties, organoleptic attributes.

INTRODUCTION

Banana is one of the vegetable fruits that grow well in the tropics (Ihekoronye and Ngoddy, 1985). Since then, development of high yield, short-time growth, disease resistant banana varieties by institutions of agriculture have increased the volume of banana at harvest. These bananas are mainly transported to urban areas, where they would be eaten as fruit vegetables. However, unavoidable delay in transport, poor post harvest technology and fluctuating market demand result in over-ripe and senescence of fruits prior to market delivery. Hence, large amount of banana post-harvest losses are usually recorded. These unbearable post-harvest losses serve as impetus to the study on processing and application of mature green bananas with view to diversify utilization of the crop. Consequently, the objectives of the study were production and characterization of pasting properties of mature green banana flour as well as application and organoleptic assessment of banana flour in whole maize meal.

MATERIALS AND METHODS

Raw materials

Six varieties of freshly harvested matured green banana (*Musa* spp) fruits, Gross michel (GM), Dwarf Cavendish (DG), Cavendish (CA), Lacatan (LA), Poyo (PO) and Red skin (RS), were purchased at Sabo farm gate, Sabo, Ikere Ekiti, Ekiti State, Nigeria.

Production of banana flour

Banana flour was produced according to the procedure of Perez-sira (1997) with little modification for prevention of enzymatic browning. The procedure is as follows: fresh mature green bananas were peeled under water treated with 0.05% sodium metabisulphite and then sliced at average thickness of 1 cm using sharp knife. The slices were then dried at 50 °C for 48 h in air oven. The dried chips were milled in Christy hunt model hammer mill to obtain flour from mature green banana fruits (Figure 1). The flour was sieved and packaged for subsequent use.

Proximate composition determination

Proximate composition of samples were determined according to the method of AOAC (1980) with analytical codex number 14.062, 14.063, 14.064, 14.066 and 14.067 for moisture, total ash, crude fibre, crude fat and crude protein, respectively. Carbohydrate was obtained by difference. All tests were the average of duplicate analysis.

*Corresponding Author E-mail: daramola_bode@yahoo.co.uk.

Table 1. Proximate composition (%) of banana flours.

Variety	Moisture	Protein	Ash	Fat	Crude fibre	Carbohydrate
DC	*10.8	1.45	0.85	0.2	0.65	85.05
GM	11.1	1.05	0.55	0.4	0.45	86.45
PO	11.7	3.25	3.60	0.85	0.40	80.20
CA	12.1	1.75	0.85	0.25	0.70	84.35
LA	10.9	2.00	0.92	0.60	0.30	85.28
RS	11.5	1.95	1.00	0.50	0.20	84.85

*Averages of determinations

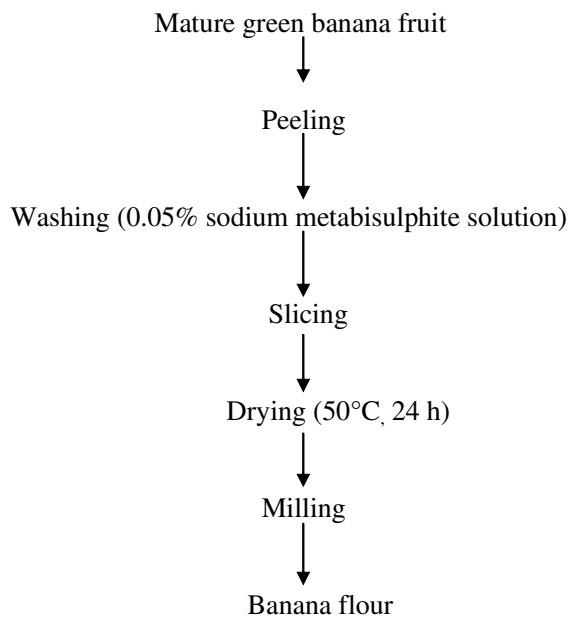


Figure 1. Flow diagram for production of flour from mature green banana fruit.

Determination of pasting properties

Pasting properties of flour were characterized by using Rapid Visco Analyser (RVA) as described by Delcour et al. (2000). 5 g of accurately weighed treated starch was added into water to obtain a ratio 1:2 (w/w). The treated starch was heated from 28 to 150°C at 4°C/min and all experiments were carried out in triplicate. The RVA-3d was operated with 250 g of 9.9% treated starch in water suspension. The temperature profile included a 2 min isothermal step at 50°C, linear temperature increases to 95°C in 7 min, a holding step (8 min at 95°C), a cooling step (7 min) with a linear temperature decrease to 50°C and a final isothermal step at 50°C. Duplicate measurement always agreed within 5 rapid visco units (RVU) over the whole profile.

Application of CA banana flour in whole maize meal

This was accomplished using standardized procedure of traditional method of making "agidi" a typical pounded yam simulate in Western Nigeria. Mash obtained from fresh whole maize was made

into paste with water (3:2, w:v). The paste was wrapped with thermostable polythene and cooked (boiled at 100°C for 25 min). The procedure was repeated for CA banana flour except that the ratio of flour to water was 1:1 (w:v) and also cooked as described above. Five different CA banana and maize puddle combination gradient were pounded using standard kitchen mortar and pestle. The resulted banana-corn meals were assessed organoleptically for binding property, colour, and mouth feel using 9 panelists that are familiar with agidi.

Statistical analysis

Sensory scores were assessed for significant difference at $p=0.05$ using analysis of variance (ANOVA). The means were separated using Turkey's test (Snedecor, 1956).

RESULTS AND DISCUSSION

Proximate composition

Proximate composition of the banana flours is shown in Table 1. The low (10.8-12.1%) moisture content of the flour signifies good storability of the product. Milled food products with moisture content of less than 13% are stable from moisture dependent deterioration (Potter and Hotchkiss (1995). Generally, all the samples are high (80.20 to 86.05%) in carbohydrate. Consequently, they are good source of energy food with characteristic gelation properties of starchy food when cooked. Gelation is a functional attribute of starch and may be desirable in some food products. In addition, the result revealed that products with high starch content can be obtained from banana fruits without sophisticated purification procedure.

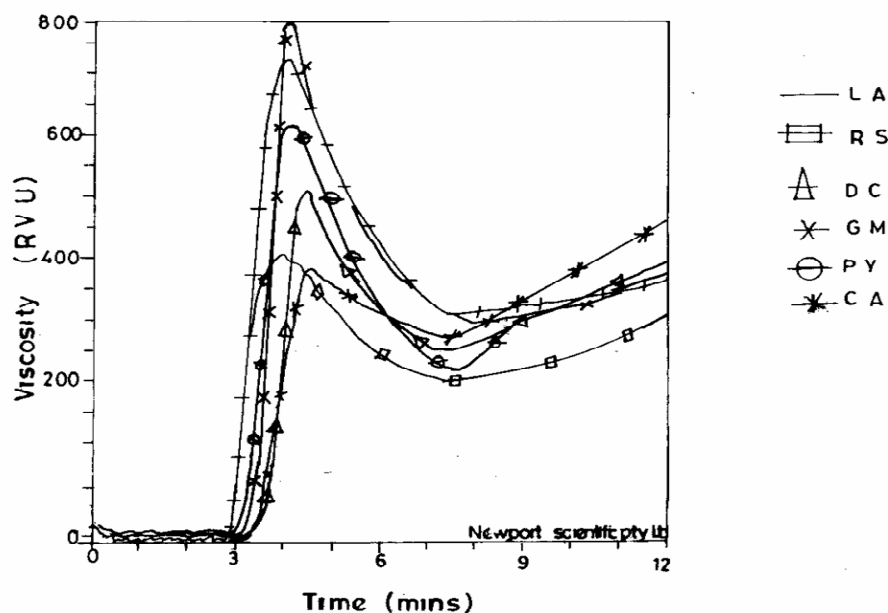
Pasting properties

Pasting properties of the mature green flours are shown in Figure 2 and Table 2. Variance in pasting spectral (Figure 2) of the samples signified heterogeneous starch granules in the samples. GM has the highest peak viscosity (837.17 RVU) which implied the sample with highest water-binding potential. CA has the highest resistant to heating, shear-thinning as revealed by its

Table 2. Pasting properties of banana flours.

Banana variety	PV(RVU)	BV(RVU)	FV(RVU)	SV(RVU)	PT(min)	Pt(°C)
GM	837.17	487.92	410.92	426.25	4.07	64.45
DC	556.67	260.25	439.67	117.00	4.43	67.55
CA	434.75	115.42	504.92	70.14	4.56	65.30
LA	771.00	411.85	418.00	353.00	4.01	64.45
PO	663.33	405.33	418.92	244.41	4.01	64.10
RS	453.75	205.92	355.00	98.75	3.92	64.35

PV=peak viscosity; BV=break down viscosity; FV=final viscosity; SV=set back viscosity; PT=peak time; Pt=peak temperature

**Figure 2.** Rapid visco-analysis diagram of banana flours.**Table 3.** Sensory qualities of different formulations of banana-whole maize product.

Attribute	*A ₁₀₀	B ₇₅	C ₅₀	D ₂₅	E ₀
Mouth feel	2.35a**	3.45b	6.35c	5.85c	4.00b
Binding property	7.00c	7.10c	5.38b	6.32b	2.00a
Colour	4.00a	4.85a	4.99a	6.00ab	6.42b

*Fractional percentage of banana (CA) flour in banana whole maize product

**Means that are not followed by the same letter are significantly different.

break down viscosity (115.42 RVU). Added to this, CA had the lowest set-back viscosity (70.17 RVU) from the peak (Table 2). This reflects the stability of the cooked paste against retrogradation (Mazurs et al., 1957). The shortest cooking time observed was 3.94 min for RS. Cooking time has cost implication. PO has the lowest pasting temperature (64.1°C). Pasting temperature

provides an indication of the minimum temperature required to cook a given sample. This can have implication on stability of other components in a formulation and also influence energy cost (Smith, 1967). Statistical result ($P=0.05$) of sensory scores (Table 3) of different formulations of banana (CA) flour-whole maize meal showed that banana flour imparted improvement on formulated products in terms of mouth feel and binding properties with no significant difference in colour of base-product.

Conclusions

The simple method of processing and application reported in this study will enhance the extension of shelf life and utilization of mature green banana fruits. The method yielded flour products with low moisture contents that signaled high storability potentials. The pasting properties evaluated can give insight to applicabilities of the flours in food and non-food products.

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