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Material balance, proximate and functional analysis of green banana flour prepared by cabinet drying method

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Material balance of the process involved in preparation of green banana flour is an important aspect to be overlooked. Unripe green banana flour prepared by pretreatment of banana slices with sodium metabisulphite followed by cabinet drying method, produced a flour with fairly white colour, good nutritive value and also yield was about 26 per cent. Proximate composition and functional properties such as bulk density, water absorption capacity, swelling capacity, foaming capacity, emulsification capacity and rehydration characteristics of prepared banana flour were determined. Also cost of production of banana flour was about Rs. 9.50/100g which is much less than any other advanced processing technique and is quite affordable.

Key Words : Green Banana, Sodium metabisulphite, Cabinet drying, Yield

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INTRODUCTION

Bananas have been part of humans' diets for many years and is the second most important fruit crop in India next to mango. Its year round availability, affordability, varietal range, taste, nutritive and medicinal value makes it the favorite fruit among all classes of people. Usually, a fully ripened banana contains about 80 per cent moisture that limits its storage stability and also fruit gets spoiled within 4-7days. In the peak period they are either consumed fresh, sold at relatively cheap prices or are allowed to go waste due to inadequate processing (Abano, 2010). Drying is one of the oldest methods for the preservation of food products. Newer techniques of drying such as heated air drying due to hygienic and economic considerations have been developed (Das *et al*., 2004 and Motevali *et al*., 2010). Little attention is given to drying of tropical fruits for consumption and improving their storage life. Dried food could be consumed directly or treated as secondary raw material (Menges and Ertekin, 2006). Green Banana flour is an alternative to reducing banana wastes and it is also a low cost material for food industry. Most unripe banana flour, produced from the green unripe fruit is often sun dried, it reduces quantitative and qualitative value of the dried product due to difficulties encountered in drying conditions (temperature and time), also under these conditions the quality of the product is very variable (Kaddumukasa *et al.,* 2005). Being rich in starch content it has diversified uses in bakery products, weaning mixes and supplementary foods (Zhang *et al*., 2005). Flour from green banana also possess a good export potential. Currently the market prefers high quality dried products with good reconstitution properties and excellent sensory attributes at an affordable price. Adopting advance processing methods adds additional processing cost to

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the product. Also development of reasonably priced new products is a strategic area of the food industry. The major objectives of this study were to determine material balance during green banana flour preparation and cost economics involved in the process. Along with these proximate composition and functional properties of GBF were determined during 2015.

METHODOLOGY

Procurement of raw material:

Unripe green banana fruits were procured from local market of Parbhani district, Maharashtra state, India.

Processing of green banana fruits:

Fruits were inspected for any physical damage and sorted, damaged fruits were removed. Selected healthy fruits were washed; hand peeled and cut into about 5mm thick slices for facilitating quick drying. The initial moisture content of fruit was determined by oven dry method (Aghbashlo *et al*., 2010). Banana slices were treated with 2 per cent sodium metabisulphite solution for 10 min (Kaddumukasa, 2005) and dried at 70^{0}C by cabinet drying.

Unripe green banana

↓

Sorting , selecting healthy fruit

↓

Peeling, cutting into slices (5mm thickness)

↓

Dipping of slices in
2 % sodium metabisulphite solution/10min

↓

Draining and washing with water (3-4times)

↓

Cabinet drying at 70^{0}C/ 3-4hrs

↓

Grinding in to flour and sieving

↓

Packing in airtight container

↓

Storage at ambient temperature

Fig. A : Flow sheet for preparation of unripe green banana flour

Proximate composition:

Moisture, fat, protein, ash and crude fibre were determined by AOAC (2000) methods, carbohydrate was determined by difference method. Determination of vitamin C was done according to titration method in AOAC (2000).

Functional properties:

Bulk density, swelling capacity, emulsification capacity of green banana flour were determined according to the method of Okaka and Potter (1977). Water absorption capacity as per method of Sosulski *et al.* (1976), foaming capacity was determined by method of Narayana and Narasinga (1982) along with some modifications.

Rehydration characteristics:

The re-hydration tests were conducted to assess the reconstitution qualities of the GBF. 5 g of the dried samples was soaked in enough amount of water for 10 minutes at room temperature. The ratio of mass of re-hydrated and dried samples was used to determine the rehydration ratio and co-efficient of rehydration.

Rehydration ratio= C/D

$$\text{Co - efficient of rehydration} = \frac{C \times (100 - A)}{D \times (100 - B)}$$

where,

A = Moisture content of samples before drying (%w b)

B = Moisture content of dried samples (%w b)

C = Mass of sample after soaking (g)

D = Test mass of sample before soaking (g)

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Drying curve :

Changes in moisture content of unripe green banana during cabinet drying at 70^{0}C is shown in Fig.1. It indicates that there was a gradual decline in moisture content followed by constant drying rate till moisture content of 6.63 per cent was attained from initial moisture content of 73.75 per cent.

Material balance data :

Material balance data obtained during preparation of green banana flour is presented in Table 1. It shows

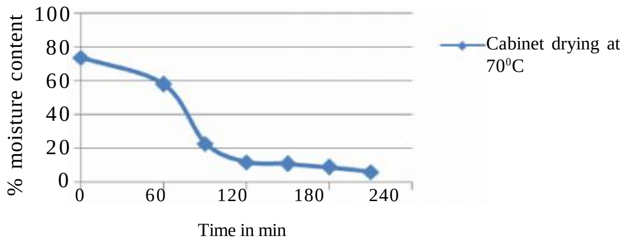

Fig. 1 : Drying rate curve of unripe green banana

Table 1 : Material balance data for green banana flour preparation by cabinet drying

Average weight of banana fruit	81.05 g
Edible index	58.07 %
Waste index	41.92 %
Drying	Cabinet drying
Drying temperature	70^0C
Time required for drying	3hrs 45 min
Initial moisture	73.75%
Final moisture	6.63 %
Yield	26.24%

that edible index of fruit was 58.07 per cent, while waste index of the fruit was also considerable with a value of 41.92 per cent. Cabinet drying of banana slices at 70^0C reduced drying time as compared to conventional sun drying method also it had prevented contamination. Final moisture of the dried banana was about 6.63 per cent which was safe for preparing powder with good storage life. Yield of the flour from unripe green banana was only 26.24 per cent.

Proximate composition of unripe green banana flour:

Colour of the banana flour was white which indicates browning was inhibited by pre treatment of sodium metabisulphite. Masamba *et al.* (2013) reported colour protective effect of sodium metabi sulphite and results obtained are backed by the findings of Mozumder *et al.* (2012) who reported that potassium metabisulphite and calcium chloride treated samples show a better colour.

Moisture content was about 6.63 per cent which was safe for storage. Protein content was about 2.20g/100g. These results are consistent with those reported by Alam *et al.* (2014). Carbohydrate content of the banana flour was significantly higher (87.67%) than other nutritional components. While fat (1.45%) and ash (0.59%) content was less due to heat treatment. Heat, moisture and autoclave treatment had an impact on physico-chemical properties of flour (Zowariah and Noor Aziah, 2009). Use of sodium metabisulphite has proved to be effective in reducing the degradation rate of vitamin C in the dried fruit powder and this protective nature of sodium metabisulphite on vitamin C has also been reported in similar previous studies (Karim, 2005 and Masamba, 2013).

Functional properties of green banana flour:

Dried banana flour can be used as a secondary raw material for preparation of various food products and during these functional properties of flour plays an important role. Bulk density is a measure of heaviness of powder and is an important parameter that determines

Table 2 : Proximate composition of unripe green banana flour

Sample	Proximate composition (%)						Vit. C (mg/100 g)
	Moisture	Fat	Protein	Ash	Fibre	Carbohydrate	
C	6.40 ±0.04	1.38 ±0.06	2.19 ±0.03	0.65 ±0.02	1.55 ±0.03	87.74±0.7	8.62
SMBSD	6.63 ± 0.06	1.45±0.04	2.20±0.04	0.59±0.06	1.46 ±0.02	87.66±0.8	6.89

C: Control, SMBS: sodium metabisulphite dipped

Table 3 : Functional properties of unripe green banana flour

Functional property	Control	SMBS pretreated
Bulk density (g/ml)	0.56 ± 0.03	0.522 ±0.04
Swelling capacity (g/g dry sample)	2.37±0.28	2.09 ±0.22
Water absorption capacity (g/g dry sample)	1.66±0.03	2.21± 0.07
Foaming capacity (%)	6.32±0.35	6.92 ± 0.32
Emulsification capacity (%)	1.62±0.08	1.54 ± 0.02
Rehydration characteristics		
Rehydration ratio	1.17 ± 0.02	1.27 ± 0.04
Co-efficient of rehydration	0.33±0.03	0.36 ± 0.02

the suitability of powder for the ease of packaging and transportation of particulate foods as well as for infant formulations. Bulk density of GBF was about 0.522 (g/ ml) which indicates that prepared flour can be used for infant food formulation. The low bulk density powders/ flours are desirable in infant food preparation. High swelling power is an important criterion for good quality powder/flour. Swelling capacity of GBF was 2.09 g paste/ g dry sample, WAC of flour is useful indicator of protein that can be incorporated with aqueous food formulations (Appiah *et al.*, 2011) which was about 2.21 g/g dry sample, foaming capacity of GBF prepared by cabinet drying was about 6.92 per cent, foaming capacity is a functional property that depends upon protein molecules configuration, also flexible proteins have good foaming capacity (Graham and Philips, 1976). Emulsification capacity was about 1.54 per cent. Rehydration ratio of banana flour was about 1.27 with co-efficient of rehydration about 0.36 which fully agrees with those reported by Abano and Sam- Amonah (2011).

Cost economics of unripe green banana flour:

Cost of cabinet dried banana flour was calculated out to be Rs. 9.50/ 100g which was high as compared to conventional drying method but quality and colour of banana flour was much better than oven dried flour. Also drying by cabinet method reduced drying time. Singh *et al.* (2004) reported that oven dried green banana flour costs about 8.90/100g.

Conclusion:

The present study demonstrated that yield of banana flour by cabinet drying was about 26.24 per cent, also cost of flour was more than conventional method but that was affordable as compared to other costlier methods such as freeze drying. A good quality nutritious GBF flour with white colour was prepared by pretreatment and cabinet drying method adopted in the study and it was superior than banana flour prepared by conventional drying.

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