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Int. J. Agriworld, Vol. 6[1] January 2025 ©2020 SVPSS, India Online ISSN: 2582-7537 Journal's <u>URL:http://www.svpss.in/ijaw</u>

DOI: https://doi.org/10.51470/IJAW.2025.06.01.23

Received 05.11.2024

ORIGINAL ARTICLE

Revised 15.12.2024

Accepted 10.01.2025 OPEN ACCESS

Characterization of Mango (*Mangifera indica* L.) Fruit and Fruit Pulp of Some Mango Varieties of Ranaghat Market Area, Ranaghat, West Bengal

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Abstract

Mango is an economically and nutritionally significant fruit species, widely cultivated in tropical and subtropical regions in India. This fruit offers substantial health advantages when consumed fresh and when mature (Sarkar, 2016). The tropical and subtropical climate of West Bengal, especially in regions like Malda, Murshidabad, and Nadia, is ideal for mango cultivation. The state contributes approximately 7.4% of India's total mango production, making it one of the leading mango-producing states in the country. Ranaghat, Nadia district, West Bengal, is famous for the availability of different kinds of mango varieties. This study aimed to characterize selected mango varieties have different morphological characteristics, including fruit size, shape, peel colour, pulp colour, fibre content, and unique taste, flavour, and fragrance. Several cultivated mango varieties, which are available in the Ranaghat market area- Himsagar, Langra, Amrapali, Chaunsa, Bombai, Fazli, Chatterjee, Golapkhas and Golapjam, were evaluated for fruit and pulp traits. The investigation reveals extremely high pulp juiciness in Himsagar, Chaunsa, and Golapjam. The amount of fibre is higher in Chaunsa and Golapkhas. Himsagar, Langra, Amrapali, Bombai, Golapkhas, and Fazli varieties are commonly found in regional markets during the mango season.

Keywords: Mango fruit, morphological characteristics, DUS testing, pulp analysis, Ranaghat.

Introduction

Mango (Mangifera indica L.), often called the "king of fruits" (Halder et al., 2020), is one of the most popular fruits, belonging to the family Anacardiaceae, order Sapindales (Ahmed et al., 2015). It is one of the most important tropical fruits marketed in the world. Mango has been cultivated in India for more than 4000 years (Dutta et al., 2020). India has the richest collection of mango cultivars, with more than 1,000 distinct varieties grown under diverse agro-climatic conditions (Rajan et al., 2021). As the largest mango producer, India accounts for almost 40% of global mango production (Rajan, 2021; Hussain et al., 2021). Mango is one of the most important horticultural fruits in West Bengal (Ahmed et al., 2015). It is grown naturally or cultivated in the tropical and subtropical regions, particularly in districts such as Malda, Murshidabad, and Nadia (Halder et al., 2020). Ranaghat, Nadia district, West Bengal, is famous for the availability of different kinds of mango varieties in the summer. Ranaghat town and its surrounding areas like Dhantala, Matikumra, and Aistala serve as major suppliers to the Ranaghat market. In addition, nearby towns such as Chakdaha, Bagula, Shantipur, Majhdia, and Bathnaha also contribute significantly to the supply of mangoes. These regions ensure a consistent flow of diverse mango varieties into the Ranaghat market, supporting both local consumption and export to other regions.

The morphological traits of mangoes, such as fruit size, shape, and colour, are critical for classification and breeding (Sankaran *et al.*, 2021). Morphological Characterization is the simplest of the formal, standardized, repeatable methods of identifying and presenting mango's genetic diversity (Rajan *et al.*, 2021). The International Plant Genetic Resources Institute (IPGRI, 2006) descriptors provide standardized methods for assessing mango traits and allow for the use of visual assessment tools of morphological traits to characterize mango germplasm (Rajan, 2021). The DUS (Distinctness, Uniformity, and Stability) testing system serves as the scientific basis for mango characterization (Sankaran *et al.*, 2021; Rajan *et al.*, 2021).

Mango is considered the most popular fruit not only for its rich taste and fragrant aroma, but also for its numerous health benefits. Mangoes are rich in vitamins, minerals, and bioactive compounds, contributing to various health benefits, including antioxidant and anti-inflammatory properties (Hussain et al., 2021). The period from May to July is considered the peak season for mango ripening, but different mango varieties become available during different months, aligning with their natural ripening cycles. For example, Himsagar is typically available from May to June; Golapkhas, Golapjam, Fazli, and Chatterjee are found from June to July; Chaunsa, Bombai, and Langra are commonly available in July (Dey et al., 2014). Among all varieties, Himsagar has a great demand in the local market of Ranaghat due to its exceptional taste and texture.

This study was conducted to Characterize selected mango varieties based on DUS morphological descriptors and fruit pulp quality parameters to assess their distinctness, uniformity, and stability across seasons.

Popular Mango Varieties Commonly Found in Ranaghat, West Bengal

Himsagar

Himsagar is a highly popular and premium mango cultivar, often referred to as the "Champagne of mangoes". It is prized for its rich taste, smooth texture, and superior quality. The inner flesh of Himsagar is a vibrant yellow to orange in colour and is completely fibreless, making it ideal for table consumption. The fruit is medium-sized, typically weighing between 250 and 350 grams, and has a high pulp content of around 77%, which contributes to its creamy texture and sweetness. It also has a good shelf life, making it suitable for transportation and short-term storage. Himsagar is also known by the local name Khirsapati. The mango ripens in May and is usually available in markets from the second week of May to the end of June. It is primarily grown in the Chapai Nawabganj district of Bangladesh, and in Malda, Murshidabad, Nadia, and Hooghly districts of West Bengal in India (De et al., 2014; Pal et al., 2017).

Amrapali

Amrapali is a well-known mango cultivar that was introduced in 1971. It was developed as a hybrid variety of two popular mango cultivars- 'Dasheri' and 'Neelum', bred by Dr. Pijush Kanti Majumdar at the Indian Agriculture Research Institute (IARI), New Delhi. Amrapali was specifically developed to combine the desirable traits of its parent varieties, resulting in a mango known for its sweet taste, deep orange-red pulp, small size, and good keeping quality. One of its key advantages is that it can be grown densely and is highyielding, making it ideal for commercial cultivation (Ram *et al.*, 1997).

Fazli

Fazli is a prominent mango cultivar, noted for their large size, with individual fruits often weighing up to one kilogram (Khara *et al.*, 2016). It is a latematuring variety, typically becoming available after most other mango cultivars have ripened, making it especially valuable during the latter part of the mango season. The pulp is juicy and mildly sweet, making it suitable for both fresh consumption and culinary uses. Fazli is commonly used in the preparation of jams, pickles, and preserves due to its rich pulp content and firm texture. The Rajshahi Division of Bangladesh is a major production centre for Fazli mangoes (Singh *et al.*, 2017). On the Indian side, it is widely grown in Malda and Murshidabad districts of West Bengal (Khara *et al.*, 2016; Singh *et al.*, 2017).

Chaunsa

Chaunsa mango, a prized cultivar from South Asia, is renowned for its exceptional flavour, nutritional value, and market demand (Panhwar, 1999). This variety, celebrated for its golden-yellow skin and juicy, fibreless pulp, is primarily cultivated in Pakistan and India (Chatha *et al.*, 2020). Historically, it gained prominence through the Indian ruler Sher Shah Suri, who named it after the battle of Chausa. It is sometimes regarded as the best mango cultivar due to its exceptional aroma, sweetness, juiciness, and nutritional value (Chatha *et al.*, 2020). It is usually available in markets from early June to the third week of August.

Langra

Langra mango, also known as Banarasi Langra, is a prominent cultivar primarily cultivated in northern India, particularly in Varanasi, and in regions of Bangladesh and Pakistan (Barua *et al.*, 2012; Dash *et al.*, 1997). This variety is characterized by its greenish skin even when ripe, along with a fibreless, aromatic pulp that balances sweetness and tanginess, making it highly appealing to consumers (Anu *et al.*, 2015; Mukherjee, 1953). The fruit is noted for its high sugar content (16-18% w/v) and nutritional benefits, contributing to its popularity (Kumar *et al.*, 2020). The peak market availability occurs in June and July.

Golapkhas

The Golapkhas mango is a notable variety recognized for its unique characteristics, including its appealing flavour, aroma, and visual attributes. It is easily identifiable by its blushing pink or reddish skin, which adds to its visual and market appeal. This mango is particularly valued for its non-fibrous pulp, making it suitable for various culinary applications. This variety is typically available between May and June, marking it as an early-season mango. Golapkhas mangoes are relatively small in size, but they are known for their intense aroma and flavour (Singh *et al.*, 2017).

Bombai

The Bombai mango, a prominent variety from West Bengal, is celebrated for its unique flavor, juicy pulp, and aromatic qualities. This medium-sized mango, typically ovate-oblique, retains a green skin during ripening, occasionally showcasing a red blush. Its deep orange flesh is known for a rich, spicy-sweet taste, and while it is often described as fiberless, some may exhibit minor fibrous textures (Singh *et al.*, 2017). The easily removable seed enhances its appeal for consumption and processing. The peak ripening period occurs between June and July, aligning with high market demand.

Golapjam

The Golapjam mango, a cherished variety from West Bengal, is renowned for its sweet, juicy flavor and vibrant appearance. This variety is not as commercially widespread as some hybrid cultivars but remains a favorite in traditional markets due to its strong aroma (Singh *et al.*, 2017; Kundu *et al.*, 2009). The Golapjam mango's unique characteristics, such as its round shape, yellow and red speckled skin, and soft, sweet pulp, make it ideal for direct consumption (Dutta *et al.*, 2020). It becomes available in local markets starting in June (Kundu *et al.*, 2009).

Chatterjee

Chatterjee mango is a well-known traditional mango variety in West Bengal. This variety has regional significance for its distinct flavour and attractive appearance. The mature fruit maintains a green outer skin, even when fully ripe. However, the flesh inside is bright yellow, soft, and sweet, making it suitable for fresh consumption (Singh *et al.*, 2017). The mango is typically ovoid in shape, and its size is moderate compared to other regional varieties.

Chatterjee mangoes are available in local markets from June onwards.

Materials and Methods

Ranaghat town is located on the bank of the Churni River, in the Nadia district of West Bengal, India. Geographically, it lies at 23.1745°N latitude and area 88.5606°E longitude, covering an of approximately 7.72 square kilometers. The region falls under the tropical to subtropical climatic zone, which, combined with its alluvial soil, makes it highly suitable for mango cultivation. Markets like Rathtala market, Municipality market, Rail market, Hijuli market, Supermarket store, and Nokari market of Ranaghat town collectively serve as vital points for collecting and distributing mangoes, making Ranaghat a significant market hub for mango distribution.



Fig 1:-A. Map showing Nadia district in West Bengal. B. Ranaghat Municipality ward map

A three-month survey conducted from May 2021 to July 2021 across various markets in Ranaghat, West Bengal, revealed the presence of a considerable number of mango varieties in local circulation. For this study, nine mango varieties were collected and studied. Among the nine collected mango varieties, six varieties were found to be commonly available in the local markets, and three varieties were identified as rare, indicating limited distribution and possibly lower cultivation or market demand. These mangoes also have different times of ripening; some of them ripen as early as May, some of them in June, and a few ripen only in July.

To scientifically document and differentiate these mango varieties, morphological characterization was carried out following the guidelines of the Distinctness, Uniformity, and Stability (DUS) Test (Sankaran *et al.*, 2021; Rajan *et al.*, 2021; Kanchan *et al.*, 2018; Bihari *et al.*, 2012; De *et al.*, 2014). The parameters assessed included- mature fruit length & width, fruit shape, skin colour & thickness, flesh or pulp colour & texture, juiciness & fibre content, etc. Their pH has been measured with the help of pH paper. The type of cultivar (classified as wild type or hybrid type) is also mentioned.

Results

Nine mango varieties were collected from the local market, and their variety name, availability, and ripening time were noted. The list of mango varieties with their availability, place of origin and ripening time is given in Table 1.

Table 1: List of mango varieties with their availability,place of origin and ripening time

Sl.	Variety	Locally Place of		Ripening
No.	Name	availability	origin	time
1	Himsagar	Frequently India		May-
				June
2	Langra	Frequently	India	July
3	Chattarjee	Rare	India	June
4	Chaunsa	Rare	India	July
5	Amrapali	Frequently	India	July
6	Bombai	Frequently	India	June-July
7	Golapkhas	Frequently	India	June
8	Golapjam	Rare	India	June
9	Fazli	Frequently	Bangladesh	June-July

Morphological characterization was done with the help of Distinctness, Uniformity and Stability (DUS) test. Table-2 shows the result of DUS test.

The pulp colour, pulp juiciness and their pH were also noted. The result is mentioned in Table-3.

The types of cultivars (classified as wild type or hybrid type) of all different mangoes were noted. Table-4 shows the result of types of cultivars.

Discussion

The present study highlights the rich diversity of mango varieties available in the local markets of Ranaghat, West Bengal. A total of nine mango varieties were identified during the market survey conducted between May and July 2021. Among these, Himsagar, Langra, Amrapali, Bombai, Golapkhas, and Fazli were commonly available, while Chatterjee, Chaunsa, and Golapjam appeared to be relatively rare. In terms of origin, eight out of nine varieties were native to India, with only Fazli originating from Bangladesh. The ripening times of these mangoes varied significantly. Himsagar emerged as the earliest ripening variety, whereas most of the varieties ripened in July, making it the peak season for mango availability in Ranaghat markets (Table-1).

Different mango varieties exhibit distinct characteristics in terms of taste, fragrance, size, and

flavour. Morphological characterization reveals significant variation among them. Fazli is the largest, while Chaunsa is the smallest in size. These varieties also differ in fruit shape, skin colour, ripened fruit colour, speckling of skin, skin thickness, skin-to-flesh adherence, and flesh texture. Notably, Himsagar, Chaunsa, and Golapjam have very high juiciness, making them highly desirable for fresh consumption. On the other hand, Chaunsa and Golapkhas exhibit the highest fibre content, which may influence their texture and culinary applications. (Table-2).

The pulp colour of the studied mango varieties ranged from yellow to orange, with Langra showing a pale-yellow pulp; Chatterjee, Bombai, Golapkhas, and Fazli displaying yellow pulp; Himsagar, Chaunsa, and Amrapali having orangeyellow pulp; and Golapjam presenting a distinct orange pulp. Pulp juiciness varied across the varieties, with Himsagar, Chaunsa, and Golapjam showing very high juiciness; Amrapali and Fazli exhibiting high juiciness; and Langra, Chatterjee, Bombai, and Golapkhas having medium juiciness. The pH of the pulp ranged from 4 to 7, indicating differences in acidity levels-Fazli and Chatterjee recorded the highest pH of 7 (least acidic), while Langra had the lowest pH of 4 (most acidic), reflecting diversity in taste, texture, and storage potential among the mango varieties (Table-3).

Among the nine mango varieties studied, Himsagar, Langra, Chatterjee, Amrapali, Bombai, Golapkhas, Golapjam, and Fazli are classified as hybrid varieties, while Chaunsa stands out as the only wild variety (Table-4).

Conclusion

In the markets of Ranaghat, the mango season begins with the arrival of Himsagar and concludes with the late-ripening Fazli. This study focused on the characterization of nine mango varieties, among which Himsagar emerged as the most popular in the local market. The analysis highlighted the unique features of each variety, including differences in morphology, pulp quality, ripening time, and market availability. While the study provides valuable insights into the diversity of mangoes in Ranaghat, it also opens avenues for further in-depth research. Future studies can build upon these findings by incorporating more advanced analyses and expanding the variety pool for a more comprehensive understanding.

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Morphological	Mango Varieties								
Parameters	Himsagar	Langra	Chattarjee	Chaunsa	Amrapali	Bombai	Golapkhas	Golapjam	Fazli
Mature fruit length	7	7	9	1	5	3	3	5	9
Mature fruit width	5	5	5	1	3	3	3	3	7
Mature fruit ratio L/W	7	7	7	1	3	3	5	5	9
Mature fruit shape	3	1	2	3	2	3	1	3	2
Mature fruit skin colour	1	2	1	4	1	4	8	8	1
Predominant colour of ripe fruit	3	2	3	2	2	3	3	3	1
Speckling of skin	5	1	1	3	1	1	5	7	1
Thickness of skin	5	5	5	7	7	5	3	3	5
Adherence of skin/flesh	3	3	3	5	3	3	3	3	3
Main colour of flesh	4	2	3	4	4	3	3	5	3
Juiciness	7	5	5	7	5	5	5	7	3
Texture of flesh	7	5	7	3	5	5	3	5	7
Amount of fibres	1	3	1	7	1	5	7	5	1

Table-2: Results of DUS test of nine mango varieties using several morphological parameters.

Table-3: Pulp quality of nine different mango varieties with their pH value

Sl. No.	Variety Name	Pulp colour	Pulp juiciness	pH value
1	Himsagar	Orange-yellow	Very high	6
2	Langra	Pale yellow	Medium	4
3	Chattarjee	Yellow	Medium	7
4	Chaunsa	Orange-yellow	Very high	6
5	Amrapali	Orange-yellow	High	5
6	Bombai	Yellow	Medium	5
7	Golapkhas	Yellow	Medium	6
8	Golapjam	Orange	Very high	6
9	Fazli	Yellow	High	7

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Fig 2: Pie chart illustrating the comparative pulp pH levels of nine mango varieties **Table- 4:** List of types of cultivars of all different mangoes

Sl. No.	Wild type	Hybrid type
1		Himsagar
2		Langra
3		Chattarjee
4	Chaunsa	
5		Amrapali
6		Bombai
7		Golapkhas
8		Golapjam
9		Fazli



Fig 3&4: Photographs showing size, shape, skin and pulp colour of different mango varieties.

A. Himsagar, B. Langra, C. Chattarjee, D. Chaunsa, E. Amrapali F. Bombai, G. Golapkhas, H. Golapjam, I. Fazli

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CITATION OF THIS ARTICLE

Saha, P., Das, D. and Das, B. (2025). Characterization of Mango (*Mangifera indica* L.) Fruit and Fruit Pulp of Some Mango Varieties of Ranaghat Market Area, Ranaghat, West Bengal, *Int. J. Agriworld*, 6 [1]: 23-30.