

Critical Studies on the Physico-Chemical Properties of Mango Pulp

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Abstract

This work was conducted to study critically the physico-chemical properties of pulp of some fresh popular varieties of mango and processed canned mango pulp. Four mature varieties e.g. Langra, Himsagar, Fazli and Lakhanbhog, and canned mango pulps- e.g. Totapuri, Natural and Pran were used for this study. The physical properties viz. average weight, peel%, stone%, pulp%, waste%, specific gravity, density, moisture%, total solids%, water soluble solids%, water insoluble solids%, and the chemical properties i.e. p^H, titratable acidity, total ash, alkalinity of ash, alkaline number of ash, reducing, non-reducing and total sugar content, crude protein, total fat, crude fiber, vitamin A&C, equivalent weight of pectin content were determined, and calculated. The pulp/peel, pulp/stone, pulp/waste, brix/acid and sugar/acid ratios were also calculated from the results. The results indicated that, among the four fresh mango varieties, Himsagar was the best because of its highest brix, specific gravity, density, water soluble solids, total solids, p^H, titratable acidity, reducing sugar and protein content. It also contained least amount of moisture, brix–acid ratio and crude fiber. In the same way, Langra was second in position. The third position could be given to Fazli and Lakhanbhog which was inferior in quality amongst the four fresh pulps. Among the three canned mango pulp, Totapuri was the best because of its highest brix, water soluble solids, total solids, brix/acid ratio, sugar acid ratio, p^H, ascorbic acid, reducing sugar and total sugar content. The least amount of moisture, water insoluble solids, titratable acidity was also found in Totapuri. However, the Natural was better and the Pran could be placed in good degree. From the study it was revealed that the highest brix does not always indicated the highest sugar content, which was evident in case of fresh as well as canned mango pulp. It was also found that, heat treatment has a significant effect on non-reducing sugar content, because high temperatures enhance the acid hydrolysis of non reducing sugar. Furthermore, heat treatment has an effect on carotenoids and ascorbic acid content. These vitamins were notably decreased in processed pulps.

Key words: Brix, pectin, reducing sugar, non-reducing sugar, total sugar, soluble solids, insoluble solids.

Introductions

Mango is the most popular and valuable fruit in Bangladesh due to its excellent taste and aroma. It is one of the excellent sources of vitamin A and C. The elite varieties are- Himsagar, Langra, Fazli, Gopalbhog, Lakhanbhog, Mohanbhog, Misribhog etc. These are prominent among the varieties and have wide demand in the market.

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Normally the quality of the variety is judged on the basis of organoleptic characters as well as sensory evaluation because the differences among and within the varieties vary for their said characters. But the organoleptic characters depend on the physico-chemical properties of the variety¹. So, the physico-chemical properties could correctly evaluate the quality of mango than the organoleptic characteristics. That is why physico-chemical properties are important for the selection and evaluation of quality of mango as well as its pulp. The relevant and pertinent literatures were reviewed in this context^{2,3,4,5,6}.

The literatures which were reviewed, about the mangoes grown in different countries of the world, but no detailed or such type of literature has not been found yet. Since the geographical area, the climatic condition and soil properties have got the profound influence on the physico-chemical properties of mango and its variety, the quality of mango will differ from country to country. Bangladesh is situated in the tropical zone having characteristic climatic condition and soil properties. So, the physico-chemical properties of mango of this country will differ from that of other countries of the world. Therefore, with the above context, it was felt necessary to study critically the physico-chemical properties of fresh mango pulp and compared it with that of processed ones, and thus the topic was selected. However, the study was based on the following objectives:

- i. Critical analyses of the physico-chemical properties of the mango pulp with a view of ideal manufacturing of quality mango pulp.
- ii. Application of analyses results of the pulp in the improvement of existing products e.g. mango bar, juice, jam, jelly and in the development of newer products.

Materials & Methods

According to the objectives the study was planned and for that, the following standard conventional methods were followed and the materials were required. Four fresh varieties of ripe (harvest after maturity and allowed to ripe) mangoes e.g. Langra, Himsagar, Fazli and Lakhanbhog were also collected from the local market. Three canned mango pulp viz. Totapuri (Coimbatore, India) and Natural mango pulp as trade name (a product of Abdul Monem Ltd., Dhaka Bangladesh) were obtained from Igloo Food products, and the Pran mango pulp were also collected from Agriculture marketing Co., Dhaka for the study. Sound and uniformly ripe fruits were selected and purchased. A total number of four fresh mangoes, one from each variety were taken and were washed thoroughly in clean water and hand peeled. Then the pulp was squeezed out from properly peeled fruits. It was blended in an ETA-MERA electric blender and sieved through a fine cloth. During processing hygienic precautions were taken to avoid any contamination.

Determination of the properties of the samples:

Determination of Brix was carried out by hand refractometer, specific gravity by pycnometer, and density by volumetric flask. Moisture and water insoluble solids

was determined by conventional method as given in AOAC, 1984⁷. The p^H of the pulps was determined by p^H meter. Titratable acidity, ascorbic acid and total carotenoid content were determined by the methods described in AOAC (1998)⁷ respectively where spectrophotometer was used. Total sugar was estimated according to Lane-Eyanon's method⁸. Total ash, alkalinity of ash and alkaline number of ash were also determined following the method given in AOAC (1984)⁷. Protein was determined by modified Kjeldahl method. Crude fibre, fat and equivalent weight of pectin were determined according to AOAC (1984)⁷ method. The average weight of various parts of mangoes were also estimated and recorded.

Results

The physical and chemical properties of the fresh and canned mango pulp were determined according to the methods described in the materials and methods and the results were recorded which are given below.

Physical properties of four fresh mango pulp

Average weight, peel (%), seed or stone (%), edible part (%), waste (%), pulp-peel ratio, pulp-stone ratio and pulp-waste ratio of Langra were 315.00gm, 9.95%, 10.75%, 79.30%, 20.70%, 7.96:1, 7.38:1 and 3.83:1; Himsagar gave 277.35gm, 11.37%, 17.75%, 70.88%, 29.12%, 6.23:1, 3.99:1 and 2.43:1 respectively. It was 577.30gm, 9.35%, 10.05%, 80.60%, 19.40%, 8.62:1, 8.02:1 and 4.15:1 for Fazli respectively. Lakhanbohag showed 492.00gm, 9.13%, 11.69%, 79.18%, 20.72%, 8.67:1, 6.77:1 and 3.80:1 of av.wt., peel percentage, seed percentage, percent of edible part, waste percentage, pulp-peel, pulp-seed and pulp-waste ratios respectively. Table 1a shows the results.

Table 1a: Physical properties

Parameters of Physical Properties								
Variety of mango	Average weight (gm)	Peel %	Seed or Stone %	Edible part %	Waste %	Pulp-peel Ratio	Pulp-stone ratio	Pulp-Waste ratio
Langra	315.00	9.95	10.75	79.30	20.70	7.96:1	7.38:1	3.83:1
Him sagar	227.35	11.37	17.75	70.88	29.12	6.23:1	3.99:1	2.43:1
Fazli	577.30	9.35	10.05	80.60	19.40	8.62:1	8.02:1	4.15:1
Lakhan bhog	492.00	9.13	11.69	79.18	20.82	8.67:1	6.77:1	3.80:1

Physico-Chemical properties of four fresh mango pulp

The table 1b shows the results of more physico-chemical properties of fresh and canned mango pulps. It would be seen from the table that the Brix were, 18, 19, 16, 16, 15, 14 and 14; specific gravity were 1.0836, 1.0859, 1.0707, 1.0712, 1.0590, 1.0596 and 1.0578; densities were 1.0256, 1.0278, 1.0134, 1.0138, 1.0024, 1.0030 and 1.0011 gm/cc respectively for fresh as well as canned pulps. The moisture content of the same pulps were 81.22, 80.33, 83.51, 83.43, 84.70, 85.61 and 85.04%. Water soluble solids were however recorded as 17.83, 18.84, 15.90, 15.89, 14.95, 13.94 and 13.84%. Water insoluble solids were 0.95, 0.83, 0.59, 0.68, 0.35, 0.45, and 1.12%; total solids were 18.78, 19.67, 16.49, 16.57, 15.30, 14.39, and 14.96%; The °Brix-acid ratio were 66.67, 63.33, 80.00, 88.89, 33.33, 24.14 and 15.55; and the ratio of sugar-acid were determined as 91.63, 75.17, 74.00, 79.44, 32.89, 24.81 and 17.98 for the four varieties of fresh and canned pulps respectively.

Table 1b: Physico-Chemical properties

Parameters of Physico-Chemical properties									
Variety of mango	Brix ^a	Specific gravity	Density (gm/cc)	Moisture %	Solids			Brix-acid ratio	Sugar-acid ratio
					Water soluble solids %	Water insoluble solids %	Total solids %		
Langra	18	1.0836	1.0256	81.22	17.83	0.95	18.78	66.67	91.63
Himsagar	19	1.0859	1.0278	80.33	18.84	0.83	19.67	63.33	75.17
Fazli	16	1.0707	1.0134	83.51	15.90	0.59	16.49	80.00	74.00
Lakhan bhog	16	1.0712	1.0138	83.43	15.89	0.68	16.57	88.89	79.44
Canned mango pulp									
Totapuri	15	1.0590	1.0024	84.70	14.95	0.35	15.30	33.33	32.89
Natural (Fazli)	14	1.0596	1.0030	85.61	13.94	0.45	14.39	24.14	24.81
Pran (mixed)	14	1.0578	1.0011	85.04	13.84	1.12	14.96	15.55	17.98

Chemical properties of fresh and canned mango pulps:

The results of the chemical properties of two types of pulps are shown in the table 2a. The p^H were 5.9, 6.2, 4.25, 4.5, 4.4, 4.2 and 4.0; titratable acidity were 0.27, 0.30, 0.20, 0.18, 0.45, 0.58 and 0.90 gm%; total ash were 0.52, 0.54, 0.77, 0.67, 0.35, 0.25 and 0.46 gm%; alkalinity of ash were 5.5, 9.6, 9.2, 10.4, 9.8, 9.7 and 9.2; the alkaline

number of ash were 10.58, 17.18, 11.95, 15.52, 28.00, 38.80 and 20.00 respectively. However, the reducing sugars were determined as 6.48, 8.35, 5.53, 5.57, 9.59, 8.62 and 7.62%; the non-reducing sugars were 18.26, 14.20, 9.27, 8.82, 5.21, 5.77 and 8.56 % and the total sugar were 24.74, 22.55, 14.80, 14.39, 14.80, 14.39 and 16.18% respectively.

Table 2a: Chemical properties

Variety of mango	p ^H	Titratable acidity %	Total ash %	Alkalinity of ash (ml)	Alkaline number of ash	Sugar content		
						Reducing sugar %	Non-reducing sugar %	Total sugar %
Langra	5.9	0.27	0.52	5.5	10.58	6.48	18.26	24.74
Himsagar	6.2	0.30	0.54	9.6	17.18	8.35	14.20	22.55
Fazli	4.2	0.20	0.77	9.2	11.95	5.53	9.27	14.80
Lakhanb hog	4.5	0.18	0.67	10.4	15.52	5.57	8.82	14.39
Canned mango pulp								
Totapuri	4.4	0.45	0.35	9.8	28.00	9.59	5.21	14.80
Natural (Fazli)	4.2	0.58	0.25	9.7	38.80	8.62	5.77	14.39
Pran (mixed)	4.0	0.90	0.46	9.2	20.00	7.62	8.56	16.18

Other chemical properties of four fresh and canned pulp:

More chemical properties were also determined as the protein content of the pulps of fresh and canned ones were 0.76, 0.77, 0.44, 0.62, 0.60, 0.73 and 0.78gm%; fat were 0.68, 0.56, 0.71, 0.59, 0.64, 0.71 and 0.53gm%; Crude fiber content were 0.52, 0.28, 0.68, 0.38, 0.27, 0.37 and 0.41gm% respectively. The ascorbic acid were 58.33, 21.42, 23.43, 9.29, 9.03, 5.98 and 2.33mg/100gm; The total carotenoid were 243.00, 174.37, 194.62, 388.69, 57.27, 88.64 and 41.34µg/100gm; equivalent weights of pectin were 48.08, 43.10, 40.32, 56.15, 41.41, 43.58 and 40.56 respectively. Table 2b shows the results.

Table 2b: Other chemical Properties

Parameters of More Chemical Properties						
Variety of mango	Crude protein %	Total fat %	Crude fibre %	Vitamin content		Equivalent weight of pectin
				Total carotene µg/100gm	Ascorbic acid mg/100gm	
Langra	0.76	0.68	0.52	243.00	58.33	48.08
Himsagar	0.77	0.56	0.28	174.37	21.42	43.10
Fazli	0.44	0.71	0.68	194.62	23.43	40.32
Lakhanbhog	0.62	0.59	0.38	388.69	9.29	56.15
Canned mango pulp						
Totapuri	0.60	0.64	0.27	57.27	9.03	41.41
Natural (Fazli)	0.73	0.71	0.37	88.64	5.98	43.58
Pran (mixed)	0.78	0.53	0.41	41.34	2.33	40.56

Discussion

From the results it would be seen that among the four fresh mango varieties (one from each variety), the pulp of Fazli showed highest av.wt., pulp percentage, fat, and crude fibre content that made the variety superior. Besides these properties, Fazli also showed lowest amount of peel, stone and waste content which also indicated its superiority. But the variety showed the lowest brix, sp.gr.(specific gravity), density, protein total solid, reducing sugar and the highest moisture content made the variety inferior to other test varieties. Highest brix, density, sp.gr., total solids, water soluble solids, higher pH, reducing sugar content and protein content were determined for Himsagar and that evidenced its superiority. But its highest peel and waste content and lowest fat content indicated its inferior side. When the properties of Langra is considered, it would be seen from the tables that the total sugar, non reducing sugars, water insoluble solids and ascorbic acid content were the highest, which showed its status elite grade. The lowest amount of total ash i.e. the minerals content of Langra was evidenced its lower nutritive values. On the other hand, Lakhanbhog showed its highest carotenoid content among the four varieties. But its highest percentage of seed content, lowest water soluble solids, total non reducing sugar and ascorbic acid content put the variety in the lower status in quality gradation.

Similarly the results of properties of the three canned pulps could be discussed as the highest degrees of Brix was shown in Totapuri. The pulp also showed highest total and water soluble solids, pH, reducing sugars and ascorbic acid content proved its

superiority. Totapuri contained the lowest amount of fibre which also indicated its superiority. On the contrary, the Natural pulp showed its superiority in its highest density, sp.gr., fat and carotenoid content. But the highest moisture content, lowest total solid and total sugar content showed its inferiority. On the other hand, when Pran pulp is concerned, it was seen that it contained the highest total sugar, non-reducing sugars, total ash and protein and that could claim its superiority but the lowest degrees of Brix, sp.gr., density, water soluble solids, pH, reducing sugars, highest fibre content and lowest fat content evidenced the inferiority of the pulp.

After the discussion of the results it could be concluded that the fresh mango pulps were comparatively better than that of canned pulps. Among the four fresh mango varieties, Himsagar was considered as the best. Langra could be placed in second position. However, third and fourth position could be provided to Fazli and Lakhanbhog respectively. Similarly, amongst the three canned pulp, Totapuri was the best, Natural was better and Pran was good in quality. From the results it was also revealed that, the highest brix does not always indicate the highest sugar content. Although Himsagar showed the highest brix but the highest sugar content was found in Langra variety, because of pulp which contains not only sugar but also acids, vitamins, minerals, pectin, fat, protein and fiber that have a significant effect on refractive index⁹. That is why, higher Brix does not always indicate the highest amount of sugar incase of pulpy fruits like mango. Processed pulp contained more reducing sugars than fresh ones; this is happened due to acid hydrolysis of non reducing sugars during heat treatment because high temperature enhance the acid hydrolysis of non-reducing sugars. As a result the amounts of reducing sugar were increased¹⁰. Total carotenoid and ascorbic acid content also conspicuously decreased in processed mango pulp, this loss might be due to heat treatment and processing or might be due to variations in the varieties¹¹.

However, after the above discussion it is revealed that, Himsagar is the best for juice, squash etc. preparation because of its highest soluble solid content¹². Fazli is the most excellent for mango pulp preparation because of its highest pulp content and low waste percentage. Fruit manufacturer could be benefitted by using these fruits. Moreover, from the fruit technological point of view, the selection of the pulps is thought to be worthwhile for the development of newer products.

The findings of the study:

The findings of the study that could be highlighted are given below:

- i) Highest brix does not always indicate the highest sugar content.
- a. Heat treatment has a significant effect on non-reducing sugar of pulp. Increasing reducing sugar content by acid hydrolysis of mango pulp after heat treatment. Because high temperature enhance the acid hydrolysis of non-reducing sugar.

- b. Total carotenoid and ascorbic acid content notably decreased in processed canned mango pulp.

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