



Full Length Research Paper

Effect of ambient storage condition on physiochemical and microbial characteristics of mango mesocarp flour

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Moderately, ripe mango fruits from local variety were proceeds into flour using mobile wooden solar cabinet dryer at 60-70°C for 5 hours for five sunny days, to 10% moisture content level. A control sample that had been under storage study for about 96 weeks was used for the storage quality study, using physical, chemical microbiological and sensory attributes indices of evaluation. Sensory evaluation result showed no significant difference in colour at $P < 0.05$. Results showed increased bulk density, viscosity and swelling index in the range 0.55% -2.44%, 1-1.5%, 4.15% -5.70%, at 30°C, 4.45%-6.80%, at 70°C. Chemical constituents increased slightly with storage period, 1.85% -2.2% fat, 1.50% -2.13% ash, 1.80% -1.90% crude fibre, and 80.84% -83.87% total carbohydrate. The mean moisture content ranged from 5.95% -5.75% total microbial count increased to tolerable level with the storage period. Storing mango mesocarp flour at this condition and package material resulted into significant change in its physical, chemical and microbial quality.

Keywords: Ambient storage, Physiochemical, Mrcobial, Mangomesocarp flour.

INTRODUCTION

Mango (*Mangifera indica* L) tree is a common tropical tree just as apple in the temperate region. It is a drupe characterized by its succulent tissue widely eaten by children and adults. Many mango trees are grown in homes and gardens as well as in plantations. The most popular varieties are the local and improved types, including the "pointed" Roundish and "Peter".

The shelf life of mango fruits pose a lot of concern to the rural dwellers since there is no efficient storage facility that exists, and processing into unstable form such as jam, juice are costly, and involves processing operations that require skills. Due to these, mango fruits are lost to eating fresh during the glut season and also lost to spoilage. Processing mango mesocarp into flour, can reduce losses, and provide wholesome mango product for consumption and/or raw material for some food-based industries.

Mango fruits are rich in pro-vitamin A and vitamin C. the kernels are used in soap making as cocoa butter substitute (Baliga and Shitole, 1981). Blends of the dried mesocarp with legumes and cereal flour had improved pro-vitamin A content (Badifu et al., 2000) of complementary food and as dairy fortifier (Britnell, 1991).

The promotion of shelf life stability practice could

potentially reduce colossal losses to seasonal wastage.

From this research work it is hoped that the storage stability of local variety of mango mesocarp flour under tropical ambient condition (34+₂°C) would be established. This would lend credence to consumer confidence in the adaptability of the technology of the technology of production and its product.

MATERIALS AND METHODS

Source of Raw Materials

Mango flour that had been under storage study at ambient temperature (34+₂°C) for 96 weeks was supplied by my supervisor. Mango fruits of the same local variety and of similar degree of ripeness were obtained from Makurdi market, Benue State. The fruits were processed into flour as described below and used as control in the study.

Processing

Moderately ripe mango fruits were sorted, washed,

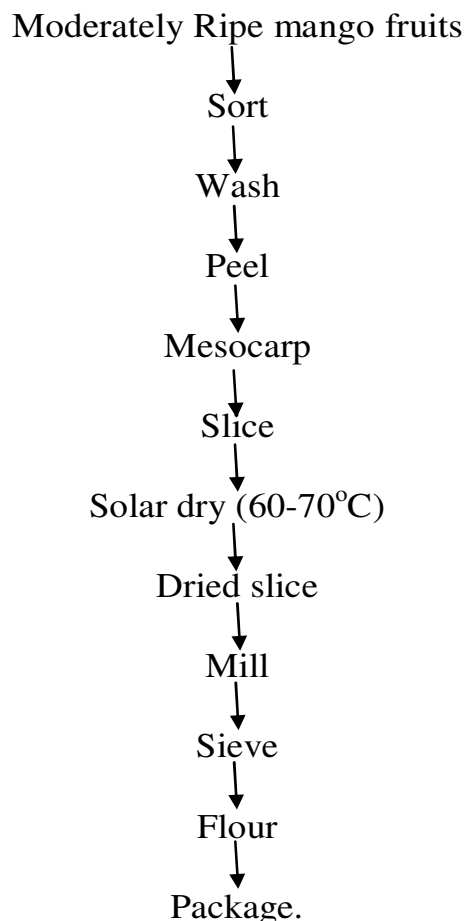


Figure 1. Flow diagram showing the production of mango mesocarp flour from moderately ripe mango fruit. source: Badifu et al. (2000).

cleaned, manually peeled and sliced out using cleaned kitchen knife, into oval shape of 1.8mm circumference and 1.9mm thickness. The slices were placed in a metal tray and dried at 60-70°C temperature in a mobile cabinet solar dryer in five sunny hours for a period of five days. Drying was done until 10-10.5% moisture level was attained. The slices were further oven dried at 80°C for 5 minutes, cooled and crushed using the attrition mill. The flour was sieved using <math> < 50\mu\text{m}</math> sieve size. The mango mesocarp flour used for the storage stability studies was under ambient storage condition (34+ 2°C) in an air tight plastic custard container from where samples were drawn periodically for storage study. The freshly prepared mango flour was used as control to compare quality changes with the one that was under storage for 96 weeks. The processing steps are as shown in Figure 1.

Chemical analyses

Proximate composition was according to (AOAC 1990).

The carbohydrate was obtained by difference.

Physical analyses

Swelling index was by (AACC 2000), viscosity was by (AOAC 1990), Bulk density was by (Banigo and Akpapunam 1987) and water absorption was by Okezie and Bello (1988). Sensory evaluation was by (Steel and Torries 1960).

The microbial analysis was carried out as outlined by Adegoke, 2004

RESULTS AND DISCUSSION

Result of sensory evaluation

Table 1 below showed the mean scores of mango flour prepared and stored at ambient temperature for 96 weeks and that recently produced (control). The mango

Table 1. Result on sensory evaluation of mango mesocarp flour stored under ambient condition (34 + 2°C).

Sample	Colour	Flavour	General Acceptability
A	3.9a	4.5b	4.3a
B	3.4a	3.3c	3.6b

Mean within the same row with different alphabet are significantly ($p < 0.05$) different. Values are the Means \pm SD with $n=2$ for each group.

Scale 5. like extremely 1-dislike extremely A = Control (Recently produced) B = Stored mango mesocarp flour for 98 weeks in airtight custard plastic container.

Table 2. Physical characteristics of mango mesocarp flour stored under ambient condition (34+ 2°C).

Sample	Bulk density (g/ml)	Swelling index (ml/g)			Water Absorption $g^{(H_2O)} / g^{(Sample)}$	Viscosity(cP)20%w/v Spindle 1		
		30°C,	70°C,	90°C		3.	6.	12.(rpm)
A	0.55a	4.15b	4.45c	9.95d	3.60e	1.0f	1.0g	1.0h
B	2.44i	5.70j	6.80k	9.70l	0.63m	1.5n	1.5l	1.5k

Mean within the same column with different alphabet are significantly ($p < 0.05$) different.

Values are the Means \pm SD with $n=2$ for each group.

Sample A = Control

Sample B = Stored mango mesocarp flour for 96 weeks in air-tight custard plastic container.

flour stored for 96 weeks showed no significant difference in colour, but showed difference in flavour and general acceptability $P < 0.05$. The flour stored for 96 weeks had lower mean score value for colour, flavour and general acceptability than the control. The least scored in flavour, colour and general acceptability was the 96 week stored flour. This indicates that the colour was acceptable and this could be due to package material and storage condition. The significant difference in flavour from the control tends to confirm that flavour of mango mesocarp flour changes with storage period.

Physical characteristics of mango mesocarp flour

Table 2 above showed result of the physical characteristics of mango mesocarp flour stored under ambient condition (34 + 2°C). There was increase in bulk density, swelling index and viscosity, with storage period, in contrast, there was decrease with increased storage period in water absorption capacity.

The 0.55%-2.44% range increase in bulk density may be due to the fibre content, air space or porosity of the granules. Swelling index of 96 weeks stored flour was significantly different at 30°C, 70°C and 90°C from the control. This could be due to high ration of amylase to amylopectin leaching at increasing temperature (Gomez et al., 2009). The swelling power may also be due to starch lipid. The viscosity of the recently produced (control) flour was 1 centipoise (cp) respectively, at

increased speed of 3, 6 and 12 rpm. Similarly, there was slight increase in viscosity of 1.5cp in stored flour of 96 weeks. This low viscosity might be due to protein denaturation, Extent of starch damage (Gomez et al., 2009). Disaccharide delays gelatinization, and reduces peak viscosity; the amounts of sugar and lipid triglyceride had been reported to reduce peak viscosity, hence exerting plasticizing effect (James et al., 1985). The 3.6% -0.62% decrease in water absorption capacity with increased storage period indicates low starch damage (Gomez et al., 2009). The storage condition (34+ 2°C) and the package material could be the reason for low hygroscopicity of the 96 weeks stored flour.

Chemical composition of mango mesocarp flour

Table 3 below showed results of chemical composition of mango flour stored at ambient storage condition (34 + 2°C). The fat, ash crude fibre and the carbohydrates increased with storage period, while crude protein and moisture content took a reversed trend.

The increase in fat content in the range 1.85%-2.2% slightly agrees with 2.5% fat value in green mango flakes reported (Gangapadyaya et al., 1986). Periodic determination of 8.6% moisture level, 3.5% protein, 2.2% ash, 2.5% fibre and 81.2% carbohydrate, by difference over 22 months (Badifu, 2000) , showed significant difference with the 96 weeks stored flour proximate composition values.

Table 3. chemical composition of mango flour stored at ambient storage condition (34 + 2°C).

Sample	Protein% (Nx6.25)	Fat%	Ash%	Crude fibre%	Moisture Content%	Total carbohydrate% (by difference method)
A	8.42a	1.85b	1.50 c	1.80d	5.95e	80.48f
B	4.15g	2.20b	2.13 h	1.90bi	5.75j	83.87k

Mean within the same column with different alphabet are significantly ($p < 0.05$) different.

Values are the Means \pm SD with $n=2$ for each group

Where A = Control

B = Mango flour sample stored in air-tight plastic custard container for 96 weeks.

Table 4. Estimation of total plate counts on mango flour sample stored under ambient condition (34 + 2°C).

Sample		Count (cfu/g)
A	Total plate count	5.3×10^{2a}
	Mould and yeast	1.2×10^{2b}
B	Total plate count	1.4×10^{4c}
	Mould and yeast	2.5×10^{2d}

Mean within the same column with different alphabet are significantly ($p < 0.05$) different.

Values are the Means \pm SD with $n=2$ for each group.

A = Control

B = Stored mango flour in air-tight plastic custard container for 96 weeks.

The moisture value decreased with storage period. The recently produced flour showed higher moisture level of 5.95% to 5.75%, than the 96-weeks stored flour. This might be due to processing method and relative humidity of the ambient condition. However, these moisture levels may not permit microbial change and hence gives stability of the flour during storage.

Najundaswany (1989), reported that crude protein value of osmo air dried mango product and mango cereal flake was 2.2% and 3.9% which are slightly below 4.15%, of 96-week stored mango flour. The difference in protein range from 8.42%-4.15% with storage periods, could be due to processing method and chemical interaction

Total carbohydrate increased from 80.48% to 83.87% with storage period. The increased value to 83.87% of the 96weeks stored flour could be due to break down of starch.

Microbial count of mango flour

Table 4 above showed the estimated total plate count on mango flour sample stored under ambient condition.

The total microbial count of the mango flour increased with increased storage periods. Flour stored had total plate count of 1×10^4 cfu/g as control. Mould and yeast count was lower in the control, with 1.2×10^2 cfu/g

compared to the stored flour with 2.5×10^2 cfu/g compared to the stored flour, 2.5×10^2 cfu/g.

The stored flour could be microbiologically safe, since the count fell below flour mould count of 2×10^3 cfu/g and bacteria count of 500 to 5×10^5 cfu/g (Adegoke, 2004). The slight difference in microbiological count between the stored and the control flours, would be due to handling during and after processing. The increase in microbial load of stored flour might be due to decrease in acidic content on storage.

CONCLUSION

The results of the study showed that the colour of the products were acceptable. Storing mango mesocarp flour for 96 weeks increased the bulk density, swelling index and viscosity, with significant change in water absorption capacity. Storing mango mesocarp flour at ambient condition in air-tight packing material with no exposure to light, preserved its quality. Mango flour stored for 96 weeks is potential high energy and mineral source, the fat, ash, crude fibre and total carbohydrate content did not change appreciably with storage period.

The flour was microbiologically safe because the total load count was within permissible level required by standard.

Furthermore, it was found that storing mango mesocarp flour in appropriate container under ambient storage condition would make the product available all the year round, would reduce the mango fruit wastage and increase its food diversification.

RECOMMENDATION

It is therefore recommended that processors should harness the possibility of processing mango mesocarps into flour and storing at ambient temperature for two or more years. These would:

Reduce seasonal wastage

Enhance macro and micro nutrient supplement in dietary foods.

Diversify usage in homes and small-scale food processing industries.

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