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A review-based study on fortification of fruit leather with protein enriched products

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Abstract
Fruits are an important part of the diet. According to the Food Safety and Standards Regulations. 2011, fruit leather are dried sheet of fruit pulp which have delicate, is becoming famous for its taste, chewy nature & nutritive worth. They might be eaten as snack food & a solid option for boiled sweets and also utilized in manufacturing cookies, cakes, and ice cream. They are also used in form of form tablets in some Asian companies.

Whey protein is a useful ingredient known for its medical advantages like immunity enhancement, cholesterol decreasing, and reduces blood pressure. It is a decent food supplement for making fruit leather and energy bars. The utilization of whey protein in sports and snack products conveys supplements that have a positive effect on body composition. Mango fruit leather has a benefit for protein advancement attributable to simplicity, lower creation cost, better shopper claim and is popular among children. Fruit leather is dried fruit or dehydrated fruit, high in fibre and carbohydrates, whilst low in fats. Fruit leathers are chewy, have a pleasant flavour, and are consumed as a sweet snack. Due to its appealing nature, dried fruit leathers are another practical way to increase the consumption of solid fruit, especially for children and old age people. Since fruit leathers are concentrated, with a higher nutrient density compared to fresh fruit due to dehydration, this makes them a healthier and convenient alternative snack compared to candies and confections. In addition, fruit leathers contain fewer calories per serving and greater nutritional value in terms of antioxidants and minerals due to the dehydration process concentrating the nutrients; therefore, they are suitably healthy food for health food markets. The lower moisture content of fruit leathers also reduces microbial infestation during storage and transportation. Fortification is the process of adding micronutrients which are present in the food in low quantity or were present in high quantity but got lost during heating or processing. This can be done on the order of government or for personal reasons. Mango fruit leather is fortified with roasted gram flour because children are found to have low levels of protein and gram flour is high in protein.

Keywords: Mango leather, Natal plum, calcium, whey protein, *Aloe vera*

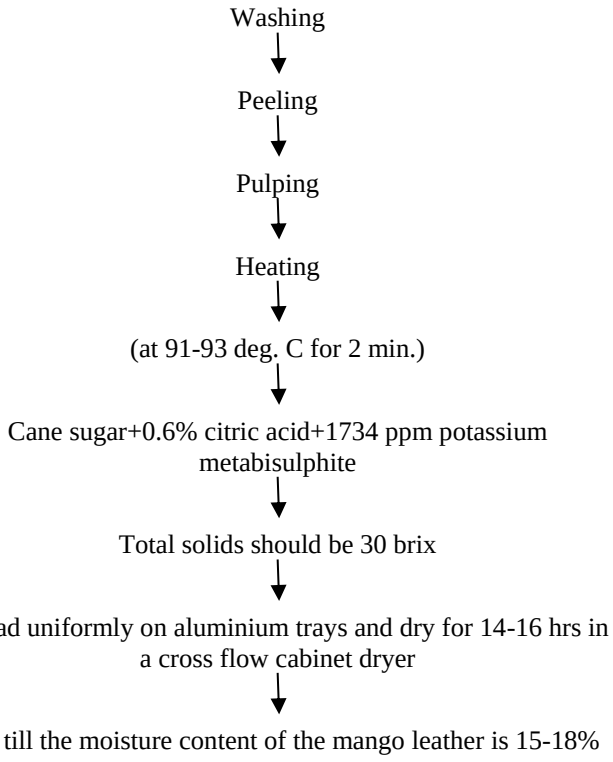
Introduction
Fruit leather or bar means the product prepared by blending pulp/puree from sound ripe fruit, fresh or previously preserved nutritive sweeteners, butter or other vegetable fat or milk solids & other ingredients appropriate to the product & dehydrated to form a sheet that can be desired shape or size.

Fruit leather is a dried or dehydrated fruit that is rich in fibre, carbohydrates and low in fats. Fruit leather can be consumed as a sweet snack as it has a pleasant flavour and is chewy in texture. Because of its attractive nature children, old people love to eat fruit leather and even those communities which are affected by war or any natural disaster where food is insecure.

Fruit leather is concentrated, with a high nutrient density as compared to fresh fruit due to the process of dehydration this is why they are considered a healthy snack also fruit leather contains fewer calories per serving. And due to low moisture content microbial activity is less during storage and transportation.

Fortification of kesar mango leather by whey protein
Mango leather offers tremendous advantages for protein enrichment owing to its simplicity, lower production cost better consumer appeal and very popular among children. Food enrichment and fortification are the most cost-effective and sustainable strategies to address the problem of malnutrition.

Preparation



Mango bar fortified with roasted Bengal gramflour

Blending the Mango leather bar with other constituents leads to a significant improvement in the physicochemical properties of the final product studies on fortifying Mango Fruit Leather with Roasted Bengal Gram Flour and observed that TSS (total soluble solids) increases when the final product is being developed. Also, a slight colour difference is observed. Enhancement in Colour and texture is found in the final product with the increase in nutritional quality. The fortified bars are found to be superior in OAA (overall acceptability). They are much richer in minerals and proteins as compared to plain bars after fortification and processing.

Mango fruit leather fortified with sapota

Sapota is a fruit that is consumed freshly or in processed form like Juice, jam and dried worldwide. It is good for health and prevents heart diseases, lungs diseases, asthma, liver cancer etc. Author R.F Chavan and team have developed a Mango-Sapota Mixed fruit bar by mixing their pulp having 70% of the Mango pulp and 30% of the Sapota pulp. The final product has the combined nutritional benefits of both fruits with a good amount of vitamins, fibres, minerals etc. Also, a better texture of bars is produced. They have gained a good taste and mouthfeel with the enhancement of color and flavor of the product. Physio-chemical properties like TSS (total soluble solids), acidity, ph, moisture etc are also much improved for consumption.

Mango fruit leather fortified with amla/Indian gooseberry

Amla is a fruit mainly valued for its pharmacological and nutritional properties. It is rich source of minerals and vital antioxidants like polyphenols and ascorbic acid. These qualities are used in Unani and ayurvedic systems. Author Dr. Deepika and team (in 2017) developed an Mango-Amla mixed fruit bar. They standardized 75% of Mango pulp with 25% of Amla pulp. Adding of amla showed an increase of non-reducing, reducing, total sugars and total soluble solids in the resultant product. Also, enhanced nutrition like dietary source of Vitamin C and amino acids. Increased Quality with increased shelf life of the product. Much improved color and appearance with antimicrobial properties and altered palatability. It has also appropriate softness and texture with much improved sweet taste in it.

Fortification of soy-peach fruit leather

With the increase in population, the demand for protein is also increasing. Soybean is a cheap and good source of protein. Peach is perishable fruit grown in Jammu& Kashmir. As peach is a perishable fruit so it can be spoiled so fast so after the preparation of peach-soy fruit leather the wastage of peach fruit can be avoided. The control peach leather recorded the highest TSS, per cent moisture, titratable acidity, reducing sugar and total sugar as compared to soy-slurry blended peach leather, this blended leather was rich in protein and fats. Peach pulp and soy-slurry leather of ratio recorded a maximum ratio of protein, fats and ascorbic acid contents. The various blends of peach- soy leather exhibited an increase in moisture, TSS, titratable acidity and sugar but a decrease in protein, fat, ascorbic acid contents and all the sensory attributes during four months of storage at room temperature. Based on sensory evaluation, peach pulp and soy-slurry leather was found to be the best among different blends when compared to zero storage as well as after four months of storage. Peach fruit can be blended with the soybean up to 15% to yield nutritious value-added products. These types of products can be kept for a longer duration without adversely affecting their Physico-chemical and sensory properties and by preparing fortified peach fruit products, the processing can fulfil the dual purpose of better use of this fruit and higher returns to the growers successfully.

Protein fortification of mango and banana bar using roasted Bengal gram flour and skim milk powder

Mango and banana is the most important culmination crop and occupies a considerable location for production worldwide, however, put up harvest losses of these crops had been stated to be very high. These losses can be minimized by making products of them like fruit leather. For mango earlier, sun drying methods were used to prepare fruit bars but due to the unhygienic and lengthy process sun drying methods are not more usable, now cabinet drying is one of the methods which is used for the preparation of fruit leather. Thick pulpy varieties yielded better product and thin pulps required blending with other constituents for the preparation of products like the bar. Among the various proportions of roasted Bengal gram flour (RBF) and skim milk powder (SMP) the optimized degree turned into decided on for the practice of mango and banana bar, respectively.

Fortification of *Ficus carica*/*Malus domestica* fruit with *Moringa oleifera*

Fresh fruits namely *Malus domestica*, Manilkarazapota, *Musa paradisiaca*, *Ficus carica* and *Moringa oleifera* leaves were obtained. The fruits were immediately processed into the fruit leather after purchasing. The *Moringa oleifera* powder is employed as an essential component to induce fortification. fresh and clean *Moringa oleifera* leaves were weighed and cleaned with water. The cleaned leaves were then spread over a plate and shade dried for a period. The dried leaves are then powdered using a blender. The powder is then passed through a mesh filter to obtain uniformly sized particles. This powdered form is used as the fortificant.

Fortification of tomato leather with calcium carbonate powder

Tomato was taken and it was fortified with calcium carbonate powder. The highest mean of total protein % was recorded in the experiment. The decreasing trend of total protein content might be due to decreasing concentration of tomato pulp in the final product & pulp contains protein & there is zero protein in calcium carbonate powder. There was significant difference between all the treatments which may be described.

Fortification of guava bar and strawberry bar with sesame protein isolate

Sesame protein isolate is a good source of protein. Hence it could be incorporated as nutritive ingredients in the production of healthy nutritious fruit bars (guava and strawberry). The fortified fruit bars had acceptable quality attributes and improved nutritional value as compared to control fruit bars. Sesame (*Sesamum indicum* L.) is one of the most important and oldest oil seed crops known to man. It is a rich source of oils, protein, carbohydrate, minerals as well as natural antioxidants. Sesame plays an important role in human nutrition, medicinal, pharmaceutical, industrial and agricultural uses.

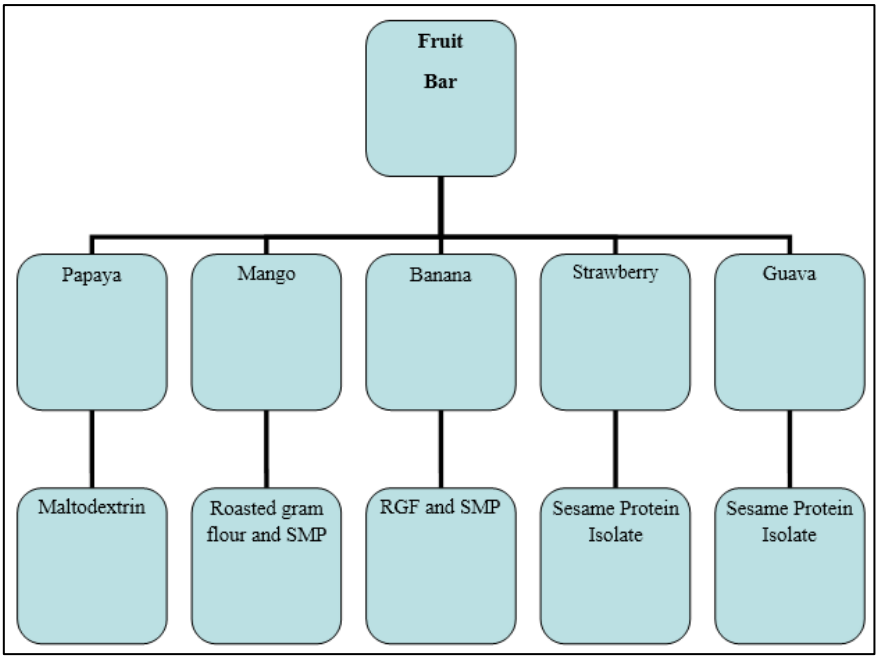


Fig 1: Fruit bar

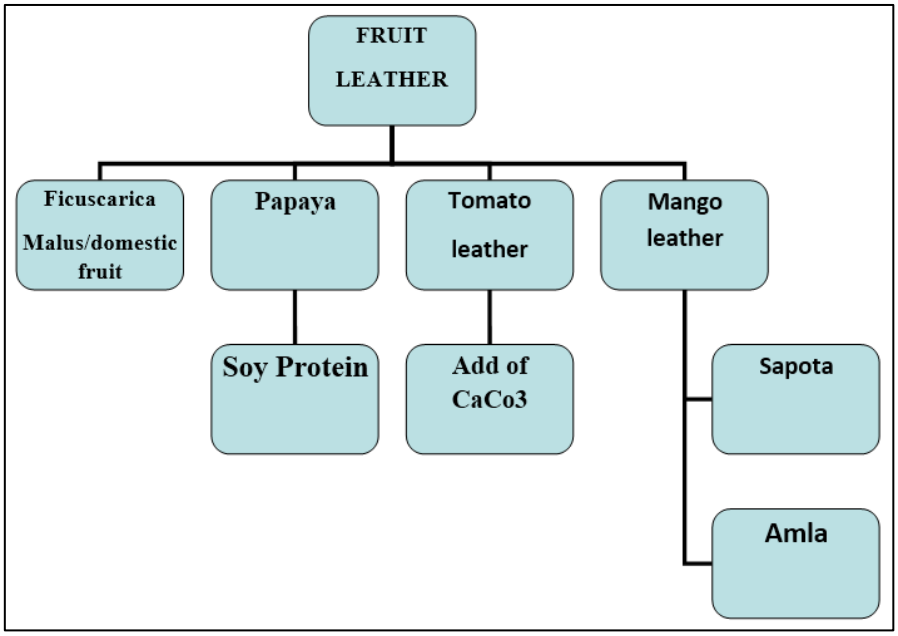


Fig 2: Fruit leather

Fortification of papaya fruit bar with maltodextrin

The basic ingredients used in papaya fruit bar were papaya pulp, defatted soy flour, stevia and maltodextrin. Defatted soy flour increased the protein content of the fruit bar while stevia substituted sugar for giving sweet taste. Maltodextrin replaced sugar in imparting body and texture to the product.

Table 1: Fortification of papaya fruit bar with maltodextrin

Fruit Leather	Method	Protein Content Without Fortification	Protein Content With Fortification	References
Ficus carica/ *Malus domestica*	*Moringa oleifera*	3.3%	3.8%	By Nivedhaa G.K. & Ivoromauld, 2000
Papaya Soy Fruit Leather	Soy Protein	0.32%	1.77%	By Mir, M. A., &Nirankar, N, 2001
Tomato Leather	Calcium Carbonate	2.46%	2.38%	By Madhav, K. Parimita, 2009
Mango Bar	Roasted Gram Flour And Skim Milk Powder	0.6%	3.44%	By Kamlesh, P., 2012.
Banana Bar	Roasted Gram Flour And Skim Milk Powder	1.1%	4.4%	By Prasad, K., 2017.
Kesar Mango Leather	Whey Protein	6.15%	12.91%	By Kumar, N., & Vyas, D. K., 2020
Guava Bar	Sesame Protein Isolate	1.58%	5.38%	By Karayire, A., & Fabien, M., 2021
Strawberry Bar	Sesame Protein Isolate	8.48%	12.15%	By Mir, M. A.,
Papaya Fruit Bar	Maltodextrin	1.98%	2.68%	By Ghimire, R., & Ojha, P., 2016
Mango Leather	Sapota	3.48%	4.56%	By Sakhale, B. K., 2016
Mango Leather	Amla	0.87%	1.3%	By Deepika, D., & Panja, P., 2017.

Conclusion

Mango leather had a lower antioxidant activity and phenolic content compared to Natal plum leather. Increasing amounts of Natal plum in mango–Natal plum leather significantly improved cyanidin components, flavonoids, and antioxidant activity. Mango–Natal plum leather also contained carbohydrates, was high in fibre, and low in sodium, and can therefore be regarded as a potential functional snack. Leather is one such product that is liked by everyone. The leather is prepared from a single fruit or by blending different fruits. Leathers are made by using different types of fruits like Guava, Apple, Mango, Banana, Apricot, Papaya, Pineapple, Kiwi, Grapes, Strawberry etc. The leather is made by washing, peeling and pulping the fruits and then the addition of ingredients like sugar, honey for taste KMS, citric acid to prolong the shelf life, maltodextrin, wheat starch, pectin and gums to prevent the stickiness of the leather. Fruits are a good source of minerals, vitamins, phytochemical compounds and many other essential components which are a major part of our daily diet. Consuming fruits daily results in the building up of the best immune system and keeps the diseases at a distance. India is the major producer of fruits and vegetables among the other countries. To avoid the post-harvest losses the produced fruits are further processed into a different types of value-added products.

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