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EFFECT OF PACKAGING MATERIAL FOR THE QUALITY OF BANANA FLOUR UNDER AMBIENT STORAGE CONDITIONS

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ABSTRACT

Fully mature green bananas of cv. Kovvur Bontha were pretreated by blanching at 60°C for 5 minutes + 0.25% KMS dip for 20 minutes and dried in tray drier at 55°C and packed in 200 gauge Polythene bags (T_1), 300 gauge Polythene bags (T_2), 100 gauge Polypropylene bags (T_3), 200 gauge Polypropylene bags (T_4), Aluminium foil covers (T_5), Glass bottles (T_6) and stored at ambient conditions for six months to study the storage behaviour and evaluate the best packaging material for maximum retention of nutrients. During storage moisture, weight, TSS, sugars showed an increasing trend while acidity, ascorbic acid, ash content and crude protein content showed a decreasing trend. There was no microbial contamination for the initial two months which increased further during storage. Aluminium foil covers were found to be best followed by glass bottles in retaining various nutrients and quality attributes and recording lesser microbial load in banana flour.

KEYWORDS: Bananas, Packaging, Drying, Moisture, Weight, TSS, Sugars, Acidity, Ascorbic acid, Ash content, Crude protein content, Microbial load, Aluminum foil covers, Glass bottles.

Banana is one of the ancient and most important fruit crops of the tropical and subtropical world regions. It is the major contributor of the world food production and is an important staple food for millions of people inhabiting the humid tropics and subtropics. Banana is a climacteric fruit, highly perishable and bulky with poor shelf life, so, it requires processing into a more stable and convenient form. Though limited at present, there is a good market potential for banana products *viz*., banana puree, figs, wafers, dehydrated banana slices, flakes, flour *etc* (Karthiayani and Devdas, 2005). Green unripe bananas have antimicrobial properties and have been used as medicine in ancient India and China, apart from its food applications (Fagbemi *et al*., 2009). In many cases, green banana is also used for medicinal purpose for its higher content of antioxidants than the ripe ones. The green bananas are not consumed raw. These are peeled, sliced and then either dehydrated, fried, cooked or boiled before consumption. During the recent years, the demand of green dried bananas has increased both within and outside the country.

Drying/dehydration brings about a substantial reduction in weight and volume, there by minimizes packaging, storage and transportation cost and also enables storability of the product under ambient temperatures especially in developing countries (Senadeera *et al*., 2005). Dehydrated fruits are unique in taste and nutritious. To enhance the utilisation of mature green fruits, they are processed in to different products like dried banana chips, flour *etc*. Flour obtained from green bananas has wide applicabilities in foods such as baby-weaning foods, puddings, soups, gravies and non food products like thickener, water binder, emulsion stabiliser *etc*. As banana flour contains high content of starch, it is used for the formulation of nutritious weaning mixes and supplementary foods. Banana flour can also be used as one of the main component in various food items like puris, parathas, cakes, toffees, sweets, desserts *etc*. Keeping this in view, the present study has been formulated with an objective to study the changes in nutritional and chemical composition of banana flour during storage and evaluate the best packaging material for storage of banana flour.

MATERIALS AND METHODS

The experiment was conducted at the lab of Post Harvest Technology of Horticultural Crops, College of Horticulture, Dr. YSRHU, Hyderabad during the year 2011-12. Mature, green and uniform size fruits of **Banana var. Kovvur Bontha** were collected from the Banana Research Station, Kovvur, West Godavari district, Andhra

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Pradesh. They were subjected to pretreatment i.e. blanching at 60°C for 5 minutes, peeled manually and cut into slices of 0.5 cm thickness with a stainless steel knife and dipped in 0.25% KMS for 20 minutes. These pretreated banana slices were spread thinly on stainless steel trays which were kept in a cabinet tray drier for dehydration. Banana slices were thoroughly air dried at 55°C temperature till the fruits reached the desired moisture content of less than 3% and product quality. After cooling, these slices were ground in grinding machine, to obtain fine flour and was sieved through 40 mesh size to get uniform flour. Banana flour of 100 g was weighed and filled in different packaging materials, sealed, labelled and subjected for storage studies under ambient conditions for a period of 6 months.

Moisture, gain in weight, TSS, acidity, ascorbic acid, ash and crude protein were determined by the methods described by Ranganna (1986). The reducing sugars, total sugars and non reducing sugars were determined according to the method described Ranganna (1991). Microbial load was evaluated by dilution plate method as suggested by Cruik Shank *et al.,* 1975. Data for physico chemical attributes were analysed by completely randomized design.

RESULTS AND DISCUSSION

Moisture (%)

Packaging materials significantly influenced the moisture content of the flour. Results revealed that aluminium foil covers absorbed minimum moisture (4.50) during storage which was on par with glass bottles (4.60).The changes in moisture content may be due to differences in water vapour permeability of the packaging films and aluminium foil having very low water vapour transmission rate. Similar findings were reported in dehydrated apple rings by Sharma *et al.* (2006), ripe banana powder by Evelin Mary *et al.*(2007), banana chips by Molla *et al.* (2009) and soy flour by Dipika *et al.* (2011).

There was a progressive increase in the moisture content of the flour upon storage. This might be due to absorption of moisture from the atmosphere by the packaging material. Similar observations were made by Sagar and Khurdiya (1998) in dehydrated ripe mango slices, dehydrated apple rings by sharma *et al.*(2006), ripe banana powder by Evelin Mary *et al.*(2007), banana chips by Molla *et al.* (2009) and soy flour by Dipika *et al.* (2011).

Gain in weight (%)

There was slight increase in weight of banana flour from the fourth month of storage only which might be due to absorbed moisture. Among the packaging materials, aluminium foil covers proved best with minimum weight gain (2.20).These findings were similar to the observations made by Molla *et al.* (2009) in banana chips.

TSS (°brix)

Total soluble solids of banana flour showed no significant changes during storage in different packaging materials.

Total sugars(%)

An increasing trend was observed in total sugar content of banana flour upon storage. It may be due to partial hydrolysis of starch to sugars. The starch having been formed in storage cells and tissues may become transferred into sugars particularly sucrose, glucose and fructose during the post harvest period. (Sagar and Khurdiya, 1998; Sagar *et al.*, 2000; Sharma *et al.*, 2006 and Evelin Mary *et al.*, 2007).

Total sugars were significantly lower in flour packed with aluminium foil covers (28.63) followed by glass bottles (37.13). The excellent barrier properties of these packaging materials might have protected the product against moisture ingress there by reducing the rate of hydrolysis of polysaccharides like starch to sugars. Similar results were reported by Sharma *et al.* (2006) in dehydrated apple rings and Evelin Mary *et al.* (2007) in banana powder.

Reducing sugars (%)

Reducing sugars exhibited an increasing trend in the flour during storage which might be due to hydrolysis of polysaccharides and their subsequent conversion to reducing sugars. Similar findings were observed by Sagar *et al.* (2000) in ripe mango powder and Evelin Mary *et al.* (2007) in banana powder.

Packaging materials influenced the reducing sugar content of the flour with significantly lower reducing sugars in aluminium foil covers (16.49) followed by glass bottles (20.56) in the present study. It may be due to lesser moisture absorption capacity of these packages leading to slower rate of hydrolysis and hence retaining complex polysaccharides like starch which is an important

Table 1. Effects of packaging material and storage on quality of banana flour

Treatments	Moisture (%)		Gain in weight (%)		TSS (°brix)		Total sugars (%)		Reducing sugars (%)		Non reducing sugars (%)	
	1st month	6th month	1st month	6th month	1st month	6th month	1st month	6th month	1st month	6th month	1st month	6th month
T_1 (200gauge Polythene)	3.02	5.21	1.00	4.70	3.20	4.00	6.05	39.51	2.27	28.32	3.78	11.19
T_2 (300gauge Polythene)	3.02	5.00[b]	0.80	4.20	3.00	4.00	6.15	38.67	2.21	20.56	3.94	18.11
T_3 (100gauge Polypropylene)	3.20	5.50	1.60	6.00	3.00	4.20	6.25	48.08	2.59	40.60	3.66	7.48
T_4 (200gauge Polypropylene)	3.10	5.30	1.20	5.90	3.00	4.08	6.15	45.39	2.46	33.22	3.69	12.17
T_5 (Aluminium foil covers)	3.00	4.50	0.00	2.20	3.00	3.28	5.77	28.63	2.06	16.49	3.71	12.14
T_6(Glass bottles)	3.01	4.60	1.00	3.80	3.00	3.92	5.95	37.13	2.08	20.56	3.87	16.57
S.E(m)±	0.021	0.106	0.32	0.17	0.298	0.346	0.028	0.866	0.028	0.797	0.341	2.649
CD at 5%	0.06	0.31	NS	0.50	NS	NS	0.08	2.56	0.08	2.36	NS	NS

Treatments	Ascorbic acid content (mg/100g)		Acidity (%)		Bacterial count (cfu/g)		Crude protein (%)		Ash content (%)	
	1st month	6th month	1st month	6th month	1st month	6th month	1st month	6th month	1st month	6th month
T_1 (200gauge Polythene)	16.33[b]	09.65	0.60	0.48	0	54.00	3.62	1.69	3.59	5.65
T_2 (300gauge Polythene)	16.33[b]	09.66	0.60	0.51	0	56.00	4.00	1.81	3.64	5.51
T_3 (100gauge Polypropylene)	16.00	09.00	0.54	0.42	0	62.00	3.03	1.63	3.21	5.59
T_4 (200gauge Polypropylene)	16.00	09.64	0.58	0.45	0	57.00	3.27	1.63	3.45	5.50
T_5 (Aluminium foil covers)	16.66	10.66	0.63	0.55	0	31.00	4.61	1.93	3.96	6.59
T_6 (Glass bottles)	16.33	10.00	0.63	0.53	0	32.00	4.26	1.87	3.96	5.89
S.E(m)±	0.069	0.133	0.073	0.021	0	0.885	0.496	0.215	0.340	0.418
CD at 5%	0.20	0.39	NS	0.06	NS	2.62	NS	NS	NS	NS

constituent of banana flour. Similar observations were recorded by Sharma *et al*. (2006) in dehydrated apple rings and Evelin Mary *et al*. (2007) in banana powder.

Non reducing sugars (%)

No significant changes were observed in non reducing sugars of banana flour stored for six months in different packaging materials.

Ascorbic acid content (mg/100g)

The banana flour stored in aluminium foil covers significantly retained higher amount of ascorbic acid (10.66) among all the packaging materials and corroborates with the findings of Khurdiya and Roy (1974) in guava powder and Sharma *et al*. (2006) in dehydrated apple rings. This might be due to better protection against oxidation by aluminium foil covers due to less permeability of the film compared to other packaging materials.

Ascorbic acid content of the flour showed a declining trend upon storage of six months which might be due its oxidation and as a substrate in non enzymatic browning. Similar findings were recorded by Sagar and Khurdiya (1998) in ripe mango powder, Sharma *et al*. (2006) in dehydrated apple rings and Mandalik *et al.* (2009) in ripe banana flour.

Acidity (%)

The results in the present investigation reveals that acidity of flour slightly decreased upon storage. The retention of acidity was significantly higher in flour packed in aluminium foil covers (0.55) and glass bottles (0.53) as compared to other packaging materials during the storage period of six months. The loss of acids might be due to utilization of acids for conversion of non-reducing sugars to reducing and in non enzymatic browning reactions (Krishnaveni *et al*., 1999; Sharma *et al*., 2006; Evelin Mary *et al*., 2007 and Mandalik *et al*., 2009).

Microbial load (cfu)

The microbial load of banana flour gradually increased upon storage of six months. Similar trend was observed by (Krishnaveni *et al*., 1999 and Evelin Mary *et al*., 2007). Increase in bacterial count of flour can be attributed to rise in moisture content of the flour and to the increase in environmental temperature. However the contamination remained within the prescribed limits by International Commission for Microbiological Standards for Foods (1986) even after six months of storage.

Lowest bacterial count was observed in flour packed in aluminium foil covers(31.00) which was on par with glass bottles(32.00) indicating them to be ideal packaging materials for long term storage of banana flour. Similar findings were recorded by Krishnaveni *et al*. (1999) in jackfruit bars and Evelin Mary *et al*. (2007) in ripe banana powder. The storage stability may be attributed to the preservative effect of KMS and the lower permeability of the packing material to oxygen and water resulting in slower degradation of flour hence enhancing the shelf-life.

Crude protein (%)

The results pertaining to the crude protein content of banana flour showed a decreasing trend with storage and was similar to the reports of Masood *et al*. (2005) in whole wheat flour and Dipika *et al*. (2011) in soyflour. However crude protein content was not effected by different packaging materials in the study.

Ash content (%)

No significant changes were observed in ash content of banana flour stored for six months in different packaging materials.

CONCLUSION

Aluminium foil covers were found to be best packaging materials followed by glass bottles in retaining various nutrients and quality attributes of banana flour like minimal moisture gain, weight gain, sugars, better retention of acidity and ascorbic acid and lesser microbial load when compared to the other packaging materials.

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