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Characterization of physio-chemical quality traits of different mango varieties under the northern dry zone of Karnataka

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Abstract
Evaluation of fruit crops has been successfully utilized for studying the performance of varieties under different agroclimatic regions from time to time. In the present study, cultivars were characterized based on their physico-biochemical attributes. Totapuri" and "Malgoa" were found superior in terms of fruit weight (554.56 and 384.56 g), size, pulp weight (232.00 and 226.78 g) and pulp stone ratio (6.15 and 4.11). "Khadar" excelled in terms of reducing sugar (20.82%), while "Dashehari" in TSS (19.11°B) possessed the highest amount of total soluble solids while the lowest amount in Totapuri (12.44 °B). The study shows the potential of Malgoa in terms of its quality, being late can meet the demand in the northern dry zone of Karnataka

Keywords: Biochemical, characterization, evaluation, mango, physical

Introduction
The evaluation of varieties is an important process to screen the potential cultivars for any specific region. Although a cultivar may express a unique behavior under a certain area, it may fail or sustain that peculiar character when grown in different locations. The genetic diversity within mangoes offers various opportunities to utilize these genomic resources and technologies to manipulate desirable traits. India has the richest germplasm collection and center for cultivating mangoes. Assessment of genetic variation within natural populations and among breeding lines is crucial for effective conservation and exploitation of genetic resources for crop improvement programs. In India, mango occupies a production share of 20.7% with an area of 2.21 million tons, annual production of 18.50 million tons having productivity of 8.3 metric tons per hectare (Anonymous, 2015) [3]. Proper identification of genetic resources is the basic need for carrying out successful improvement work. Characterization is an important aspect of documentation of the performance of the studied cultivars, which would help to select and cultivate the existing mango varieties. To ease this work of characterization, IPGRI (2006) [9] has developed descriptors that do not emphasize much on biochemical parameters. Continuous studies on performance and evaluation help us to select an ideal cultivar for the specific region, which can help us to promote its cultivation and also help to fetch good prices in the market based on its quality characteristics.
Various studies have been carried out on the morphological diversity and horticultural attributes of Indian mangoes (Kumar *et al*., 1999, Singh and Bana, 1976) [16, 26]. Development of mango hybrids that are efficient in nutrient utilization, provide better returns and are also able to endure adverse environmental conditions, forms the major aims of modern fruit breeding (Khan, 2004) [13]. An ideal mango cultivar should have characteristics like precocious, dwarf, regular and prolific in bearing, early flowering and fruit set, attractive fruit colour and size, and resistant to major diseases and other biotic-abiotic stresses (Litz, 2009) [17]. The application of morphological characterization is the simplest of the formal, standardized and repeatable methods of evaluating crop genetic diversity. Some of the most important advantages of using morphological characterization are that published descriptor lists are readily obtainable for most major crop species, they can be carried out in situ, are relatively low- cost and easy to perform. Morphological characterization is the first step that should be done before more profound biochemical or molecular studies are carried out (Hoogendijk and Williams, 2001) [12]. However, the interpretation of genetic diversity based on morphological characters has several limitations.

Morphological characters have complex inheritance patterns and are vulnerable to environmental conditions. Evaluation forms an important aspect of studying the constant performance of genotypes in a particular environment. Hence, an attempt was made to evaluate the physiochemical quality of the potential varieties of mango under the northern dry zone of Karnataka.

Materials and Methods

The investigation was carried out at the Main Horticultural Research and Extension Center (MHREC) UHS, Bagalkot (Karnataka) from August to June 2020. Bagalkot is situated in the north-eastern part of Karnataka at latitude 16° 10' 48.00" N longitude 75° 42° 0.00" E and altitude of 559 meters above the mean sea level. Bagalkot enjoys a subtropical climate, hot and dry summers and cold winters are the main characteristic features of this region. In general, the highest and lowest temperature goes above 45 ºC and below 15 ºC, respectively. The annual rainfall varies from 550 to 700 mm which is received mainly from July to September. The experimental material consisted of eight varieties of mango *viz*., Langra, Malgoa, Khadar, Dashehari, Pairi, Kesar, Totapari and Alphonso and free from the attack of insect pests and diseases. Healthy and vigorous eight-year-old plants were selected for the present study.

Physical parameters: The physical parameters such as fruit weight, size, volume, pulp weight, stone weight, pulp-to-stone ratio and peel weight were measured using twelve (8) fruits of mango from different replications under each treatment, randomly selected and weighed using top pan balance. The length and diameter were measured using a digital Verniercalliper and expressed in grams (g), millimetres (mm) and centimetres (cm), respectively.

Biochemical characteristics: The total soluble solids of fruits were measured by using a digital hand refractometer (Atazo, Japan) at room temperature and results were expressed in terms of degree Brix (°B). The titrable acidity was determined by titrating 10 ml aliquot against 0.1N sodium hydroxide solution using phenolphthalein as an indicator. The result was expressed as percent citric acid. The reducing sugar, nonreducing and total sugar were estimated and expressed in percentages. The extract was taken and titrated against 10ml of mixed Fehling solution A and B using methylene blue as the indicator. The results were expressed as the percentage of reducing sugar. The sugar extracts were hydrolyzed with concentrated hydrochloric acid and titrated against 10 ml of mixed Fehling‟s solution (5 ml Fehling A + 5 ml Fehling solution B) using methylene blue as the indicator. Results were expressed as percent total sugar. The amount of non-reducing sugar was calculated by subtracting reducing sugars from total sugar and multiplying the difference by a factor of 0.95 as suggested by AOAC (1980) [4].

Statistical analysis: The different observations were subjected to statistical analysis by using randomized block design (RBD). The mean difference was tested by the „F‟ test at a 5 percent level of significance (LOS). Critical difference (CD) at a 5 percent level of probability was used for comparison among treatments. Data were subjected to analysis of variance (ANOVA)

Results and Discussion

Fruit physical parameters: Data related to fruit weight presented in Table 1, revealed that a wide range of fruit weight (160.61 to 554.56 g) was observed in different cultivars of mango. The higher fruit weight was found in Totapuri (554.56 g) followed by Malgoa (384.56 g), Khadar (339.78 g), and Baneshan (323.00 g) and they were found statistically at par with each other. The lower fruit weight was observed in Dashehari (160.61g), which was statistically at par with Kesar (210.44 g). The higher or lower fruit weight might be due to the varietal or genetic characteristics. A similar trend in the variation of fruit weight from 365.33-219.00 has also been reported by Majumder *et al*., 2011 [18] while evaluating different mango cultivars. The mean value for the fruit length ranged from 8.97 cm to 13.48 cm. The higher fruit length was recorded in cv. Totapuri (13.48 cm) followed Baneshan (12.29 cm) and Khadar (11.92 cm).

The mean value of fruit width showed a range of 7.23 cm to 10.54 cm. The higher fruit width was reported in Baneshan (10.54 cm), which was statistically at par with Khadar (9.22 cm). The variation in length (8.97 cm to 13.48 cm) and width (7.23 cm to 10.54 cm) of fruit in mango was also observed by Kher and Sharma (2002) [14] and Abirami *et al*. (2008) [1]. The variations in the fruit size depend upon the genetic makeup of an individual variety and are highly influenced by environmental factors.

The mean value of the peel weight ranged from 26.22 g to 54.31 g. The minimum peel weight was noted in Dashehari (26.22 g), which was statistically at par with Alphonso (35.11 g). The maximum peel weight was exhibited by Baneshan (54.31 g), which was statistically at par with Malgoa (45.00 g). The present findings related to peel weight are also by the results of Anila and Radha (2005) [2] who observed the highest peel weight (51.74 g) in Ratna. Mitra and Mitra (2001) [20-21] evaluated 19 cultivars and reported differences in peel weight in various cultivars. A significant difference at 0.05% was also found concerning the peel thickness. The mean value of peel thickness ranged from 0.67 mm to 1.53 mm. Similar trends of results were also obtained by Mannan *et al.* (2003) [19], who reported the range of peel thickness varied from 1.48 mm to 2.72 mm in different mango varieties *viz*., Amrapali, Fazli, Neelambari, Indian Tota and Madrazi Tota. Peel thickness provides protection against fruit flies and helps to reduce post-harvest losses; however, this fact could increase the difficulty of removing peel before processing. It is evident from the data that the mango cultivars significantly differed concerning their pulp weight. Totapuri ranked first in pulp weight (232.00 g) followed by Khadar (226.89 g) and Malgoa (226.78 g). The lower pulp weight was recorded in cv. Dashehari (60.17g) which was statistically at par with Kesar (128.78 g). The lower pulp weight in the cultivar Dashehari was due to its smaller fruit size.

The stone weight varied significantly among the different cultivars of mango under study. The lower weight of stone was observed in Dashehari (26.44 g) followed by Totapuri (34.00 g) and Kesar (37.44 g). The higher stone weight was recorded in cv. Alphonso (90.48 g). The present findings related to stone weight are also by the results of Jilani *et al*. (2010) [10] and Anila and Radha (2005) [2], who observed that stone weight ranged from 22.99 g to 47.07 g in four varieties and two hybrids *viz*., Alphonso, Prior, Muvandan, Neelum and hybrids Ratna (Neelum x Alphonso) and H-151 (Kalapady x Neelum). The data on the ratio of pulp and stone

revealed that the variety Totapuri (6.15) had a higher ratio followed by Baneshan (5.29). The lower values were obtained for Dashehari (2.07) followed by Alphonso (2.21) and Kesar (3.35).

The mean value for the fruit volume showed a range of 137.56 to 510.78 ml. Minimum fruit volume was noticed in cv. Dashehari (137.56 ml) which was statistically at par with Kesar (191.56 ml). The maximum fruit volume was observed in Totapuri (510.78 ml), which was statistically on par with Malgoa (336.89 ml), Khadar (318.11 ml), Baneshan (292.44 ml), Pairi (248.67 ml), Alphonso (246.16 ml), and Kesar (191.56 ml).

Table 1: Fruit parameters of mango varieties under the Northern dry zone of Karnataka

Sl. No.	Treatment	Fruit weight (g)	Fruit size		Fruit volume (ml)	Pulp weight (g)	Stone weight (g)	Pulp to Stone ratio	Peel weight (g)	Fruits per tree	Estimated yield per hectare (t)
			Fruit length (cm)	Fruit width (cm)							
1	Khadar	339.78	11.92	9.22	318.11	226.89	45.56	4.95	44.67	153.33	11.42
2	Baneshan	323.00	12.29	10.54	292.44	211.33	42.89	5.29	54.31	197.78	13.94
3	Alphonso	314.11	9.38	7.39	246.16	200.41	90.48	2.21	35.11	147.33	5.48
4	Kesar	210.44	11.00	8.07	191.56	128.78	37.44	3.35	34.67	285.78	12.89
5	Dashehari	160.61	8.97	4.91	137.56	60.17	26.44	2.07	26.22	279.78	9.41
6	Pairi	266.22	9.32	7.23	248.67	162.89	43.56	3.80	36.22	200.56	8.43
7	Totapuri	554.56	13.48	9.12	510.78	232.00	34.00	6.15	34.67	206.78	15.88
8	Malgoa	384.56	10.64	9.21	336.89	226.78	54.89	4.11	45.00	138.22	10.60
	S.Em±	21.22	0.24	0.25	10.92	4.63	1.00	0.11	1.02	11.90	0.85
	CD at 5%	64.34	0.73	0.74	33.11	14.03	3.02	0.33	3.10	36.09	2.58
	CV (%)	11.51	3.86	5.18	6.63	4.42	3.68	4.75	4.55	10.24	13.38

Chemical characteristics: Based on the analysis, it was observed that mango cultivar, Dashehari (19.11°B) possessed higher amount of TSS followed by Baneshan (18.56°B), Kesar (18.11°B), A lower amount of T.S.S was observed in Totapuri (12.44°B), followed by Alphonso (12.74◦B), Khadar (14.89°B) and Pairi (17.56°B). Therefore, in the present investigation, the variation in TSS ranged from 12.44 °B to 19.11°B, however, these findings partially agreed with the results of Bhuyan and Guha (1995) [6], who also reported TSS from 16.22 to 24.14 °B in 14 mango germplasm under the climatic conditions of Rajshahi. Similar variation was also reported by Teaotia *et al*. (1972) [27] and Samad *et al*. (1975) [25] in mango fruits. Variation in TSS (16.11 °B to 23.00 °B) is also reported by Singh (2002) [25].

The maximum titrable acidity was observed in Kesar (0.34%) followed by Alphonso (0.33%), whereas its minimum content was found in Totapuri (0.17%) (Table 2). The ratio of TSS: acidity was found maximum in Dashehari (78.28) followed by Baneshan (74.68) and Totapuri (73.67), whereas Alphonso registered a minimum ratio of TSS and acidity (32.63) followed by Kesar (54.91). The values of titrable acidity are by the results of Kumar (1998), who reported a range of 0.17 to 0.33% in different mango cultivars. Its wide range of values from 0.11 to 0.43% was also supported by Bakshi and Bajwa (1959) [5]. The variation in the acidity in the different varieties of mango could be due to their varietal characteristics. Moreover, the TSS acidity ratios as reported in the present study were similar to those of Palaniswamy *et al*. (1975) [22]. Similar findings have also been reported by Mitra *et al*. (2001) [20-21], Dhillon *et al*. (2004) [7], Sharma and Josan (1995) [24] and Kher and Sharma (2002) [14] while working on fruit quality characteristics of different mango varieties under different climatic conditions. Kher and Sharma (2002) [14] and Hoda *et al*. (2003) [11] also reported a similar trend of variation i.e., 39.36 to 152.39 in sugar percentage in different mango cultivars. The reducing sugar was found maximum in Khadar (6.42%) followed by Totapuri (6.09%), whereas minimum in Pairi (2.19%) followed by Alphonso (2.20%) and Kesar (2.60%). A wide variation in reducing sugar has been reported by Doreyappa and Ramanujaneya (1994) [8].

Table 2: Biochemical parameters of mango varieties under the Northern dry zone of Karnataka

Sl. No.	Treatment	Self-life of fruit (days)	TSS (ºB)	Acidity (%)	TSS: Acidity ratio	Reducing sugar (%)
1	Khadar	12.56	14.89	0.23	62.62	6.42
2	Baneshan	12.67	18.56	0.25	74.68	5.76
3	Alphonso	11.67	12.74	0.33	32.63	2.20
4	Kesar	11.00	18.11	0.34	54.91	2.60
5	Dashehari	13.56	19.11	0.25	78.28	4.64
6	Pairi	9.78	17.56	0.24	74.52	2.19
7	Totapuri	13.67	12.44	0.17	73.67	6.09
8	Malgoa	11.33	17.78	0.25	72.27	5.73
	S.Em±	0.30	0.62	0.01	1.45	0.05
	CD at 5%	0.14	1.88	0.02	4.40	0.14
	CV (%)	4.38	6.56	4.72	3.84	1.77

Conclusion

Based on the findings of the present study, it can be concluded that significant variation exists within the verities based on physicochemical characteristics. “Totapuri” and “Malgoa” were found superior in terms of fruit weight, size, pulp weight and pulp stone ratio. “Khadar” excelled in terms of reducing sugar (20.82%), while “Dashehari” in TSS (19.11ºB). The northern dry zone of Karnataka possesses a suitable climate that can be used for mango; Therefore, evaluation forms an important prerequisite for starting a breeding programme.

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