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Studies on Nutritional Components, Antioxidant Activities and Microbial Load in Simple Processed Product Developed from Banana (cv. Bhimkol)

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Banana (cv. Bhimkol) fruit is considered as a good natural source of food among the rural masses of North Eastern region of India. However, the processed form of this fruit is very negligible. Considering nutritional status of the fruit and to impart place, consumer and form utility, a dehydrated powder was prepared, to which primary preservative added (sugar) and stored in glass container. The mineral content (nitrogen, potassium, calcium, iron and phosphorus), microbial load and antioxidant activity were determined up to six months of storage, both at refrigerated condition and room condition. The result showed better retention of minerals and antioxidant activities in refrigerated condition than in room storage. Result of the microbial count did not show any health hazard.

Keywords: Banana (cv. Bhimkol), Dehydrated powder, Microbial load, Antioxidant activity.

INTRODUCTION

The perishable fruit are available as seasonal surpluses during certain parts of the year in different regions and are wasted in large quantities due to absence of processing facilities and lack of awareness about the know-how of the proper handling and storage. Large amount of perishable fruit produced during a particular season result in the glut in the market and become scarce in other seasons. The entire amount neither can be consumed in fresh condition nor sold at economic prices.

Banana (*Musa spp*) is one of the most important and oldest crops in the world scenario of economic fruit of excellent quality. Banana is a complete fruit packed with all the necessary energy and health promoting elements. On account of these properties combined with delicious taste and flavour, it is in general demand in fresh as well as processed form all over the world and is gaining commercial popularity in the international fruit trade market [1].

North Eastern region of India is very rich in indigenous banana germplasm of both wild and cultivated types. Interestingly, the region is endowed with two types of seeded balbisiana diploid cultivars *viz.*, 'Bhimkol' and 'Athiakol' which are not encountered in other banana growing regions of the world. They are robust in growth, very hardy, resistant to pests, diseases and drought and high yielder [2]. The banana (Bhimkol) fruit is considered as a good natural source of baby/ children food among the rural masses of this region. The possibility of formulating an acceptable 'Bhimkol' based weaning food was also reported [3]. The ripe pulp can also be made into jam and jelly. The fruit can be successfully employed for preparation of instant squash [4] and baby food powder [5].

Due to paucity of work on low cost value added product made from the banana (Bhimkol) fruit, an attempt was taken in the present study to know the changes in some major minerals and antioxidant activities, together with microbial qualities of the value added banana (Bhimkol) powder during different periods of storage.

EXPERIMENTAL

The raw banana (Bhimkol) fruit were collected from the local market of Jorhat town. Fresh ripe (not over ripe) banana (Bhimkol) were weighed on a weighing balance. Weight of the peel was also taken. The peeled fruit was split longitudinally in to four parallel parts without affecting the seeds. Seeds were removed manually and the fresh weight of seed recorded. Then the pulp was immersed in 0.5 % solution of potassium meta bi-sulphite. The pulp was removed after 1 h, which was then kept over perforated sieve for 10 min and then kept in trays of previously set hot air oven at 60 °C till it reached the constant weight. Then the banana was powdered using a laboratory grinder and sieved through 250 µ sieve. Powdered sugar, sieved

through 250 μ sieve was added to the banana powder as preservative at the rate 1:1 by weight, mixed uniformly and the mixed product was stored air tight in glass bottles, both at room temperature (average 30 °C and 80 % RH) and in the refrigerator (average 4 °C, 50 % RH).

Nitrogen content of the banana product was determined by Micro Kjeldahl method [6]. Calcium and potassium were determined with flame photometer. Iron was determined with spectrophotometer [7]. Phosphorus content was also determined with spectrophotometer [8]. Antioxidant activity was determined by the method given by Molyneux [9]. Free radical scavenging ability of 1,1-diphenyl-2-picryl hydrazyl (DPPH) was determined on methanolic extracts of treated samples. Antioxidant activity of L-ascorbic acid was assayed as standard. Each estimation was replicated four times.

The microbial analysis was done using standard method. For this, 1 g of the dry sample was blended in 9 mL sterile water (0.85 % w/v NaCl in water) in a stomacher lab-blender (400, Seward, UK) for 2 min. A serial dilution of the same diluents was made. Microbial enumeration was done with the following selective media-MRS (de man, Rogosa and Sharpe) for lactic acid bacteria, Potato Dextrose Agar (PDA) for molds, Yeast Extract Agar (YEA) for yeasts and Plate Count Agar (PCA) for total viable bacterial count. All media were obtained in their readymade form from HiMEDIA. All enumerations were done by colony counting after an incubation period of 48 h at 27 °C. The colonies that appeared after incubation were counted, calculated as colony forming units (cfu) per gram of sample and expressed as cfu g^{-1} for banana powder.

RESULTS AND DISCUSSION

The details regarding the average fresh fruit weight, peel content, seed content, fresh pulp content (deseeded fruit), dry weight recovery of banana (Bhimkol) and the solubility of sugar added banana powder (Table-1), revealed the values to be 165 g, 27.3 %, 38.47 %, 61.52 %, 26.94 % and 61 % respectively. It was observed that from 1 Kg fresh fruit about 120 g dry matter and 240 g finished product could be obtained.

Nitrogen, calcium, potassium, iron and phosphorus content (Table-2) of the value added banana powder revealed the nitrogen content for banana powder at 1 week after storage to be 0.336 % (room temperature storage) and 0.364 % (refrigerated storage), which was lower than the value (0.79 %) reported earlier [5]. However, Gopalan *et al*. [10] observed nitrogen content of banana to be 0.192 % on fresh weight basis. Thaper [11] reported protein content in drum-dried pure banana powder to be 4.69 %, which represented a nitrogen content of 0.750 %.

Progressive decrease in protein content of pulp sample was observed over the entire storage period of 90 days in preserved mango pulp, as reported by Akhtar *et al*. [12]. Decrease in protein content supported the decrease in nitrogen content.

The calcium content in 100 g of banana powder was found to be 11.78 mg (at room temperature storage), when analyzed 1 week after storage. However, Thaper [11] reported calcium content in drum-dried banana to be 2.53 %. Hui [13] reported the calcium content to be 22 mg/100 g in banana powder. Mahanta [5] reported calcium content in dehydrated powder of banana (Bhimkol) to be 30 mg/100 g.

The potassium content in 100 g of banana powder was found to be 747.63 mg (at room temperature storage), when analyzed 1 week after storage. Hui [13] reported potassium content in 100 g of banana powder to be 1491 mg. However, Mahanta [5] reported potassium content in dehydrated banana (Bhimkol) powder to be much lower (112.65 mg/100 g).

The iron content in 100 g of banana powder was found to be 0.605 mg (at room temperature storage), when analyzed after 1 week of storage. Hui [13] reported an iron content of 1.15 mg/100 g banana powder. Thaper [11] reported iron content in drum-dried banana powder to be 0.80 mg/100 g. However, Mahanta [5] reported a higher amount of iron content in dehydrated powder of banana (Bhimkol) to be 6.82 mg/100 g.

The phosphorus content in 100 g of banana powder was found to be 38.01 mg (at room temperature storage), when analyzed after 1 week of storage. Mahanta [5] reported phosphorus content in dehydrated powder of banana (Bhimkol) to be 62.44 mg/100 g. Hui [13] reported a phosphorus content of 74 mg/100 g of edible portion of banana fruit. However, Thaper [11] reported phosphorus content in drum-dried banana to be 9.20 %.

TABLE-1
DESCRIPTION OF BANANA (BHIMKOL) FRUIT AND SUGAR ADDED POWDER

Single fruit fresh weight with peel (g)	Peel % (w b)	Seed (%) of peeled fruit (w b)	Pulp (%) of peeled fruit (w b)	Dry matter (without seed) having 8.5 % moisture recovered (w b)	Solubility of sugar added banana powder in hot water (15 g in 100 mL) (%)
165	27.3	38.47	61.52	26.94	61.0

Data are average of four samples

TABLE-2
BIOCHEMICAL COMPOSITION OF THE BANANA (BHIMKOL) POWDER

Storage time	N (g/100 g)		Ca (mg/100 g)		K (mg/100 g)		P (mg/100 g)		Fe (mg/100 g)	
	Stored at RT	Stored in refrigerator	Stored at RT	Stored in refrigerator	Stored at RT	Stored in refrigerator	Stored at RT	Stored in refrigerator	Stored at RT	Stored in refrigerator
1 week	0.336	0.364	11.780	12.270	747.63	747.63	38.01	37.990	0.605	0.6140
2 months	0.217	0.336	10.310	11.780	693.75	740.60	36.74	37.940	0.199	0.5720
4 months	0.140	0.329	7.960	10.310	628.12	728.88	34.63	37.850	0.023	0.4730
6 months	0.084	0.315	6.560	9.840	600.00	705.46	32.25	37.110	0.006	0.4540
CD at 5 %	0.028	0.029	0.700	0.200	24.58	27.72	0.79	0.611	0.009	0.0234

RT = Room temperature.

Observation of lower value of nitrogen, calcium, potassium, iron and phosphorus content in the present investigation compared to those reported by Mahanta [5], Hui [13] and Thaper [11] might be due to the addition of equal quantity of powdered sugar to the banana powder. Decrease in mineral content in banana powder with progress in storage period, might be due to the hygroscopic nature of the banana powder which might have captured some amount of moisture while handling for sampling.

A decreasing pattern in ash content in preserved mango pulp over the entire storage period of 90 days was reported by Akhtar *et al*. [12]. Decrease in ash content supported the decrease in mineral content also.

Antioxidant activity: The antioxidant activities in terms of DPPH scavenging for the powder prepared from banana were analyzed after 1 week of storage and after 6 months of storage (Table-3).

The results revealed that antioxidant activity decreased during storage, which might be due to decrease in phenolic compounds. Gupta *et al*. [14] reported the importance of phenols in DPPH scavenging activity of herbs *Portulaca oleracea* and *Rhadiola imbricata*, respectively. For banana powder, the antioxidant activity decreased during 6 months of storage. At 1 week after storage, 50 % DPPH inhibition was shown by 6.95 mg of banana powder. After 6 months of storage, the 50 % DPPH inhibition was shown by 26.32 mg and 13.99 mg of banana powder, stored at room temperature and in refrigerator, respectively. Antioxidant activity was retained better for banana powder which was stored in refrigerated temperature than that in room temperature. Das and Dutta [15] reported that 1mg dry sample of ber (*Zyziphus jujube*) produced 23 to 41 % DPPH scavenging activity after 1 week of drying, which reduced on storage. Li *et al*. [16] reported that 1 mg concentrated extract of Chinese jujube produced 33.6 to 98.6 % DPPH scavenging activity, just after harvest. However, Sanja *et al*. [17], Gupta *et al*. [14] and Bhatia and Mishra [18] reported that 12.67 mg leaves of *Portulaca oleracea,* 4.391 mg roots of *Rhadiola imbricata* and about 50 mg seeds of *Zizyphus mauritiana* showed 50 % DPPH inhibition. The lower values observed by some of these workers might be due to higher antioxidant activity and/or utilization of dried alcoholic/aqueous extract of samples for DPPH scavenging assay.

Microbial analysis: There was difference in the number of microbial colonies in the products of banana during different periods of storage (Table-4). Detection of higher number of *Lactobacillus* sp. in comparison to total viable bacterial count might be due to selective growth of the *Lactobacillus* sp. in MRS media.

However, the present study revealed lesser number of microbial count in banana powder as compared to some other similar products. Patel and Patel [19] reported total microbial count to be between 1.4×10^6 cfu/g to 9.0×10^6 cfu/g in dried mango pulp, which was stored for 60 days using different packaging materials.

The value added products of banana exceeded the microbial count specified by 'Prevention of food adulteration rules, 1956', which might be counting of colonies in the present investigation after 48 h (a longer time gap) of incubation. According to above rule, total plate count in dehydrated fruits and vegetable products should not be more than 4×10^4 per gram. The high counts, observed in the present product may not necessarily pose hazard to the health of the consumers, provided that these are not potential pathogenic strains.

Conclusion

Banana (cv. Bhimkol) powder (8.5 % moisture on fresh wt basis), prepared in the present study can be used as a component in composite extruded products or as a mix for cereal or millet based breakfast product up to 6 months of its preparation, preferably under refrigerated storage. It will not be good in the form of beverage powder, as solubility of this powder in hot water is less (61.0 %)

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TABLE- 3
ANTIOXIDANT ACTIVITY FOR THE BANANA (BHIMKOL) POWDER

Sample	50 % DPPH inhibition (after 1 week of storage) (mg)	50 % DPPH inhibition (after 6 months of storage) (mg)
Banana beverage powder kept at room temperature	6.95	26.32
Banana beverage powder kept at refrigeration temperature (4 °C)	6.95	13.99
Ascorbic acid	0.0223	0.0223
CD at 5 %	2.865	20.503

TABLE-4
GROWTH OF MICROORGANISMS IN BANANA (BHIMKOL) POWDER DURING DIFFERENT PERIODS OF STORAGE

Microorganisms	Growth after 1 week of preparation (cfu g^{-1})		Growth after 2 months of preparation (cfu g^{-1})		Growth after 4 months of preparation (cfu g^{-1})		Growth after 6 months of preparation (cfu g^{-1})	
	Stored at RT	Stored in refrigerator	Stored at RT	Stored in refrigerator	Stored at RT	Stored in refrigerator	Stored at RT	Stored in refrigerator
Yeast	1×10^5	1×10^5	1×10^5	nil	nil	nil	Nil	Nil
Fungus	nil	nil	nil	nil	nil	nil	Nil	Nil
Lactobacillus species	5×10^5	4×10^5	4×10^5	2×10^5	3×10^5	3×10^5	3×10^5	2×10^5
Total viable bacterial count	2×10^5	1×10^5	1×10^5	2×10^5	2×10^5	1×10^5	3×10^5	1×10^5

Each value is the mean of three replications

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