

## A Study on the Physico-chemical Characteristics of Some Mango Varieties in Khulna Region

M.A. Mannan, S.A.K.U. Khan, M.R. Islam, M. Sirajul Islam, Ayesha Siddiq  
Agrotechnology Discipline, Khulna University, Khulna, Bangladesh

**Abstract:** Fruit characteristics of some mango varieties grown in Khulna region were studied at the Horticulture Laboratory, Agrotechnology Discipline of Khulna University, Khulna during the period from March to December, 2002. The objectives of the experiment were to evaluate the pattern of physico-chemical properties of mango varieties Amrapali, Sharmai Fazli, Neelambori, Indian Lota and Madrazi Tota. Mango fruits were collected from mango growers of Botiaghata Upazila, Khulna. The experiment was laid out in Completely Randomized Design (CRD) with three replications. Observations were made on different fruit characteristics, physical and chemical properties in three ripening stages viz. green, ripe and over ripe stage. The fruits of the varieties Amrapali, Sharmai Fazli, Neelambori, Indian Lota and Madrazi Tota weighed 189, 455, 180, 170 and 592 g, respectively. Maximum percentage of edible portion (78.53%), juice content (56.50-72.77%) and highest Total Soluble Solids (18.66%) were found in Madrazi Tota. Riped Madrazi Tota tastes very sweet in comparison to other varieties of mangoes under study. Indian Lota was higher in content of titratable acidity (0.04091%) and lowest in Neelambori (0.01866%).

**Key words:** Physico-chemical, mango, amrapali, sharmai fazli, lota, tota

### INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae, which was originated in south Asia or Malayan archipelago. It has been cultivated for more than 4000 years (Candole, 1984). The mango is a commercial crop in many countries of South-East Asia, India, Pakistan, the Philippines, Indonesia, Malaysia, Thailand, Burma, Sri Lanka and Java. The main mango producing countries of the world are India, Pakistan, Mexico, Brazil, Haiti, the Philippines and Bangladesh.

In Bangladesh, mango ranks first in terms of area and third in production. According to Anonymous (1999), Bangladesh produces 184 thousand tons of mangoes per annum from 50.60 thousand hectares of land. Most of the cultivated mango varieties in Bangladesh are grown from seedling. Though a number of recommended varieties namely- Gopalbhog, Langra, Fazli, Mohonbgog, Himsagar, Ashwini are grown in the country but they cover small area and mainly concentrated in Chapai Nawabganj, Rajshahi, Dinajpur, Meherpur, Chuadanga, Jessor and Satkhira districts.

The composition, in general, differs with the cultivar and the stage of maturity. The unripe green mangoes are reported to have 90% moisture, 0.7% protein, 0.1% fat, 8.8% carbohydrates, 0.01% calcium, 0.02% phosphorus, 4.5 mg/100 g iron, carotene (vitamin A- 150 i.u.), 30 µg per 100g riboflavin, 3 mg/ 100 g ascorbic acid (Anonymous, 1962).

Mango is a popular fruit of Bangladesh is rightly called the 'King of fruits'. A large number of mango cultivars are grown in different region of Bangladesh. But the physico-chemical characteristics of most of these cultivars have not yet been studied. However, Kamaluddin (1967), Mollah and Siddique (1973), Hossain (1974), Samad and Faruque (1976) and Bhuyan and Islam (1990) reported only sketchy information of some common mango cultivars. But the information on many other cultivars are still lacking. An attempt has been made in this study to make a detailed assessment of the physico-chemical characteristics of five locally popular cultivars of mango grown under Khulna region.

### MATERIALS AND METHODS

The experiment was carried out in the Horticulture Laboratory, Agrotechnology Discipline of the Khulna University, Khulna during the period from March to December, 2002. The two factor experiment was laid out in Completely Randomized Design (CRD) with three replications. Factor A- Five mango varieties namely Amrapali, Sharmai Fazli, Neelambori, Indian Lota, Madrazi Tota were selected as experimental materials for the investigation of the experiment. Those fruits used in the experiment were collected from mango growers of Botiaghata Upazila under Khulna district. Factor B- Three ripening stages of mango. Mangoes of the following 3 stages were collected for the experiment.

**Green mango:** when the shoulders were in the line with the stem end and color was pale green, hard textured pulp.

**Ripe mango:** when the skin of the fruit was with the mixture of green and yellow and the pulp was softer than green fruits.

**Over ripe mango:** when the yellow portion of the skin is greater than green portion, very soft textured pulp and slightly rotten but in edible condition.

Observations were made on different fruit characteristics, physical and chemical properties in three ripening stages viz. green, ripe and over ripe stage. Data were recorded on skin color and thickness, pulp color and texture, flavour fibreness, taste, fruit weight, fruit and stone size, edible and non-edible portion, juice content, TSS, pH, density, salinity and titratable acidity. The collected data were statistically analysed by Analysis of Variance method. The mean of different parameters were compared by Duncans Multiple Range Test.

## RESULTS AND DISCUSSION

**Qualitative characteristics:** Skin and pulp color at different stages of ripening varied from deep green to greenish yellow and cream to reddish, respectively (Table 1). The skin was thin in over ripe Indian Lota (1.80 mm) and Neelambori (1.81 mm) while it was thick in green Sharmai Fazli (3.16 mm). Pulp texture was firm at green condition while it was medium soft to soft at ripe and over ripe condition. Pleasant flavour was recorded in green Indian Lota, ripe and over ripe Amrapali, Sharmai Fazli, Indian Lota and Madrazi Tota while green Amrapali, Sharmai Fazli, Neelambori, Madrazi Tota and ripe and over ripe Neelambori were unpleasant in flavour. High fibreness was observed in green Madrazi Tota. The remaining varieties produced the fruits of very low to scanty fibreness. Over ripe Amrapali, Indian Lota, Madrazi Tota and ripe Indian Lota, were excellent in taste while other varieties were inferior in organoleptic test.

### Quantitative characteristics

**Fruit weight:** It is evident that the fresh weight of fruit was significantly varied with the varieties (Table 2). It was found maximum (564.0 g) in Madrazi Tota followed by Sharmai Fazli (427.0 g). The minimum fresh weight was found in Neelambori (160.0 g). From field trials in 1981-90 in Bihar Radha *et al.* (1996) reported that cultivar Fazli had the highest fruit weight (545.0 g) The variability might be due to genotypic and environmental influence and management practices.

The difference in fruit weight in respect of stage of ripening was highly significant (Table 3). In the present experiment fruit weights were increased (270.2 to 315.2 g)

during ripening which is partially agreed by Kudachikar *et al.* (2001). In the study they showed that developing fruits increased in weight initially after ripening and then slightly decreased. The combined effect of variety and stage of ripening was highly significant in relation to fruit weight (Table 4). Over ripe Madrazi Tota was highest in fruit weight (592 g) followed by ripe Madrazi Tota (575 g) and minimum fruit weight was found in green Neelambori (120 g).

**Size of fruit:** There was significant variation among the mango varieties in relation to fruit size (Table 2). The highest fruit length (15.53 cm), width (7.23 cm) and depth (6.16 cm) was found in Madrazi Tota followed by Sharmai Fazli (12.31 cm, 5.23 cm and 5.60 cm, respectively). Smaller fruit length (6.333 cm), width (5.30 cm) and depth (4.52 cm) was observed in Indian Lota (Table 2). Some mango cultivars were evaluated for their physico-chemical properties by Rajput and Pandey (1997). According to them Mallika was superior to the other cultivars in respect of fruit size. Langra and Sunderja also produced fruits of good size. The variation might be due to the location enjoying different types of environmental conditions, year of production and out crossing among different varieties.

There were also wide variation in respect of fruit size due to the interaction effect of variety and stage of ripening (Table 3 and 4). The highest fruit length (17.00 cm), width (8.310 cm) and depth (6.81 cm) was observed in Madrazi Tota at ripe condition followed by same variety at green condition (length; 15.60 cm) and over ripe condition (width; 7.63 cm and depth; 5.80 cm) while the minimum length (6.100 cm) was minimum in over ripe Indian Lota (Table 3). The lowest fruit width (4.80 cm) and depth (4.40 cm) was found in Indian Lota at green condition.

**Size of stone:** The stone size was highly significant among the selected varieties (Table 2) Higher stone length (13.06 cm) was found in the variety Madrazi Tota but the stone width (4.75 cm) and depth (1.61 cm) maximum in Sharmai Fazli and minimum stone length (5.433 cm), width (3.44 cm) and depth (1.29 cm) was observed in Indian Lota.

The stone size varied significantly in different stage of ripening (Table 3). It was observed that the stone length decrease during fruit ripening (length 9.333 cm to 8.080 cm) from green to over ripe condition but wide and depth of fruit was maximum (4.13 cm and 1.30 cm) at ripe condition and those was minimum (3.63 cm and 1.17 cm) at green condition. The combined effect of variety and stage of ripening on stone size was also significant (Table 4). The highest length (14.90 cm) and width (5.50 cm) of stone was found in Madrazi Tota at ripe while the lowest length (5.00 cm) was observed in Indian Lota at over ripe

Table 1: Different qualitative and quantitative characteristics of mangoes

Stage	Variety	Skin color	Skin thickness			Pulp color	Pulp texture	Flavour	Fibreness	Taste
			(mm)							
Green condition	Amrapali	Deep green	2.58			Cream	Firm	Unpleasant	Scanty	Sour
	Sharmai Fazli	Light green	3.16			Cream	Firm	Unpleasant	Medium	Odd
	Neelamboi	Yellowish green	2.24			Whitish cream	Firm	Unpleasant	Scanty	Sour
	Indian Lota	Green	2.54			Yellow	Firm	Pleasant	Scanty	Good
	Madrazi Tota	Yellowish green	2.84			Light yellow	Firm	Un Pleasant	High	Sour
Ripe condition	Amrapali	Deep green	1.84			Deep yellow	Medium soft	Pleasant	Very low	Good
	Sharmai Fazli	Light yellowish green	2.89			Deep yellow	Soft	Pleasant	Scanty	Good
	Neelambori	Yellowish green	2.06			Cream	Soft	Unpleasant	Scanty	Sour
	Indian Lota	Greenish yellow	2.04			Orange yellow	soft	Pleasant	Medium	Excellent
	Madrazi Tota	Yellowish green	2.63			Orange yellow	Soft	Pleasant	Scanty	Sour
Over ripe condition	Amrapali	Deep green	1.48			Reddish	Soft	Pleasant	Very low	Excellent
	Sharmai Fazli	Yellowish green	2.72			Deep yellow	Soft	Pleasant	Very low	Good
	Neelambori	Light green	1.81			Yellowish cream	Soft	Un Pleasant	Scanty	Sour
	Indian Lota	Greenish yellow	1.80			Deep yellow	Soft	Pleasant	Scanty	Excellent
	Madrazi Tota	Yellowish green	2.23			Deep yellow	Soft	pleasant	scanty	Excellent

Table 2: Physical characteristics of mango as influenced by varieties

Variety	Fruit weight (g)	Fruit size (cm)			Stone size (cm)			Edible portion (%)	Non-edible portion (%)
		Length	Width	Depth	Length	Width	Depth		
Amrapali	174.7c	9.367c	5.224b	4.389c	8.300c	3.228c	1.200b	67.58bc	34.33ab
Sharmai Fazli	427.0b	12.31b	5.228b	5.600b	10.57b	4.750a	1.607a	67.76bc	29.34c
Neelambori	160.0d	8.233d	5.350b	4.642c	6.167d	3.707b	1.157b	64.60c	35.33a
Indian Lota	165.0cd	6.333e	5.300b	4.520c	5.433e	3.440bc	1.290b	70.98b	28.90c
Madrazi Tota	564.0a	15.53a	7.234a	6.160a	13.06a	4.443a	0.893c	78.53a	30.68bc
Level of significance	**	**	**	**	**	**	**	**	**

\*\* = Significant at 1% level

Table 3: Physical characteristics of mango as influenced by different stages of ripening

Stage	Fruit weight (g)	Fruit size (cm)			Stone size (cm)			Edible portion (%)	Non-edible portion (%)
		Length	Width	Depth	Length	Width	Depth		
Green	270.2b	10.64a	5.259c	4.923b	9.333a	3.632b	1.174b	62.86b	34.97a
Ripe	309.0a	10.55a	6.055a	5.312a	8.700b	4.131a	1.304a	74.57a	32.48a
Over Ripe	315.2a	9.880b	5.688b	4.952b	8.080c	3.977a	1.210ab	72.23a	27.70b
Level of significance	**	**	**	**	**	**	**	**	**

\*\* = Significant at 1% level

Table 4: Combined effect of variety and different stages of ripening on physical characters of mango

Stage x Variety	Fruit weight (g)	Fruit size (cm)			Stone size (cm)			Edible portion (%)	Non-edible portion (%)
		Length	Width	Depth	Length	Width	Depth		
S <sub>1</sub> V <sub>1</sub>	170.0ef	10.40e	5.230bc	4.470e	9.500e	3.200efg	1.270cd	61.68cde	38.21ab
S <sub>1</sub> V <sub>2</sub>	376.0d	12.50d	5.250bc	5.700bc	11.00cd	4.600bcd	1.530ab	55.44e	35.89abc
S <sub>1</sub> V <sub>3</sub>	120.0g	8.300f	5.250bc	4.170e	7.300f	3.060fg	0.870ef	58.37de	41.63a
S <sub>1</sub> V <sub>4</sub>	160.0f	6.400g	4.800c	4.400e	6.000g	3.500ef	1.500abc	67.42bcd	32.45bcd
S <sub>1</sub> V <sub>5</sub>	525.0b	15.60b	5.763b	5.873b	12.87b	3.800def	0.700f	71.42bc	26.66de
S <sub>2</sub> V <sub>1</sub>	165.0ef	8.500f	5.333bc	4.467e	7.300f	2.670g	1.370bc	70.23bc	35.71abc
S <sub>2</sub> V <sub>2</sub>	455.0c	12.53d	5.333bc	5.600bcd	10.70cd	4.797abc	1.660a	73.62b	26.37de
S <sub>2</sub> V <sub>3</sub>	180.0ef	8.200f	5.400bc	4.857de	5.300g	4.030de	1.300bcd	67.71bcd	32.19bcd
S <sub>2</sub> V <sub>4</sub>	170.0ef	6.500g	5.900b	4.830de	5.300g	3.660ef	1.270cd	73.47b	26.42de
S <sub>2</sub> V <sub>5</sub>	575.0a	17.00a	8.310a	6.807a	14.90a	5.500a	0.920ef	87.82a	41.74a
S <sub>3</sub> V <sub>1</sub>	189.0e	9.200f	5.110bc	4.230e	8.100f	3.813def	0.960e	70.85bc	29.06cde
S <sub>3</sub> V <sub>2</sub>	450.0c	11.90d	5.100bc	5.500bcd	10.00de	4.853ab	1.630a	74.21b	25.77de
S <sub>3</sub> V <sub>3</sub>	180.0ef	8.200f	5.400bc	4.900cde	5.900g	4.030cde	1.300bcd	67.71bcd	32.19bcd
S <sub>3</sub> V <sub>4</sub>	165.0ef	6.100g	5.200bc	4.330e	5.000g	3.160fg	1.100de	72.05b	27.82de
S <sub>3</sub> V <sub>5</sub>	592.0a	14.00c	7.630a	5.800b	11.40c	4.030cde	1.060de	76.35b	23.64e
Level of significance	**	**	**	NS	**	**	**	*	**

V<sub>1</sub>=Amrapali, V<sub>2</sub>=Sharmai Fazli, V<sub>3</sub>=Neelambori, V<sub>4</sub>=Indian Lota, V<sub>5</sub>=Madrazi Tota

S<sub>1</sub>=Green Condition, S<sub>2</sub>=Ripe Condition, S<sub>3</sub>=Over Ripe Condition

\*\* = Significant at 1% level, \* = Significant at 5% level and NS =Non Significant

condition and width (2.67 cm) in Amrapali at ripe condition.

**Edible portion and non-edible portion:** A considerable variation was also observed in the edible and non-edible portion in respect of different variety (Table 2). Edible portion was highest in Madrazi Tota 78.53% followed by Indian Lota 70.98%. The lowest was found in Neelambori 64.60%. Non-edible portion was highest in Neelambori 35.33% followed by Amrapali 34.33% and the lowest in Indian Lota 28.90%. Saha *et al.* (1994) reported an average edible portion from 72.9-84.2, 70.1-84.7, 60.0-70.0 and 65.6-73.9% in Ashwina, Fazli, Kuapahari and Mohanbhog respectively. The variation might be due to varietals differences.

Highly Significant variation was also recorded in edible and non-edible portion in different stages of ripening (Table 3). Edible and non-edible portion at green condition was 74.57 and 34.97%, while it was 72.23% and 32.48% for ripe condition and 62.86 and 27.70% for over ripe mango, respectively. It is evident from the result that the edible and non-edible portion decreased from green to ripe stage and from ripe to over ripe stage. The edible and non-edible portion was more or less similar as studied by Samad and Faruque (1976).

Significant variation was also found in relation to edible and non-edible portion at different stages of ripening of the selected varieties (Table 4). Edible portion was found to be the highest in ripe Madrazi Tota 87.82% followed by same variety at over ripe condition 76.35%. The lowest edible portion was found in green Sharmai Fazli 55.44%. The highest non-edible portion was observed in ripe Madrazi Tota 41.74% followed by green Neelambori 41.63% and the lowest non-edible portion was found in over ripe Madrazi Tota 23.64%.

### Chemical characteristics

**Juice content:** Juice content was found to be maximum in Sharmai Fazli (65.89%) followed by Neelambori (65.45%) in contrast with the other varieties (Table 6). The minimum juice content was found in Amrapali (61.49%). Juice content was increased with the maturity but decreased after ripening i.e. at over ripe stage. The highest juice content was found at ripe stage (71.17%) followed by over ripe stage (63.44%) and it was minimum at green stage (51.12%) (Table 7). Similar result was observed by Kudachikar *et al.* (2001). They found that Neelambori at ripe condition contained maximum juice (83.64%) followed by Madrazi Tota at ripe condition (77.54%) and minimum juice content was observed in Neelambori at green condition (43.36%). The variation in juice content among the selected varieties at different stages of ripening was

also highly significant. It was maximum in ripe Neelambori (83.64%) followed by over ripe Indian Lota (77.54%) and it was minimum in ripe Sharmai Fazli (43.36%) (Table 8).

**Total soluble solids (TSS):** The variation in relation to TSS content among the selected mango varieties were highly significant (Table 6). Total soluble solids (TSS) content was found to be maximum in Indian Lota 18.02% followed by Sharmai Fazli 17.45% and it was minimum in Neelambori 17.07%. But Sardar *et al.* (1998) found in his experiment the highest TSS content in the cultivar Langra 21.6% followed by Gopalbhog 20.6% while Sadawala had the lowest 14.3%.

In this experiment green but mature mango contained 17.80% TSS while ripe and over ripe mango contained 17.29 and 17.08%, respectively (Table 7). The result of present study was in agreement with the findings of Kudachikar *et al.* (2001). They reported that there is no great change of TSS during ripe and over ripe condition. The combined effect of varieties and stages of ripening was highly significant. The maximum TSS content was observed in Madrazi Tota at green condition 18.66% followed by green Amrapali 18.44% and minimum in Sharmai Fazli at ripe condition 16.90% (Table 8).

**Pulp pH:** The highest pulp pH was recorded in Sarmai Fazli (3.923) followed by Amrapali (3.908). The lowest pulp pH was observed in Neelambori (3.411) (Table 6). Kumar and Singh (1993) noticed that maximum pH (4.64) in Fazli. Similar result was also observed by Yuniarti (1980) while Absar *et al.* (1993) reported the highest pulp pH in 'Khirshapat' (5.2) and the lowest in 'Jaibanda' (4.0) The differences was due to variety and climatic condition. In this experiment higher pulp pH was found at over ripe stage (3.768) and lowest at ripe stage (Table 7). This result was agreement with the findings of Kumar and Singh (1993). They reported that pH of mango rose steadily during ripening and reached the maximum at over ripe stage. The combined effect of varieties and stages of ripening in relation to pulp pH was non-significant. It was highest in green Neelambori (4.267) and lowest in ripe Sharmai Fazli (3.347) (Table 8).

**Density of pulp:** The variation between the varieties in relation to pulp density is non significant. In the present experiment higher density was found in Madrazi Tota (1.017g/cc) and lower in Neelambori (1.004g/cc) (Table 5). The pulp density was also insignificant in case of stage of ripening. However, higher density was found at over ripe stage (1.013 g/cc) and minimum at green condition (1.004g/cc) (Table 7). The interaction effect of variety and stage of ripening was also insignificant in regard to pulp density (Table 8).

Table 6: Effect of varieties on chemical characteristics of mango

Variety	Juice content (%)	TSS (%)	pH	Density (g/cc)	Salinity (%)	Titrateable acidity (%)
Amrapali	61.49c	17.24bc	3.908a	1.007	8.000b	0.02683a
Sharmai Fazli	65.89a	17.45b	3.923a	1.008	9.333ab	0.02279ab
Neelambori	65.45a	17.07c	3.411b	1.004	5.333c	0.03015ab
Indian Lota	54.14d	18.02a	3.539b	1.005	5.667c	0.03224bc
Madrazi Tota	62.59b	17.17c	3.710ab	1.017	10.00a	0.02843c
Level of significance	**	**	**	NS	**	**

\*\* = Significant at 1% level NS = Non Significant

Table 7: Effect of different stages of ripening on the chemical characteristics of mango

Stages of ripening	Juice content (%)	TSS (%)	PH	Density (g/cc)	Salinity (%)	Titrateable acidity (%)
Green Condition	51.12c	17.80a	3.667	1.004	5.000b	0.03005a
Ripe Condition	71.17a	17.29b	3.659	1.008	8.600a	0.03001a
Over Ripe Condition	63.44b	17.08c	3.768	1.013	9.400a	0.02422b
Level of significance	**	**	NS	NS	**	**

S<sub>1</sub> =, S<sub>2</sub> =, S<sub>3</sub> = \*\* = Highly Significant NS = Non Significant

Table 8: Combined effect of variety and different stages of ripening on the chemical characteristics of mango

Stage x Variety	Juice content (%)	TSS (%)	PH	Density (%)	Salinity (%)	Titrateable acidity (%)
S <sub>1</sub> V <sub>1</sub>	48.65i	17.79c	3.803	1.003	5.000b	0.03386a
S <sub>1</sub> V <sub>2</sub>	72.36c	16.96e	3.653	1.006	7.000b	0.02798ab
S <sub>1</sub> V <sub>3</sub>	63.45e	16.97e	4.267	1.011	12.00a	0.01866ab
S <sub>1</sub> V <sub>4</sub>	55.46g	18.03bc	3.873	1.004	5.000b	0.02677bc
S <sub>1</sub> V <sub>5</sub>	72.77c	17.09e	3.817	1.012	12.00a	0.02121b-d
S <sub>2</sub> V <sub>1</sub>	69.43d	17.23de	4.080	1.009	11.00a	0.02040b-d
S <sub>2</sub> V <sub>2</sub>	43.36j	16.90e	3.347	1.003	4.000b	0.03482b-e
S <sub>2</sub> V <sub>3</sub>	83.64a	17.04e	3.483	1.004	6.000b	0.03079b-f
S <sub>2</sub> V <sub>4</sub>	69.34d	17.27de	3.403	1.004	6.000b	0.02484b-f
S <sub>2</sub> V <sub>5</sub>	56.50g	18.66a	3.610	1.005	6.000b	0.02346c-g
S <sub>3</sub> V <sub>1</sub>	49.52i	18.44ab	3.527	1.004	5.000b	0.04091c-g
S <sub>3</sub> V <sub>2</sub>	56.41g	16.96e	3.480	1.007	6.000b	0.03236d-g
S <sub>3</sub> V <sub>3</sub>	51.63h	17.63cd	3.703	1.004	5.000b	0.03132e-g
S <sub>3</sub> V <sub>4</sub>	77.54b	16.91e	3.817	1.012	13.00a	0.02914fg
S <sub>3</sub> V <sub>5</sub>	58.59f	16.98e	3.610	1.034	12.00a	0.02484g
Level of significance	**	**	NS	NS	**	**

V<sub>1</sub>=Amrapali, V<sub>2</sub>=Sharmai Fazli, V<sub>3</sub>=Neelambori, V<sub>4</sub>=Indian Lota, V<sub>5</sub>=Madrazi Tota  
 S<sub>1</sub>=Green Condition, S<sub>2</sub>=Ripe Condition, S<sub>3</sub>=Over Ripe Condition \*\* = Significant at 1% level and NS =Non Significant

**Pulp salinity:** There was significant variation in pulp salinity due the influence of variety (Table 6). The highest pulp salinity was found in Madrazi Tota (10.00%) followed by Sharmai Fazli (9.333%) and the lowest (5.333%) was found in Neelambori. Salinity also varied significantly in different stage of ripening (Table 7). The highest salinity was recorded from the ripe condition (8.60%) and it was lowest in green condition (5.00%). Significant variation was also found in pulp salinity due to the interaction effects of variety and ripening stages. Salinity was the highest in Madrazi Tota at ripe condition (13.00%) and the lowest in Neelambori at green condition (4.00%) (Table 8).

**Titrateable acidity:** There was significant variation in titrateable acidity among the 5 varieties. The maximum titrateable acidity (0.03224%) was found in Indian Lota followed by Neelambori (0.03015%) and the minimum titrateable acidity (0.02279%) was found in Sharmai Fazli (Table 6). Fruits of ‘Amarelinha’ had the highest titrateable acidity and lowest in CExrema as noticed by Goncalves *et al.* (1998).

Stage of ripening also showed significant variation in titrateable acidity (Table 7). The highest titrateable acidity (0.03005%) was found at green stage and lowest at over ripe stage (0.02422%) This result is in agreement with the findings of Upadhyay and Tripathi (1985), Leon and Lima (1968) and Medlicott *et al.* (1986). According to them acidity was reduced during later stage of growth on attainment of maturity and ripening. The variation in titrateable acidity among the selected mango varieties in relation to variety and stages of ripening was significant (Table 8). It was highest in over ripe Amrapali (0.04091%) followed by ripe Sharmai Fazli (0.03482%) the lowest was (0.01866%) in green Neelambori.

The findings of the present investigation indicated that Madrazi Tota was superior among the selected varieties in relation to fruit weight, edible portion, juice content, TSS content, pH, density, salinity and titrateable acidity. And ripe condition of most of these varieties was suitable for consumption. However, further investigations are suggested on physico-chemical characteristics (including vitamin A, vitamin C, mineral contents etc.) of these varieties associated with different stages of maturity and ripening.

REFERENCES

- Absar, N., M.R. Karim and M.A.L. Amin, 1993. A comparative study on the changes in the physico-chemical composition of ten varieties of mango in Bangladesh at different stages of maturity. Bangladesh J. Agril. Res., 18: 201-208.
- Anonymous, 1962. Wealth of India, Raw Materials, C.S.I.R., New Delhi.
- Anonymous, 1999. Monthly Statistical Bulletin, Bangladesh. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of People's Republic of Bangladesh, pp: 55.
- Bhuyan, M.A.J. and M.S. Islam, 1990. Physico-morphological Characters of some popular mango cultivars. Bangladesh J. Agril., 14: 181-187.
- Candole, A.D., 1984. Origin of cultivated plants. Vegal Paul Trench and Co., London, pp: 1-67.
- Goncalves, N.B., V.D.de. Carvalho, J.R.de-A. Goncalves, S.R.M. Coelho, G.de. Silva, T. Das and V.D. Carvalho, 1998. Physical and chemical characterization of fruits of mango (*Mangifera indica* L.) cultivars. Ciencia e Agrotecnologia, 22: 72-78.
- Hossain, M.A., 1974. Characteristics of Bangladesh mango grown at Rajshahi. M. Sc. (Ag.) thesis, Bangladesh Agricultural university, Mymensingh, Bangladesh.
- Kamaluddin, A.S.M., 1976. Amer Chash. Kamrun Nahar, 2/24 Block B, Muhammadpur Housing Estate, Dhaka, pp: 112.
- Kudachikar, V.B., S.G. Kulkarni, M.N.LK. Prakash, M.S. Vasantha, B.A. Prasad and K.V.R. Ramana, 2001. Physico-chemical changes during maturity of mango (*Mangifera indica* L.) variety "Neelum". Food Sci. Tech, Mysore, 38: 540-542.
- Kumer, P. and S. Sing, 1993. Effect of GA<sub>3</sub> and ethrel on ripening and quality of mango cv. Amrapali. Hort. J., 6: 19-23.
- Medlicott, A.P., S.B. Rynolds and A.K. Thompson, 1986. Effect of temperature on ripening of mango fruit (*Mangifera indica* L. var. Tommy Atkins ). J. Sci. Food Agric., 37: 469-474.
- Mollah, S. and M.A. Siddique, 1973. Studies on some mango varieties of Bangladesh. Bangladesh Hort., 1: 16-24.
- Radha, T., S.R. Nair and K.C. Sreejaya, 1996. Physico-chemical analysis of Alphonso and Bangalora varieties of mango. Trop. Agric., 34: 145-146.
- Rajput, S.S. and S.D. Pandey, 1997. Studies on physico-chemical characteristics of some mango cultivars under Chhattisgarh region of Madhya Pradesh. Horti., 10: 9-14.
- Saha, N.N., M.A.J. Bhuyan, M.S. Islam and A.K.M. Amzad Hossain, 1994. Fruit characteristics of some late mango (*Mangifera indica*) varieties of Bangladesh. Ann. Bangladesh Agric., 4: 25-30.
- Samad, M.A. and A.H.M. Faruque, 1976. A study on the physical characteristics of some common mango varieties of Bangladesh. Bangladesh Hort., 4: 18-23.
- Sardar, P.K., M.A. Hossain, M.S. Islam and S.M.A.T. Khondoker, 1998. Studies on the physico-morphological characters of some popular mango cultivars. Bangladesh J. Agril. Sci., 25: 1-4.
- Upadhyay, N.P. and B.M. Tripathi, 1985. Post harvest changes during storage and ripening Gaurjeet mango (*Mangifera indica* L.) fruit. Prog. Hort., 17: 25-27.
- Yuniarti, 1980. Physico-chemical changes of Arumanis mangoes during storage at ambient temperature. Bul. Penelition Hortikulture, Indonesia, 8: 11-17.