

DEVELOPMENT OF PROTEIN ENRICHED FUNCTIONAL FRUIT BAR

ABSTRACT

Food Enrichment and fortification are the most cost effective and sustainable strategies to address micronutrient malnutrition. The present study was conducted to standardize the protocol for preparation of sapota-papaya fruit bar and to enhance the nutritional value by fortifying with whey protein concentrate. Sapota, Papaya and a mixture of Sapota: Papaya pulp in 1:1 ratio were blended with sodium alginate, citric acid and whey protein concentrate and the mixture was dried in a mechanical tray drier at $60 \pm 2^\circ\text{C}$ for 14 h. The bars were graded on the basis of sensory evaluation. The quality of fruit bars were subjected to chemical analysis, texture profile analysis and microbial analysis. The protein content of the fruit bars ranged from 2.1% to 2.5%. The products developed from this study aims to enhance the bioavailability of fibre and protein in human diet.

Key words: Food Enrichment, Fortification, Fruit bars, Malnutrition, Fruit leather

INTRODUCTION

India is the second largest producer of fruits, as well as vegetables, (FAO,UN). India's horticulture production is estimated to have risen annually by 1.37 per cent to 351.92 million tonne in 2022-23 due to better productivity.

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The major fruit growing states in India are Maharashtra, Tamil Nadu, Karnataka, Andhra Pradesh, Bihar, Uttar Pradesh, Madhya Pradesh and Gujarat (MIDH, 2013-14). Fruits, known to be excellent source of energy, minerals, vitamins, bioactive compounds and fibres play a unique role in meeting the nutritional needs of our population. The importance of fruits in our diet therefore increases manifold. The post harvest losses of fresh fruits is estimated to be 20- 30 %. One of the best ways of utilizing and preserving fresh fruits is processing them into various products such as fruit juices, concentrates, canned fruits, jam, jellies, leather etc.

Sapota is from the Sapotaceae family with a diverse and significant range of 700 species and 35 to 40 poorly defined genera (Peiris, 2007). The largest producers of sapota in the world are India,

Mexico, Guatemala, and Venezuela (Athmaselvi *et al.*, 2014; Saxena, 2014; Hiwale, 2015). The fruit is a good source of digestible sugar (15-20%) protein, fat, fibre and minerals .

India is also the largest producer of papaya, contributing 42% of world production from 30% of the global area under papaya cultivation as per FAO report for 2012 (IIFPT, 2020). This nutritious fruit, ranks first among 13–17 fresh fruits for vitamin C content per 100 g edible portion. It is an excellent source of provitamin A (carotenoids), which is important for eye sight, helping to prevent early blindness in children. Papaya has more carotene compared to apple, guava and plantain, which helps to prevent damage by free radicals as reported by Hewajulige and Dhekney (2016).

Fruit leather is a dried fruit treat, chewy and flavourful. Fruit leather, bar or slab is the term used for the products prepared by dehydration of fruit pulp with or without acid and sugar. When water is removed from fruit pulp by drying, sugars, acids, fibre and many vitamins and minerals become concentrated in the remaining solid part of the fruit bar/leather. This makes dried fruits, high in sugar and other nutrients (Ayotte,1980).Whey proteins are widely used as food ingredient due to their nutritional properties and functional properties (Morr *et al.*, 1993).This protein has a biological value (BV) that exceeds that of egg protein (by 15 percent) and other high protein foods (meat, soy and casein). It is one of the good sources of protein, which can be fortified in fruit pulp. Smithers, (2008) reported that whey protein is a rich source of essential amino acids when compared to other typical food proteins and is rich in branched chain amino acids (leucine, isoleucine, and valine >20%, w/w). These amino acids are believed to be metabolic regulators in protein and glucose homoeostasis and lipid metabolism and may play a role in weight control (Smilowitz, *et al.*, 2005; Zemel, 2004). Fortification of fruit bar with whey protein from baelfruit has been tried by different researchers. (Parimita and Arora, 2015)

Thus the present trial was under taken to develop fruit bars with different combinations of papaya, sapota ,combination of sapota and papaya and fortify with whey protein concentrate.

MATERIALS AND METHODS

Materials

In this study fruit bars were prepared using papaya,sapota , WPC₈₀ sugar,sodium alginate and citric acid.

Formulation of the fruit bars

Three different fruit bars, Papaya bar (Sample A), Sapota bar (Sample B and 1:1 ratio of Sapota - Papaya (Sample C), were formulated as given below.

Table 1 : Ingredient composition of the fruit bars

Samples	Papaya(%)	Sapota(%)	Whey protein concentrate(%)	Citric acid(%)	Brix°	Sodium alginate(%)
A	100	---	2	0.5	25-30	0.5
B	---	100	2	0.5	25-30	0.5
C	50	50	2	0.5	25-30	0.5

Methodology

The fruits were subjected to pretreatments such as washing, weighing, peeling, cutting and grinding. For enrichment of protein, 2% whey protein concentrate (WPC₈₀) was added to the fruit pulps mixed thoroughly and heated. Cane sugar was added to fruit pulp to adjust TSS to 25 ° Brix. Pulp acidity was adjusted to 0.5 per cent using citric acid. Sodium alginate at 0.5% was added to the pulp. The prepared pulp was spread in the form of thin layer up to 1cm on greased aluminum trays and placed in tray dryer at 60°C 14 hours.

The dried sheets were cooled and cut in rectangular pieces of 8 × 4 × 0.5 cm. The cut pieces were wrapped in a butter paper, packed and stored in an air tight container.

Chemical Analysis

The Nutritional parameters like Moisture, Fat, Protein, Fiber and Ash of the three fruit bars were analyzed as per the methods described in AOAC (1990).

Textural analysis

Textural analyzer (Stable micro system, TA-XTplus) was used for textural analysis, of the fruit bars



Picture 1 : Textural Analyser (TA-XTplus)

Sensory analysis: Protein enriched functional fruit bars were organoleptically evaluated by semi-trained panelists of the institute. The Fruit bars were judged for various sensory attributes using 9 point hedonic scale. The parameters included were appearance, colour, texture, sweetness, flavour, mouthfeel and overall acceptability. The average of the scores awarded by the panelists were recorded as mean value for sensory score.

Microbial Analysis: Total viable count, Coliform count, Yeast and mould counts of processed samples were determined by the method described by American Public Health Association (APHA), 1984.

RESULTS AND DISCUSSION



Fig 1 Papaya bar



Fig 2 Sapota bar



Fig 3. Sapota - Papayabar

Protein enriched functional fruit bars were analyzed for protein, fat, fibre, ash and moisture content, according to methods described in AOAC (1990) and their results have been summarized below.

Table 2 : Nutritional profile of the Fruit bars

S.No	ATTRIBUTES	PAPAYA BAR	SAPOTA BAR	SAPOTA:PAPAYABAR(1:1)
1.	Protein (%)	2.5	2.1	2.3
2.	Fat (%)	1.6	3.5	3.3
3.	Fibre (%)	8.6	6.6	9.6
4.	Ash (%)	1.3	1.8	1.5
5.	Moisture content (%)	22	20	21

The Moisture percent in the present study is concordant to the work of Ahmad *et.al.*,(2007) who prepared fruit bars from blend of ripe papaya and tomato pulps in the ratio 75:25 on weight basis. They found that the seven different samples of fruit bars had moisture contents in the range of 20.9–22.1%. The nutritional content in the present trial for papaya, sapota and spaota :papaya bars were 1.6, 3.5,3.3 in (%)for fat ;1.3,1.8,1.5 in (%)for ash; 8.6,6.6,9.6 in (%)for fibre thus indicating the high nutrient content of sapota and papaya and is comparable to the findings of Rabeta *et. al.*(2016) who reported sapodilla fruit bars to contain carbohydrates (72.8%), proteins

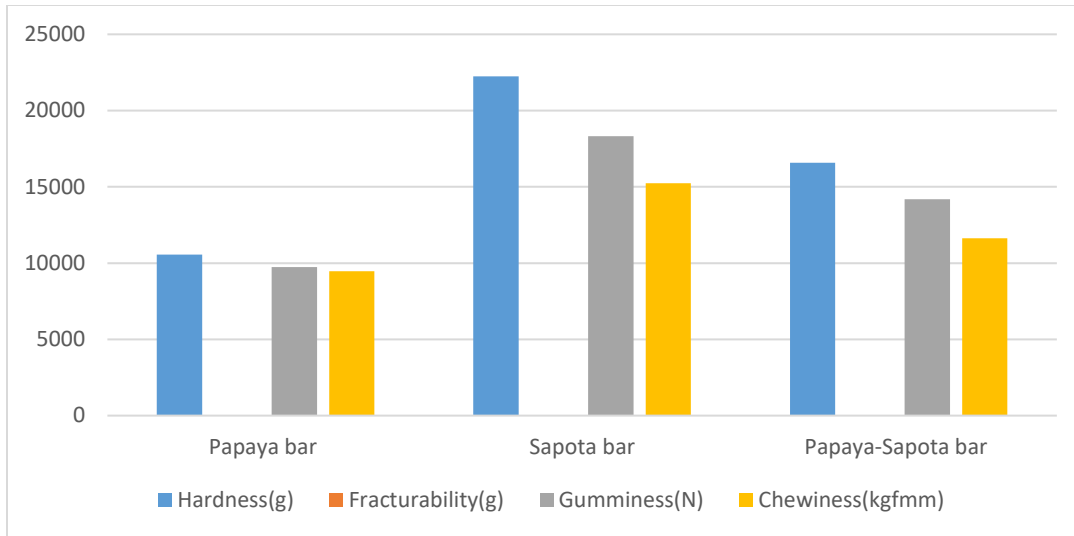
(0.3%), fats (3.2%), fibers (2.5%), ash (1.8%), phenols (169.9 mg GAE/100 g) and calorie (323.0 kcal/100 g).

Textural analysis:

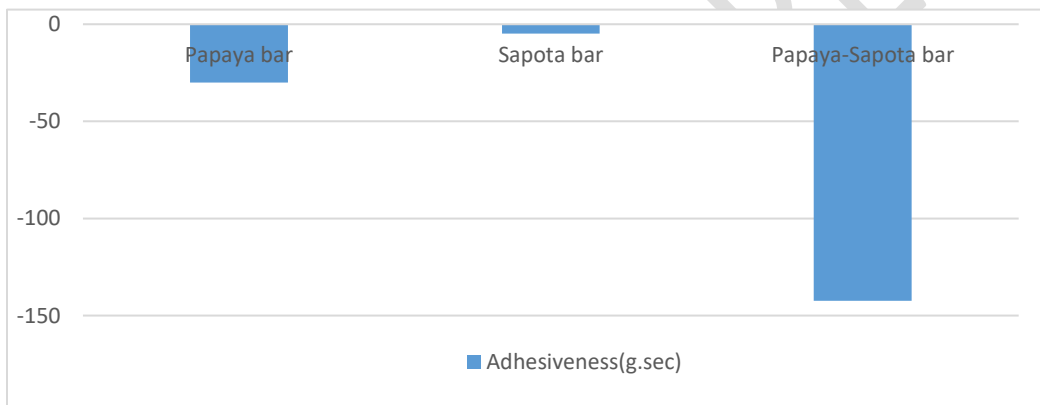
Table 3 : The textural characteristics of the protein enriched functional fruit bars are presented in the table below.

Characteristics	Papaya bar	Sapota bar	Sapota -Papaya bar
Hardness (g)	10560.493	22242.064	16580.894
Fracturability (g)	0	0	0
Adhesiveness(g.sec)	-30.002	-4.820	-142.453
Springiness (mm)	0.973	0.832	0.819
Cohesiveness	0.922	0.824	0.856
Gumminess	9737.798	18325.208	14196.113
Chewiness (kgfmm)	9472.660	15240.767	11630.973
Resilience	0.697	0.632	0.635

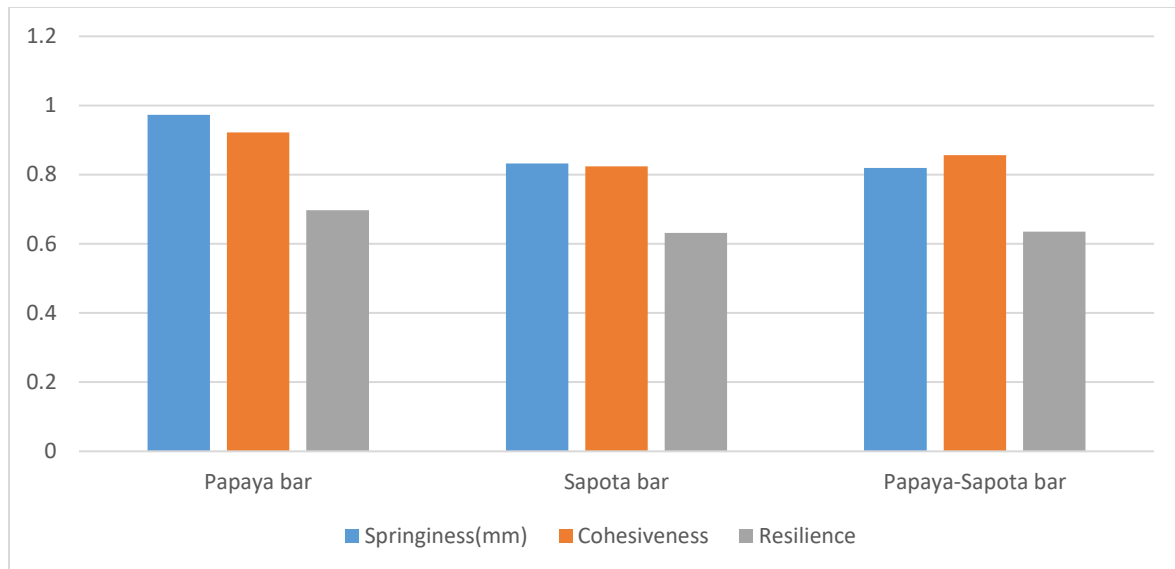
Graph 1 Textural profile analysis (hardness, fracturability, gumminess, chewiness) of different types of fruit bar



Graph 2 : Textural characteristics (adhesiveness) of different fruit bars



Graph 3 : Textural characteristics (springiness, cohesiveness, resilience) of different fruit bars



Hardness was more in sapota bar 22242.064(g) followed by sapota papaya bar 16580.894(g) The fruit bars obtained 0 value for fracturability, indicating semi-solid jelly type product. Similar report of adhesiveness and chewiness with slight variations in sapodilla fruit bar was reported by Rabeta *et.al.*(2016). They reported Hardness value of (1,534 g) with 3% pectin. Similarly, hardness in date bars was reported by Muhammad *et al.*(2012) who used response surface methodology and found that both independent variables contribute towards increase in firmness, upto 2468.56 g in date bars at 0 to 90 days storage intervals

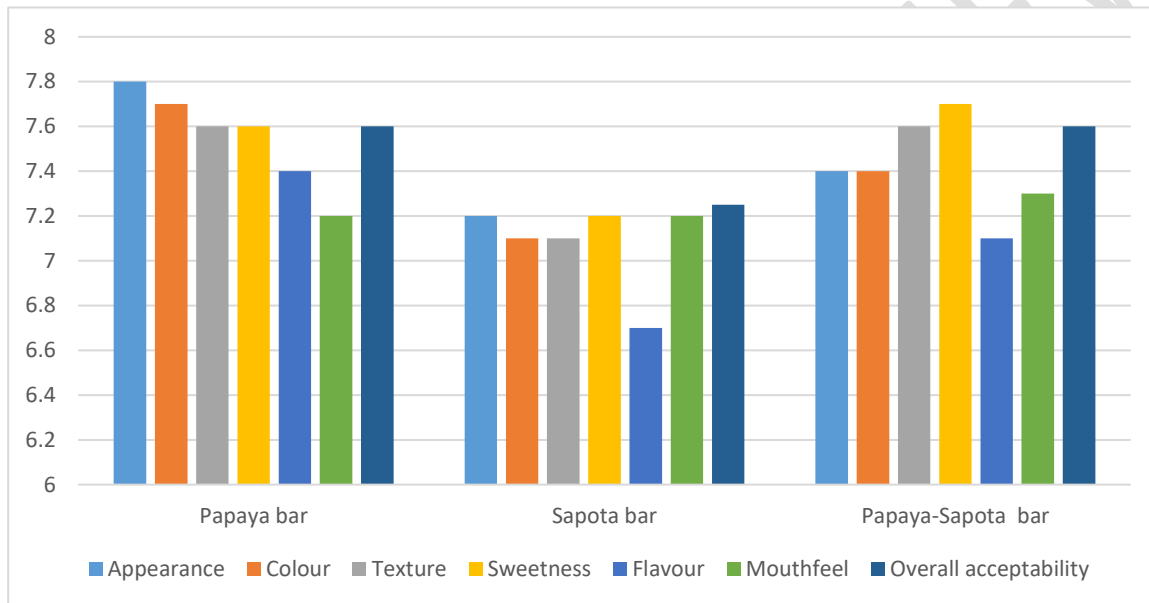
The values for Adhesiveness(g.sec) for papaya, sapota and sapota papaya bar were- 30.002, -4.820 and -142.453 respectively which is in agreement to the work of Rabeta *et.al.*(2016), where the adhesiveness of sapodilla fruit bars containing 2 or 3% pectin was higher than the control ($P < 0.05$). They opined that increasing the pectin concentration increased the cohesiveness of sapodilla fruit bars ($P < 0.05$). The gumminess and chewiness in the present trials increased due to the addition of sodium alginate as a gelling agent. Springiness and Cohesiveness were maximum in papaya bar than sapota and sapota-papaya bar. Gumminess was minimum in papaya bar while other two bars had slight variations.

Similar values for Springiness and chewiness were observed by Rabeta *et.al.*(2016). They observed that addition of 1% pectin increased the springiness and chewiness from 0.422 and 582 (control) to 0.506 and 1125, respectively

. Adhesiveness was maximum in sapota -papayabar in the present study as it was sticky compared to papaya bar.

Sensory Analysis: The prepared protein enriched functional fruit bars (papaya bar, sapota bar and sapota -papaya bar) were evaluated by panelist for sensory characteristics using 9 point hedonic scale. The sensory characteristics evaluated were appearance, colour, texture, sweetness, flavour, mouthfeel and overall acceptability.

Graph 4 : The average mean of score of the sensory characteristics are presented



Sensory characteristic of different types of fruit bars

The sensory evaluation of fruit bars were similar to that of papaya-tomato fruit bar by incorporating hydrocolloids where all the samples of the fruit bar were acceptable in taste, color, and aroma as reported by Ahmad *et. al.*, (2005). These parameters were also in tandem to the sensorial quality of fig mango bar reported by Pawase *et. al.*, (2017), sensory characteristics of dehydrated guava by Mohammad Ayub *et. al.*,(2005) and development of fruit bar using apple-banana pulp supplemented with Omega-3 fatty acid by Parimita and Arora (2015).

From the results of this trial ,the fruit bar containing sapota and papaya in the ratio 1:1 had an appreciable overall acceptability for sensory qualities as evaluated by semi-trained panelist.

Microbial Analysis: Total count is an index of quality of intermediate moisture food, and a high count indicates contamination of the product during handling and processing. The viable count for papaya, sapota and mixed bar were 55×10^9 , 50×10^9 and 60×10^9 respectively.

Coliform and yeast and mold were not detected in the fruit bars. Similar results for yeast & mould count and coliform count on apple-banana fruit bar were reported by Parimita and Arora (2015).

Conclusion

Sapodilla and papaya being a good and cheap source of vitamins and other nutrients, are underutilized as a functional food compound. Effective processing can preserve a significant content of the nutrient in the form of fruit bars. The protein enriched bars with stabilizers helps to prolong shelf life, as well as to improve the texture of fruit bars without significantly affecting the nutritional value and color. Hence whey protein enriched fruit bars can act as an effective food fortified and enriched source especially for children.

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