Asian Journal of Current Research

Volume 9, Issue 3, Page 65-72, 2024; Article no.AJOCR.12189
ISSN: 2456-804X

Development of Protein Enriched Functional Fruit Bar

A. Ayisha Sithika [a++] and Rita Narayanan [a#*]

[a] *Department of Food Processing and Technology, College of Food and Dairy Technology, TANUVAS, Ch-52, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Author AAS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors RN and AAS managed the analyses of the study, managed the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/ajocr/2024/v9i38747

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.ikprress.org/review-history/12189

Original Research Article

Received: 16/04/2024
Accepted: 19/06/2024
Published: 26/06/2024

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± 2ºC 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.

[++] *B. tech (Food Technology);*
[#] *Professor and Head;*
**Corresponding author: E-mail: ritanarayanan@yahoo.com;*

Cite as: *Sithika, A. Ayisha, and Rita Narayanan. 2024. "Development of Protein Enriched Functional Fruit Bar". Asian Journal of Current Research 9 (3):65-72. https://doi.org/10.56557/ajocr/2024/v9i38747.*

Keywords: Food enrichment; fortification; fruit bars; malnutrition; fruit leather.

1. 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. (https://economictimes.indiatimes.com/news/economy/agriculture/horticulture)

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 [1]. The largest producers of sapota in the world are India, Mexico, Guatemala, and Venezuela [2-4]. 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 [5].

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 [6]. Whey proteins are widely used as food ingredient due to their nutritional properties and functional properties [7]. 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, [8] 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 [9,10]. Fortification of fruit bar with whey protein from baelfruit has been tried by different researchers. Parimita and Arora, [11].

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.

2. MATERIALS AND METHODS

2.1 Materials

In this study fruit bars were prepared using papaya, sapota, WPC_{80} 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.

3. METHODOLOGY

The fruits were subjected to pretreatments such as washing, weighing, peeling, cutting and grinding. For enrichment of protein, 2% whey protein concentrate (WPC_{80}) was added to the fruit pulps mixed thoroughly and heated. Cane sugar was added to fruit pulp to adjust TSS to 25 ^{o} 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℃ 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.

3.1 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 [12].

3.2 Textural Analysis

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

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.

4. RESULTS AND DISCUSSION

Protein enriched functional fruit bars were analyzed for protein, fat, fibre, ash and moisture content, according to methods described in AOAC [12] and their results have been summarized 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

Picture 1. Textural analyser (TA-XTplus)

Fig. 1. Papaya bar

Fig. 2. Sapota bar

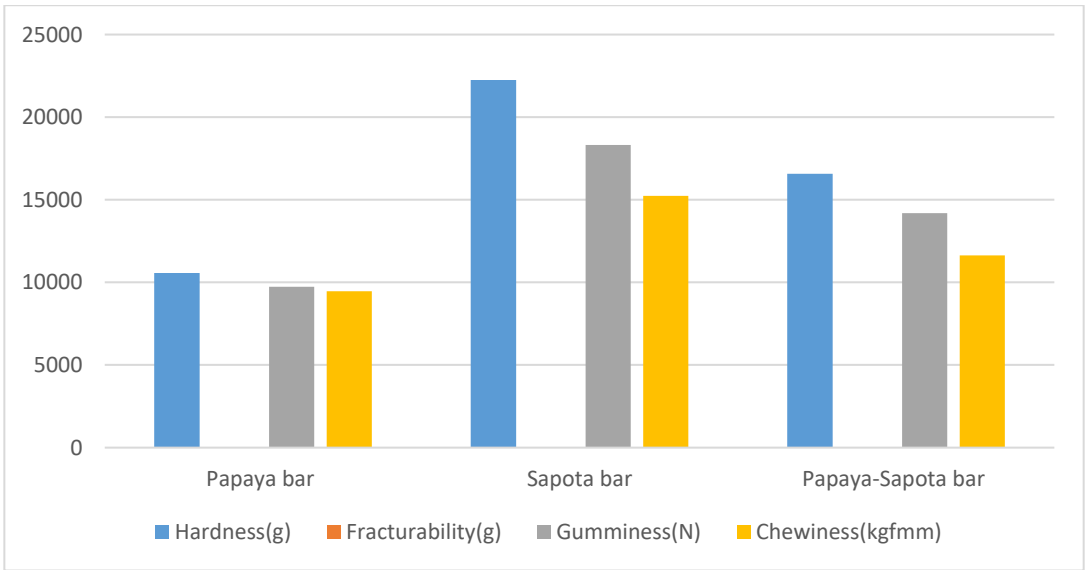
Fig. 3. Sapota- Papayabar

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

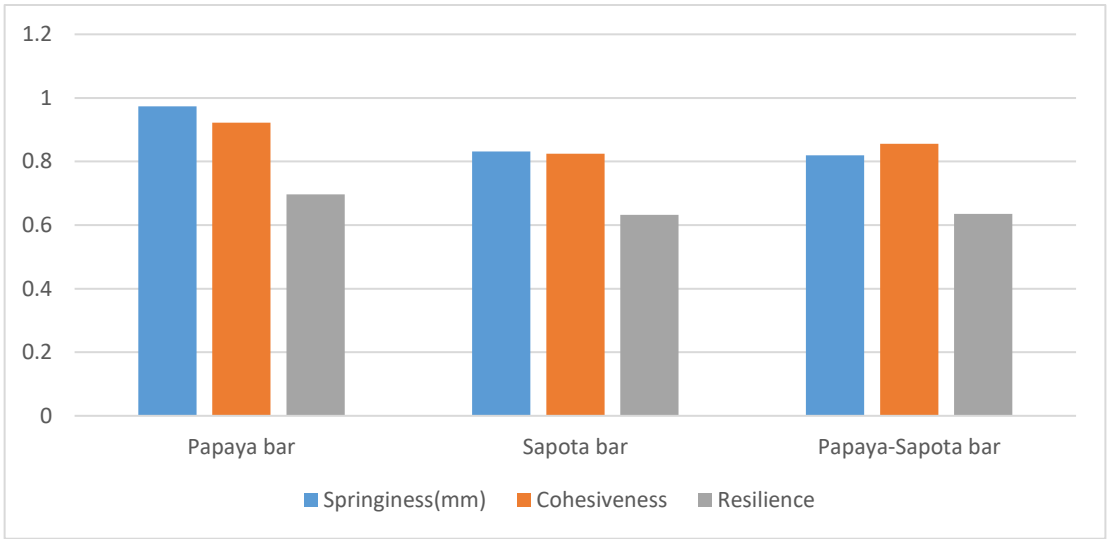
Table 3. The textural characteristics of the protein enriched functional fruit bars are presented in the table below

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

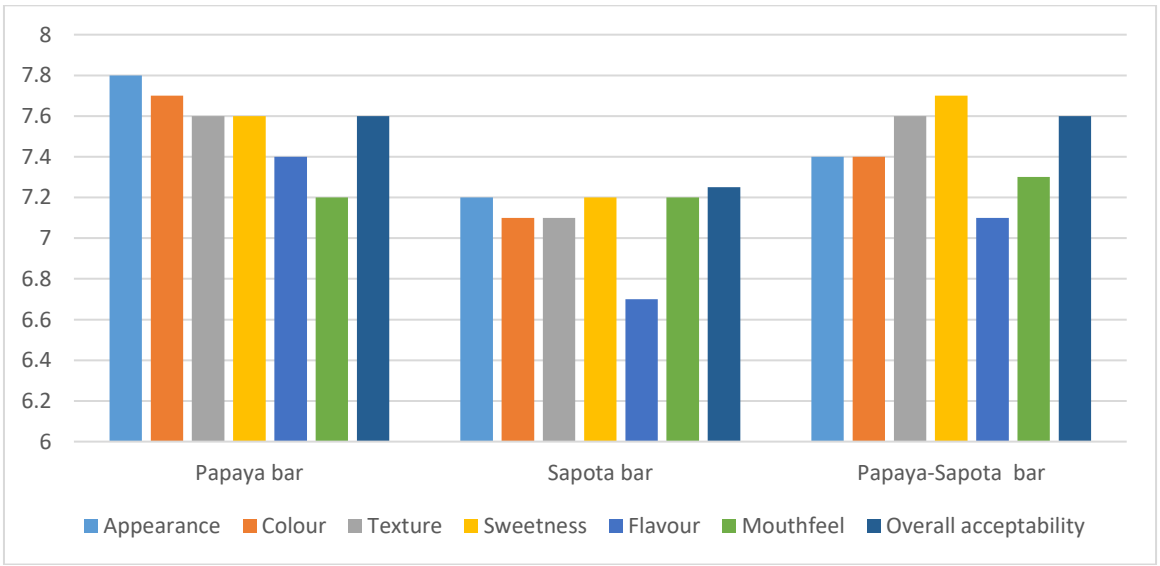


Graph 1. Textural profile analysis (hardness, fracturability, gumminess, chewiness) of different types of fruit bar

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



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



Sensory characteristic of different types of fruit bars

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

The Moisture percent in the present study is concordant to the work of Ahmad et.al., [13] 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.* [14] 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).

4.1 Textural Analysis

Hardness was more in sapota bar 22242.064(g) followed by spaota 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.* [14]. They reported Hardness value of (1,534 g) with 3% pectin. Similarly, hardness in date bars was reported by Muhammad *et al.* [15] 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 spaota papaya bar were-30.002, -4.820 and -142.453 respectively which is in agreement to the work of Rabeta *et.al.* [14] 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.* [14]. 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.

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.,* [16] sensory characteristics of dehydrated guava by Mohammad Ayub *et. al.,* [15] and development of fruit bar using apple-banana pulp supplemented with Omega-3 fatty acid by Parimita and Arora [11].

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 [17-19].

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 [20,21].

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 [11].

5. 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.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Peiris K. Sapodilla Manilkara zapota L. p.183–224. In: D.K.N.G. Pushpakumara, H.P.M. Gunasena, and V.P. Singh (eds), Underutilized fruit trees in Sri Lanka. van Royen Publisher: World Agroforestry Centre, South Asia Office, New Delhi, India; 2007.
2. Athmaselvi K, Pandian Jenney C. Pavithra and Ishita Roy, Physical and biochemical properties of selected tropical fruit. Int. Agrophys. 2014;28:383-388.
   Doi: 10.2478/intag-2014-0028.
3. Saxena M. Handbook on horticulture statistics. Government of India Ministry of Agriculture Department of Agriculture and Cooperation: New Delhi; 2014.
4. Hiwale S. Sustainable horticulture in semiarid dry lands. Springer; 2015.
5. Hewajulige IGN, Dhekney SA. Papayas. The Encyclopedia of Food and Health. 2016;209-212.
6. Ayotte E. Fruit Leather, Publication no. P-228, University of Alaska Cooperative Extension Service, Fairbanks, Alaska, USA; 1980.
7. Morr C, Ha E. Whey protein concentrates and isolates: processing and functional properties. Critical Reviews in Food Science & Nutrition. 1993;33(6): 431-476.
8. Smithers GW. Whey and whey proteins from ‘gutter-to-gold’. International Dairy Journal. 2008;18 (7):695-704.
9. Smilowitz JT, Dillard CJ, German JB. Milk beyond essential nutrients: The metabolic food. Australian Journal of Dairy Technology. 2005;60:77–83.
10. Zemel MB. Role of calcium and dairy products in energy partitioning and weight management. American Journal of Clinical Nutrition. 2004;79(Suppl.):907S.
    DOI:10.1111/jfpp.12806
11. Parimita E, Arora EP. Studies on development of whey protein fortified fruit bar from bael (Aegle marmelos). International Journal of Engineering Studies and Technical Approach. 2015; 1(3):1-8.
12. AOAC. Association of Official Analytical Chemists. Official Methods of Analysis of the Association of Official Analytical Chemists. 15th ed. Arlington VA; 1990.
13. Ahmad S, Vashney AK, Srivasta PK. Quality attributes of fruit bar made from papaya and tomato by incorporating hydrocolloids. International Journal of Food Properties. 2007;8(1):89–99.
14. Rabeta Mohd Salleh, Tee Lee Ying and Leila Mousavi, Development of Fruit Bar using Sapodilla (*Manilkara zapota* L.). Journal of Food Processing and Preservation. 2016;41(2).
15. Mohammad Ayub, Alam Zeb, Javid Ullah and M Muzaffar, Effect of non-nutritive sweeteners, chemical preservatives and antioxidants on microbial and sensory characteristics of dehydrated guava. J.Sc. & Tech. Univ. Peshawar. 2005;29(1).
16. Pawase PA, More DR, Satwadhar PN. Effect of addition of pectin on textural and sensorial quality characteristics of fig mango bar. Journal of Pharmacognosy and Phytochemistry. 2017;6:5.
17. American Public Health Association. Compendium of Methods for the Microbiological Examination of Foods, 2nd ed. APHA, Washington, DC; 1984.
18. Indian Institute of Food Processing Technology Ministry of Food Processing Industries, Govt. of India Thanjavur Project report papaya tutti frutti manufacturing unit; 2020.
19. Muhammad Nadeem, Salim-ur Rehman, Faqir Muhammad AnjumMian and Anjum Murtaza, Development, Characterization,

and Optimization of Protein Level in Date Bars Using Response Surface Methodology. The Scientific World Journal. 2012;(3): 518702.
DOI:10.1100/2012/518702

20. Available:https://economictimes.indiatimes.com/news/economy/agriculture/horticulture-output-rises-to-351-92-million-tonne-in-2022-23)
21. Available:https://midh .gov.in statewise horticulture status

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.ikprress.org/review-history/12189