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Physico-chemical properties of Chaunsa mangoes

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Abstract
Mango (*Mangifera indica* L.) is the most important fruit of India. Processing of mango generates its peel and seed as waste, which is approximately 40-50% of the total fruit weight. Present study was undertaken to study nutritional properties of mango pulp, peel and seed kernel. Mangoes of Chaunsa variety were procured from local market. The weight ratios of mango pulp, peel and seed kernel were measured. Properties such as weight, TSS, pH, titratable acidity and ascorbic acid were estimated for mango pulp. Nutritional properties of such as moisture content, ash content, crude protein, total phenolic compound, tannins, total soluble protein were determined for mango peel and seed kernel. The average weight percentage of pulp is higher as compared to seed kernel and peel which is 61.3%, 10.1% & 14.83%, respectively. The average TSS, pH, titratable acidity and ascorbic acid for pulp were 12.96 °brix, 5.71, 0.204% and 171 mg/100 g, respectively. The moisture content of dried mango peel and kernel was 8.6% and 12.7%, respectively and minerals present in the mango peel and seed kernel was 3.8% and 2.4%, respectively. The crude protein content for peel and seed kernel was 4.85% and 6.25% & total phenols present in peel and seed samples was 7.82 (mg/g) and 1.7 (mg/g), respectively. Tannins present in peel and seed samples was 7.37 mg/g and 4.876 mg/g, respectively.

Keywords: Mango, Chaunsa and nutrition

Introduction
Mango (*Mangifera indica* L.) is the most important fruit of India. It is believed to have originated in Indo-Burma region and has been in cultivation in India for the past 4000 years. It is rightly titled as the "King of fruits "because of its wide adoptability, high nutritive value, richness in variety, delicious taste, excellent flavor, attractive appearance and popularity among the masses [1].

India ranks first among worlds mango producing countries with 57.18% of the total world mango production of 19.22 MT. Mango is cultivated in India in an area of 1.23 million hectares with an annual production of 10.99 MT and average productivity of 8.95 ton per hectare [2]. It accounts for 22% of the total area (5.57 M ha) and 22.9% of the total production of fruits (47.94 MT) in the country. Uttar Pradesh has the largest area of 0.27 M ha under mango followed by Andhra Pradesh (0.26 M ha) and Bihar (0.15 M ha) [3]. Regarding production, Andhra Pradesh is largest producer followed by Uttar Pradesh, Bihar, Gujarat, Karnataka and Madhya Pradesh.

The 'Chaunsa' mango is extensively grown in South Punjab, i.e., Multan and Rahim Yar Khan. It is also called as King of mangoes due to its unique sweetness, wonderful fragrance and succulent flesh with minimum fiber contents. The geographical coordinates of Rahim Yar Khan are 28° 25′ 0″ North, 70° 18′ 0″ East whereas Multan is situated at 30° 11′ 44″ North, 71° 28′ 31″ East. Besides Multan and Rahim Yar Khan, Chaunsa is also grown in Muzzafargarh and Bahawalpur [4].

Mango contains high nutritional benefits. It is a low-calorie fruit that is rich in fibre and is a great source of vitamins A and C. It also contains folate, B_6, iron, vitamin E and little calcium and zinc. Mangoes are good source of anti-oxidants containing certain phytochemicals such as gallo-tannins and mangiferin.

Mango pulp is produced from ripe mangoes is a value-added product with wide applications in food industry, mainly fruit juice beverages industry. The waste is generated by mango pulp producing industries and includes mango peel, mango kernel and pulper waste. Ripe mango fruit comprises of 15-20 g/100 g peel as a waste. Mango peel has good amount of proteins, phenols, tannins and pectin and other carbohydrates.

There are several reports available concerning the traditional uses of mango kernel in various parts in the world. In Fiji, mango kernel is consumed as the cure for dysentery and asthma.

In India, dry seed powder is applied on head to remove dandruff and also applied as anti-diarrheal agent. Kernel starch is eaten as famine food. Phenolic compounds play an important role in the color and flavor of foods and beverages and regular consumption is associated with high beneficial effects for human health. Some phenolic compounds present in mango are anti-oxidants contributing to a reduction in the risk of cardiovascular diseases. While others such as gallic acid and quercetin are claimed to have activity against allergies, inflammation, hypertension, arteries and carcinogenesis.

Materials and Methods

Mango (*Mangifera indica* L.) samples used in all the studies were purchased at a local market, cleaned and stored at 8-10 °C. The mango cultivars used was 'Chaunsa'. They were taken from the store and kept at room temperature 24 h before being used. All the experiments were performed in triplicate.

Measurement of pulp, peel and seed kernel weight

Five mangoes were randomly selected, peel removed from the mango using a sharp knife manually. Weights of pulp, peel and seed kernel weight were measured in grams using weighing balance.

Fig 1: Measurement of mango pulp, peel and kernel weight

Properties of mango pulp

a. Total soluble solids (TSS)

TSS of mango pulp was measured using hand refractometer (Atago, Japan) and expressed in brix %.

Fig 2: Refractometer

b. pH of mango pulp

pH is the measure of the molar concentration of hydrogen ions in the solution. pH meter was used to measure the mango pulp pH.

Fig 3: Measurement of mango pulp pH

c. Titratable acidity

Titratable acidity of mango pulp was determined by the method [5].

Materials

Weighing balance, Test tube, Beaker, Muslin cloth, Pestle and mortar.

Reagents

The following reagents were used for determination of titratable acidity:

1. Standard NaOH solution (0.1 N),
2. 1% methyl red.

Extraction of mango juice

10 g of mango pulp was taken in a 100 mL beaker and then it was homogenized with distilled water in a blender. The blended materials were then filtered and transferred to a 100 ml volumetric flask, and the volume was made up to the mark with distilled water.

Method

5 ml of aliquot was taken from five mango pulp samples into volumetric flask. Aliquot was titrated with 0.1N NaOH by adding 2-3 drops of phenolphthalein indicator until solution changed to pink color and noted the titrate value.

Fig 4: Measurement of titratable acidity

$$\text{Acidity \%} = \frac{\text{Titrate value} \times \text{volume made} \times \text{Normality of NaOH} \times \text{equivalent weight of acid} \times 100}{\text{Weight of sample} \times \text{volume taken} \times 1000}$$

d. Estimation of Ascorbic acid

Sample of known weight (5 g) was ground to a paste in a mortar and pestle with the addition of 5 ml of 3% (w/v) meta phosphoric acid. The mixture was further ground and strained through a muslin cloth and the final volume of the extract was made up to 50 ml with 3% meta phosphoric acid in a standard flask. An aliquot (5 ml) of the meta phosphoric acid extract of sample was titrated with 2, 6 dichlorophenol indophenol dye until pink color appeared and readings were noted [6, 7].

Nutritional properties of mango peel and seed kernel

Sample preparation

The seed kernel and the seed coat were separated manually and the by-products were washed using tap water to remove the adhered materials. The by-products were oven dried at 70 °C and ground into fine powder and packed in a plastic bag for further processing.

a. Moisture content

Known mass of the sample was dried at 105 °C in drying oven until the weight of the sample becomes constant. The sample was cooled in a desiccator and the moisture content

was calculated using the following formula [9]:

$$\text{Moisture content \%} = \frac{Intial\ weight - Final\ weight}{Initial\ weight} \times 100$$

b. Ash Content

The ash content is calculated on the basis of the dry weight of the original sample, and after the sample is ignited at a 575±25 °C [9].

$$\text{Ash content \%} = \frac{Weight\ of\ ash}{Weight\ of\ test\ specimen} \times 100$$

c. Crude protein

For the determination of crude protein, a Kjeldahl apparatus was used, as per the procedure described in AACC (2000) method no. 46-30 [9]. The percentage nitrogen content of each sample was calculated as shown below. This was multiplied by a conversion factor of 6.25 to obtain the percentage crude protein.

$$\text{Nitrogen content \%} = \frac{(\text{Sample T.V.} - \text{Blank T.V.}) \times \text{Normality of HCl} \times 14}{\text{Weight of sample (g)} \times 1000} \times 100$$

d. Total phenolic compound

Total phenolics were determined using Folin-Ciocalteu reagent [8].

Materials

Test tubes, grade 4 filter paper, beaker, micro pipette, spectrophotometer and water bath.

Reagents

Folin Reagent (1 N), sodium carbonate (20%) and ethanol (Stock 0.2 mg/ml).

Preparation of reagents

1. Commercially available FCR reagent was diluted 2 times to make it 1N.
2. 20 g of sodium carbonate (Na_2CO_3) was dissolved in water distilled and final volume was made to 100 ml.

Method

100 µl of diluted sample extract was taken in a test tube and its volume was made to 3 ml with double distilled water and added 0.5 ml FCR reagent followed by 2 ml of 20% Na_2CO_3. It was mixed well on vortex mixture and was kept at 85 °C in water bath for 2 minutes. The mixture was then cooled at room temperature and the absorbance of blue color produced was measured at 650 nm. Amount of total phenol present in samples was calculated.

e. Estimation of tannins by Folin-denis reagent

Materials

Test tubes, grade 4 filter paper, beaker, micro pipette, spectrophotometer and Soxhlet apparatus.

Chemicals

Sodium tungstate, phospho-molybdic acid, phosphoric acid, 35% sodium carbonate.

Preparation of reagents

Folin-Denis reagent was prepared by dissolving 10 g of sodium tungstate and 2 g of phospho-molybdic acid in 75 ml of double distilled water in a beaker and 5 ml of phosphoric acid was added. Mixture was refluxed for 2 h in soxhlet apparatus and final volume was made to 100 ml with double distilled water.

35% Sodium carbonate was prepared by mixing 35 g of sodium carbonate in DDW and volume was made to 100 ml with DDW.

Method

Weighed 0.5 g of powdered material and transferred to a 250 ml conical flask, added with 75 ml of water, heated the flask gently and boiled for 30 minutes. Grade 4 filter paper was used to collect the clear solution. Transferred 0.1 ml of the sample extract to a 10 ml volumetric flask containing 7.5 ml water and added 0.5 ml of Folin-Denis reagent, 1 ml of sodium carbonate solution and diluted to 10 ml with water. Shook well and read the absorbance at 700 nm after 30 minute. Prepared a standard graph by using 1-10 µg tannic acid.

Results and Discussion

Ratio of peel, pulp and seed kernel by weight of Chaunsa mango weight of mango pulp was more than seed kernel and peel weights. The average percentage of pulp is higher as compared to seed kernel and peel which is 61.3%, 10.1% & 14.83%, respectively.

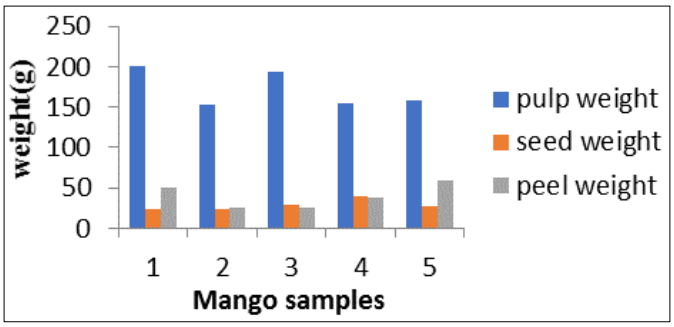

Fig 5: Weights of mango pulp, seed kernel and peel

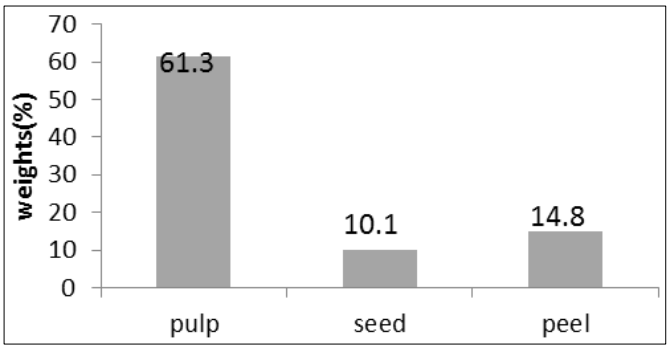

Fig 6: Mango peel, seed kernel and pulp weight ratio

TSS, pH, acidity, vitamin-C of mango pulp

Table 1 shows physico-chemical properties of chaunsa variety mango pulp. The average TSS % of mango pulp was 12.96 °brix and average pH value of chaunsa mango pulp was 5.71. The % average titratable acidity of pulp was 0.204 and the average Vitamin-C content of mango pulp was 171.0 mg/100 g fresh weight of pulp.

Table 1: Determination of physico-chemical properties for mango pulp

Mango pulp	Sample-1	Smaple-2	Sample-3	Sample-4	Sample-5	Average
TSS (°brix)	11.7	16	13.2	11.8	12.1	12.96
pH	5.67	5.88	5.65	5.73	5.65	5.71
Acidity (%)	0.128	0.197	0.273	0.226	0.2	0.204
Vitamin-C (mg/100 g)	127.68	161.88	198.36	141.36	225.72	171

Nutritional properties of mango peel and seed kernel

Moisture content

The initial moisture content of mango peel and seed kernel was 85% and 35%, respectively and reduced continuously. After drying the moisture content of mango peel and kernel was 8.6% and 12.7%, respectively.

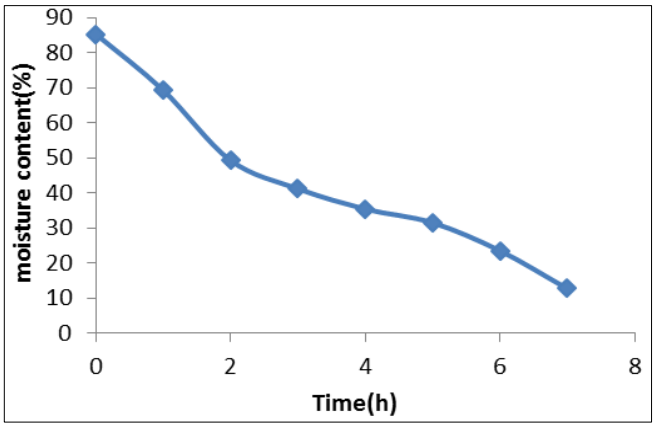

Fig 7: Drying curve of mango peel

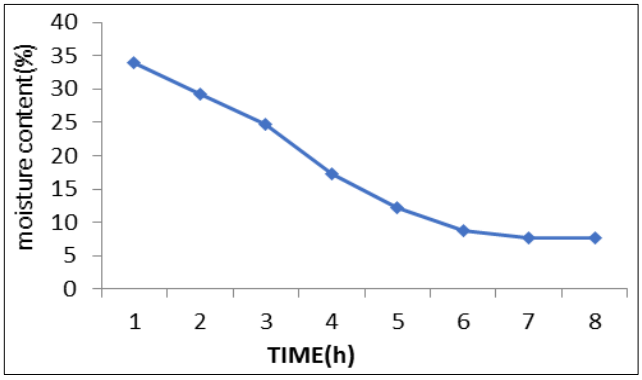

Fig 8: Drying curve mango kernel

Ash content

The amount of minerals present in the mango peel and seed kernel was 3.8% and 2.4%, respectively. Mango peel results in high amount of minerals than seed kernel.

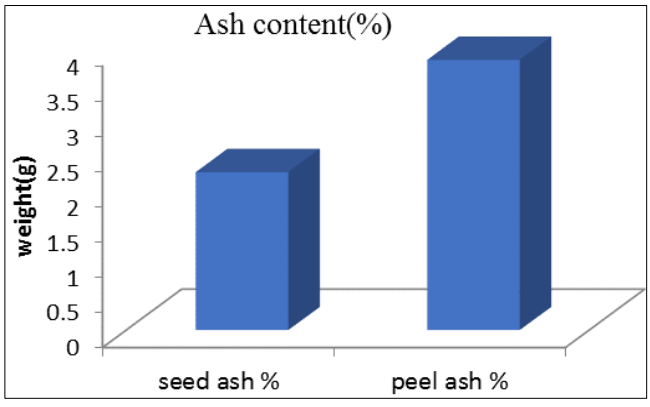

Fig 9: Ash content of mango peel and seed kernel

Crude protein content

Table 2. Shows the available nitrogen and protein % of peel and seed kernel of chaunsa mango variety. Available nitrogen and protein were less in mango peel compared to mango seed kernel.

Table 2: Percentage of nitrogen and protein content

Sample	Titrate value	%Nitrogen	% Protein
Mango peel	2.30	0.777	4.85
Mango seed kernel	2.57	0.966	6.25

Total phenolic compound

The total phenols present in peel and seed samples was 7.82 (mg/g) and 1.7 (mg/g), respectively.

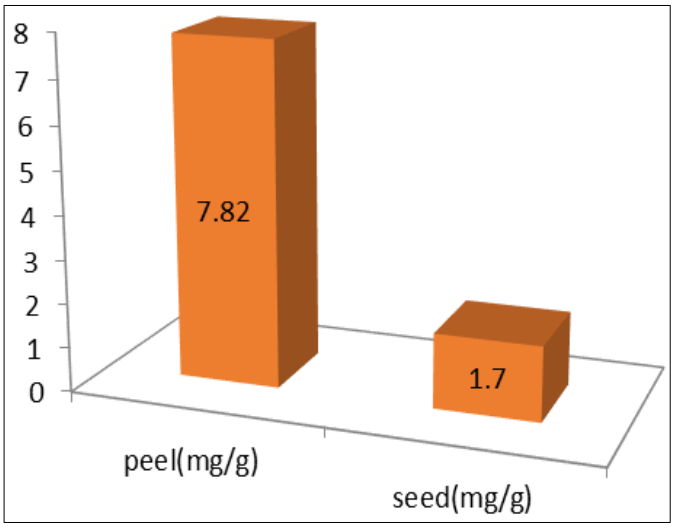

Fig 10: Phenols in mango peel and kernel

Tannins

Tannins present in peel and seed samples was 7.37 mg/g and 4.876 mg/g, respectively.

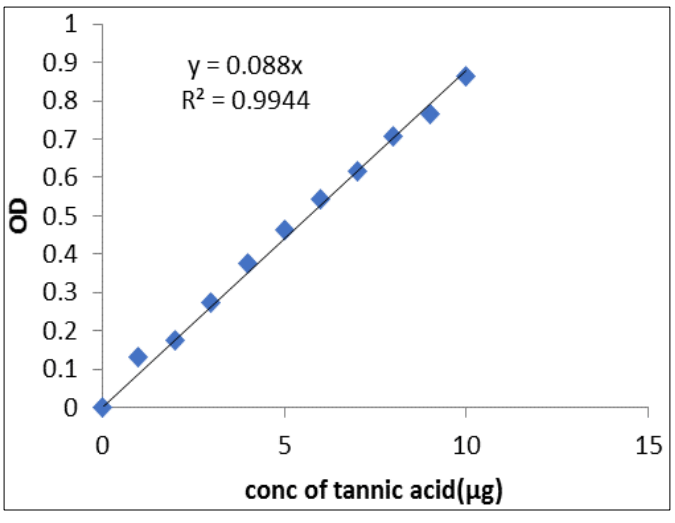

Fig 11: Standard curve for concentration of tannic acid

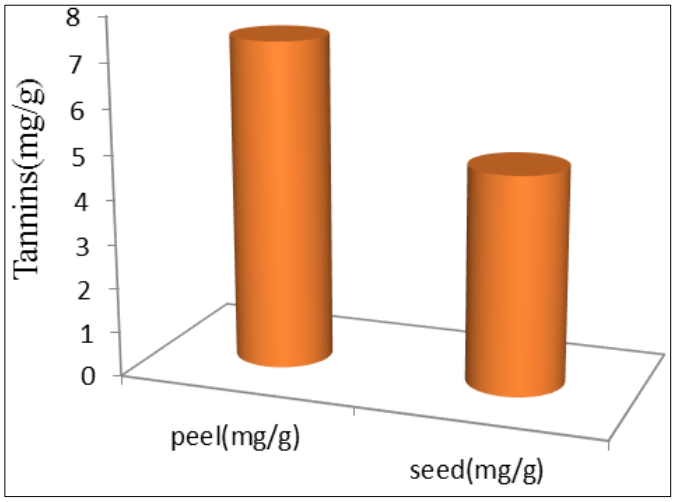

Fig 12: Tannins content in mango peel and kernel

Conclusion

Mango has high nutritional benefits in all parts i.e., pulp, peel and seed kernel. Mango pulp has vitamin-C & pulp and kernel have minerals, protein, phenols and tannins. The use of these wastes as livestock feeding and as a bio-fertilizer is a way of reducing environmental concerns. The content of phyto-chemical compounds is higher in mango waste with respect to the edible tissue.

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