

Studies on Fruit Morphological and Physico-Chemical Characters of Mango Varieties and Hybrids in Gujarat

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ABSTRACT

Mango (*Mangifera indica* L.) is, as a king of fruit, dominating fruit in consumer point of due to its delicious taste and flavour in India. Being a largest producing country in the world, it has more than thousand varieties in biodiversity. Though, the production the production is very low as compare to other country. Hence, the study has been framed to evaluate thirteen varieties and seven hybrids of mango at ripe stage for their morphological, physical and biochemical characters were made under South Gujarat agro-climatic conditions at Navsari Agricultural University, Navsari. Improvement in mango through hybridization is a very tedious and long task as it has

more than seven years of juvenile phase. For the goal oriented improvement work, systematic morphological characterization of genetic material is the basic and necessary work which is useful for the selection of parental materials in improvement program as well as identification of different varieties. The experimental results revealed that the mango varieties/hybrids expressed the morphological variations from genotype to genotype. Among these twenty genotypes, seven characters for fruit viz., fruit shape (obovoid, round, ovate, elliptical, oblong); color of ripen fruit (yellow, green with red blush, greenish yellow, bright orange, saffron yellow, apricot yellow, cadmium yellow, golden yellow); fiber content (fiberless, medium, low, high); pulp texture (intermediate, soft, firm); beak type (perceptible, pointed, mammiform); sinus type (shallow, prominent, absent) and fruit apex (obtuse, round, acute) were examined and documented. The cultivar Rajapuri had the maximum fruit weight (974.33 g), length (17.63 cm), thickness (12.73 cm), peel weight (87.77 g) while stone weight (57.57 g) was highest in cv Baneshan. The maximum content of pulp percentage was noted in cv Totapuri (89.61 %). Among the chemical parameters, the maximum total soluble solids (TSS) was recorded in cv. Kesar (21.96 °Brix). The maximum total sugars (19.34 %), reducing sugars (6.08 %), non-reducing sugars (12.88 %) and minimum titrable acidity (0.17%) were recorded in cv Alphonso. The maximum ascorbic acid content was observed in cv Langra (55.73 mg/100g). Based on the overall performance of the mango cultivars Rajapuri, Baneshan and Totapuri were found better in physical properties whereas, Kesar, Alphonso and Langra exhibited their superiority in chemical

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qualities.

Keywords Mango, Morphological, Physical, Biochemical, Varieties/Hybrids.

INTRODUCTION

Mango (*Mangifera indica* L.) is the most popular tropical fruit which belongs to the family Anacardiaceae and originated from the Indo-Burma region. India is the largest mango producer and share of 40% in total global mango production. India is also a prominent exporter of fresh mangoes in the world. Alphonso, Kesar, Totapuri and Banganpalli are leading export varieties from India. The area and production of mango cultivation in India is 23.15 lakh ha and 208.99 lakh MT, respectively with productivity of 9.03 MT ha⁻¹. In Gujarat, the area under mango cultivation is 1.66 lakh ha with production of 12.19 lakh MT, with productivity of 7.34 MT ha⁻¹ (Anon 2021).

The fruits of mango are reputed for their pleasant flavor, high nutritional value, attractive appearance and wide adaptability. There are many health benefits of mango fruit and it plays an important role in balancing human diet. The fruit pulp is also rich in vitamin B, carotenoids and essential mineral nutrients like potassium, calcium. Fruits can be utilized at all stages of development. Raw fruits are used for the preparation of curries, chutneys, preserves, mango powder and pickles (Singh *et al.* 2017), while ripe fruits are processed into different forms like juice, candy, mango leather. The eating quality of mango is a function of its flavor which in turn is associated with its chemical characteristics like soluble solids, sugar content, titrable acidity. The fruits with high soluble solid and low acidity content are most preferred by the consumers.

The aim of the present study was to determine physico-chemical and other characteristics of mango fruits, especially, locally grown varieties in South Gujarat. This study will help to identify suitable parents and potential mango cultivars for further evaluation, conservation and utilization in crop improvement program.

MATERIALS AND METHODS

The present study was carried out at ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India during the year 2020-2021. The experiment was laid out in a Completely Randomized Block Design having thirteen varieties viz., Alphonso, Baneshan, Chausa, Dadamio, Dashehari, Jamadar, Kesar, Langra, Neelum, Rajapuri, Totapuri, Vanraj, Vashibadami and seven hybrids viz., Amrapalli, Mallika, Neeleshan, Neelswari, Neelphanso, Ratna and Sonpari. Age of the trees used in the experiment was 20-30 years. Plants were maintained under uniform conditions as per the recommended package of practices of Navsari Agricultural University. The optimum mature fruits were harvested and collected randomly from the selected trees of mango. After uniform ripening at ambient temperature, five fruits in each variety were used in the study for different morphological, physical and chemical properties.

Morphological parameters

The morphological characters recorded by panel test as per the descriptors of IPGRI (Anon 2006).

Physical parameters

Fruit weight, stone weight and peel weight recorded by using digital balance, the length and thickness of fruit measured with vernier callipers. Fruit pulp percentage was calculated based on fresh weight basis.

Biochemical parameters

Total soluble solids (TSS) was measured with the help of a hand refractometer. Reducing sugars were estimated by titrimetric method. Titrable acidity and total sugars were estimated following the methods of AOAC (Anon1980). The amount of non-reducing sugars was calculated by subtracting reducing sugars from total sugars and multiplying the difference by factor 0.95 as suggested by AOAC (Anon 1980). Ascorbic acid content was estimated by volumetric method as suggested by Sadasivam and Manickam (2009).

Table 1. Morphological characters of fruits of various mango varieties/hybrids.

| Sl. No. | Varieties | Fruit shape | Color of ripen fruit | Fiber content | Pulp texture | Beak type | Sinus type | Fruit apex |
|---------|-------------|---------------------|----------------------|---------------|--------------|-------------|------------|------------|
| 1 | Alphonso | Obovoid | Orange yellow | Absent | Intermediate | Perceptible | Absent | Obtuse |
| 2 | Baneshan | Round | Yellow | Medium | Soft | Perceptible | Absent | Obtuse |
| 3 | Chausa | Ovate | Bright yellow | Low | Firm | Pointed | Shallow | Obtuse |
| 4 | Dadamio | Ovate reniform | Green with red blush | High | Firm | Perceptible | Absent | Round |
| 5 | Dashehari | Narrowly elliptical | Yellow | Low | Soft | Perceptible | Absent | Obtuse |
| 6 | Jamadar | Oblong | Yellow | Medium | Firm | Perceptible | Absent | Obtuse |
| 7 | Kesar | Oblong | Bright orange | Absent | Firm | Pointed | Shallow | Obtuse |
| 8 | Langra | Ovate | Greenish yellow | Low | Soft | Pointed | Absent | Obtuse |
| 9 | Neelum | Ovate | Saffron yellow | Low | Intermediate | Perceptible | Shallow | Round |
| 10 | Rajapuri | Oblong | Greenish yellow | Medium | Soft | Perceptible | Shallow | Obtuse |
| 11 | Totapuri | Oblong | Greenish yellow | Low | Firm | Mammiform | Shallow | Obtuse |
| 12 | Vanraj | Obovoid | Green with red blush | Low | Intermediate | Perceptible | Absent | Obtuse |
| 13 | Vashibadami | Oblong | Greenish yellow | Low | Intermediate | Prominent | Shallow | Obtuse |
| Hybrids | | | | | | | | |
| 14 | Amrapalli | Elliptical | Yellow | Low | Intermediate | Perceptible | Absent | Obtuse |
| 15 | Mallika | Oblong | Cadmium yellow | Low | Firm | Perceptible | Absent | Obtuse |
| 16 | Neeleshan | Obovoid | Cadmium yellow | Absent | Firm | Perceptible | Absent | Obtuse |
| 17 | Neeleswari | Narrowly oblong | Apricot yellow | Low | Firm | Perceptible | Prominent | Obtuse |
| 18 | Neelphanso | Ovate | Apricot yellow | Low | Soft | Perceptible | Absent | Acute |
| 19 | Ratna | Round | Greenish yellow | Low | Intermediate | Prominent | Shallow | Obtuse |
| 20 | Sonpari | Obovoid | Golden yellow | Absent | Firm | Perceptible | Absent | Obtuse |

RESULTS AND DISCUSSION

Morphological characters

Various different cultivars significantly differ in fruit shape (Table 1). The fruit shape was oblong in five varieties (Jamadar, Kesar, Rajapuri, Totapuri, Vashibadami) and one hybrid (Mallika) while narrowly oblong shape observed in Neeleswari; obovoid shape exhibited in two varieties (Alphonso, Vanraj) and two hybrids (Neeleshan, Sonpari). Amrapalli exhibited elliptical fruit shape and Dashehari exhibited narrowly elliptical fruit shape. While Baneshan and Ratna showed round shape fruits. Ovate reniform shape noted in Dadamio. Remaining three varieties (Chausa, Langra, Neelum) and one hybrid (Neelphanso) showed ovate shaped fruits. Saheda *et al.* (2019) reported similar findings in fruit shape as oblong, oblong elliptic, roundish and ovate oblong.

It is evident from the data presented in Table 1 that the ripe fruit skin color was found different among the mango cultivars. The fruit skin color was greenish yellow in cultivars like Langra, Rajapuri,

Ratna, Totapuri, Vashibadami; orange yellow and bright yellow color in Alphonso and Chausa varieties, respectively, whereas Amrapalli, Baneshan, Dashehari, Jamadar were yellow in color. Cultivars Dadamio and Vanraj were in green with red blush color. Cadmium yellow color in cultivars Mallika and Neeleshan; Apricot yellow color in Neeleswari and Neelphanso; saffron yellow in Neelum; golden yellow in Sonpari and bright orange color in Kesar cultivar. Fruit color is genetically controlled character and may be affected by environment. Importance of different fruit colors of mango cultivars was earlier reported by Bhamini *et al.* (2018) in different cultivars.

The fibre content of the fruit varied from fibreless, low fiber, medium fiber and high fiber. The ripe fruits of Amrapalli, Chausa, Dashehari, Langra, Mallika, Neeleswari, Neelphanso, Neelum, Ratna, Totapuri, Vanraj, Vashibadami were found with low fiber, whereas Baneshan, Jamadar, Rajapuri noted with medium fiber and mango varieties like Alphonso, Kesar, Neeleshan, Sonpari were found fibreless. Dadamio variety showed high fiber content among all cultivars of mango (Table 1). Saheda *et al.* (2019);

Rymbai *et al.* (2015) studied the mango varieties in fruit fiber varied from scanty, high, medium and very low.

A distinct variation was observed in pulp texture in different cultivars (Table 1). Firm texture was found in cultivars Chausa, Dadamio, Jamadar, Kesar, Mallika, Neeleshan, Neeleswari, Sonpari and Totapuri whereas soft texture of fruits was found in Baneshan, Dashehari, Langra, Neelphanso and Rajapuri. The pulp texture of Alphonso, Amrapalli, Neelum, Ratna, Vanraj and Vashibadami was noted intermediate. Similar findings are reported by Shah *et al.* (2013) in different cultivars of mango.

Significant variation was observed in terms of beak type (Table 1). Alphonso, Amrapalli, Baneshan, Dadamio, Dashehari, Jamadar, Mallika, Neeleshan, Neeleswari, Neelphanso, Neelum, Rajapuri, Sonpari and Vanraj exhibited perceptible beak; Ratna and Vashibadami possess prominent beak type and varieties like Chausa, Kesar, Langra recorded pointed beak. Totapuri variety noted mammiform beak type. Shah *et*

al. (2013) noted that beak type of most of the cultivars of mango varied from prominent, perceptible, pointed and mammiform in South Gujarat region.

Sinus type of the fruit varied from shallow, prominent, absent (Table 1). The fruits of Neeleswari showed prominent sinus, whereas sinus was absent in cultivars like Alphonso, Amrapalli, Baneshan, Dadamio, Dashehari, Jamadar, Langra, Mallika, Neeleshan, Neelphanso, Sonpari and Vanraj. Mango cultivars Chausa, Kesar, Neelum, Rajapuri, Ratna, Totapuri and Vashibadami were recorded shallow sinus type. Bhamini *et al.* (2018) recorded that fruit sinus of most of the varieties varied from shallow to absent in Khulna region.

The fruit apex differed among the cultivars of the mango (Table 1). Obtuse fruit apex was recorded in cultivars of Alphonso, Amrapalli, Baneshan, Chausa, Dashehari, Jamadar, Kesar, Langra, Mallika, Neeleshan, Neeleswari, Rajapuri, Ratna, Sonpari, Totapuri, Vanraj and Vashibadami while, acute apex showed in Neelphanso. Dadamio and Neelum recorded round

Table 2. Physical characteristics of fruits of various mango varieties/hybrids.

| Sl. No. | Varieties | Fruit weight (g) | Fruit length (cm) | Fruit thickness (cm) | Pulp (%) | Peel weight (g) | Stone weight (g) |
|---------|-------------|------------------|-------------------|----------------------|----------|-----------------|------------------|
| 1 | Alphonso | 293.00 | 10.68 | 8.30 | 70.48 | 47.03 | 38.45 |
| 2 | Baneshan | 722.67 | 16.17 | 10.90 | 84.40 | 53.53 | 57.57 |
| 3 | Chausa | 560.75 | 15.80 | 11.81 | 79.70 | 60.35 | 52.31 |
| 4 | Dadamio | 403.33 | 11.30 | 9.00 | 73.54 | 78.17 | 27.85 |
| 5 | Dashehari | 284.33 | 12.98 | 8.27 | 71.37 | 52.00 | 28.83 |
| 6 | Jamadar | 364.67 | 12.66 | 8.70 | 76.10 | 47.63 | 38.26 |
| 7 | Kesar | 352.00 | 14.36 | 9.00 | 69.75 | 67.88 | 37.63 |
| 8 | Langra | 363.41 | 11.77 | 8.50 | 80.92 | 45.87 | 22.50 |
| 9 | Neelum | 291.00 | 9.77 | 9.00 | 70.41 | 49.37 | 35.86 |
| 10 | Rajapuri | 974.33 | 17.63 | 12.73 | 85.55 | 87.77 | 51.87 |
| 11 | Totapuri | 564.00 | 16.18 | 9.67 | 89.61 | 12.72 | 44.93 |
| 12 | Vanraj | 962.67 | 14.26 | 10.13 | 85.64 | 87.73 | 48.89 |
| 13 | Vashibadami | 428.74 | 14.66 | 8.37 | 76.73 | 51.73 | 46.98 |
| Hybrids | | | | | | | |
| 14 | Amrapalli | 335.00 | 13.13 | 7.30 | 75.68 | 40.08 | 40.50 |
| 15 | Mallika | 480.00 | 13.00 | 7.50 | 78.94 | 76.80 | 23.37 |
| 16 | Neeleshan | 438.00 | 13.40 | 9.77 | 87.47 | 13.05 | 40.84 |
| 17 | Neeleswari | 264.33 | 12.80 | 6.93 | 77.45 | 29.66 | 29.10 |
| 18 | Neelphanso | 243.67 | 10.75 | 7.20 | 72.93 | 30.85 | 34.13 |
| 19 | Ratna | 482.00 | 12.90 | 9.93 | 78.95 | 56.67 | 43.80 |
| 20 | Sonpari | 588.00 | 13.63 | 10.65 | 84.17 | 46.10 | 45.98 |
| | SEm± | 1.496 | 0.376 | 0.358 | 0.027 | 0.346 | 0.358 |
| | CD (P=0.05) | 4.26 | 1.07 | 1.02 | 0.08 | 0.98 | 1.57 |

Table 3. Biochemical characteristics of fruits of various mango varieties/hybrids.

| Sl. No. | Varieties | TSS (°Brix) | Total sugars (%) | Reducing sugars (%) | Non-reducing sugar (%) | Titration acidity (%) | Ascorbic acid (mg/100g) |
|---------|-------------|-------------|------------------|---------------------|------------------------|-----------------------|-------------------------|
| 1 | Alphonso | 20.10 | 19.34 | 6.08 | 12.88 | 0.17 | 20.23 |
| 2 | Baneshan | 18.55 | 15.50 | 4.16 | 10.25 | 0.20 | 16.93 |
| 3 | Chausa | 21.40 | 16.50 | 5.01 | 11.00 | 0.30 | 29.71 |
| 4 | Dadamio | 17.65 | 15.76 | 4.65 | 9.98 | 0.36 | 15.99 |
| 5 | Dashehari | 20.85 | 16.50 | 5.45 | 10.50 | 0.30 | 32.62 |
| 6 | Jamadar | 17.47 | 15.13 | 4.85 | 9.95 | 0.23 | 19.27 |
| 7 | Kesar | 21.96 | 16.08 | 4.17 | 11.55 | 0.24 | 15.84 |
| 8 | Langra | 18.63 | 16.63 | 5.50 | 10.35 | 0.38 | 55.73 |
| 9 | Neelum | 19.09 | 15.83 | 3.55 | 11.10 | 0.23 | 15.94 |
| 10 | Rajapuri | 17.35 | 15.79 | 5.31 | 9.38 | 0.20 | 10.01 |
| 11 | Totapuri | 15.60 | 13.09 | 3.00 | 9.31 | 0.37 | 18.89 |
| 12 | Vanraj | 17.20 | 15.51 | 3.84 | 10.09 | 0.32 | 24.45 |
| 13 | Vashibadami | 14.90 | 13.23 | 3.10 | 9.48 | 0.25 | 18.77 |
| Hybrids | | | | | | | |
| 14 | Amrapalli | 19.93 | 17.03 | 5.89 | 10.85 | 0.24 | 22.99 |
| 15 | Mallika | 20.04 | 18.87 | 4.99 | 11.96 | 0.29 | 33.33 |
| 16 | Neeleshan | 16.50 | 13.11 | 3.05 | 9.48 | 0.21 | 15.00 |
| 17 | Neeleswari | 19.40 | 13.91 | 3.10 | 10.02 | 0.21 | 25.95 |
| 18 | Neelphanso | 20.50 | 14.42 | 4.03 | 9.78 | 0.18 | 16.92 |
| 19 | Ratna | 19.67 | 16.21 | 5.47 | 10.02 | 0.25 | 43.28 |
| 20 | Sonpari | 19.83 | 14.46 | 3.76 | 10.25 | 0.18 | 18.95 |
| | SEm± | 0.027 | 0.023 | 0.030 | 0.027 | 0.013 | 0.063 |
| | CD (P=0.05) | 0.08 | 0.06 | 0.09 | 0.08 | 0.04 | 0.18 |

apex. Fruit apex of mango is a genetically controlled character. Similar findings are reported by Saheda *et al.* (2019) in different cultivars of mango.

Physical properties of fruits

The data presented in Table 2 revealed that the physical properties of fruits of these cultivars have been evaluated in terms of weight, length, thickness, pulp percentage, peel weight, stone weight. The maximum fruit weight (974.33 g), fruit length (17.63 cm), fruit thickness (12.73 cm) and peel weight (87.77 g) was recorded in cv. Rajapuri, whereas lowest fruit weight (243.67 g), fruit length (10.75 cm), fruit thickness (7.20 cm) in cv Neelphanso and lowest peel weight (12.72 g) in cv Totapuri. On the other hand, the stone weight was maximum in cv Baneshan (57.57 g) and minimum in cv Langra (22.50 g). The highest pulp percentage was noted in cv. Totapuri (89.61 %) followed by cv Vanraj (85.64 %). Varietal variations regards with physical properties of fruit were also observed by Rymbai *et al.* (2015); Bora *et al.* (2017) and Xess *et al.* (2018).

Biochemical properties of fruits

The fruit quality of different cultivars was analyzed in terms of total soluble solids (TSS), total sugars, reducing sugars, non-reducing sugar, titration acidity and ascorbic acid (Table 3). The maximum TSS was found in cv. Kesar (21.96 °Brix), followed by cv Chausa (21.40 °Brix), while the minimum was noted in cv Neeleshan (16.50 °Brix). The variation in TSS was observed which could be attributed to seasonal variation and soil/climatic conditions. TSS of fruit is a genetic character, which might be affected by the days of maturity after fruit set (Patel *et al.* 2014, Singh *et al.* 2017).

The fruits having high total sugars (19.34 %), reducing sugars (6.08 %) and non-reducing sugars (12.88 %) content were showed in cv Alphonso and low in cv Totapuri (13.09 %, 3.00 % and 9.31 %). The titration acidity in the fruits was maximum in cv. Langra (0.38 %) followed by Totapuri (0.37 %) and lowest in cv Alphonso (0.17 %). The level of titration acidity in mango fruits decreases continuously with

the development of skin color and increase in sugar contents. The variation in fruit acidity was also reported by Husen (2019) in different cultivars of mango.

On the other hand maximum ascorbic content was noted in cv Langra (55.73 mg/100g), whereas minimum in cv Rajapuri (10.01 mg/100g). Variation in ascorbic acid content of mango was recorded due to varietal character and with the increase of TSS, sugars and vitamin C contents generally decline on ripening. Lad *et al.* (2017) and Xess *et al.* (2018) also find variation in ascorbic content among different varieties of mango.

CONCLUSION

From the present investigation, it can be concluded that the significant variation exist within the varieties and hybrids based on fruit morphological and physico-chemical characters. The morphological variations have an ability to distinguish the mango varieties/hybrids with each other. The mango cvs. Rajapuri, Baneshan and Totapuri found promising for fruit physical characters and as per bio-chemical characters, the cultivars like Kesar, Alphonso and Langra were found to be superior than rest of the varieties / hybrids. These varieties can be evaluated at particular location for yield and quality and use in mango breeding programs, to help assess consumer preference and market demands.

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