Protein Fortification of Mango and Banana Bar using Roasted Bengal Gram Flour and Skim Milk Powder

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ABSTRACT

Among the various proportions of roasted Bengal gram flour (RBF) and skim milk powder (SMP), 0, 5 and 10%, the optimized level was selected for the preparation of mango and banana bar, respectively. The effect of acidity (0.30, 0.45 and 0.60 %, as citric acid) and TSS (20, 25 and 30 ^{O}brix.) was studied on the sensory attributes (colour, texture, flavour and over all acceptability) of fortified mango and banana bars. The results indicated that 5 % level of RBF and SMP in mango and banana bar, respectively gave better sensory attributes. The acidity and TSS, adjusted to 0.60% & 30 ^{O}brix for fortified mango pulps and 0.45% & 25 ^{O}brix for fortified banana pulps resulted into the products of superior quality in terms of sensory attributes. The fortified bars were found to be richer in protein and minerals in comparison to plain bars and also found to be superior in terms of over all acceptability (OAA) having score of 8.5 and 8.1 in comparison to plain mango and banana bar with the sensory OAA score of 7.8 and 7.5, respectively.

Keywords: Fruit bar, fruit leather, fortification, protein, India

INTRODUCTION

Mango and banana is the major fruits crop and occupies vast area for production worldwide, but post harvest losses have been reported to be very high (Srinivas et al., 1997). These losses can be minimized from the value addition of these fruits into the products of great importance to the society and industry. Mango and banana bars are important products, prepared traditionally from unmarketable, but sound ripe fruits. Traditionally, sun drying technique is employed for preparing mango bar results into the dark brown product due to the unhygienic and lengthy process and coincidence of rainy season (Rameshwar, 1979) with the ripening of mango fruits. Cabinet drying process was optimized for the plain mango bar (Heikal et al., 1972 and Mir and Nath, 1995a). Blended mango pulp with other fruits like banana, guava, papaya, jamun or pineapple was used (Mathur et al., 1972). Mango-pineapple bar has been reported to be superior to other samples. All the varieties are not suited for the preparation of bar (Nanjundaswamy et al., 1976). Thick pulpy varieties yielded better product and thin pulps required blending with other constituents for the preparation of product like bar. Blending with other constituents may change the physico-chemical properties of the desired products and intermediate products. The quantity of various additives, to be added may be required differently. To the best of my knowledge, no attempts have been made to study the changes in the various properties after blending. Therefore, in this present study, attempts were made to explore the physico-chemical properties of the finished and intermediate products and to optimize the level of total soluble solids (TSS), citric acid (CA) and various other constituents to be blended.

2. MATERIALS AND METHODS

Mango (*Mangifera indica* L) cv. Totapuri, banana (*Musa paradisiaca*) cv. Pachbale, roasted Bengal gram (*Cicer arietinum*) flour and skim milk powder (SMP) were obtained from reliable sources.

Fruit bars were prepared from pulp of soft ripe fruits. The mango and banana were washed, peeled, pulped. The pulps were acidified to 0.3 % CA, heated for 5 min. at 85 ^{O}C to destroy enzymes, cooled, sulphited with 1000 ppm of SO_2 and stored in 5 Kg glass containers at 11±1 ^{O}C for its further use. A portion of unsulphited but pasteurized pulp was packed in polyethylene sherephthalate (PET) containers at –18 ^{O}C.

The different proportions of RBF and SMP (0, 5 and 10 %) were incorporated for the optimization of the respective level of RBF and SMP usage in the bar preparations. Total soluble solids of pulps were raised to different levels (20, 25 and 30 %) using powdered cane sugar. Acidity were adjusted (0.30, 0.45 and 0.6 %) using citric acid to the pulps and blends which were spread uniformly on stainless steel trays (tray load 12.5 kg/m^2), and dried in a cross flow cabinet drier at 70±1^{0}C for a prescribed interval of time (14-16 hrs for mango bars and 18 hrs for banana bars) as optimized by Prasad et al., (2002). Dried sheets were cut into rectangular (3.5×10 cm^2) bars, packed in poly propylene (PP) pouches and stored at refrigerated temperature (11±1 ^{O}C) till subjected to sensory and chemical evaluation.

Samples were analyzed for moisture by using vacuum oven method, protein by micro-Kjeldahl method, fat by Soxhlet extraction method and sugars by Lane and Eynon method (Ranganna, 1986). Beta-carotene and total carotenes were estimated by AOAC (1975) methods. Total ash, acidity, calcium, phosphorus and iron were determined by the procedure described by the Ranganna (1986). Sensory evaluation of the samples was carried out at nine point hedonic scale (Amerine et al., 1965) and the sensory data were subjected to analysis of variance (Rangannna, 1986).

3. RESULTS AND DISCUSSION

The proportions of RBF and SMP at different levels 0, 5 and 10 % were incorporated in mango and banana pulp in order to achieve better sensory attributes of the finished products (Table 1&2). It was observed that RBF at the level of 5 % showed significant difference in terms of dehydration behaviour (Prasad et al., 2002) and colour from the 0 to 10% level, whereas the mean texture, flavour and over all acceptability (OAA) values at 5 % level were significantly ($P \leq 0.05$) higher than the products obtained at the level of 10 % (Table 1). From the incorporation of SMP, at the level of 5 %, the colour and OAA were increased significantly; whereas further incorporation did not show any significant improvement in the sensory quality of banana bar (Table 2). Therefore, RBF and SMP both were optimized in their proportion at the level of 5 % for the incorporation in mango and banana pulps, respectively.

Addition of citric acid (CA), to adjust the acidity in the ratio of 0.30, 0.45 and 0.60 affected significantly (Table 1) all the sensory attributes (colour, texture, flavour and OAA). The colour, flavour and OAA of the bars were improved significantly ($P \leq 0.05$) upon addition of CA to a level of 0.6 %. This may be due to increased liberation of SO_2 from KMS at lower pH and subsequent inhibition of browning. The texture was found to improve on addition of CA. Addition of CA to a level of 0.45% in banana pulp improved the colour, texture and OAA (Table

2) significantly (P≤0.05) as compared to 0.3 and 0.6 %. Higher addition of CA in banana pulp resulted into a product of excessive acidic taste, very soft and sticky.

Table 1. Effect of addition of sugar, citric acid and RBF on sensory attributes of mango bars.

Ingredients (%, w/w)	Mean sensory score[1]			
	Colour	Texture	Flavour	OAA
RBF				
0	7.10^{b}	7.80^{a}	7.90^{a}	7.60^{a}
5	7.92^{a}	7.94^{a}	8.14^{a}	8.00^{a}
10	5.92^{c}	6.02^{b}	6.36^{b}	6.10^{b}
SEM	0.026	0.117	0.215	0.035
C.D. (at P≤0.05)	0.439	0.931	1.262	0.509
Citric acid[2]				
0.30	6.90^{b}	6.12^{c}	7.26^{b}	6.76^{b}
0.45	7.52^{ab}	7.12^{b}	8.10^{ab}	7.58^{a}
0.60	8.38^{a}	8.22^{a}	8.32^{a}	8.20^{a}
SEM	0.173	0.059	0.118	0.085
C.D. (at P≤0.05)	1.132	0.661	0.935	0.793
TSS[2]				
20	6.50^{a}	5.50^{b}	6.94^{c}	6.31^{b}
25	7.40^{a}	7.18^{a}	7.44^{b}	7.34^{a}
30	7.42^{a}	8.24^{a}	8.54^{a}	8.07^{a}
SEM	0.159	0.210	0.011	0.074
C.D. (at P≤0.05)	1.085	1.247	0.285	0.740

[1]Maximum score 9.0, scores within a column having one common subscript do not differ significantly (P≤0.05) when subjected to analysis of variance.
[2]Ingredient added to maintain the specified concentrations

Total soluble solids of fortified mango pulp were raised to 20, 25 and 30 ^{O}brix in order to reduce the drying period. Sensory colour was not affected significantly from the enhancement of TSS from the level of 20 to 30 ^{O}brix (Table 1). Significant changes in texture and OAA were observed on increasing TSS to 25 %, thereafter-insignificant increase was observed. The sensory flavour score also increased significantly from the increase in TSS up to 30 % (Table 1). Significant decrease in colour was noticed by changing the TSS in fortified banana pulp from 25 to 30 ^{O}brix (Table 2). The texture, flavour and OAA scores were better (P≤0.05) when TSS rose to 25 % in comparison to 20 and 30 %. At 30 % TSS level the product was very soft, too sweet and had problem in removal from the tray.

Table 2. Effect of addition of Sugar, citric acid and SMP on sensory attributes of banana bars.

Ingredients (%, w/w)	Mean sensory score[1]			
	Colour	Texture	Flavour	OAA
SMP				
0	7.30^{b}	7.18^{a}	7.86^{a}	7.44^{b}
5	8.08^{a}	8.02^{a}	8.38^{a}	8.16^{a}
10	8.00^{a}	7.66^{a}	7.62^{a}	7.76^{ab}
SEM	0.034	0.151	0.201	0.054
C.D. (at P≤0.05)	0.502	1.057	1.220	0.632
Citric acid[2]				
0.30	6.18^{b}	6.76^{b}	7.60^{a}	6.85^{b}
0.45	7.48^{a}	7.66^{a}	8.18^{a}	7.57^{a}
0.60	6.90^{ab}	5.56^{c}	6.52^{b}	6.33^{b}
SEM	0.148	0.076	0.053	0.067
C.D. (at P≤0.05)	1.047	0.750	0.627	0.704
TSS[2]				
20	7.52^{a}	6.12^{b}	6.98^{b}	6.87^{b}
25	7.62^{a}	8.08^{a}	8.14^{a}	7.95^{a}
30	6.48^{b}	6.24^{b}	7.20^{b}	6.64^{b}
SEM	0.060	0.242	0.043	0.030
C.D. (at P≤0.05)	0.667	1.339	0.564	0.471

[1]Maximum score 9.0, scores within a column having one common subscript do not differ significantly (P≤0.05) when subjected to analysis of variance.
[2]Ingredient added to maintain the specified concentrations

The lesser TSS in banana pulp for the preparation of bar than the mango pulp may be due to the compositional differences (Table 3). Therefore, TSS level were optimized to 30 and 25 ^{O}brix for mango and banana products, respectively.

The incorporation of RBF and SMP for the preparation of mango and banana fortified bar, respectively resulted into the product of richer in protein and mineral content (Table 3). Similar results were obtained in the other studies conducted on incorporation with the soy protein and coconut powder fortified mango bar (Mir and Nath, 1993; Mir and Nath, 1995b) and soy protein isolate and whey protein concentrate in guava pulp for the preparation of different product to combat against malnutrition problem (Sethi et al., 2007). Fortified and the plain mango and banana bars, prepared under optimized conditions were subjected to sensory evaluation for OAA. The fortified mango and banana bars were found to be superior in terms of OAA having score of 8.5 and 8.1 in comparison to plain mango and banana bar with the sensory OAA score of 7.8 and 7.5, respectively.

Table 3. Chemical constituents of Mango pulp, Banana pulp, RBF, SMP, PMB, Mango-RBF bar, PBB and Banana-SMP bar.

Constituents	Mango Pulp	Banana Pulp	RBF	SMP	PMB*	Mango-RBF bar	PBB*	Banana-SMP bar
Moisture, %	80.1	74.2	10.2	4.1	13.2	16.2	11.9	12.6
Proteins, N×6.25, %	0.6	1.1	22.7	38.2	2.0	3.44	32	4.4
Fat, %	0.1	0.3	4.9	0.1	0.3	0.5	0.9	0.9
Ash, %	0.7	1.1	2.7	7.2	2.0	2.08	2.2	2.97
Carbohydrate, % by difference	18.5	23.3	59.5	50.4	82.5	77.8	81.4	79.1
Acidity, % CA	0.26	0.10	-	-	1.23	1.27	1.21	1.20
Sugars, %								
Total	15.6	18.1	-	47.80	65.94	59.46	61.88	58.00
Reducing	3.2	5.4	-	46.12	20.71	18.56	50.18	45.10
Calcium, mg %	22	25	52	1382	122	134	128	540
Phosphorus, mg %	23	38	333	998	138	145	192	496
Iron, mg %	2.0	0.4	8.6	1.2	8.9	8.9	1.6	2.1
Residual SO_2, ppm	-	-	-	-	667	689	657	672
Carotenoides, mg %								
Total	3.1	0.1	-	-	12.2	10.1	-	-
Beta	1.5	-	-	-	6.7	6.3	-	-

*PMB – Plain mango bar, PBB - Plain banana bar

4. REFERENCES

A.O.A.C. 1975. Official method of analysis. 12th ed. Association of Official Analytical Chemists, Washington DC.

Amerine, M. A., Pangborn, R. M. and Roessler, E. B. 1965. *Principles of sensory evaluation of food* . Academic Press Inc. New York. 602 p.

Heikal, H. A., El-Sanafiri, N. Y., Shooman and M. A., 1972. Some factors affecting quality of dried mango sheets. *Agricultural Research Review,* 50, 185-194.

Mathur, V. K., Das, S. A., Jayaraman, K. S. and Bhatia, B. S. 1972. Preparation of fruit bars for use in combat rations. *Indian Food Packer,* 26, 33-35.

Mir, M. A. and Nath, Nirankar, 1993. Storage changes in fortified mango bars, *J. Food Sci. Technol.*, 30(4), 279-282

Mir, M. A. and Nath, N., 1995a. Loss of moisture and sulphur dioxide during air cabinet drying of mango puree, *J. Food Sci. Technol.*, 32**,** 391-394.

Mir, M. A., Nath, Nirankar, 1995b. Sorption isotherms of fortified mango bars, *J. Food Engg.*, 25(1), 141-150.

Nanjundaswamy, A. M., Shetty, G. R. and Saroja, S., 1976. Studies on the development of newer products from mango. *Indian Food Packer*, 30(5), 95-102.

Prasad, K, Nath, N. and Nanjundaswamy, A. M., 2002. Dehydration behaviour of plain and fortified mango pulps in the preparation of bars. *Journal of Tropical Agriculture and Food Science.* 30(1): 83-88.

Rameshwar, A. 1979. Tandra (mango leather) industry in Andhra Pradesh. *Indian Food Packer*, 34(3), 64 – 71.

Ranganna, S., 1986. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. (2nd edn.) Tata McGraw Hill Publ. Co., New Delhi, India. 1112 p.

Sethi, V., Vasudeva, K.R., Sethi, S. and Singh, G. 2007. Diversified use of guava to combat malnutrition. *Acta Hort*, 735:609-619.

Srinivas, R. N., Venkatesh Reddy, T., Ravi, P. C. Achoth, L. and Chinnappa Reddy, B. V. 1997. Post harvest loss assessment of 'Totapuri' and 'Alphonso' mangoes. *J. Food Sci. Technol.*, 34, 70 – 72.