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Evaluation of mango (*Mangifera indica* L.) cultivars for physical characteristics and quality parameters of fruit under indo-gangetic plains

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Abstract
The present investigation was conducted at the Horticulture Unit, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P., India during the year 2014-15 and 2015-16. The main aim was to investigate the physical characteristics and quality parameters of different mango cultivars. Outcome of the present research work revealed that maximum fruit length (14.38 cm), fruit breadth (8.08 cm), fruit weight (382.78 g) and fruit volume (373.67 ml) was observed in cv. Mallika. Specific gravity ranged between 1.013 to 1.074. Maximum T.S.S. (24.10°Brix), minimum acidity percentage (0.18%) and maximum value of T.S.S./acid ratio (137.38) was observed in Cv. Chausa. Maximum ascorbic acid was recorded in cultivar Langra (51.78 mg/100g) while, maximum total carotenoides content was found in cultivar Amrapali (8.78 mg/100 g).

Keywords: Evaluation, mango, cultivars, physical, quality

Introduction
Mango (*Mangifera indica* L.) is an important fruit crop of India belonging to the family Anacardiaceae and acknowledged as "King of Fruits". Mango belongs to the group of plants, in which an antagonism between vegetative vigour and flowering intensity is observed. The irregularity of flowering in mango, which varies in time and intensity of flowering from year to year to almost complete biennial (alternate flowering habit), is not an uncommon phenomenon. The characteristics of each variety vary widely with change in agro-ecological conditions. A large number of mango varieties are being grown in India, most of them do not satisfy the requirements of an ideal commercial variety and fail in competition with other countries.

The fruit quality is attributed to its physical characteristics, especially the color of skin and fruit's shape and size. Mango is known to be a very good source of vitamins such as vitamin C, thiamine, riboflavin, and niacin and ß-carotene. Mango contains numerous polyphenolic and phytonutrient compounds that have been shown to exhibit antioxidant properties. Mangoes can be considered as a good source of dietary antioxidants, such as ascorbic acid, carotenoids and phenolic compounds (Ribeiro *et al*., 2007) [27]. β-carotene is the most abundant carotenoid in several cultivars. During ripening, mango develop pigments by carotenoid biosynthesis, change in carbohydrates or conversion of starch into sugars, organic acids, phenolics and volatile compounds, thus leading to ripening of fruits with softening of fruits to acceptable quality (Gill and Dhillon, 2008) [13].

Study of physical and chemical characteristics of mango trees can help to identify the best varieties for consumption and industrialization. There are many factors that influence yield, maturity and quality of fruits, the same cultivar can attain different characteristics in different growing conditions. Even in the same region, different environmental conditions at different years can affect maturity and quality of the fruit (Devilliers, 1998) [10]. Therefore, evaluation of different promising mango cultivars for a given set of ecology is one of the pre-requisite for successful mango cultivation.

Materials and Methods
The present investigation was conducted at Horticulture Unit, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P., India during 2014-15 and 2015-16.

The experimental orchard comes under the Indo-gangetic alluvial track in eastern Uttar Pradesh in class II of land capability class and irrigated by tube well. Varanasi is situated in eastern part of Utter Pradesh, which lies between 25°19′59″ North latitude and 83°00′00″ East longitude at an elevation of 76.80 meter above mean sea level. The mean annual rainfall is about 850-1100 mm. The experiment was carried out on healthy and bearing of 20 years old trees.

The different cultivars taken for study were Amrapali, Langra, Dashehari, Mallika, Chausa, Fazli, Bombai, Himsagar, Sepiya, Alphonso, Gulabkhas. The experiment was laid out in Randomized Block Design (RBD). The number of treatments were eleven and these treatments were replicated three times. Therefore, altogether thirty three plants were selected for this investigation. Observations on different characters under study were recorded for two years. The observations were recorded on physical characteristics and quality parameters of fruits as fruit length (cm), fruit breadth (cm), fruit weight (g), fruit volume (ml), specific gravity, T.S.S. (^{O}Brix), acidity (%), T.S.S./acid ratio, ascorbic acid (mg/100g) and total carotenoides (mg/100g).

Results and Discussion

Physical attributes of fruits

It is evident from the data presented in Table 1 that maximum fruit length (14.38 cm) and fruit breadth (8.08 cm) was recorded in Cv. Mallika and minimum fruit length (7.32 cm) and fruit breadth (6.12) was observed in Cv. Sepiya. These results are in conformity with the findings by Chanana *et al.* (2005) [7], Kher and Sharma (2002) [18], Abirami *et al.* (2004) [2], Hossain *et al.* (2015) [17], Kundu *et al.* (2009) [22], Majumder *et al.* (2011) [23], Abourayya *et al.* (2011) [3] and Abdualrahman (2013) [1]. Fruit size is governed by polygenes in mango. The increase in size with increase in age can be justified as the fruit shows single sigmoid growth in early stages and the size becomes constant after maturity because of the fact that all metabolites are involved in other physiological process as ripening. The different parameters like cell size, lacticiferous canals, intercellular space, etc. leads to difference in fruit size of different mango cultivars. Maximum fruit weight (382.78 g) and fruit volume (373.67 ml) was found in Cv. Mallika and minimum fruit weight (167.62 g) and fruit volume (158.67 ml) was observed in Cv. Sepiya. Specific gravity varies from 1.013 to 1.074. These results are in conformity with the findings by Hoda *et al.* (2003) [16] and Abourayya *et al*. (2011) [3]. Sarkar *et al.* (2001) [28] reported that the fruit weight varied within the cultivars. The weight of fruits may be assigned to the factor of assimilation and accumulation of photosynthates. The volume of fruit is directly proportional to size of fruits and it is a purely varietal character which influenced by environments and locations. The specific gravity of the fruit is governed not only by physical growth but also by its internal compositions.

Table 1: Data regarding physical characteristics of fruit (fruit length, fruit width, fruit volume and specific gravity)

Treatments (Cultivars)	Length of fruit (cm)			Width of fruit (cm)			Weight of fruit (g)			Volume of fruit (ml)			Specific gravity		
	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean
Amrapali	8.60	8.85	8.73	6.30	6.06	6.18	220.00	221.33	220.67	209.67	213.00	211.33	1.052	1.039	1.046
Langra	9.04	11.19	10.11	6.59	7.28	6.93	303.60	323.17	313.39	292.67	312.08	302.38	1.038	1.038	1.038
Dashehari	10.32	10.73	10.52	6.90	6.53	6.72	177.83	169.83	173.83	175.33	170.00	172.67	1.022	1.004	1.013
Mallika	14.52	14.23	14.38	7.70	8.46	8.08	382.23	383.33	382.78	373.33	374.00	373.67	1.024	1.026	1.025
Chausa	10.88	10.79	10.84	6.18	7.09	6.64	275.30	288.00	281.65	264.00	276.67	270.33	1.041	1.044	1.043
Fazli	13.65	12.35	13.00	7.33	7.63	7.48	338.41	352.83	345.62	327.67	341.00	334.33	1.035	1.038	1.036
Bombai	9.00	9.62	9.31	7.06	7.89	7.48	294.66	308.50	301.58	283.67	298.33	291.00	1.045	1.043	1.044
Himsagar	8.54	8.79	8.67	7.02	7.56	7.29	249.42	259.33	254.38	239.00	248.33	243.67	1.036	1.041	1.039
Sepiya	6.86	7.77	7.32	5.76	6.47	6.12	171.90	163.33	167.62	163.00	154.33	158.67	1.066	1.082	1.074
Alphonso	7.58	9.27	8.42	6.24	6.57	6.40	285.67	282.50	284.08	273.33	272.00	272.67	1.045	1.039	1.042
Gulabkhas	8.44	8.57	8.51	6.11	6.40	6.25	225.33	233.33	229.33	213.33	223.33	218.33	1.095	1.075	1.085
SEm±	1.03	0.67	0.69	0.54	0.29	0.24	12.12	8.94	10.25	7.16	7.44	5.62	0.056	0.049	0.047
C.D. at 5%	3.03	1.99	2.06	1.13	0.87	0.71	35.77	26.40	30.26	21.12	21.96	16.59	N.S.	N.S.	N.S.

Quality parameters of fruit

Total soluble solids (^{O}Brix)

The data revealed that cultivar Chausa had maximum T.S.S. percentage (24.10^{O}Brix). Similar variation was also reported by Bhuyan and Guha (1995) [6], Sengupta *et al.* (2006) [29], Dutta *et al.* (2008) [12], Gill and Dhillon (2008) [13], Uddin *et al.* (2006) [33], Bakshi *et al.* (2013) [4], Okoth *et al.* (2013) [26], Shafique *et al.* (2006) [30], Abourayya *et al.* (2011) [3] and Modesto *et al.* (2016) [25]. This variation in T.S.S is obvious as it is an inherent character of the variety. The hydrolysis of polysaccharides and its conversion into sugars gives an indication of Total soluble solids. The mobilization of carbohydrates to organic acids may be the possible cause behind the inherent T.S.S. of a particular variety.

Titratable Acidity (%)

Minimum acidity percentage was observed in cultivar Chausa (0.18%) and maximum acidity percentage was recorded in cultivar Sepiya (0.34%). These findings related to titratable acidity are in accordance with the result of Kumar (1997) [19], Chaudhari *et al.* (1997), Uddin *et al.* (2006) [33], Bakshi *et al.* (2013) [4], Okoth *et al.* (2013) [26], Shafique *et al.* (2006) [30], Abourayya *et al.* (2011) [3] and Modesto *et al.* (2016) [25]. Fruit acidity is respondent to the ripening stage of the variety. It is also dependent on prevailing environmental conditions. The variation in the acidity in different varieties of mango could be due to their varietal characters.

T.S.S./acid ratio

Cultivar Chausa showed maximum value of T.S.S./acid ratio (137.38) and minimum value was observed in cv. Sepiya (51.14). The similar findings have also been reported by Mitra *et al.* (2001) [24], Dhillon *et al.* (2004) [11], Sharma and Josan (1995) [31], Kher and Sharma (2002) [18], Okoth *et al.* (2013) [26], Shafique *et al.* (2006) [30], Abourayya *et al.* (2011) [3] and Modesto *et al.* (2016) [25].

Ascorbic acid (mg/100g)

The maximum ascorbic acid was recorded in Cv. Langra (51.78 mg/100g) and minimum ascorbic acid content

observed in Cv. Alphonso (13.59 mg/100g). Similar variation in ascorbic acid content was reported by Gowda and Ramanjaneya (1994) [14], Mitra *et al*. (2001) [24], Bhowmick and Banik (2005) [5], Chatterjee *et al.* (2005) [8], Sengupta *et al.* (2006) [29], Uddin *et al*. (2006) [33], Shafique *et al.* (2006) [30] and Modesto *et al*. (2016) [25]. Such variation in ascorbic acid could be attributed to the nature and extent of genetic variability present in the experimental material. The higher level of ascorbic acid might be due to the perpetual synthesis of glucose 6- phosphate during the growth and development of fruits, which is considered to be the precursor of ascorbic acid. The increase in ascorbic acid content is probably due to the catalytic influence of growth substances on the biosynthesis of ascorbic acid from sugars.

Total carotenoides content (mg/100g)

The maximum total carotenoides was recorded in Cv. Amrapali (8.78 mg/100g) and minimum value was noted in Cv. Fazli (1.82 mg/100g). These findings related to total carotenoides contents are in accordance with the result of Hoda *et al*. (2003) [16], Singh and Singh (2004), Kumar and Singh (2005), Modesto *et al*. (2016) [25], Hossain *et al*. (2015) [17] and Haque *et al*. (2015) [15]. Total carotenoides provide an expression of natural appearance to the fruit product and their higher content in fruits offer distinct advantages, particularly in the international trade where addition of artificial colour is discouraged.

Table 2: Data regarding fruit quality attributes (T.S.S., acidity, T.S.S./acid ratio, ascorbic acid and total carotenoides)

Treatments (Cultivars)	Total soluble solids (^{O} Brix)			Titratable acidity (%)			T.S.S./acid ratio			Ascorbic acid (mg/100g)			Total carotenoides (mg/100g)		
	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean
Amrapali	22.13	20.47	21.30	0.20	0.26	0.23	111.18	78.93	95.05	36.13	34.90	35.52	8.63	8.92	8.78
Langra	20.20	18.13	19.17	0.27	0.29	0.28	75.89	63.52	69.71	50.50	53.06	51.78	2.79	2.69	2.74
Dashehari	18.43	19.60	19.02	0.29	0.28	0.29	64.41	70.80	67.61	24.56	25.19	24.88	3.03	2.83	2.93
Mallika	23.30	22.43	22.87	0.19	0.22	0.21	122.68	103.13	112.90	34.43	32.92	33.67	8.12	7.93	8.03
Chausa	24.43	23.77	24.10	0.18	0.17	0.18	134.91	139.84	137.38	32.55	35.76	34.16	2.74	2.57	2.65
Fazli	18.00	17.70	17.85	0.33	0.32	0.33	54.25	55.53	54.89	27.74	23.24	25.49	1.88	1.76	1.82
Bombai	21.37	22.73	22.05	0.22	0.20	0.21	99.16	106.58	102.87	31.04	28.28	29.66	6.06	5.77	5.92
Himsagar	19.67	20.53	20.10	0.27	0.26	0.27	72.80	79.27	76.04	21.19	19.73	20.46	3.01	3.23	3.12
Sepia	16.70	17.33	17.02	0.34	0.33	0.34	49.48	52.79	51.14	13.55	16.52	15.04	2.29	2.14	2.21
Alphonso	21.47	21.17	21.32	0.22	0.24	0.23	98.77	88.29	93.53	14.25	12.92	13.59	2.57	2.72	2.65
Gulabkhas	21.07	21.40	21.23	0.26	0.24	0.25	80.71	92.22	86.46	36.33	33.72	35.03	6.73	6.61	6.67
SEm±	0.31	0.53	0.33	0.016	0.189	0.011	4.18	3.22	2.56	2.46	2.89	1.51	0.25	0.25	0.16
C.D. at 5%	0.93	1.59	0.98	0.047	0.055	0.032	12.33	9.50	7.57	5.10	8.49	4.44	0.74	0.75	0.47

References

1. Abdualrahman. Physico-chemical characteristics of different types of mango (*Mangifera indica* L.) fruits grown in Drafur regions and its use in jam processing. Science International 2013; 1(5):144-7.
2. Abirami K, Nachegowda V, Reddy YTN. Physico-chemical attributes of certain poly-embryonic varieties of mango. South Indian Horticulture. 2004; 52(1/6):291-6.
3. Abourayya MS, Kassim NE, El-Sheikh MH, Rakha AM. Fruit physical and chemical characteristics at maturity stage of Tommy Atkins, Keitt and Kent mango cultivars grown under Nubariya conditions. Journal of American Science. 2011; 7(3):228-33.
4. Bakshi P, Kumar R, Jasrotia A, Sharma A. Variability in physico-chemical and sensory attributes of mango genotypes under rainfed conditions of Shivalik foothills of Himalayas. Asian Journal of Horticulture. 2013; 8(1):39-42.
5. Bhowmick N, Banik BC. Yield and physico-chemical properties of some mango cultivars in new alluvial zone of West Bengal. Environment and Ecology. 2005; 3(3):503-6.
6. Bhuyan MAJ, Guha D. Performance of some exotic mango germplasms under Bangladesh conditions. Bangladesh Horticulture. 1995; 23(1&2):17-22.
7. Chanana YR, Josan JS, Arora PK. Evaluation of some mango cultivars under North Indian conditions. Proceedings of International Conference on Mango and Date Palm: Culture and Export 20-23rd, 2005, pp. 34-38.
8. Chatterjee D, Maurya KR, Mandal MP. Physico-chemical characteristics of mango (*Mangifera indica* L.) hybrids in Bihar. The Orissa Journal of Horticulture. 2005; 33(2):57-60.
9. Chaudhary SM, Patil BT, Desai UT. Performance of south Indian mango varieties under semi-arid region of Maharashtra. Journal of Maharashtra Agriculture Universities. 1997; 22(1):72-4.
10. Devilliers EA. The cultivation of mango. Institute of Tropical and Subtropical Fruits, 1998, pp. 28-30.
11. Dhillon WS, Sharma RC, Kahlon GS. Evaluation of some mango varieties under Punjab conditions. Haryana Journal of Horticultural Sciences. 2004; 33(3/4):157-9.
12. Dutta P, Chakraborty K, Roy SK, Samanta A. Physico-chemical qualities and storage behaviour of some promising mango hybrids grown in new alluvial zone of West Bengal. Haryana Journal of Horticultural Sciences. 2008; 37(3/4):247-8.
13. Gill KS, Dhillon BS. A study of the physico-chemical and quality changes in fruits of mango (*Mangifera indica* L.) cv. Dashehari during storage. Haryana Journal of Horticultural Science. 2008; 37(1/2):93-9.
14. Gowda DIN, Ramanjaneya KH. Studies on physico-chemical characteristics of some commercial cultivars of mango. Indian Food Packer. 1994; 48(2):45-9.
15. Haque S, Begum P, Khatun M, Islam SN. Total carotenoid content in some mango (*Mangifera indica*) varieties of Bangladesh. International Journal of Pharmaceutical Sciences and Research. 2015; 40:4875-8.
16. Hoda MN, Singh S, Singh J. Evaluation of mango (*Mangifera indica* L.) cultivars for quality attributes. Indian Journal of Agricultural Sciences. 2003; 73(9):504-6.

17. Hossain MA, Mannan MA, Roy SK, Shil P. Physico-chemical analysis of mango (*Mangifera indica* L.) germplasm available in the south-western region of Bangladesh. Bangladesh Research Publications Journal. 2015; 11(3):242-51.
18. Kher R, Sharma RM. Performance of some mango cultivars under subtropical rainfed region of Jammu. Haryana Journal of Horticultural Sciences. 2002; 31(1/2):8-9.
19. Kumar N. Physico-chemical characteristics of some south and west Indian mangos. Haryana Journal of Horticultural Sciences. 1997; 26(1/2):99-100.
20. Kumar N, Jaiswal US. Bearing behaviour of some South and West India mangoes and its vegetative growth. Haryana Journal of Horticultural Sciences. 2004; 33(1/2):9-10.
21. Kumar R, Singh S. Evaluation of mango genotypes for flowering, fruiting and fruit quality attributes. The Orissa Journal of Horticulture. 2005; 33(1):77-9.
22. Kundu S, Sanyal N, Datta P. Studies on potentiality of some mango varieties in West Bengal. Journal of Crop and Weed. 2009; 5(2):68-71.
23. Majumder DAN, Hassan L, Rahim MA, Kabir MA. Studies on physiomorphology, floral biology and fruit characteristics of mango. Journal of the Bangladesh Agricultural University. 2011; 9(2):187-99.
24. Mitra S, Kundu S, Mitra SK. Evaluation of local strains of mango (*Mangifera indica*) grown in West Bengal. Indian Journal of Agricultural Sciences. 2001; 71(7):466-8.
25. Modesto JH, Leonel S, Segantini DM, Souza JMA, Ferraz RA. Qualitative attributes of some mango cultivars fruits. Australian Journal of Crop Science. 2016; 10(4):565-70.
26. Okoth EM, Sila DN, Onyango CA, Owino, WO, Musyimi SM, Mathooko FM. Evaluation of chemical and nutritional quality attributes of selected mango varieties at three stages of ripeness, grown in lower Eastern province of Kenya - part 2. Journal of Animal & Plant Sciences. 2013; 17(3):2619-30.
27. Ribeiro SMR, Queiroz JH, Queiroz MELR, Campos FVM, Santana HMP. Antioxidant In Mango (*Mangifera indica* L.) Pulp. Plant Foods For Human Nutrition. 2007; 62:13-17.
28. Sarkar SK, Gautham B, Neerja G, Vijaya N. Evaluation of mango hybrids under Telangana region of Andhra Pradesh. The Horticulture Journal. 2001; 14(1)13-21.
29. Sengupta S, Munsi PS, Pujari MM. Studies on the performance and prospect of some promising mango hybrids in the Gangetic plains of Eastern Bihar. The Orissa Journal of Horticulture. 2006; 34(2):74-7.
30. Shafique MZ, Ibrahim M, Helali MOH, Biswas SK. Studies on the physiological and biochemical composition of different mango cultivars at various maturity levels. Bangladesh Journal of Scientific and Industrial Research. 2006; 4(1/2):101-8.
31. Sharma JN, Josan JS. Performance of mango cultivars under arid-irrigated regions of Punjab. Indian Journal of Horticulture. 1995; 52(3):179-81.
32. Singh S, Singh J. Evaluation of mango hybrids for flowering, fruiting and fruit quality attributes. Progressive Horticulture. 2004; 36(2):344-6.
33. Uddin MZ, Rahim MA, Alan MA, Barman JC, Wadud MA. A study on biochemical characteristic of different mango germplasm grown in the climatic condition of Mymensingh. International Journal of Sustainable Crop Production. 2006; 1(2):16-9.