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Studies on the Physiological and Biochemical Composition of Different Mango Cultivars at Various Maturity Levels

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Abstract

A comparative study on physiological and biochemical composition of ten varieties of mangoes was carried out at three maturity stages viz. immature, mature and ripe to find out the standard one. During the investigation, whole weight of the mangoes, pulp content, weight of peel and stone, total soluble solid (TSS), pH, acidity, sugar content and vitamin C were determined at three maturity stages. It was observed that all the varieties at ripe stages had higher sugar content as compared to immature and mature stages. Attractive flavour and pleasant taste were also developed in ripe stages and differed from one another due to varietal specific. This characteristics odour which appeared during ripening is due to ester and components of carbonyl types.

Introduction

Mango is now recognized as one of the best fruits of all indigenous fruits due to its excellent flavour, attractive fragrance, beautiful shades of colour, delicious taste and high nutritive value.[1] It is grown commercially in eighty seven countries.[2,3] Several hundred varieties are grown in the Indian subcontinent but a few specific varieties are commercialized according to preferences of different regions of the countries. India contributes about 64 % of the world mango production. Other mango producing countries are Mexico, Pakistan, Brazil, Philippines and Thailand. The total world production of Mango is 15.7 million metric tonnes.[3] About 250 varieties of mangoes are grown in Bangladesh.[4] Little information about some varietal characteristics have so far been recorded. But information about its export is still unknown though it has a great export potential. Among the main constituents of this fruit, carbohydrate and acid contribute a great deal to the food value of the fruit. Of the three parts of the mango, pulp is the part most utilized for human consumption. It is cross pollinated and largely propagated by seeds. Awareness in respect of improved mango production is lacking. In view of the above aspects, the present study has been undertaken to throw light on some of the

constituents of mango with a view to apprehending the fruit as a supplementary food having a good calorific value as well as to select the varieties for plantation with a hope to be a member of the mango exporting countries.

Materials and Methods

The present experiment was carried out at BCSIR Laboratories, Rajshahi during the period from March to August 2002. The mangoes used for this experiment were procured randomly from three mango gardens adjacent to BCSIR Laboratories, Rajshahi to get a clear picture about the constituent and quality of the mango cultivars. In this experiment mango of ten varieties were selected and each variety contained ten mangoes. The mangoes under experiment were Fazli, Ashina, Langra, Surjapuri, Khirshapat, Gopalbhog, Kisanbhog, Mohanbhog, Latabombai and Ranipasand. The mangoes were analyzed at three different maturity stages viz. immature (40 days after pollination), mature and ripe stages. The immature mangoes were cleaned, weighed, peeled and the stone was separated. The physical characteristics of the mangoes viz. whole weight of mango, weight of skin, weight of stone, weight of pulp were determined using standard methods and recorded in Table I. The total soluble solid (TSS) were determined with a hand refractometer.[5] Sugar was determined by colorimetric method,[6,7] vitamin C was determined titrimetrically using 2, 6-dichlorophenolindophenol,[8,9] acidity was determined titrimetrically with the visual acid-base method[10] and the pH was determined with a digital pH meter.[11] The chemical composition of the mangoes were determined at the above three stages and the results are recorded in Table IIa and IIb. The above data were statistically analysed and the mean of different parameters was compared by least significant difference (LSD) test. The organoleptic tests and the physical characters (e.g. colour, flavour and taste) of these ripe mangoes were carried out and evaluated by a panel of seven judges. The mangoes were classified as follows on the basis of their grading; excellent - 80 % or above, good - 70-79 % and fair below 70 % depending on colour, flavour and taste. The results are given in table III.

Results and Discussion

It is evident from Table I that the whole weight of all the mangoes increased gradually with maturity. The rate of increase is different for different Significant difference was observed among the cultivars at three maturity stages. In the immature stage, the lowest weight was found in Ranipasand (16.1 gm) and the highest weight was found in Fazli (123.2 gm). At mature and ripe stages, the minimum and maximum weights were also found in Ranipasand and Fazli varieties respectively. The results agreed with the reported results of Hossain *et al*.[12] In the immature stage skin content of Fazli and Surjapuri is 20.3 g but Mohanbhog and Ranipasand were 22.4 and 22.7 g respectively.

Table I. The Physiological characteristics of ten mango varieties at different maturity levels

Sl. No.	Name of mango varieties	Whole weight (g)			Skin (%)			Stone (%)			Pulp (%)		
		*Maturity stages			*Maturity stages			*Maturity stages			*Maturity stages		
		1	2	3	1	2	3	1	2	3	1	2	3
1	Fazli	132.2	245.5	650.2	20.3	14.3	12.2	6.2	10.4	11.2	73.5	75.3	76.6
2	Ashina	93.5	185.2	590.4	21.7	15.6	13.7	6.9	11.8	11.0	71.4	72.6	75.3
3	Langra	59.3	103.3	315.5	22.3	18.5	15.1	9.9	12.3	12.8	67.8	69.2	72.1
4	Surjapuri	27.6	95.6	260.3	20.3	16.8	13.8	9.1	11.1	13.1	70.6	72.1	73.1
5	Khirshapat	32.4	72.5	276.5	22.3	18.2	16.7	10.8	14.2	13.5	66.9	67.6	69.8
6	Gopalbhog	29.3	65.6	208.7	20.6	17.4	14.7	10.2	11.3	13.1	69.2	71.3	72.2
7	Kisanbhog	34.2	107.2	303.5	21.4	17.8	15.0	10.1	12.5	13.8	68.5	69.7	71.2
8	Mohanbhog	38.6	135.1	370.5	22.4	18.0	15.3	10.3	13.8	14.2	67.3	68.2	70.5
9	Latabombai	19.5	85.0	193.4	22.1	18.1	16.2	11.5	14.5	14.3	66.4	67.4	69.5
10	Ranipasand	16.1	532	150.6	22.7	17.2	16.8	10.8	15.3	14.5	66.5	67.5	68.7
	LSD (0.01 %)	3.43	3.55	4.78	2.01	1.18	0.34	1.25	0.52	0.42	2.82	3.72	0.83
	LSD (0.05%)	2.67	2.61	3.50	1.48	0.86	0.25	0.92	0.38	0.31	2.07	2.72	0.61

* Maturity Stage 1= Immature stage, Maturity stage 2 = Mature stage, Maturity stage 3 = Ripe stage

Table IIa. The biochemical characteristics of ten mango varieties at different maturity levels

Sl. No.	Name of mango varieties	pH			Vitamin C (m/100gm)			Acidity as citric acid (%)			Sugar-Acid ratio (%)		
		*Maturity stages			*Maturity stages			*Maturity stages			*Maturity stages		
		1	2	3	1	2	3	1	2	3	1	2	3
1.	Fazli	3.5	4.2	5.4	0.53	0.24	0.15	90.3	56.5	43.5	12.26	47.31	108.67
2.	Ashina	2.8	3.7	4.8	0.65	0.32	0.16	103.2	65.7	36.4	09.69	33.75	96.25
3.	Langra	2.7	3.2	4.6	0.62	0.31	0.13	86.5	52.7	42.3	09.19	43.55	131.54
4.	Surjapuri	3.2	3.5	5.1	0.58	0.35	0.15	92.3	56.4	40.8	11.03	32.57	101.33
5.	Khirshapat	2.9	3.4	4.8	0.61	0.28	0.12	96.4	62.3	48.5	09.51	45.36	162.50
6.	Gopalbhog	2.5	2.8	4.2	0.57	0.30	0.13	84.2	60.5	40.3	10.88	39.33	150.00
7.	Kisanbhog	2.7	3.2	4.7	0.64	0.29	0.16	92.5	63.6	39.2	08.28	39.31	116.88
8.	Mohanbhog	2.5	2.7	4.5	0.58	0.33	0.15	90.4	62.5	37.3	11.21	33.94	114.67
9.	Latabombai	2.8	3.4	4.3	0.63	0.30	0.14	93.1	61.6	38.1	08.57	35.00	112.00
10.	Ranipasand	2.6	3.6	4.9	0.57	0.34	0.13	95.2	65.4	35.2	11.93	40.00	120.00
	LSD (0.01 %)	0.26	0.24	0.27	0.024	0.026	0.029	0.31	0.29	0.31	0.196	0.043	0.806
	LSD (0.05%)	0.19	0.18	0.20	0.018	0.019	0.021	0.23	0.21	0.23	0.144	0.032	0.591

* Maturity stage 1= Immature stage, Maturity stage 2 = Mature stage, Matuity stage 3 = Ripe stage

Table III. The grading of ripen mango fruits as judged by the panel of seven judges based on general qualities of mango

Sl. No.	Name of mango cultivars	Physical characters	Marking by individual judges							Total	Mean	Order of rating
			1	2	3	4	5	6	7			
1	Fazli	Colour	70	65	68	75	72	71	69	490	70.0	Good
		Flavour	63	58	57	67	53	59	64	521	60.1	Fair
		Taste	81	83	85	84	82	80	82	577	82.4	Excellent
2	Ashina	Colour	60	52	57	49	50	52	48	368	52.6	Fair
		Flavour	45	43	41	50	53	51	49	332	47.4	Fair
		Taste	63	61	58	45	61	56	45	389	55.6	Fair
3	Langra	Colour	73	78	69	73	75	71	76	515	73.6	Good
		Flavour	93	74	88	71	74	98	96	614	87.7	Excellent
		Taste	90	93	89	94	96	84	87	633	90.4	Excellent
4	Khirshapat	Colour	92	90	88	87	93	94	87	631	90.1	Excellent
		Flavour	75	82	74	85	70	76	84	546	78.0	Good
		Taste	78	88	78	86	88	86	83	587	83.9	Excellent
5	Gopalbhog	Colour	75	72	78	63	86	69	77	520	74.3	Good
		Flavour	72	83	70	75	78	80	81	539	77.0	Good
		Taste	90	86	95	79	88	87	82	607	86.7	Excellent
6	Kisanbhog	Colour	67	77	65	72	78	71	62	492	70.3	Good
		Flavour	60	57	54	63	65	60	59	418	59.7	Fair
		Taste	73	68	74	77	69	65	72	498	71.1	Good
7	Mohanbhog	Colour	65	71	60	74	66	75	68	479	68.4	Fair
		Flavour	63	60	68	72	65	76	70	474	67.7	Fair
		Taste	70	73	61	66	74	70	62	476	68.0	Fair
8	Latabombai	Colour	72	78	73	80	84	70	74	531	75.9	Good
		Flavour	66	72	65	63	68	81	62	477	68.1	Fair
		Taste	74	73	79	82	85	80	76	549	78.4	Good
9	Ranipasand	Colour	71	76	72	85	80	75	71	530	75.7	Good
		Flavour	68	62	60	65	59	63	54	436	61.6	Fair
		Taste	75	72	76	82	86	75	84	550	78.6	Good
10	Surjapuri	Colour	82	76	72	80	84	82	79	555	74.3	Good
		Flavour	78	72	68	73	78	82	81	532	76.0	Good
		Taste	80	85	81	78	85	82	80	571	81.6	Excellent

In the ripe stage, Fazli was only 12.2 % whereas Khirsapat, Ranipasand, Mohanbhog, Kishanbhog and Langra have higher skin content than that of Fazli. Although skin is the non-edible portion of mango, the mangoes of some varieties contained skin significantly different from others. A gradual increase in weight of stone was also observed with the increase of maturity. The seed (stone) content of some variety differs significantly from others. In ripe stage, Fazli and Gopalbhog have 11.2 % and 13.1 % seed respectively which were analysed statistically and LSD results found significant both at 0.05 % Levels. The pulp content is the edible portion of mangoes and is given much importance during evaluation. The composition of mango pulp varies from location of cultivation, variety and stage of maturity. The major constituents of the pulp are water, carbohydrates, organic acids, fats, minerals, pigments, tannins, vitamins and flavour compounds. It was determined at the three maturity stages, which varied from 66.4 to 73.5 %, 67.4 to 75.3 % and 68.7 to 76.6 % for immature, mature and ripe mangoes respectively. The difference in pulp content was significant among the mango cultivars at the three maturity levels.

Table IIa shows that pH of the mangoes ranged from 2.5 to 3.5, 2.7 to 4.2 and 4.2 to 5.4 for immature, mature and ripe mangoes respectively. LSD results show that the changes are significant both at 0.01 % and 0.05 % levels. The acidity of all the mangoes decreased with maturity. It is due to the breakdown of starch into more sugars thereby lowering down the percentage of acidity of the fruits.[13] The acidity was determined at all the three stages and reported as citric acid. A gradual decrease for all the varieties was observed with the changes in advancement of maturity. The gradual decrease in acid content may be due to conversion of acids into sugars by some physiological and biochemical changes in the fruits. Our findings agree with the results as reported by Robbani *et al.* [14]

Regarding vitamin C, a gradual decrease in vitamin C content was observed with the increase of maturity. Fazli contains 90.3 %, 56.5 % and 43.5 % vitamin C at immatue, mature and ripe stages respectively. The results were statistically analysed and found significant both at 0.01 % and 0.05 % levels respectively. TSS content is considered as a measure of quality for most of the fruits. Generally taste and particularly sweetness of the fruits depend on the percentage of TSS content. From the Table IIa, it is evident that, in ripe stage Khirsapat, Gopalbhog and Ranipasand contained 21.8 %, 22.6 % TSS respectively. Langra also contained 20.2 % TSS. It is well known to all that the above cited varieties are quality mangoes and have a great demand. Sucrose, glucose and fructose constitute the bulk of carbohydrate and most of the soluble solid in mango pulp. It is rich source of β-carotene.[15]

The characteristics odour that appeared in the fruits during ripening is components of ester

and carbonyl types. The difference in odour among the varieties is due to variation in flavoring components. More than hundred volatile components have been identified, major ones being terpenes although several other hydrocarbons, esters and alcohol were also present in ripe mango fruit.[16]

A gradual decrease in non-reducing and reducing sugars were found untill maturity. When the fruits started to ripen on the tree i.e. after about 96 days from fruit set, a decrease in reducing sugar was noted. The soluble sugars of the fruit pulp consist mainly of glucose, fructose and sucrose. The rate of starch accumulation was rapid at the beginning of fruit growth and slowed down later but it continued to increase up to maturity.

Like TSS content, sugar-acid ratio is also considered as a measure of quality of fruit. It is generally recognized that quality fruits have higher sugar-acid ratio whereas fruits of less quality have lower sugar-acid ratio, Khirsapat, Gopalbhog and Langra have sugar-acid ratio of 162.50, 150.00 and 131.25 respectively. On the other hand, Mohonbhog and Ashina have sugar-acid ratio of 114.67 and 96.25 respectively. Our findings agree with the reported results elsewhere.[17]

Mangoes are generally harvested at physiological mature stage and ripened for optimum fruit quality. The fruit displays erratic ripening behaviour either on the tree or after harvest depending on the variety and environmental conditions. It is evident from Table III that the taste of Khirshapat, Langra, Gopalbhog and Surjapuri is excellent. The excellent colour was found in the case of Khirshapat. All the three parameters of Ashina and Mohanbhog are fair in rating. It is concluded from Table III that Khirshapat, Langra, Gopalbhog and Surjapuri are best quality mangoes. On the other hand, Fazli, Kishakbhog, Lata Bombai and Ranipasand are also quality mangoes but not like Langra, Gopalbhog, Khirshapat etc.

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