

Quality of diversified value addition from some minor fruits

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Abstract Diversified value added products like palm spread, palm toffee, palm *burfi*, passion-mango blended squash, passion rind pickle, passion rind candy, blended jamun nectar and jack-passion spread from various minor fruits including palmyra palm (*Borassus flabellifer* L), passion fruit (*Passiflora edulis* Sims), jamun (*Syzygium cumini* Rom) and jackfruit (*Artocarpus heterophyllus* Lam) were developed and their quality assessed. Among these two products viz. passion-mango blended squash and palm spread were rich in antioxidant properties. Passion rind pickle and passion-mango blended squash stored up to 1 year in sealed glass bottle under ambient temperature (25–37 °C). Similarly, passion-mango blended squash has a longer storage life of 15 months followed by jack-passion spread (14 months) under refrigerated temperature (8–10 °C). Passion rind pickle, jack-passion spread and passion-mango blended squash were the most acceptable with a score of above 3.5 out of 5.0. The microbial population of the products showed acceptable limit with respect to the yeast and bacterial count till their respective storage period.

Keywords Minor fruits · Quality attributes · Storage life

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Diverse agro-climatic regions and wide variety of soils supplemented with substantial rainfall have made West Bengal a forerunner in minor fruit production. Most of the minor fruits are enriched with nutritional and medicinal value, and can be grown even in wastelands without much care. Therefore, it is worthwhile to look into the organized cultivation and improvement of minor group of crops like jamun (*Syzygium cumini* Rom), jackfruit (*Artocarpus heterophyllus* Lam), palmyra palm (*Borassus flabellifer* L) and passion fruit (*Passiflora edulis* Sims), so that their utilization can be maximized. There is always demand from consumers for new, delicious, nutritious and attractive food products. To satisfy this demand, there is a constant effort to develop products from diverse sources. The potentiality of processed products from some minor fruits in the country is still untapped. However, efforts have been made for the development of value added products by Roy and Singh (1979), Khurdiya and Roy (1985), Waskar and Khurdiya (1987), Deka et al. (2002), Kannan and Thirumaran (2004), Sakate et al. (2004), Chavan et al. (2007), Chakraborty et al. (2008), Kenghe (2008) and Mitra et al. (2008). This paper reports on the feasibility for the development of some diversified value added products from some of the minor fruit crops grown in West Bengal in order to minimize the wastage, to promote these products as export items and to uplift the nutritional and socio-economic status of the vulnerable communities of West Bengal.

Materials and methods

The minor fruits like jamun (*Syzygium cumini*), jack fruit (*Artocarpus heterophyllus*), palmyra palm (*Borassus*

flabellifer) utilized for the study were procured from the market and passion fruit (*Passiflora edulis*) (yellow type) was collected from Horticultural Research Station of the Viswavidyalaya. The procedure for the development of value added products from these fruits is outlined below.

Product from jamun For the extraction of jamun juice, water to fruit (1:1) was added, heated up to 60 °C for 10 min and inserted into a pulper to collect the juice and strained it. After removing the peel and seed, extraction of (*Litchi chinensis*) juice was done by a pulper and strained the juice.

Preparation of blended nectar Jamun and litchi juice (2:1 ratio) was mixed with strained syrup (Sugar + water + citric acid). The nectar was poured into a sterilized bottle with the addition of preservative (sodium benzoate), capped, labeled and stored at both ambient (25–37 °C) and refrigerated temperature (8–10 °C) (Table 1).

Products from palmyra palm The pulp to water at 1:1 ratio with heat treatment (70 °C for 10 min) was found suitable for pulp extraction. The pulp along with other ingredients mentioned in Table 1 was mixed to develop palm spread, palm toffee and palm burfi at desired level of total soluble solids (TSS) and acidity.

Preparation of palm spread Palmyra pulp after extraction was mixed with all ingredients and allowed to be heated at low flame with continuous stirring. The product was removed from heat at 65 to 68° Brix TSS, filled into sterilized bottles, stored at ambient (25–37 °C) and refrigerated temperature (8–10 °C) after capping and labeling.

Preparation of palm toffee Pulp was mixed with ingredients and cooked for about 40 min with continuous stirring. The toffee mixture was spread on an aluminium tray smearing a layer of oil/butter followed by drop test in water. The toffee preparation was kept overnight in air and cut into 3×1.5 cm size, wrapped with white cellophane and stored at ambient temperature (25–37 °C).

Preparation of palm burfi Pulp was mixed with ingredients and cooked for 30 min with continuous stirring. Oil was smeared on aluminium tray and the *burfi* mixture was spread followed by drop test in water.

The product was kept overnight in air, cut into 3×2 cm size, wrapped with white coloured thin cellophane sheet and stored at ambient temperature (25–37 °C).

Products from passion fruit Yellow type fruits were halved to scoop out the aril part. Fruit juice was extracted with the help of mixer and strained to get the clear juice. Similarly

Table 1 Recipe of value added products from minor fruits

Ingredients	Blended Jamun nectar	Palm spread	Palm toffee	Palm burfi	JK-PN spread	PN rind pickle	PN rind candy	PN blended squash
Juice, ml	J- 130 L-70	–	–	–	–	PN juice 400	–	PN180 Mg70
Pulp, g		1000	1000	1000	JK-800 PN-200	PN rind 1000	PN rind 1000	–
Sugar, g	150	1000	1000	700	1000	–	1500	500
Glucose, g			100					
Citric acid, g	2.5	5.0	–	–	–	–	5.0	5.0
Water, ml	800	–	–	–	–	–	–	750
Salt, g	–	–	–	–	–	200	–	–
Preservative, %	0.015 SB	–	–	–	–	–	–	0.07 KMS
Vinegar, ml	–	–	–	–	–	10	–	–
Skim milk Powder, g	–	100	400	Kh-700	–	–	–	–
Spices, g	–	Car-10 no	–	–	–	–	–	–
Wheat flour, g	–	–	50	Butter	–	–	–	–
Starch, g	–	–	100	100	–	–	–	–
Lime water, ml	–	–	–	70	–	–	10%	–

J- Jamun, L- Litchi, SB- Sodium benzoate, KMS- potassium meta bisulphite, Car -Cardamom, CS-Common salt, JK- Jack fruit, PN- Passion fruit, Kh – Khoa, gh- Ghee, Mg - Mango

mango pulp was extracted and blended with passion fruit juice. The blended juice was mixed with other ingredients mentioned in Table 1 to develop mango blended squash. Passion fruit rind after juice extraction was utilized for the preparation of candy and pickle. The procedure for the preparation of these products is given below.

Passion mango blended squash Blending of passion and mango fruit juice (2.57:1 ratio) was done and mixed with strained syrup (Sugar + water + citric acid). The prepared squash was kept in sterilized bottles followed by adding of preservative (potassium metabisulphite), labeled and stored at ambient (25–37 °C) and refrigerated temperature (8–10 °C).

Preparation of passion rind candy The passion fruit rind was peeled and cut into suitable size. The slices were first dipped in lime water over night and blanched at 80 °C for 10 min. After cooling again it was dipped in syrup of 45° Brix over night. Collected the rind pieces from syrup and again dipped in syrup of higher strength. The same process repeated for three times to adjust the TSS of the candy in between 67 and 70° Brix, removed the candy pieces from syrup and dipped in passion fruit juice for 5 min. The product was spread on tray and dried at 60 °C for 20 h, packed in small size polypropylene pouches, sealed and stored at ambient temperature (25–37 °C).

Preparation of passion fruit rind pickle Passion fruit rind was cut into suitable size and salt (20%) curing was followed for 6 days. Then the rind pieces were mixed with passion fruit juice, filled into sterilized jars and stored at ambient temperature (25–37 °C) after capping and labeling.

Extraction of jack fruit pulp For the extraction of pulp from jack fruit, bulbs were removed from ripe fruit after removing the seeds and the thin tissue enclosing the seeds they were passed through a pulper fitted with a fine sieve.

Jack-passion fruit spread Pulp of passion fruit and jack fruit at correct ratio was mixed with other ingredients, heated at low flame with continuous stirring till the TSS increased between 65 and 68° Brix removed from heat, filled into sterilized bottles and stored at ambient temperature (25–37 °C) after capping and labeling.

The palm toffee, palm *burfi*, passion rind pickle and passion rind candy were stored under ambient condition (25–37 °C, 62–69% relative humidity) and blended jamun nectar, palm spread, jack-passion spread and passion blended squash were stored under both ambient (25–37 °C) and refrigerated temperature (8–10 °C).

The TSS content of fresh and stored products was measured with hand refractometer. Acidity was estimated by titrating against standard alkali (0.1 N NaOH) solution using phenolphthalein as an indicator and was expressed as percentage in terms of citric acid (AOAC 1990). Ascorbic acid was determined by the titration method using 2, 6 dichlorophenol indophenol solution as described by Ranganna (2000). β -carotene content of the fresh as well as the stored products were analyzed by using Elico-India made UV–VIS spectrophotometer, model no. SL 159 (Ranganna 2000) after extraction with acetone and in petroleum ether base. Protein content of palm products was estimated by Lowry's method (Lowry et al. 1951). Sensory evaluation (overall acceptability) of processed products was accomplished by a panel of 10 judges following 5-point Hedonic scale (Ranganna 2000). The end of storage life of the processed products was determined mostly on the basis of sensory quality (sensory rating 3 and above). The microbial analysis was carried out at the end of storage as determined on the basis of sensory evaluation. The microbial load (yeast and bacteria) in the products was estimated following standard dilution plate technique (10 fold dilution series in sterile water) using selective media of yeast extract dextrose and nutrient agar. Along with yeast growth these media also supported the

Table 2 Storage life of value added product at different temperature on the basis of sensory quality

Name of the product	Storage life, months ($n=5$)		Hedonic score in 5.0 scale ($n=10$ panelists)	
	Ambient temp (25–37 °C)	Refrigerated temp (8–10 °C)	Ambient (25–37 °C)	Refrigerated (8–10 °C)
Palm spread	8	12	3.1	3.1
Palm toffee	7	–	3.3	–
Palm burfee	4 days	–	3.0	–
Blended passion squash	12	15	3.4	3.6
Passion rind candy	8	–	3.3	–
Passion rind pickle	12	–	4.3	–
Blended jamun nectar	6	11	3.2	3.5
Jack-passion spread	8	14	3.2	3.6

5 = highly acceptable; 4 = fairly acceptable; 3 = moderately acceptable; 2 = least acceptable; 1 = unacceptable

Table 3 Microbial population of value added products at the end of storage

Name of the product	Yeast load, 10 ³		Bacterial load, 10 ³	
	Y. D. medium (log cfu/ml or g)		N. A. medium (log cfu/ml or g)	
	Ambient temp (25–37 °C)	Refrigerated temp (8–10 °C)	Ambient temp (25–37 °C)	Refrigerated temp (8–10 °C)
Palm spread	2.3	2.1	7.1	7.0
Palm toffee	4.5	–	7.5	–
Palm burfi	7.1	–	7.9	–
Blended passion squash	3.2	1.8	2.5	1.5
Passion rind candy	6.2	–	7.0	–
Passion rind pickle	2.3	–	6.3	–
Blended jamun nectar	4.4	3.7	2.2	1.6
Jack-passion spread	6.6	5.7	6.9	4.9

(n=5)

growth of mold. However, mold growth was not observed in any of the products. The treatment mean were separated by least significant difference at 5% level of significance (Gomez and Gomez 1984). Each of the treatment was replicated for 5 times.

Results and discussion

Passion rind pickle and passion-mango blended squash could be stored up to 1 year under ambient condition (Table 2). Similarly, passion-mango blended squash has a longer storage life of 15 months followed by jack-passion spread (14 months) under refrigerated condition. The storage life of palm *burfi* was comparatively less, only 3–4 days at ambient temperature, which might be due to incorporation of *khoa*. Chetana et al. (2010) observed that

milk *burfi* prepared by using sugar could be stored up to 3–4 days, although it could be stored up to 5–6 days when sorbitol was used as sugar substitute.

The sensory attributes in terms of overall acceptability value was also higher in refrigerated products than their ambient stored counter parts after a given period of storage (Table 2). The study revealed that passion rind pickle, jack-passion spread and passion-mango blended squash were the most acceptable products with a score of above 3.5. The least score for overall acceptability was observed for palm *burfi* and palm spread. The visible colonies of yeast and bacteria were examined after 72 h of inoculation under 34 and 28 °C temperatures at the end of storage of each product. The microbial load count of the products stored under two temperature regimes was slightly lower at refrigerated temperature than at ambient temperature as the microbes grow well at 28 to 34 °C temperature (Table 3). Similarly the microbiological evaluation of

Table 4 Nutritional composition of value added products after preparation and at the end of storage at ambient temperature (25–37 °C)

Name of the product	TSS, % Brix		β- carotene, I.U.		Protein, %		Ascorbic acid, mg/100 g		Titratable acid, %	
	Initial	Storage	Initial	Storage	Initial	Storage	Initial	Storage	Initial	Storage
Palm spread	66.9	68.3	594.2	278.6	2.5	1.3	13.4	1.1	0.3	0.5
Palm toffee	68.9	69.7	325.4	164.1	2.2	1.6	3.1	NF	0.2	NF
Palm burfi	71.9	72.1	380.0	172.2	2.1	1.7	NF	NF	NF	NF
Blended squash (PM::1:3)	45.3	47.0	1958.3	1286.0	3.9	1.8	16.4	5.2	1.0	1.1
Passion rind candy	27.0	27.2	NF	NF	2.9	2.1	NF	NF	0.3	0.29
Passion rind pickle	12.5	13.2	560.0	258.0	2.4	1.1	12.3	4.1	3.4	4.7
Blended jamun nectar	16.2	17.8	NF	NF	NF	NF	12.0	4–6	0.3	0.5
Jack-passion spread	69.5	72.8	413.2	276.2	1.8	0.8	15.2	5.1	0.4	0.6
LSD (0.05) (n=5)	4.65	4.05	6.53	5.06	0.36	0.14	1.02	0.37	0.09	0.06

N.F. = Not found

processed products of minor fruits stored under both ambient and refrigerated conditions was earlier investigated by Monteiro et al. (2005). Mazumder et al. (2009) developed cucumber-litchi-lemon blended juice and observed that the product was microbiologically safe for consumption after 6 months at ambient temperature. However, all the products under the present study showed acceptable limit (ICMSF 1997) with respect to the yeast and bacterial count up to their respective storage period.

The TSS content was higher (more than 68° Brix) in palm based products and jack-passion spread at the end of storage (Table 4). Rapid increase in TSS was observed in all the products during storage. The increase in TSS might be due to loss in moisture and hydrolysis of polysaccharides into simple sugar. Similar findings were reported by Kenghe (2008) while preserving the bael products. The β -carotene content decreased during storage. The highest β -carotene content (1,958.3 IU) was found in passion-mango blended squash followed by palm spread (594.2 IU) and passion rind pickle (560.0 IU) at the initial stage. Similarly, the β -carotene content of these products was higher at the end of their respective storage period. However, 33–53% loss in β -carotene content was observed for all products. The ascorbic acid content of the products decreased during storage (Table 4). The fall in ascorbic acid might be attributed to its oxidation and enzymatic degradation. However, passion-mango blended squash exhibited maximum ascorbic acid (16.4 mg/100 g) followed by Jack-passion spread (15.2 mg/100 g) and palm spread (13.3 mg/100 g) at the initial stage. Thus, most of the products were found to be rich in antioxidant properties which are beneficial to our body system. The protein content followed more or less the same trend as that of β -carotene and ascorbic acid content of these products (Table 4). However, the acid content of these products followed a decreasing trend throughout their respective storage period. The titratable acid content was maximum in passion rind pickle followed by passion-mango blended squash (Table 4). Barwal et al. (2009) reported almost similar changes in the quality attributes of functional drinks prepared from hill lemon and basil leaves during storage.

Conclusion

Out of the eight processed products, passion-mango blended squash and palm spread were the two rich in antioxidant vitamins. Passion fruit rind, which is a waste had been utilized successfully in the form of rind candy and rind pickle. Based on the quality attributes, passion rind pickle, jack-passion spread and passion-mango blended squash were the most acceptable products with a score of above 3.5 out of 5.0 even at the end of storage and could be

well comparable with traditionally prepared products. Most of the products could be stored well under both ambient and refrigerated conditions.

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