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Physico-chemical traits of raw mango (*Mangifera indica* L.) for pickle

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Abstract

The present investigation was carried out at the Horticultural Processing Laboratory, Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, Bastar (C.G.) during the session 2024–2025 to study the physico-chemical properties of raw mango (*Mangifera indica* L.) used for pickle preparation under Bastar district conditions. The physical characteristics of raw mango were recorded as fruit length (7.680 cm), fruit breadth (6.549 cm) and fruit weight (185.6 g). The chemical analysis showed pH (2.84), acidity (0.89%), ascorbic acid (130.82 mg/100 g), total soluble solids (10.52 °Brix), total sugar (4.52%), reducing sugar (3.25%), and non-reducing sugar (1.27%). The results indicate that raw mango contains good acidity and high vitamin-C content, making it suitable for pickle processing. The findings provide useful information for improving mango pickle quality, processing, and value addition for future research and commercial utilization.

Keywords: Mango pickle, Acidity, pH, TSS, total sugar, reducing sugar, non-reducing sugar

1. Introduction

Mango (*Mangifera indica* L.) is a member of the anacardiaceae family, which originated in Indo-Burma. It is one of the world most desirable fruits (Joshi *et al.*, 2013) ^[8], as well as one of the most popular fruit crops for human consumption in tropical and subtropical climates (Vasugi *et al.*, 2012) ^[13]. Mango is commonly referred to as the "King of Fruits" due to its flavour, importance and exquisite flavour. Its social and economic impact is most significant in poor and emerging nations, where mango is a highly appreciated dietary component rich in vitamins and minerals (Ribeiro *et al.*, 2007) ^[11]. Mango production in India is 22423 MT, with an area of 2401 hectares (Anonymous, 2023-24) ^[2]. The state of Chhattisgarh covers roughly 78.235 thousand hectares and produces 471.146 thousand MT of mango each year (Anonymous, 2024) ^[3]. Mango pickles in India vary widely across regions. The spicy Avakaya of Andhra Pradesh uses raw mango, chili, mustard and sesame oil, while the Punjabi aam ka achar is prepared with mustard oil, fenugreek, fennel, nigella, turmeric and chili (Farmdidi, 2023) ^[5]. Gujarat Chundo is a sweet-tangy pickle of grated mango and sugar or jaggery. In South India, Vadu Mangai/Kannimanga employs whole tender mangoes and Manga Thokku uses grated mango cooked with spices (Slurp, 2022) ^[12]. Additionally, sweet-sour mango pickles made with jaggery or sugar are popular for their unique flavour though less stable in storage (Haokip *et al.*, 2022) ^[6]. Mango pickle ranks top and is widely used across the country. Pickles fall into four categories: vinegar pickles, citrus juice pickles, brine pickles and oil pickles. Aside from the fundamental fruit or vegetable, vinegar, sugar, salt, oil and spices are frequently added to pickles. Mango pickles have nutritional content of around 78 calories, protein 0.2 g, carbs 18.5 g, fibre 0.3 g and fat 0.4 g /100gm table spoon. (Dalal, 2019) ^[4]. Raw fruits from local mango trees are used to make a variety of traditional items such as brined raw slices, amchur, pickle, murabba, chutney, sherbet and so on. Pickling, the most widely used method of preservation, originated as a way to preserve food for out-of-season use and long journeys. Mango pickle is made using a completely developed raw mango.

2. Materials and Methods

Unripe, mature green mangoes of a local (desi) variety were used for the preparation of pickle. Raw mango fruit collected from Titirgaon village of jagdalpur district, Chhattisgarh from a local farmer, shri Manoj, for use in the preparation of mango pickle. The fruits were thoroughly cleaned, washed with potable water and dried by wiping with a muslin cloth. Six mango pickle recipes were standardized with variations in ingredient composition. The ingredients used included mango, salt, mustard seeds, cloves, cumin powder, fenugreek, chilli powder, turmeric, coriander, black pepper, garlic, cardamom, oil, and jaggery.

2.1 Physical parameters of raw mango

Fruit length (cm)

Fruit length was measured as the distance from the stem end to the apex of the fruit using a vernier calliper and recorded in centimetres (cm).

Fruit breadth (cm)

The same six fruits used for measuring fruit length were also used to measure fruit breadth. Fruit breadth was determined at the widest point of the fruit using a vernier calliper and recorded in centimetres (cm).

Fruit weight (g/fruit)

The same six randomly selected fruits from various local (Desi) mango were weighed individually using an electric weighing balance, and the weight was recorded in grams per fruit.

2.2 Chemical parameters of mango pickles

TSS (°Brix)

After peeling the raw mangoes, the pulp was carefully separated and homogenized thoroughly using a mortar and pestle. A drop of the homogenized pulp was then placed on the prism of a hand refractometer to record the total soluble solids, following the standard method (A.O.A.C.,1975)

Acidity (%)

A known quantity of the liquid sample/pulp was titrated against 0.1 N sodium hydroxide solution using phenolphthalein as an indicator (A.O.A.C, 1975). For solid samples, a known quantity was macerated with 20–25 ml of distilled water, transferred to a 100 ml volumetric flask, the volume was made up and filtered. An aliquot of 10 ml was titrated against 0.1 N NaOH using phenolphthalein as an indicator (Ranganna,1997) ^[10]. The titratable acidity was expressed as per cent anhydrous citric acid.

$$\text{Acidity} = \frac{\text{Titre} \times \text{Normality of NaOH} \times \text{Equivalent Weight of acid}}{\text{Volume of sample taken} \times 1000} \times 100$$

pH

A known quantity of mango pulp was thoroughly mashed with an equal volume of distilled water using a mortar and pestle, and the pH of the prepared sample was determined with the help of a digital pH meter.

Ascorbic acid (mg/100 gm)

Ascorbic acid was quantified using the 2,6-dichlorophenol indophenol dye titration method originally proposed by Johnson (1948) ^[7] and later standardized by Ranganna (1997) ^[10]. The sample extract was prepared by mixing a measured quantity of

sample with 3 per cent metaphosphoric acid (HPO₃) and making the volume up to 100 ml, followed by filtration. A measured aliquot of the filtrate was titrated with 0.025 per cent 2,6-dichlorophenol indophenol dye until a light pink colour persisted as the end point. The ascorbic acid concentration was calculated after correcting for the dye factor and expressed as mg of ascorbic acid per 100 g of fruit pulp (Association of Vitamin Chemists, 1966).

$$\text{Ascorbic acid (mg/100gm)} = \frac{\text{Titre value} \times \text{Total volume made up} \times 100}{\text{Standard reading} \times \text{vol. taken} \times \text{wt. of sample taken}}$$

Total sugar (%)

The total sugars were estimated using the same process, which entailed reducing with 40% sodium hydroxide after acid hydrolysis of a dealed sample with 35% hydrochloric acid. To titrate this filtrate against the conventional Fehling's combination (Fehling's A and B), methylene blue was used as an indicator with a brick red finish point (Ranganna, 1997) ^[10].

$$\text{Total sugar (\%)} = \frac{\text{Factor} \times \text{Dilution}}{\text{Weight of pulp taken}} \times 100$$

Reducing sugar (%)

The reducing sugars were estimated using the Lane and Eynon (1923) ^[9] method, with a modification suggested by Ranganna (1997) ^[10]. A known weight (15 g) of the sample was mixed with distilled water, and the solution was precipitated with potassium oxalate (22% and lead acetate (45%) to remove any extraneous material. The reducing sugars were calculated by titrating this lead-free extract against the standard Fehling's mixture (Fehling's A and B) and using methylene blue to indicate a brick red end point.

$$\text{Reducing sugar (\%)} = \frac{\text{Factor} \times \text{Dilution}}{\text{Titre reading} \times \text{Weight of pulp taken}} \times 100$$

Non-reducing sugar (%)

The non-reducing sugar content was calculated by subtracting the reducing sugar value from the total sugar content.
Non-reducing sugar (%) = Total sugar (%) – Reducing sugar (%)

3. Results and Discussion

Physical parameters of raw mango

The data related to the physical characteristics of raw mango are presented in (Table 1). The raw mango fruits were observed to be medium in size with average length, breadth and weight of 7.680 cm, 6.549 cm and 185.6 g, respectively.

Chemical composition of raw mango

The data collected on parameters of raw mango such as total soluble solids, acidity, pH, ascorbic acid, total sugar, reducing sugar and non-reducing sugar are presented in (Table 1). The total soluble solids and pH of raw mango were recorded as 10.52 °Brix and 2.84, respectively. Meanwhile, acidity and ascorbic acid were noted as 0.89 per cent and 130.82 mg/100 g, respectively. The total sugar content observed was 4.52 per cent, with reducing and non-reducing sugars at 3.25 per cent and 1.27 per cent, respectively.

Table 1: Physico-chemical composition of raw mango

S. No.	Parameters	Mean $\pm$ SD value
1.	Length (cm)	7.680 $\pm$ 0.53
2.	Breadth (cm)	6.549 $\pm$ 0.38
3.	Weight (g)	185.6 $\pm$ 20.89
4.	pH	2.84 $\pm$ 0.11
5.	Acidity (%)	0.89 $\pm$ 0.03
6.	Ascorbic acid (mg/100g)	130.82 $\pm$ 4.62
7.	Total soluble solids ($^{\circ}$ Brix)	10.52 $\pm$ 0.37
8.	Total sugar (%)	4.52 $\pm$ 0.14
9.	Reducing sugar (%)	3.25 $\pm$ 0.10
10.	Non-reducing sugar (%)	1.27 $\pm$ 0.24

4. Conclusion

It may be concluded that mango is a good source of Vitamin C. Unripe, mature green mangoes are suitable for the preparation of mango pickle. Raw mango has low to medium acidity, but when it is used for making pickle, the acidity increases. Among all pickles, oil-based pickle was found to be the best. When the pickle has low to medium pH and proper acidity, its storage capacity increases. As the storage period increases, the quality and taste of the pickle also improve. Generally, in Chhattisgarh, oil-based pickle is commonly used, but for commercial purposes, the use of jaggery can be more beneficial.

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