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Studies on physical, chemical and mineral evaluation of mango (*Mangifera indica* L.)

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Abstract
The present investigation was carried out with the objective of to determine physical, chemical and mineral composition of mango (*Mangifera indica* L.) The mango is recognized as the "King of Fruits" because of its wonderful taste, delicious flavour, beautiful colour, and excellent nutritional content. Result from the analysis showed that weight was 271.6g, length was measured 8.43 cm, peel weight was 11.46g, pulp weight was found to be 203.6g and pulp recovery from mango fruit was 73.8g. further the chemical and mineral composition was reported and result revealed that moisture content was observed to be 86.51%, protein 0.56%, fat 1.6%, carbohydrate 8.54%, ash 1.95% and crude fibre 0.8% the ascorbic acid was noted to be 27.63mg/100g, TSS was 18.13(◦Bx), pH was 4.6 and titrable acidity was found to be 0.7%. The mango fruit is good source of mineral i.e. calcium, magnesium, potassium, zinc and phosphorus was observed to be 15.9mg/100g, 11.2mg/100g, 204.3mg/100g, 0.13mg/100g and 15.6mg/100g respectively.

Keywords: Mango, chemical properties, proximate composition, minerals

Introduction
The mango is India's most important fruit crop. It is recognized as the "King of Fruits" because of its wonderful taste, exceptionally agreeable flavour, beautiful colour and excellent nutritional content. (Nagaharshitha *et al.,* 2014) [14] Mangoes (*Mangifera indica* L.) belong to the genus Mangifera, which includes roughly 30 tropical fruiting trees in the flowering plant of family Anacardiaceae. It is the most important commercially farmed fruit crop and ranks second in terms of production among tropical crops. Mango is one of the most widely grown fruits in the world, with 46.50 million tonnes produced year. India is the world's largest producer and exporter of mangoes. Mango fruit conquers the second position as a tropical crop that is grown in nearly 87 countries in the world. The major mango producing countries in the world are India (42.02 per cent), China (10.69%), Thailand (7.69%), Mexico (4.92%) and Indonesia (4.89%). India had 22.67 lakh hectares under mango cultivation, with a production of roughly 202.95 lakh tonnes, accounting for 42.02 per cent of global production. The major mango producing states are Uttar Pradesh (23.06%), Andhra Pradesh (16.07%), Karnataka (9.29%), Bihar (7.52%), Gujarat (6.31%) and Tamil Nadu (5.88%). (Mukund *et al*., 2019) [13].
The mango pulp is characterized by its high fibre and water content, as well as a high level of organic acids, particularly citric acid, which makes it appealing to consumers. These concentrations decrease as the fruit matures and the content of soluble solids (sugars) increases its concentration due to the presence of the hormone ethylene, which aids in the manufacture of endogenous hydrolytic enzymes such as amylases and chlorophyllase, is responsible for this biochemical activity. (Bose and Mitra 2001) [6] The presence of phenolic acids may be responsible for several of the pharmacological effects found in mango. With their anti-diabetic, anti-oxidant, anti-inflammatory, anti-lithiatic, anti-carcinogenic, anti-fungal, and immune-modulatory capabilities, these phenolic compounds are beneficial in protecting body tissues from oxidative stress. (Chiou *et al.,* 2007) [7] Apart from the fruit, anti-diabetic, anti-lithiatic, and free radical scavenging properties have been observed in mango flesh, leaf, and stem-bark. (Bafna *et al*., 2005) [3].
Mango (*Mangifera indica* L.) is high in carbohydrates, organic acids, dietary fibre and vitamins C as well as other vitamins and minerals. Sucrose, fructose and glucose are the most common soluble sugars in mango, whereas citric and malic acid are the most common organic acids. (Medlicott and Thompson 1985) [12]. Mangoes has been found to contain a wide range of chemical components. The most abundant compound types in Mangifera are polyphenols (flavonoids, xanthones, and phenolic acids). (Berardini *et al*., 2005) [4].

The principal polyphenolic components present in Mango include Mangiferin, gallic acid, catechins, quercetin, kaempferol, protocatechuic acid, ellagic acids, propyl and methyl gallate, rhamnetin, and anthocyanins. (Nayan *et al*., 2017) [15]. Mangiferin is a well-known polyphenolic substance with diverse biological characteristics that has been widely explored. Another class of natural substances present in this plant is carotenoids. They are considered as natural organic pigments. Carotenoids are responsible for the bright yellow colour of mango fruit peel and flesh. (Delgado *et al*., 2000) [8]. They are excellent free radical scavengers on a biological level. Carotenoids in mango are biosynthesized in the fruit, and carotenoid content grows as the fruit ripens. (Gil. *et al*., 2000) [9]. The primary carotenoids contained in mango fruit flesh and peel includes -carotene, luteoxanthin, violaxanthin, neoxanthin, zeaxanthin, and cryptoxanthin.

Materials and Methods

The present investigation was carried out in Department of Food Engineering with collaboration of Department of Food Chemistry and Nutrition, College of Food Technology, VNMKV, Parbhani during year 2020-21.

Materials

Fresh and ripe Mangos were obtained from local village market, Parbhani.

Chemicals and glass-wares

The chemicals of analytical grade and glassware's required during investigation were used in the Department of Food Engineering. College of Food Technology VNMKV Parbhani.

Methods

Physico-chemical properties

Physico-chemical properties such as TSS, titrable acidity, pH, proximate analysis.

pH

A digital pH meter was used to determine the pH of mango. After calibrating the pH meter with standard buffers of pH 4.0 and 7.0, 25ml of mango juice was transferred into a beaker and pH was determined, enough time was allowed for the pH to stabilize before readings were taken.

Titratable acidity

The titratable acidity of mango was determined by the procedure as reported by Ranganna (2011) [16].

Total soluble solid (TSS)

The TSS content of mango pulp was determined with the help of Erma hand refractometer of 0-32 range in duplicate (A.O.A.C., 2005) [2]. When it is held close to the eye, the sugar content percentage (soluble sugar) was read from the scale of the refractometer.

Ascorbic acid

Ascorbic acid content determined as per AOAC (2004) [1] using dichlorophenol Indophenol dye.

Proximate analysis of mango

Different chemical properties of samples were analyzed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were carried out in triplicate and the results were expressed as an average value.

Moisture content

Moisture content was determined adopting AOAC (2005) [2]. Method as following:

$$\% \text{ Moisture content} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using AOAC (2005) [2] method. Percentage of nitrogen and protein calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{T_S\text{-}T_B \times \text{Normality of acid} \times 0.014}{\text{Weight of sample}} \times 100$$

Where, Ts = Titre volume of the sample (ml),
T_B = Titre volume of Blank (ml), 0.014 = M eq. wt. of N_2.
% Protein = Nitrogen × 6.25

Fat

AOAC (2005) [2] method using Soxhlet apparatus was used to determined crude fat content of the sample. The percent of crude fat was expressed as follows:

$$\% \text{ Crude Fat} = \frac{\text{Weight of dried ether soluble material}}{\text{Weight of sample}} \times 100$$

Total carbohydrate

The total carbohydrate content of the samples was determined as total carbohydrate by difference that is by subtracting the measured protein, fat, ash and moisture from 100 phenol sulphuric acid method as given by AOAC (2005) [2].

Ash

Drying the sample at 100 ^{0}C and charmed over an electric heater. It was then ash in muffle furnace at 550 ˚C for 5 hrs. By AOAC (2005) [2]. It was calculated using the following formula:

$$\% \text{ Ash} = \frac{\text{Weight of crucible with ash - Weight of empty crucible}}{\text{Weight of sample}} \times 100$$

Results and Discussion

Physical properties of mango

Data pertaining to various physical properties of mango such as weight, length, peel weight, pulp weight and pulp recovery were evaluated and results reported in Table 1.

Table 1: Physical properties of mango

Physical parameters	Average value
Colour	Yellowish
Weight (g)	271.66 ± 1.28
Length (cm)	8.43 ± 0.01
Peel weight (g)	11.46 ± 0.12
Pulp weight (g)	203.6 ± 1.24
Pulp recovery (%)	73.8 ± 0.4

*Each value is an average of three determinations

The physical properties of Mango were measured and results reported that weight was found to be 271.66g, length 8.43cm, peel weight 11.46g, pulp weight of mango was noted to be 203.6g and pulp recovery 73.8% and yellowish in colour.

Table 2: Proximate composition of mango

Nutrients (%)	Average value
Moisture	86.51 ± 0.23
Protein	0.56 ± 0.15
Fat	1.6 ± 0.19
Carbohydrate	8.54 ± 0.02
Ash	1.95 ± 0.03
Crude Fibre	0.8 ± 0.02

*Each value is an average of three determinations

Results presented in the Table 2 revealed that the average value of moisture content of mango was 86.51%, protein 0.56%, fat 1.6%, carbohydrates was found to be 8.54%, ash 1.95% and crude fibre 0.8% respectively. The results found to be similar with result reported by Rashid *et al*., (2019) [17].

Chemical properties of mango

The data pertaining to various chemical compositions such as TSS, pH, titrable acidity and ascorbic acid were determined and results obtained are illustrated in Table 3.

Table 3: Chemical properties of mango

Chemical parameters	Average value
pH	4.6 ± 0.14
TSS	18.13 ± 0.03
Titrable acidity (%)	0.7 ± 0.02
Ascorbic acid (mg/100g)	27.63 ± 0.30

*Each value is an average of three determinations.

The chemical composition of mango were analysed and results revealed that TSS of mango was found to be 18.13 (◦Bx), pH was 4.6, titrable acidity was 0.7% and ascorbic acid was noted 27.63 mg/100g respectively. The results found was closely resemblance with Masresha *et al*., (2020) [11] and Rashid *et al*., (2019) [17].

Mineral composition of mango

The result with respect to minerals such as calcium, magnesium, potassium, zinc and phosphorus were determined and presented in below Table 4.

Table 4: Mineral composition of mango

Minerals	Average value mg/100g
Calcium	15.9 ± 0.2
Magnesium	11.2 ± 0.13
Potassium	204.3 ± 1.20
Zinc	0.13 ± 0.18
Phosphorus	15.6 ± 0.02

*Each value is an average of three determinations

The mineral composition of Mango was analyzed and results revealed that calcium was 15.9mg/100g, magnesium was 11.2mg/100g, potassium was found to be 204.3mg/100g, zinc 0.13mg/100g and phosphorus was 15.6 mg/100gm. respectively. The study showed that mango is good source of potassium, calcium followed by phosphorus and magnesium. Results reported are in close agreement with Bommy *et al*., 2016) [5] and Maria *et al.* (2019) [10].

Conclusion

In the present investigation it could be concluded that Mango has excellent nutritional and mineral profile. Is a rich in carbohydrate, fat, ash, protein and crude fiber. TSS i.e. 18.13 (◦Bx) which is increased with ripening. Carotenoids are responsible for the bright yellow colour. Calcium, magnesium, potassium and phosphorus all these macro minerals found in mango whereas Potassium is the majorly observed (204.3 mg/100g). Mango available in particular season only but due to high nutritional profile it can be used for preparation of value added product such as fruit bar, jam, jelly or beverages and increase its availability throughout the year.

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