Int.J.Curr.Microbiol.App.Sci (2022) *11*(06): 402-414

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 11 Number 06 (2022)**
Journal homepage: http://www.ijcmas.com

Review Article https://doi.org/10.20546/ijcmas.2022.1106.046

A Review on Fruit Bar and Fruit Leather as Refreshing Energetic Products

Ashok K. Senapati[1]* and Ajay V. Narwade[2]

[1]*Center of Excellence on Post Harvest Technology, ASPEE College of Horticulture, Navsari Agricultural University, Navsari- 396450, Gujarat, India*
[2]*Department of Plant Physiology, N.M. College of Agriculture, Navsari Agricultural University, Navsari- 396450, Gujarat, India*

**Corresponding author*

Keywords

Proteins, fruit leather or fruit slabs, guava, papaya and banana

Article Info

Received:
08 May 2022
Accepted:
30 May 2022
Available Online:
10 June 2022

A B S T R A C T

An attempt was made to review on bar or leather prepared by using single fruits or blending of different fruits adopting various methods is very well organoleptically acceptable. The fruit bar prepared by blending to maintain the TSS @25ºBrix, 0.5 per cent acidity and 1000 ppm KMS improves the texture as well as higher organoleptic and overall acceptance is best for bar preparation and its storage. The blended bar may be varies according to various fruits and their blending proportion, where as the above combination showed less physico-chemical changes and also showed higher organoleptic score. Fruit bar can be stored better at ambient temperature upto six months.

Introduction

Fruit bar is a product made from fruit pulp that is high caloric and also contains certain vitamins as well as proteins. Fruit bars also called as fruit leather or fruit slabs, are confectionery products prepared from fruit pulps like mango, guava, papaya and banana, etc. Mango fruit bar is the most commercially successful traditional product in India because of its flavour, colour and textural characteristics. The traditional method of preparation of mango bar, also known as 'tandra' (in Telugu) involves extraction of pulp, mixing with jaggery in the ratio of 1:2 to 1:4, and is made from sun drying. These slabs of sun dried product are cut into slices of uniform sizes, wrapped in cellophane paper and marketed (Rameswar, 1979). Drying is one of the oldest methods of food preservation and the aim of drying food is to withdraw enough water to inhibit the chemical and enzymatic reactions but more especially to prevent the microorganisms from developing further. Microorganisms need their nutrients in dissolved (diffused) form in order to grow and therefore foods have to be sufficiently moist for the microorganisms to grow. The microorganisms are by nomeans always killed by drying, some remain alive, but in an inactive stage (spores). When water is taken up, new growth will occur. The withdrawal of water by natural and artificial drying is therefore an effective means of protecting food from microbial decay; however reaction of a particular kind may take place during drying and later in dried food with low water content when it is stored. This takes place at a slower rate but limits the storability of food which are to be stored for a long time. The sorption of water which contains dissolved salts (ions) carbohydrates, protein, acids and so on, is important in the structure of food because during the drying process, the increase in concentration of these dissolved materials, depending on the direction and speed, may lead to various chemical or enzymatic changes: hydrolysis, browning and other chemical rearrangements, protein denaturation or even enzymatic conversion. The characteristic changes which take place in dried food may have the following reason:

Microbes need sufficient water to absorb nutrients from the foodstuffs which they attack. For most microbes, the relative humidity of air (RH) for optimum growth lies between 90 to 100%. The enzymatic reaction, caused by the native enzyme in the food or enzymes from microbes (which have died) occur- much more slowly when the water content below the limits for growth of moulds. In dried fruit and vegetable, native oxidase can regenerate during storage and produce a hay-like aroma and flavouring substances if these enzymes are not completely inactivated by adequate blanching before processing. Purely, the chemical changes play a decisive part in the process of decay in dried (low moisture content) food. Non-enzymatic browning reactions can occur in almost all food when the necessary conditions are fulfilled; the presence of compounds containing reducing sugar and NH2 groups (such as amino acids, proteins), for dried potatoes, tomato powder and dried fruit. Different drying processes used are vacuum drying, microwave drying, hot-air or oven, sun drying, freeze drying etc. (Heimann, 1980). Fruit bar is a nutritional product has a chewy texture similar to dried raisins and is a good source of dietary fibre and natural sugar. Transforming guava and/or papaya pulp into fruit bar is one of the several ways to utilize fruit. Utilizing both these fruits together for preparation of fruit bar has a great opportunity for improvement in product nutritional quality as well as for decreasing production cost. Traditionally, fruit bar is prepared by sun-drying and the product obtained has dark or deep brown colour, carries a lot of dust, dirt and is very sticky. Sun-drying is undesirable from the point of higher production time and the poor quality product. The experiment was conducted with view to standardize guava and papaya based fruit bar. In this context, the relevant research work done in India on development of processed products of guava and papaya as well as other fruit crops has been reviewed briefly as below. An attempt was made to review on bar or leather prepared by using single fruits or blending of different fruits adopting various methods is very well organoleptically acceptable.

Method adopted for the preparation of fruit Bar or Fruit leather

Most of the earlier studies indicated that the process of preparation of fruit bar is almost same in all fruit crops. However, these processes are suitable for making bars with relatively few fruits such as papaya, guava, mango, banana, jack fruit etc. For extraction of the pulp, sound, healthy and ripe fruits were selected and washed with water. After washing and removing the peel and stone, the pulp was extracted by squeezing the fruits by hand. Then, pulp was strained through 1 mm mesh stainless steel sieve. The pulp was then heated to 91-93 0C to inactivate the enzyme. Cane sugar is then added to adjust TSS to 300Brix. Citric acid is then added to the puree to raise the acidity to 0.6%. The blend is sulphited with 1734 ppm potassium metabisulphite (KMS) as per the treatment. Desiccated coconut powder is added to the respective blend according to the treatments. All the blends are spreaded on smeared trays smeared by glycerin/ refined oil at the rate of 9.8 kg/m2. These trays are kept in tray drier at 63±2oC for 14-15 hr. Dried sheets of each blends are cut into rectangular pieces of 3 x 5” size and packed in polyethylene bags and stored at ambient condition. Dried sheets of each blend were cut into rectangular pieces of 3 x 5” size and packed in polyethylene bags. These bags were heat sealed and labeled appropriately with details of treatment and repetitions. During the experiment, packed products were stored at room temperature (20-350C). These were then subsequently used for periodical evaluation, up to a period of six months. The evaluation was done at monthly interval.

Fruit Bar made from single fruit pulp

Mango bar

Mir and Nath (1993) prepared three types of mango bar (plain mango, mango-desiccated coconut powder and mango soy-protein) and stored for 90 days at -18°C, 27±3°C (65% RH) and 38±1°C (92% RH). Results revealed that moisture, acidity and reducing sugar of the mango bars increased significantly during storage in all storage conditions. While, overall acceptability and textural characteristics decreased with enhancement of storage period.

Gowda *et al.,* (1995) reported the preparation and storage of mango fruit bar from Alphanso fruits that are discarded due to small size and irregular shape, by the addition of 20 per cent sugar, 0.2 per cent citric acid and 700 ppm potassium metabisulphite alone or in different proportions. Addition of sugar increased drying time, yield, moisture and sugar content of the fruit bar whereas considerable reduction in non-enzymatic browning and improvement in colour was observed due to the addition of potassium metabisulphite. Results revealed that fruit bar prepared from Alphanso pulp by the addition 20 per cent sugar, 0.3 per cent citric acid and 700 ppm of potassium metabisulphite followed by shade or tray drying produces best quality product having good colour, texture and flavour.

Mir and Nath (1995) studied effect of addition of powdered cane sugar to mango puree for raising the total soluble solids to 30ºB and drying it as plain mango bar, or after adding 4.5% soy protein concentrate or 2% desiccated coconut powder in a cross flow air cabinet drier at 63±2ºC on loss of moisture, and retention of sulphur dioxide has been investigated. They revealed that the total and reducing sugar contents of the plain mango bar and the mango-desiccated coconut powder were higher as compared to the mango-protein concentrate. Therefore, the rate of loss of total sulphur dioxide for the former two samples was lower.

Mir and Nath (2000) prepared fruit bar of mango cv. Langra fruit, by adjusting total soluble solids (TSS) of pulp to 30ºB with powdered cane sugar adding 0.6 per cent citric acid and drying in an air cabinet drier at 63 ± 2ºC for 14 h with addition of 2 per cent desiccated coconut powder (DCP) or 4.5 per cent soy protein concentrate (SPC). Results of the study have shown that mango bar of good acceptability can be prepared by addition of 2 per cent DCP and stored at room temperature (30-36ºC) was found to be acceptable with organoleptic qualities for 90 days.

Rao and Das (2003) prepared mango bar by using the formulations of sucrose, milk powder and maltodextrin. Result of the study revealed that sucrose was found to have greatest influence compared to milk powder and maltodextrin on hardness, chewiness and yellow colour of mango bar. Sangeetha and Lakshmi (2007) developed mango fruit bar from Benganapally variety using solar dried mango powder enriched with soy protein isolate (SPI) and germinated wheat flour (GWF) and were subjected to organoleptic evaluation and nutrient analysis and it was compared with control mixes. Study revealed that the mango fruit bar developed from both the methods was found to be rich in micronutrient and can be given as a supplement for the micronutrient malnutrition with higher organoleptic acceptability.

Prasad (2009b) prepared mango bar using roasted Bengal gram flour and skim milk powder for protein fortification. Among the various proportion of roasted Bengal gram flour (RBF) and skim milk powder (SMP) of 0, 5 and 10 per cent and the optimized level was selected for the preparation of mango bar, respectively. The effect of acidity (0.30, 0.45 and 0.60 per cent, as citric acid) and TSS (20, 25 and 30ºBrix) was studied on the sensory attributes (colour, texture, flavour and overall acceptability) of fortified mango bars.

The results indicated that 5 per cent level of RBF and SMP in mango bar respectively gave better sensory attributes. The acidity and TSS, adjusted to 0.60 per cent & 30ºB for fortified mango pulps resulted into the products of superior quality in terms of sensory attributes. The fortified bars were found to be rich in protein and minerals in comparison to plain bars and also found to be superior in terms of overall acceptability. Sarojini *et al.*, (2009b) studied the fortification of mango bar with soy protein concentrate (SPC), whey protein concentrate (WPC) and pea protein concentrate (PPC). The results show that protein enriched bars were leathery and only whey protein enriched bar was well accepted.

Guava bar

Harsimrat and Dhawan (2001) prepared guava fruit bar from newly developed guava hybrids (H-25-25, H-11-7, and H-3-22) and commercial cultivars (Lucknow-49 and Allahabad Safeda). Based on organoleptic rating, Allahabad Safeda was superior followed by Lucknow-49 and hybrid H-11-7. During storage, sugar and pectin contents (%), acidity (%) and browning increased while ascorbic acid (mg/100gm) contents and organoleptic rating decreased as storage advances.

Papaya bar

Papaya bar preparation was reported by Aruna *et al.*, (1999). They stored it at room temperature (25-45ºC) and the product was evaluated for 9 months. Sensory evaluation of the product revealed that higher deterioration in colour, appearance and texture was found after 6 and 9 months of storage at higher temperature. The product was found to be superior from the textural and odour point of view and with minimum physico-chemical changes up to six months of storage period at room temperature.

Aonla bar

Mishra *et al.*, (2010) standardized process of aonla bar by different levels of sugar-pulp ratio and packed it in PET jars at refrigerated as well as room temperature. Results revealed that aonla bar prepared by 125 gm aonla pulp, 100 gm sugar, 12 per cent glucose, 8 per cent skim milk powder, 8 per cent pectin and 2 per cent sodium alginate was recommended for better sensory scores attributes like colour, flavour, texture and overall acceptability.

Banana bar

The process for banana (cv. Karpuravalli) fruit bar by applying different treatments like addition of 20 per cent sugar + 0.5 per cent pectin + colour, 20 per cent sugar + 0.5 per cent pectin + colour + 0.3 per cent citric acid and plain banana bar without any additives and using potassium metabisulphite at a rate of 350 ppm as a preservative followed by tray drying (Narayana *et al.*, 2007). They packed all the products in polyethylene pouches and stored at room temperature. The study revealed that tasty banana fruit bar could be prepared by mixing 20 per cent sugar + 0.5 per cent pectin + 350 ppm KMS with smoothly blended pulp of Banana cv. Karpuravalli with all acceptable physico-chemical parameters.

Prasad (2009a) prepared banana bar using roasted Bengal gram flour and skim milk powder for protein fortification. Among the various proportion of roasted Bengal gram flour (RBF) and skim milk powder (SMF) at 0, 5 and 10 per cent, the optimized level was selected for the preparation of banana bar, respectively.

The effect of acidity (0.30, 0.45 and 0.60 per cent, as citric acid) and TSS (20, 25 and 30ºB) was studied on the sensory attributes (colour, texture, flavour and overall acceptability) of fortified banana bars.

The results indicated that 5 per cent level of RBF and SMP in banana bar gave better sensory attributes. The acidity and TSS, adjusted to 0.45 per cent and 25ºB for fortified banana pulps resulted into the products of superior quality in terms of sensory attributes. The fortified bars were found to be rich in protein and minerals in comparison to plain bars and also found to be superior in terms of overall acceptability.

Jackfruit bar

Manimegalai *et al.,* (2001) prepared jackfruit bar as per FPO specification using two varieties of jack fruit and packed in butter paper (BP), polypropylene pouches (PP) and metalized polyester low density polyethylene pouches (MPP) and stored at room temperature (30-36ºC) for 6 months. The product stored in MPP recorded higher percentage of nutrient retention and minimum microbial count than product packed in BP and PP at the end of 180 days. The reduction in vitamin-C, β-carotene and total sugar contents were observed in the samples irrespective of packaging materials. The sensory evaluation score values of the bar in MPP were found to be higher than the samples in other packaging materials.

Pineapple bar

Kulshrestha *et al.,* (2008) developed low-calorie and high protein fruit bar from pineapple using defatted soy flour for protein enrichment, stevia as sugar replace and pectin for texture improvement. The result of the study indicated that lower level of defatted soy flour and higher amount of stevia gave higher overall acceptability, while pectin had no significant effect on textural properties of the pineapple fruit bar.

Fruit Bar made from Blended fruit pulp

Blended Bar

Hemakar *et al.,* (2000) used 5, 10, 15 and 20 per cent of guava pulp to prepare mango-guava sheet for improving the texture being a natural source of pectin and maintaining the TSS at 25ºB, acidity 0.5 per cent and sulphurdioxide 1000 ppm. The result revealed that mango-guava sheet prepared with 20 per cent of guava pulp gave a good product with higher organoleptic and overall acceptance on drying followed by 15 per cent of guava pulp.

Bababola *et al.,* (2002) prepared pawpaw and guava leathers. The product was evaluated for effect of cold temperature storage on physico-chemical, microbiological and organoleptic attributes. The result of the study indicated that pawpaw leather was significantly higher than guava leather in calorific content, water activity, pH and total mould count. Guava leather was higher in texture. Beena and Soffi (2003) evaluated the organoleptic qualities of pawpaw (cv. CO-2) leather and pawpaw-mango (cv. Neelum) blended leather (60:40) in comparison with plain mango leather.

The results on sensory parameters indicated that blended leather was superior in most of the quality attributes. Storage up to 8 months could be possible with pawpaw-mango blended leather and there was no evidence of microbial contamination. Vennilla, (2004) prepared guava-papaya fruit bar and kept at room temperature to study their storage feasibility. Results showed that there was maximum retention of all the nutrients and minimum microbial count in guava and papaya blended at 50:50 ratio at the end of 180 days.

Ashaye *et al.,* (2005) evaluated the chemical and organoleptic properties of pawpaw and guava leathers. The product was evaluated for physico-chemical and organoleptic changes. Results showed that guava leather was significantly higher in protein, fat, fruitiness, smell and overall acceptability while there was no significance difference in the crude fiber of pawpaw and guava leather.

Sarojini *et al.,* (2009 a) reported that carrot can be successfully be used for fortification of the guava bar. They took three different proportions *i.e.* 10, 15 and 20 per cent of carrot puree with guava fruit pulp. Overall, the 10 per cent level is found acceptable compared to either 15 per cent or 20 per cent carrot enriched samples.

Verma and Chopra (2010) revealed that when aonla-mango mixed fruit slab prepared in different proportion at different TSS level, results revealed that aonla and mango pulp could be successfully employed in 1:1 ratio to produce mixed fruit slab after adjusting the total soluble solids (TSS) content 30 per cent. The slab packed in polyethylene bags and stored at ambient temperature was found acceptable up to seven months. Slight increment was found in moisture (%), TSS (%) and acidity (%) of slab due to storage was statistically insignificant. However, there was significant reduction in ascorbic acid (mg/100g) content and non-enzymatic browning of the product during storage.

Fruit Leather made from fruit pulp

Guava Leather

Sandhu *et al.,* (2001) prepared guava leather using two cultivars named 'Allahabad Safeda' and 'Banarasi Surkha'. They used two different methods for pulp extraction viz. cold and hot break method. The product was evaluated for physico-chemical and organoleptic changes. Results show that there was a decrease in overall organoleptic scores during three months of storage which was mainly due to increase in browning while both the cold and hot break methods were found to be equivalent for extraction of pulp.

Jain and Nema (2007) reported a process for the preparation of guava leather from five different cultivars like Red Fleshed, Allahabad Safeda, Lucknow-49, Chitidar and Apple colour. Leather quality was also observed using three different recipes for its preparation. The study revealed that organoleptic quality (*i.e.*, colour, flavour, taste, texture and overall acceptability) of leather decreased gradually with increase in the quantity of sugar added. Allahabad Safeda was found to be the best among all the cultivars for the qualities like organoleptic, maximum acidity content, maximum TSS content, minimum loss in weight. However, acidity of the leather also decreased significantly with increased sugar content.

Kumar *et al.,* (2007) reported a process for the preparation of guava leather as per FPO specification and the effect of different packing material viz. polypropylene (PP), butter paper (BP), metalized polyester polyethylene (MPP) and aluminum foil (AF) were evaluated for testing stability of the product during ambient and low temperature conditions (10 ± 1ºC). The results revealed that the sample stored in MPP retained higher percentage of nutrients and minimum microbial counts at the end of storage period. Reducing sugar increased while total sugar decreased during storage under both conditions. Organoleptic rating was also higher for the samples stored in MPP pouches. However, packing in PP sheet was found to be more economical as compared to other packing materials. Although guava leather can be stored up to three months at room temperature but the quality was not comparable with the leather under low temperature.

Papaya Leather

Chan and Cavaleto (1978) reported the preparation and storage stability of papaya leather. Papaya leather was made by mixing papaya puree with 10 per cent sugar, 552-1105 ppm SO_2, mixed and poured at the rate of 4.9 kg per square meter on to Teflon coated pans sprayed with a lecithin releasing agent. The mixture is dried in a forced draft oven at an air velocity of 110 feet per minute at 74, 84 or 94ºC to final moisture content of 12-13 per cent. The dried leathers were removed from the pans, wrapped with plastic film and rolled into scrolls. The average drying time needed to reach 13 per cent moisture at 74, 84 and 94ºC were 4.5 h, 3.9 h and 3.1 h respectively. It was concluded that drying at lower temperatures with added SO_2 produced better leather and SO_2 inhibited browning during processing and storage.

Table.1 Nutritional composition of fruit (per 100g pulp)

Composition		Level
Water (g)	:	87.00
Protein (g)	:	0.60
Fat (g)	:	0.10
Carbohydrate (g)	:	12.30
Calcium (mg)	:	12.00
Phosphorus (mg)	:	10.00
Iron (mg)	:	0.40
Potassium (mg)	:	250.00
Sodium (mg)	:	1.50
Copper (mg)	:	0.08
Magnesium (mg)	:	17.00
Carotene (Iu)	:	50.00
Vitamin B_1(mg)	:	0.02
Vitamin B_2(mg)	:	0.12
Folic acid (mg)	:	4.00
Ascorbic acid (mg)	:	50.00
Energy (calories)	:	50.00

(Chadha *et al*., 1998)

Table.2 Storage study of different fruit bar

References	Fruit	Storage conditions	Storage duration
Roy *et al*., (1997)	Mango	Ambient condition	12 months
Mir and Nath (1993)	plain mango, mango-desiccated coconut powder and mango soy-protein	-18°C, 27±3°C (65% RH) and 38±1°C (92% RH)	90 days
Gowda *et al*., (1995)	Mango		
Mir and Nath (2000)	mango cv. Langra	room temperature (30-36ºC).	90 days
Aruna *et al*., (1999).	Papaya	room temperature (25-45ºC)	six months of storage period.
Manimegalai *et al*., (2001)	jackfruit	room temperature (30-36ºC)	for 6 months.

Figure.1 Process flow chart for the preparation of fruit bar

Selection of fruit

↓

Washing and grading

↓

Peeling of fruit

↓

Preparation of fruit pieces dipping in hypertonic solution for 24 hours

↓

Draining

↓

Drying in cabinet dryer (60°C) Packing

↓

Storage

(Rashmi *et al.*, 2005)

Apple Leather

Kaushal *et al.*, (2002) reported a process for the preparation of fruit papad (leather) from apple pomace with three percentages of added sugar to pulp (T1=10, T2=15 and T3=20 per cent) was prepared and evaluated. The results revealed that during storage; the TSS, total and reducing sugar, Brix-acid ratio and acidity increased while non-reducing sugar, starch, pectin, crude fibre and ascorbic acid content decreased at various storage intervals. Treatment 1 ranked the highest as per the sensory evaluation of the products. The product remained acceptable during the entire period of 6 months storage under ambient conditions.

Banana Leather

Ekanayake and Bandara (2002) reported a process for the preparation of banana fruit leather from different Srilankan varieties like Embul, Seeni and Anamalu. Banana fruits were pureed, sweetened with different proportion of sugar (viz., 10, 20 and 30 %), acidified and dried to get thin sheets from the different thickness tray load of 5.0, 7.5 and 10.0 mm leathers. The study revealed that 15 per cent of sugar load and the tray load of 7.5 mm initial thickness of the leather was the best for the production of good quality banana leather. There was a significant difference in terms of colour, aroma, texture and taste among the leathers produced from three varieties. Variety Anamalu had the highest acceptability among other varieties and best for the production of good quality banana leather compared to other two varieties Seeni and Embul.

Jackfruit Leather

Che Man and Taufic (1995) reported a process for the preparation of jackfruit leather. Jackfruit puree was prepared by (i) using jackfruit bulbs blanched at 85ºC for 3 minutes and (ii) jackfruit bulbs soaked in 0.1 per cent sodium metabisulphite for 30 minutes. The purees types were added with 10 per cent sugar and 200 ppm sorbic acid. In addition 500 ppm SO2 was added to the blanched puree. The mixture was dried over a water bath at 45ºC for 3 h in an oven till a suitable texture is obtained. The water activity of leather prepared from blanched puree was higher (0.73) than that from soaked puree (0.5), while the colour of leather from soaked puree was darker, redder, and less yellow than that from blanched puree.

Okilya *et al.,* (2010) investigated the applicability of solar drying, a popular method in the tropics, in processing of jackfruit leather. The effect of solar drying on the quality and consumer acceptability of jackfruit leather was compared to cabinet and convection oven drying methods commonly used in the preparation of good quality fruit leathers. Results show that the moisture content of solar dried leather (18.50 %) was not significantly different from that of cabinet dried leather (18.85 %). However, the moisture content of the leather dried using these methods were significantly higher than the oven dried leather (14.79 %). Solar dried leather had significantly lower colour readings compared to cabinet dried leather. The colour loss in oven dried leather was not significantly different from solar dried leather. Instrumental results of texture showed that all the leathers were not significantly different. Solar dried leather was disliked and received significantly lower scores on all sensory attributes evaluated. Although solar drying can be used to produce jackfruit leather in a relatively short time, other studies maybe needed to improve its sensorial quality.

Kiwi Leather

Lodge (1981) reported fruit leather preparation from kiwi fruit (*Actinidia chinensis* L.). Ripe kiwi fruits having the TSS of 14ºB were crushed in a hammer mill followed by a finisher fitted with a 700 µ mesh-screen. Sucrose at the level of 15 per cent and SO2 at 500 ppm were added to the pulp. The pulp was poured on a 30µ gauge plastic film fitted inside stainless steel trays with a tray loading of 5 kg per square meter. Other types of plastic films such as CPP Polyjay (James plastics LTD, Pakuranga, Auckland) and Translease (Transpack, Glenfield, Auckland) were also found to be suitable. The puree was dried in a tunnel drier at an air velocity of 30 meters per minute at 45 or 70ºC to final moisture content of 12-13 per cent. The leathers were coated with Mor-rex, a maltodextrin of 10.5 Dextrose equivalents (DE) (Corn products, USA) to reduce hygroscopic. They observed that longer drying time at a lower temperature of 45ºC for 15 h and addition of SO2 resulted in better colour retention. A blend of 75 per cent apple pulp and 25 per cent kiwifruit was more acceptable than kiwifruit alone. The moisture content in the bar affects the water activity of the product. It was noted that water activity (aw) of 0.45 is reached after 6 h at 45ºC.

Troller (1980) reported that a moisture content of 12-13 per cent corresponding to a water activity of 0.45 is well below the minimum value needed to support the microbial growth and yet still maintaining the desired textural characteristics of fruit leather.

Mango Leather

Rao and Roy (1980a) reported a process for the preparation of leather/ sheet from the fruit of mango cultivars Baneshan, Bombay green and Dashehari, with 25ºB TSS and 0.5 per cent acidity. The results revealed that addition of pectin at the rate of 0.5 per cent in the cultivar Baneshan and 0.75 per cent in the cultivar Bombay green and Dashehari was found to improve texture of the sheet while addition of sugar increased drying time in all the cultivars and addition of pectin had no effect.

Phithakpol *et al.,* (1991) used three varieties of mango; Kaew, Pimsen and Ok-rong for making mango leather. Mango leather was made from mango puree with total soluble solid about 32±2°B and pH 4.0±0.2. Sugar, salt and citric acid were added to improve the flavour of the products. For improving the colour, sodium metabisulphite and potassium sorbate were used. Physical and chemical properties were determined. Product made from "Kaew" and "Ok-rong" resulted the highest acceptability but the colour of the product was changed during 6 months of storage.

Gujral and Khanna (2002) studied the dehydration behaviour, texture, colour and sensory acceptability of mango leather. Soy protein concentrate, skim milk powder and sucrose were added at levels of 0, 4.5 and 9 per cent to improve nutritive value and sweetness of the product. It took 7.60 h of drying time at 60±1°C for mango leather to reach 10 per cent moisture content (wb). The three ingredients lowered the drying rate of mango leather with soy protein concentrate having the most significant effect followed by sucrose and skim milk powder. The mango leather had an extensibility and energy to rupture of 10.71 mm and 0.1503 J and the extensibility and energy to rupture decreased with increasing levels of soy protein concentrate, skim milk powder and sucrose. Mango leather had L, a and b values of 42.58, 12.58 and 26.89. The yellowness of mango leather as indicated by b values decreased with increase in soy protein concentrate and increased with increase in sucrose. Soy protein concentrate lowered the sensory acceptability of mango leather whereas sucrose and skim milk powder at levels of 4.5 per cent each resulted in mango leather with the highest acceptability.

Azerdo *et al.,* (2006) reported a process for the preparation of mango leather with the objective to minimize the drying time required to product mango leather with no preservatives and no sugar added and to evaluate their acceptance and storage stability. Mango puree was spread on Petri dishes and oven-dried according to a central composite design with two independent variables: drying temperature (60-80ºC) and puree load (0.4-0.6 gm/cm²). Study revealed that minimum drying time (120 min) resulted from drying a puree load of 0.5 g/cm² at 80ºC. The product was well accepted, especially in terms of flavour. The mango leathers were packed in polypropylene bucket and stored at 25ºC. The combination between low water activity (0.62) and low pH (3.8) allowed the product to be microbiologically stable for at least 6 months without the need for chemical preservative.

An attempt was made to review on bar or leather prepared by using single fruits or blending of different fruits adopting various methods is very well organoleptically acceptable. The fruit bar prepared by blending to maintain the TSS @25ºBrix, 0.5 per cent acidity and 1000 ppm KMS improves the texture as well as higher organoleptic and overall acceptance is best for bar preparation and its storage. The blended bar may be varies according to various fruits and their blending proportion, where as the above combination showed less physico-chemical changes and also showed higher organoleptic score. Fruit bar can be stored better at ambient temperature upto six months.

References

Ahmad, S., Varshney, A. K., and Srivastava, P. K. (2004). Development, quality evaluation and shelf life studies of fruit bar prepared from tomato and papaya. *Beverage and Food World*, 31 (1): 51-55.

Amin, H. D. and Bhatia, B. S. (1962). Studies on dehydration of some tropical fruits, Part-V-nutritive value of product. *J. Food Sci.*, 11 (1): 85-87.

Anonymous (2011). Indian Horticulture Database, NHB, Gurgaon.

Arbat, S. (2009). Evaluation of different sapota (*Manilkara achras* (Mill) Fosberg) varieties for dehydrated sapota slices. M.Sc. (Hort.) Thesis submitted to Navsari Agricultural University, Navsari, Gujarat.

Aruna, K., Vimala, V., Dhanalakshmi, K. and Reddy, Vinodini. (1999). Physico Chemical changes during storage of papaya fruit (*Carica papaya* L.) bar (Thandra). *J. Food Sci. Technol.*, 36 (5): 428-433.

Ashaye, O. A., Bababola, S. O., Bababola, A. O., Aina, J. O. and Fasoyiro, S. B. (2005). Chemical and organoleptic characterization of pawpaw and guava Leathers. *World Journal of Agricultural Sciences*, 1 (1): 50-51.

Awasthi, R. K. (1984). Screening of green banana varieties for dehydration. *Ind. Food Packer*, 38 (4): 60-65.

Azerdo, H. M. C., Brito E. S., Moreira, G. E. G., Farias, V. L. and Bruno, L. M. (2006). Effect of drying and storage time on the physico-chemical properties of mango leathers. *International J. of Food Sci. and Technol.*,41: 635-638.

Bababola, S. O., Ashaye, O. A., Bababola, A. O. and Aina, J. O. (2002). Effect of cold temperature storage on the quality attributes of pawpaw and guava leathers. *African Journal of Biotechnology*, 1 (2): 61-63.

Beena C. and Soffi C. (2003). Acceptability study on blended papaya leather. *Journal of Food Science and Technology Mysore*,40 (3): 293-295.

Chan, Jr. H. T. and Cavaletto, C. G. (1978). Dehydration and storage stability of leather. *J. Food Sci.*, 43 : 23-25.

Che Man, Y. B. and Taufik. (1995). Development and stability of jackfruit leather. *Tropical Science*, 35 (3): 245-250.

Cruess, W. V. (1958). Commercial Fruit and Vegetable Products. Mc Graw-Hill book co, New York.

Eknayake, S. and Bandara, L. (2002). Development of banana fruit leather. *Annals of the Sri Lanka Department of Agriculture*, 4: 353-358.

Gowda, I. N. D., Amba Dan and Ramanjaneya, K. H. (1995). Studies on mango fruit bar preparation. *Indian Food Packer*,40(2): 17-24.

Gujral, H. S. and Khanna, G. (2002). Effect of skim milk powder, soy protein concentrate and sucrose on the dehydration behaviour, texture, colour and acceptability of mango leather. *Journal of Food Engineering*,55 (4): 343-348.

Harsimrat, K. and Dhawan, S. S. (2001). Studies on the preparation and storage of guava fruit bar. *Haryana Journal of Horticultural Sciences.* 30 (3/4): 187-189.

Hemakar, A. K., Tomar, M. C. and Singh, U. B. (2000). Studies on blending of guava pulp with mango pulp for dehydration (Mango-Guava Sheet). *Ind. Fd. Packer*., 54 (4): 45-50.

Jain, P. K. and Nema, P. K. (2007). Processing of Pulp of Various Cultivars of Guava (*Psidium guajava* L.) for Leather Production". *Agricultural Engineering International: the CIGR Ejournal Manuscript FP 07 001.*Vol. IX. August, 2007.

Kalra, S. K. and Revanthi, G. (1983). Chemical and microbial evaluation of stored guava pulp in PVC container. *J. Fd. Sci. Technol.*, 20 (3): 118-120.

Kaushal, N. K., Joshi, V. K. and Sharma, R. C. (2002). Effect of stage of apple pomace collection and treatment on the physico-chemical and sensory qualities of pomace papad (Fruit cloth). *J. Food Sci. Technol.*, 39 (4): 388-393.

Kulshrestha, N., Jha, Y. K., and Kumbhar, M. K. (2008). Process optimization of low calorie and high protein pineapple bar using response surface methodology. *Ind. Fd. Packer*, 62 (3): 37-46.

Kumar, L.L.S. and Abraham, S. (1943). A papaya its botany, culture and uses. *J. Botany Nat. his. Soci. pp.5*

Kumar, R., Jain, R. K. and Mandal, G. (2007). Storage stability of guava leather in different packing materials. *Acta Hort. 735, ISHS.*

Manimegalai, G., Krishnaveni, A., Saravana kumar, R. (2001). Processing and preservation of jackfruit (*Artocarpus heterophyllus* L.) bar (Thandra). *J. Food Sci. Technol*., 38 (5): 529-531.

Marpudi, S. L., Abirami, L. S. S.; Pushkala, R. and Srividya, N. (2011). *Indian Journal of Biotechnology*, Vol. 10, (1) January 2011, pp. 83-89.

Mehta, G. L. and Tomar, M. C. (1980 a). Studies on dehydration of tropical fruits in Uttar Pradesh II. Guava (Psidium guajava L.). *Ind. Food*

Packer, 34 (3): 8-11.

Mehta, G. L. and Tomar, M. C. (1980 b). Studies on dehydration of tropical fruits in Uttar Pradesh III. Papaya (Carica papaya L.). *Ind. Food Packer*, 34 (4): 12-15.

Meyer, L. H. (1966). Food Chemistry. Reinhold Publishing Corporation. New York.

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

Mir, M. A. and Nath, N. (1995). Loss of moisture and sulphur dioxide during air cabinet drying of mango puree. *J. Food Sci. Technol.*, Vol. 32, No. 5, 391-394.

Mir, M. A. and Nath, N. (2000). Protein fortification of mango bar using soy protein concentrate and coconut powder. *J. Food Sci. Technol*., 37 (5): 525-528.

Mishra, V., Mishra, P., Rai, G. K. (2010). Process and product standardization for the development of Amla bar. *Beverage and Food World*,37 (9): 58-60.

Naik, A. G. and Chundawat, B. S. (1996).Evaluation of Gujarat aonla-1 (*Emblica officinalis* Gaeetn.) for various processed products. *Journal of Applied Horticulture*, 2 (1-2): 56-58.

Narayana, C. K., Mustaffa, M. M. and Sathiamoorthy, S. (2007). Standardization of process for preparation of banana fruit bar. *Ind. J. Hort.*, 64 (3): 349-350.

Narayana, C. K.; Shivasankar. S.; Mustaffa, M. M. and Sathiamoorthy, S. (2003).Effect of different treatments on quality of dehydrated banana (Banana fig). *Ind. Food Packer*, 57 (5): 66-69.

Okilya, S., Mukisa, A. N. and Kaaya, A. N. (2010). Effect of solar drying on the quality and acceptability of jackfruit leather. *I. M. Mukisa. et al., EJEAFChe*, 9 (1): 101-111.

Panse,V.G. and Sukhatme, P.V. (1967). Statistical methods for agricultural workers, ICAR Pub., New Delhi, 369.

Phithakpol, B., Chavana, S. and Reungmaneepaitoon, S. (1991). Study of canned mango flesh, juice, pickle and conserve. *Inst. of Food Research and Product Development. Research Report 1988-1991. Raingan khonkhwa wichai pracham pi 2531-2534.* Bangkok (Thailand). 360 p. p. 295-297.

Prasad, K. (2009). Protein fortification of mango and banana bar using roasted Bengal gram flour and skim milk powder. *Agril. Engineering Int.: the CIGR Ejournal. Manuscript 1390.* Vol.XI October.

Purseglove, J. W. (1968). Tropical Crops. Dicotyledons; the English language Book Society., 1: 647.

Raab, C. and Oehler N. (1976). Making dried fruit leather, Fact sheet 232. Oregon State Univ. Ext. Serv.

Rajput, K. (2007). “Development of sapota (*Manilkara achras* (Mill) Fosberg) product: Dehydrated slices in cv. Kalipatti”. M.Sc. (Agri.) Thesis submitted to Navsari Agricultural University, Navsari, Gujarat.

Ranganna, S. (1986). *Hand book of Analysis and quality control for fruits and vegetables products.* Tata Mc Graw Hill Publishing Co. Ltd. New Delhi, India.

Rao, K. P. and Das, H. (2003). Fuzzy logic based optimization of ingredients for production of mango bar and its properties. *J. Food Sci. Technol.*, 40 (6): 576-581.

Rao, V. S and Roy, S. K. (1980 a). Studies on dehydration of mango pulp (a) Stadardization of making mango sheet/leather. *Ind. Fd. Packer.*, 34 (3): 64-71.

Rao, V. S. and Roy, S. K. (1980 b). Studies on dehydration of mango pulp (b) Storage studies of the mango sheet/leather. *Ind. Fd. Packer.*, 34 (3): 72-79.

Roy, S. K and Singh, R. N. (1979). Studies on utilization of bael fruit (*Aegle Marmelos* correa) for processing: III. Preparation and preservation of bael fruit products. *Indian Fd. Packer*, 33: 9-14.

Sandhu, K. S., Singh, M. and Ahluwalia, P. (2001). Studies on processing of guava into pulp and guava leather. *J. Food Sci. Technol.*, 38 (6): 622-624.

Sangeetha A. and Lakshmi.U. K. (2007). Processing and quality evaluation of mango fruit bar enriched with soy protein isolate. *Food Science Nutrition*(1-2): 1-10.

Sarojini, G., Ramakrishna Rao, M. and Veena, V. (2009). Studies on fortification of solar dried fruit bars. *International Solar Food Processing Conference.*, Indore:14 – 16 January 2009.

Savvashe, A. (2010). Effect of drying and chemical preservative on storage life and quality of banana fig (*Musa paradisiaca* L.) *cv.* Grand Naine. Thesis submitted to Navsari Agricultural University, Navsari, Gujarat.

Seth V. (1985). Simple and low-cost preservation of litchi juice. *Ind. Food Packer*, 40: 42-44.

Singh, I. D. (1990). Papaya (Carica papaya L.) Oxford and IBH Publishing Co. Pvt. Ltd., 66, Janpath, New Delhi. pp. 186-187.

Singh, J. (2002). 'Basic Horticulture' Kalyani Publ. Ludhiyana.

Singh, R., Dashora, L. K. and Upadhyay, B. (2006). Effect of pre-drying treatments and drying methods on physico nutritional quality of dehydrated aonla shreds. *Ind. Food Packer*, 60 (3): 57-60.

Sivakumar, K. P., Malathi, D., Nallakurumban, B. and Kalaiselvan, A. (2005). Studies on storage stability of guava bar in different packaging materials. *Beverage and Food World*, 32 (1): 80-81.

Vaghani, S. N and Chundawat, B. S. (1997). Processing of sapota: sun drying technique. *Journal of Applied Horticulture*, 3 (1/2): 1-7.

Vaghani, S. N. (1998)."Standardization of steeping preservation technology of sapota [*Manilkara achras* (Mill.)] fruit slices of cv. Kalipatti" Ph.D (Hort.)Thesis submitted to Navsari Agricultural University, Navsari, Gujarat.

Vennilla, P. (2004). Studies on the storage behaviour of guava-papaya fruit bar. *Beverage & Food world*,31 (2): 63-66.

Verma, G. and Chopra, C. S. (2010). Preparation and preservation of aonla-mango mixed fruit slab. *Beverage and Food World*, 37 (1): 60-61.

How to cite this article:

Ashok K. Senapati and Ajay V. Narwade. 2022. A Review on Fruit Bar and Fruit Leatheras Refreshing Energetic Products. *Int.J.Curr.Microbiol.App.Sci.* 11(06): 402-414.
doi: https://doi.org/10.20546/ijcmas.2022.1106.046