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Chemical changes in mango as influenced by different postharvest treatments

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Abstract

An experiment was carried out at the Laboratories of the Department of Horticulture and the Department of Biochemistry of Bangladesh Agricultural University, Mymensingh during June to September, 2003. Mature green Mango fruits of the varieties Fazli and Amrapali were treated with different postharvest treatments viz. control, hot water treatment at 55°C for 5 minutes, low temperature storage at 15°C, polythene bagging and hot water treatment (55°C for 5 minutes) followed by polythene bagging + low temperature storage at 15°C (hot water + polythene bagging + low temperature storage). The fruits were assessed for chemical changes during storage. Some of the chemical properties such as sugar content (reducing, non-reducing and total), total soluble solid and pH of pulp increased while titratable acidity and vitamin c (ascorbic acid) contents decreased with the increase in the duration of storage.

Keywards: Mango, Postharvest treatment, Chemical changes

Introduction

Mango (*Mangifera indica* L.) is one of the most popular fruits in Bangladesh. It is now recognized as one of the best fruits in the world market and also acknowledged as the king of fruits (Shahjahan *et al.*, 1994). Nutritionally mango is highly important because it has medium calorific value and high nutritional values. It is also rich source of vitamins, minerals and therefore, prevent many deficiency diseases. The postharvest loss is highly prominent in mango due to its high perishability and climacteric pattern of respiration. The postharvest life of any fruit consists of ripening and senescence. The ripening and senescence are the sum total of a number of postharvest physicochemical changes. The prolongation of storage life of a fruit consists of slowing down the process leading to ripening and if possible, stopping the degradation and fermentation changes that cause senescence after ripening. Hence, the physicochemical processes during storage and ripening of mango need to be studied extensively for the development of proper storage methods. In Bangladesh several researchers (Sardar *et al.*, 1998; Hassan *et al.*, 1998; Mondal *et al.*, 1998; Hossain *et al.*, 1999) studied the pattern of chemical changes of mango, but little information is available on mango varieties Fazli and Amrapali. Therefore, the present piece of study was under taken to study the chemical changes during storage of the aforementioned mango varieties.

Materials and Methods

The experiment was conducted at the Laboratories of the Departments of Horticulture and Biochemistry of Bangladesh Agricultural University, Mymensingh during the period from June to September, 2003. The experimental materials were mature green fruits of two mango varieties namely, Fazli and Amrapali which were collected from the orchard of Horticulture Centre, Kallyanpur, Chapainawabgonj. A total of 75 unblemished, physically similar fruits of approximately more or less uniform in size, shape and color were harvested manually for each variety. One hundred and fifty of

such mango fruits of both varieties were collected for the experiment. The skin adherences were cleaned with the help of a moist towel. The postharvest treatments used in the experiment were randomly assigned to the fruits. The postharvest treatments were: i. Control (T_0), ii. Hot water treatment at 55°C for 5 minutes (T_1), iii. Mangoes stored in refrigerated incubator at 15°C (T_2), iv. Mangoes stored in polythene bag (T_3), v. Hot water treatment at 55°C for 5 minutes followed by wrapping individual fruit in polythene bag and then stored at 15°C (Hot water treatment + polythene wrapping +low temperature storage) (T_4). This experiment was laid out in the completely randomized design with three replications. Fruits from each treatment and variety out of each replication were randomly collected at 3, 6, 9, and 12th days of storage for chemical analysis. The chemical parameters (Vitamin C, titratable acidity, total soluble solid, reducing sugar, non-reducing sugar, total sugar) were estimated by the methods cited in the Manual of Analysis of Fruit and Vegetable Products (Ranganna, 1979). The collected data were statistically analyzed by analysis of variance method. The means of different parameters were compared by LSD.

Results and Discussion

Different chemical changes that observed in the present study are presented and discussed under the following sub-headings:

Vitamin C (Ascorbic acid) content

Varietal difference in respect of Vitamin C content was highly significant during storage. The overall Vitamin C content was higher in Amrapali than Fazli (Table 1). The postharvest treatments exhibited significant variation in term of Vitamin C content. It was higher in hot water + polythene bag + cool stored fruits and cool stored fruits than the fruits receiving other treatments (Table 2). The combined effects of postharvest treatments and variety on vitamin C content showed highly significant variation during storage. The combinations V_1T_4 in case of Fazli and V_2T_4 in case of Amrapali were found to have highest Vitamin C contents. The Vitamin C content declined steadily during storage. This result has got support of Mondal *et al.*, (1998) and Gofur *et al.*, (1994). Reduction in Vitamin C contents during storage and ripening may be attributed to the oxidation of ascorbic acid as ripening proceeded.

Titratable acidity

Statistically highly significant differences were observed between two varieties in respect of titratable acidity (Table 1). It was observed that Fazli had higher titratable acidity than Amrapali. The postharvest treatments exhibited highly significant variation in titratable acid content during storage period except 3rd day of storage (Table 2). The low temperature treated fruits exhibited higher titratable acidity than the fruits of other treatments during storage. Marked reduction in titratable acid content was observed with the advancement of storage period. The combined effects of variety and postharvest treatments on titratable acidity were significant during storage (Table 3). The titratable acidity was in declining trend in both the varieties and the results have got support of Shahjahan *et al.*, (1994) and Rangavalli *et al.*, (1993). This decrease may be attributed to increasing rate of metabolic activities and conversion of different organic compounds in to sugars.

pH of fruit pulp

Highly significant variations in pulp pH were observed between the two varieties except 3rd day of storage (Table 1). An increasing trend of pulp pH was observed in both the varieties with duration of storage. The postharvest treatments imposed to the fruits exhibited highly significant variation in pulp pH except 3rd day of storage (Table 2). The combined effects of varieties and postharvest treatments regarding pulp pH were highly significant at 6, 9, and 12th day of storage (Table 3). The maximum pH was found in untreated fruits and the minimum pH was found in low temperature stored fruits during the storage period. In the present study an increasing fashion of pH values was recorded during storage which is in agreement with the research reports of Medlicott *et al.*, (1990) and Kumar *et al.*, (1993). The increase in the pH may be due to the continuous fall in acidity during storage.

Total soluble solids (% Brix)

The Varietal differences in term of total soluble solid content were found to be statistically significant (Table 1). The percent total soluble solid content increased with storage duration. Amrapali had higher TSS content than Fazli throughout the storage period. The postharvest treatments exhibited highly significant variation in term of TSS content up to 12th day of storage (Table 2). A progressive development of TSS content was observed in cool stored, hot water + polythene bag + cool stored and polythene bagged fruits. The combined effects of varieties and the postharvest treatments in term of TSS content were found to be significant during storage (Table 3). The increase in TSS content of fruit pulp with the advancement of storage period found in the present study was in agreement with the findings of Yuniarti and Suhardi (1992). This increase in TSS content of fruit pulp was probably due to the hydrolysis of starch and dehydration of fruits for longer period.

Sugar (Reducing, Non-reducing and Total) content

Highly significant differences were observed between the two varieties in respect of reducing, non-reducing and total sugar contents during the storage period (Table 4). Reducing sugar content was found higher in Amrapali than FAzli. Postharvest treatments exhibited significant variation in reducing and total sugars except 3rd day of storage and in non-reducing sugar content during the entire period of storage (table 3). Amrapali exhibited lower sugar contents (reducing, non-reducing and total) than fazli. At 12th day of storage, the lowest reducing sugar (6.02%) and total sugar (11.65%) was observed in cool storage and the lowest non-reducing sugar (5.63%) was observed in polythene bagged fruits. The combined effects of variety and postharvest treatments on reducing, non-reducing and total sugar of mango were found highly significant during storage period (Table 6). An increasing trend of sugars was found in both the varieties in all treatments which agrees with the findings of Tsuda *et al.*, (1999). This increase may be attributed to the metabolic transformation in soluble compounds and more conversion of organic acid into sugars.

Table 1. Effect of variety on vitamin C content, titratable acidity, pH and total soluble solid of mango

Variety	Vitamin C (mg/100 g)				Titratable acidity (%)				Pulp pH				Total soluble solid(% Brix)			
	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS
Fazli	33.30	27.23	18.32	13.82	2.15	0.776	0.572	0.312	3.77	4.06	4.58	4.73	13.56	14.89	16.27	16.26
Amrapali	46.60	37.92	28.20	19.40	2.04	0.694	0.470	0.174	3.43	3.88	4.33	4.76	14.35	16.52	19.36	19.46
LSD (0.05)	2.278	1.600	1.382	1.082	0.064	0.024	0.024	0.024	0.197	0.123	0.160	--	0.683	1.109	1.358	0.899
LSD (0.01)	3.108	2.183	1.885	1.476	0.087	0.033	0.033	0.033	0.269	0.168	0.218	--	--	1.513	1.853	1.226

Table 2. Effect of postharvest treatments on vitamin C content, titratable acidity, pH and total soluble solid of mango

Postharvest treatment	Vitamin C (mg/100 g)				Titratable acidity (%)				Pulp pH				Total soluble solid(% Brix)			
	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS
T_0	39.05	30.58	19.86	14.02	2.10	0.640	0.355	0.130	3.68	4.15	4.87	5.28	15.90	18.44	20.82	19.68
T_1	40.28	33.70	21.98	15.22	2.10	0.670	0.380	0.165	3.57	4.12	4.67	5.05	13.98	16.19	19.79	18.95
T_2	39.64	31.63	25.27	18.57	2.07	0.815	0.610	0.350	3.56	3.84	4.23	4.40	13.02	13.94	15.55	16.42
T_3	41.05	34.94	23.17	16.55	2.14	0.805	0.640	0.270	3.62	3.84	4.24	4.55	13.75	15.86	17.12	17.65
T_4	39.75	32.04	26.04	18.71	2.09	0.745	0.620	0.300	3.56	3.90	4.27	4.45	13.15	14.10	15.81	16.60
LSD (0.05)	--	2.530	2.185	1.710	--	0.038	0.038	0.038	--	0.194	0.253	0.334	1.081	1.754	2.148	1.421
LSD (0.01)	--	--	2.981	2.333	--	0.052	0.052	0.052	--	0.265	0.345	0.456	1.474	2.392	2.930	1.938

T_0 : Control
T_1 : Hot water treatment at 55°C for 5 minutes
T_2 : Stored in 15°C temperature
T_3 : Polythene wrapping
T_4 : Hot water treatment followed by polythene wrapping and then stored in 15°C temperature

Table 3. Combined effect of variety and postharvest treatments on vitamin C content, titratable acidity, pH and total soluble solid of mango

Varietyxpostharvest treatment		Vitamin C (mg/100 g)				Titratable acidity (%)				Pulp pH				Total soluble solid(% Brix)			
		3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS
Fazli	T_0	32.62	25.39	15.48	11.00	2.18	0.680	0.370	0.160	3.85	4.10	4.75	4.95	15.20	17.05	18.30	17.86
	T_1	33.55	28.34	16.89	12.29	2.15	0.700	0.390	0.190	3.75	4.15	4.63	4.72	13.05	15.10	17.25	16.80
	T_2	33.15	26.25	20.36	16.00	2.10	0.850	0.630	0.450	3.70	4.01	4.55	4.69	12.97	13.25	14.60	14.75
	T_3	34.00	29.16	17.78	13.65	2.20	0.900	0.770	0.360	3.81	3.95	4.40	4.60	13.50	15.64	16.50	16.90
	T_4	33.20	27.00	21.10	16.18	2.13	0.750	0.700	0.400	3.72	4.09	4.58	4.70	13.10	13.40	14.70	15.0
Amrapali	T_0	45.47	35.77	24.23	17.04	2.02	0.600	0.340	0.100	3.50	4.20	4.98	5.62	16.60	19.82	23.33	21.50
	T_1	47.00	39.05	27.07	18.15	2.04	0.640	0.370	0.140	3.38	4.08	4.70	5.37	14.90	17.27	22.33	21.10
	T_2	46.12	37.00	30.18	21.14	2.03	0.780	0.590	0.250	3.42	3.67	3.91	4.10	13.06	14.63	16.50	18.09
	T_3	48.10	40.71	28.55	19.45	2.08	0.710	0.510	0.180	3.43	3.73	4.08	4.50	14.00	16.08	17.74	18.40
	T_4	46.30	37.08	30.97	21.24	2.05	0.740	0.540	0.200	3.40	3.70	3.96	4.20	13.20	14.80	16.91	18.20
LSD (0.05)		5.094	3.578	3.090	2.419	0.143	0.054	0.054	0.054	--	0.275	0.357	0.473	1.528	2.480	3.038	2.009
LSD (0.01)		6.949	4.881	4.215	3.299	0.194	0.073	0.073	0.073	--	0.375	0.487	0.645	2.084	3.383	4.144	2.741
CV (%)		7.49	6.45	7.80	8.55	3.92	4.22	5.01	11.78	7.18	4.04	4.71	5.85	6.43	9.27	10.01	6.61

T_0 : Control
T_1 : Hot water treatment at 55°C for 5 minutes
T_2 : Stored in 15°C temperature
T_3 : Polythene wrapping
T_4 : Hot water treatment followed by polythene wrapping and then stored in 15°C temperature

Table 4. Effect of variety on reducing, non-reducing and total sugar of mango

Variety	Reducing sugar content (%)				Non-reducing sugar content (%)				Total sugar content (%)			
	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS
Fazli	2.56	3.29	3.91	4.33	2.58	3.59	4.63	4.39	5.15	6.89	8.55	8.72
Amrapali	3.98	4.75	7.17	8.36	2.82	6.71	6.86	7.37	6.80	11.46	14.03	15.72
LSD (0.05)	0.096	0.162	0.090	0.162	0.110	0.232	0.158	0.249	0.158	0.376	0.165	0.350
LSD (0.01)	0.131	0.220	0.123	0.220	0.151	0.317	0.215	0.340	0.215	0.512	0.225	0.477

Table 5. Effect of postharvest treatments on reducing, non-reducing and total sugar of mango

Postharvest treatment	Reducing sugar content (%)				Non-reducing sugar content (%)				Total sugar content (%)			
	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS
T_0	3.27	4.40	5.46	6.82	2.60	5.03	6.10	6.55	5.86	9.42	11.56	13.36
T_1	3.40	4.24	6.05	6.58	2.64	5.44	5.17	5.92	6.03	9.68	11.22	12.50
T_2	3.26	3.79	5.41	6.02	2.58	4.73	5.65	5.64	5.83	8.51	11.06	11.65
T_3	3.20	3.90	5.42	6.22	2.94	5.49	6.03	5.63	6.14	9.39	11.45	11.85
T_4	3.25	3.78	5.38	6.09	2.76	5.09	5.78	5.66	6.01	8.87	11.16	11.74
LSD (0.05)	--	0.256	0.143	0.256	0.175	0.367	0.250	0.394	--	0.594	0.261	0.553
LSD (0.01)	--	0.349	0.194	0.349	0.238	0.501	0.341	0.537	--	0.810	0.356	0.755

T_0 : Control
T_1 : Hot water treatment at 55°C for 5 minutes
T_2 : Stored in 15°C temperature
T_3 : Polythene wrapping
T_4 : Hot water treatment followed by polythene wrapping and then stored in 15°C temperature

Table 6. Combined effect of variety and postharvest treatments on reducing, non-reducing and total sugar of mango

Variety × postharvest treatment		Reducing sugar content (%)				Non-reducing sugar content (%)				Total sugar content (%)			
		3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS	3 DAS	6 DAS	9 DAS	12 DAS
Fazli	T_0	2.55	3.48	3.90	4.64	2.47	3.56	4.90	4.58	5.02	7.04	8.80	9.22
	T_1	2.70	3.56	4.23	4.40	2.49	3.60	4.13	4.48	5.19	7.16	8.36	8.88
	T_2	2.65	3.14	3.88	4.13	2.45	2.96	4.40	4.27	5.10	6.10	8.28	8.40
	T_3	2.39	3.20	3.85	4.32	2.85	4.18	5.14	4.29	5.24	7.38	8.99	8.61
	T_4	2.53	3.08	3.71	4.16	2.65	3.67	4.60	4.32	5.18	6.75	8.31	8.48
Amrapali	T_0	3.98	5.31	7.02	8.99	2.72	6.49	7.30	8.51	6.70	11.80	14.32	17.50
	T_1	4.09	4.92	7.87	8.76	2.78	7.28	6.21	7.36	6.87	12.20	14.08	16.12
	T_2	3.86	4.43	6.94	7.90	2.70	6.49	6.89	7.00	6.56	10.92	13.83	14.90
	T_3	4.00	4.60	6.98	8.12	3.03	6.80	6.92	6.97	7.03	11.40	13.90	15.09
	T_4	3.97	4.48	7.05	8.01	2.86	6.50	6.96	6.99	6.83	10.98	14.01	15.00
LSD (0.05)		0.215	0.361	0.202	0.361	0.247	0.519	0.353	0.557	0.353	0.840	0.369	0.782
LSD (0.01)		0.294	0.493	0.275	0.493	0.337	0.709	0.482	0.760	0.482	1.145	0.504	1.067
CV (%)		3.89	5.30	2.17	3.35	5.32	5.91	3.62	5.57	3.45	5.37	1.92	3.76

T_0 : Control
T_1 : Hot water treatment at 55°C for 5 minutes
T_2 : Stored in 15°C temperature
T_3 : Polythene wrapping
T_4 : Hot water treatment followed by polythene wrapping and then stored in 15°C temperature

References

Gofur, A., Shafique, M.Z., Helali, M.O.H., Ibrahim, M., Rahman, M.M. and Hakim, A. 1994. Effect of various factors on the vitamin C content of some mango varieties grown in Rajshahi region. Bangladesh j. Sci. Ind. Res., 29(3): 163-171.

Hassan, M.K., Mondal, M.F. and Hoque, M.S. 1998. Studies on the storage behaviour of mango. Bangladesh J. Agril. Sci., 25(2): 311-318.

Hossain, M.M., Haque, M. A., Rahim, M.A. and Roy, P.K. 1999. Chemical changes during storage of mango (*Mangifera indica* L.) as affected by different storage treatments. Progress Agric., 10 (1&2): 29-36.

Kumar, S., Das, D.K., Singh, A.K. and Prasad, U.S. 1993. Changes in nonvolatile organic acid composition and pH during maturation and ripening of two mango varieties. Indian J. Plant Physiol., 36(2): 107-111.

Medlicott, A.P., Sigrist, J.M.M. and Sy, O. 1990. Ripening of mangoes following low temperature storage. J. Amer. Soc. Hort. Sci., 115(3): 430-434.

Mondal, M.F., Hassan, M.K. and Hoque, M.S. 1998. Phycico- chemical changes and shelf life of mango as influenced by postharvest treatments. Progressive Agric., 9(1&2): 77-82.

Ranganna, S. 1979. Manual of Analysis of Fruit and Vegetable Products. Tata McGraw-Hill Pub. Co. Ltd., New Delhi.

Rangavalli, K., Ravisankar, C. and Prasad, P.H. 1993. Postharvest changes in mango (*Mangifera indica* L.) var. Baneshan. South Indian Hort., 41(3): 169-170.

Sardar, P.K., Hossain, M.A., Islam, M.S. and Khandaker, S.M.A.T. 1998. Studies on the physico-chemical characters of some popular mango cultivars. Bangladesh J. Agril. Sci., 25 (1): 1-4.

Shahjahan, M., Shell, S., Zaman, M.A. and Sakur, M.A. 1994. Optimization of harvesting maturities for major mango cultivars in Bangladesh. Bangladesh J. Sci. Res., 12(2): 209-215.

Tsuda, T., Chachin, K. and Ueda, Y. 1999. Studies on keeping quality of imported 'Carabao' mango fruit from the Philippines. J. Jap. Soc. Hort. Sci., 68(3): 669-674.

Yuniarti, S. and Suhardi, K. 1992. Ripening retardation of Arumanis mango. ASEAN Food J., 7(4): 207-208.