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EFFECT OF POSTHARVEST TREATMENTS ON SHELF LIFE EXTENSION OF GUAVA

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ABSTRACT

The experiment was conducted to develop an appropriate storage method and shelf life of two guava varieties, namely Swarupkathi and Kazi Piara under different postharvest treatments. Six postharvest treatments viz., control, hot water, neem extract, brown wrapping paper, perforated white polythene bag and non-perforated white polythene bag were assigned to the guava fruits. The two factors experiment was laid out in a completely randomized design with three replications. Among the physico-chemical parameters such as reducing and non-reducing sugar contents increased significantly, whereas titratable acidity and vitamin C contents decreased during storage in all treated and untreated fruits. Between two varieties, the shelf life of Kazi Piara (9.89 days) was higher than that of Swarupkathi (7.94 days). The postharvest treatments showed highly significant variation in the shelf life of guava. The shelf life extended up to 13.00 days by using non-perforated white polythene bag. The fruits stored in non-perforated white polythene bag having longer shelf life resulted slow change in its chemical components. The shelf life of variety Kazi Piara could be extended up to 13.00 days by using non-perforated white polythene bag.

Keywords: guava, treatments, shelf life.

INTRODUCTION

Guava (*Psidium guajava* L.) is an important resource in the domestic economy of many countries in the tropics (Yavada, 1996). Most of the people of Bangladesh suffer from malnutrition specially vitamins and minerals. Guava is a good source of readily up-take able vitamins and minerals. It is also very cheap and easily available. It is quite hardy, prolific bearer and highly remunerative even without much cares (Bose and Mitra, 1990). It can easily be grown in homestead areas throughout the country. But some region such as Barisal, Sylhet and Chittagong it is cultivated commercially. Changes in the physico-chemical properties occur during different stages of ripening and storage.

The postharvest loss highly prominent in guava because of its high perishability. A number of factors influence the shelf life and quality of guava fruit after harvest. Among them choice of cultivar, fruiting season, maturity stage, kinds of materials used for wrapping purpose during storage, temperature and humidity prevailing over the storage environment are very much important. No reliable statistical data are available especially in the context of Bangladesh to indicate proper storage method of guava. The present study was, therefore, undertaken to find out the appropriate postharvest treatment and effective packaging material for extending the shelf life of guava.

MATERIALS AND METHODS

The experiment was carried out at the Laboratory of the Department of Horticulture, Patuakhali Science and Technology University, Dumki and the Laboratory of Department of Biochemistry, Bangladesh Agricultural University, Mymensingh during the period from July to October 2010. The storage room was well ventilated with four windows and two exhaust fans. The temperatures of the

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storage room of experiment were recorded daily with a thermo-meter. The average morning (at 8.00 am), afternoon (at 2.00 pm) and night (at 8.00 pm) temperatures of the storage room were 30.04°C, 30.04°C and 30.00°C, respectively. Two varieties of guava, namely Swarupkathi and Kazi Piara were used as experimental materials for the experiment. The experiment consisted of two factors viz., variety: V_1: Swarupkathi & V_2: Kazi Piara and six postharvest treatments: T_0: control, T_1: hot water (55±1°C for 5 minutes), T_2: neem extract (50%), T_3: brown wrapping paper (40 cm×25 cm), T_4: perforated white polythene bag (40 cm×25 cm) and T_5: non-perforated white polythene bag (40 cm×25 cm). The experiment was laid out in a completely randomized design (CRD) with three replications. The postharvest treated fruits were assigned randomly in each replication where randomly selected eight fruits were set in order to each treatment combination. The collected data were statistically analyzed by Analysis of Variance method using MSTAT computer package program. The significance of difference between pair of means was tested by the least significant difference (LSD) test at 5 % level of probability (Gomez and Gomez, 1984).

Parameters

Estimation of reducing sugar content: Reducing sugar content of guava pulp was determined by Dinitrosalicylic acid method (Miller, 1972).

$$\% \text{ Reducing sugar (g/100 g of guava)} = \frac{\text{Amount of sugar obtained}}{\text{Weight of samples}} \times 100$$

Estimation of non-reducing sugar content: Non-reducing sugar content of guava pulp was calculated by using the following formula:

% Non-reducing sugar = % Total sugar - % Reducing sugar

Estimation of vitamin C (Ascorbic acid) content:

$$\text{Vitamin C content (mg/100 g of fruit)} = \frac{T \times D \times V_1}{V_2 \times W} \times 100$$

Where,

T = Titre

D = Dye factor

V_1 = Volume made up

V_2 = Volume of extract taken for estimation

W = Weight of sample taken for estimation

Estimation of titratable acidity content: Titratable acidity of guava pulp was determined by the method of Ranganna (1979).

$$\text{Titratable acidity (\%)} = \frac{T \times N \times V_1 \times E}{V_2 \times W \times 1000} \times 100$$

Where,

T = Titre

N = Normality of NaOH

V_1 = Volume made up

E = Equivalent weight of acid

V_2 = Volume of extract taken for estimation

W = Weight of sample taken for estimation

Shelf life (Days)

Shelf life of guava fruits as influenced by different storage treatments and variety was calculated by counting the days required to ripe fully as to retaining optimum marketing and eating qualities.

RESULTS AND DISCUSSION

Effect of variety

The variety had significant effect reducing sugar, non-reducing sugar, titrtable acidity, vitamin C and shelf life of guava during 3, 6, 9 and 12 DAS. The highest reducing sugar content (1.94%) was

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Where,

T = Titre

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recorded in Kazi Piara, whereas it was the lowest (1.61%) in Swarupkathi at 3 days after storage (DAS). At 6 DAS, the maximum (2.27%) and minimum (2.15%) reducing sugar were observed in Kazi Piara and Swarupkathi. At 9 DAS, the highest (3.46%) and the lowest (2.70%) reducing sugar were obtained in Swarupkathi and Kazi Piara. At 12 DAS (ripe stage), the highest (3.49%) reducing sugar was found in Kazi Piara and the lowest (2.48%) was in Swarupkathi. It was also observed that reducing sugar content was always higher in Kazi Piara than Swarupkathi except at 9 DAS. At 9 DAS, reducing sugar content was higher in Swarupkathi than Kazi Piara (Fig. 1A).

Highly significant variation was observed between the varieties in terms of non-reducing sugar content during 3, 6 and 12 DAS but it was non-significant at 9 DAS. The highest non-reducing sugar was found in Kazi Piara (2.19%), whereas it was the lowest (1.98%) in Swarupkathi at 3 DAS. At 6 DAS, the maximum (3.63%) and minimum (3.01%) non-reducing sugar was observed in Kazi Piara and Swarupkathi. At 9 DAS, the highest (4.68%) and the lowest (4.64%) non-reducing sugar was obtained in Kazi Piara and Swarupkathi. At ripe stage, the highest (5.12%) non-reducing sugar was recorded in Kazi Piara and the lowest (4.72%) was in Swarupkathi. It was also observed that non-reducing sugar content was always higher in Kazi Piara than Swarupkathi (Fig. 1B).

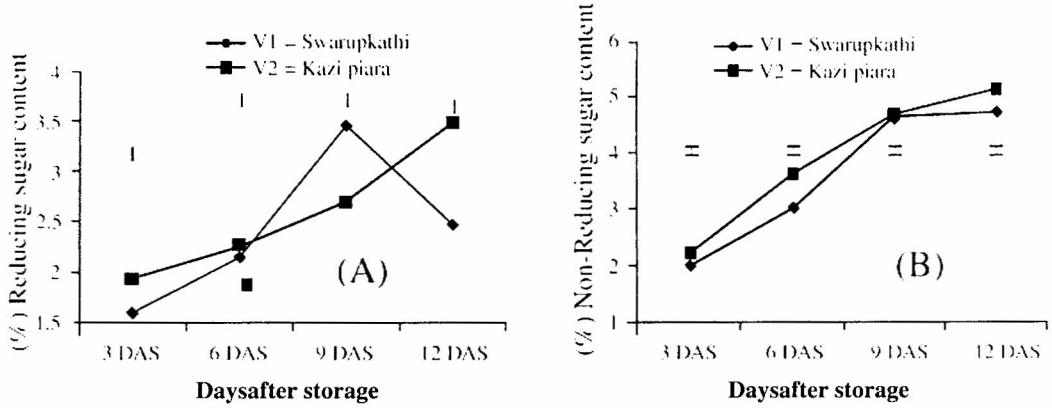

Fig. 1. Effect of variety on (A) reducing sugar (B) non-reducing sugar contents of guava during storage. The vertical bars indicate LSD at 5% level of significance.

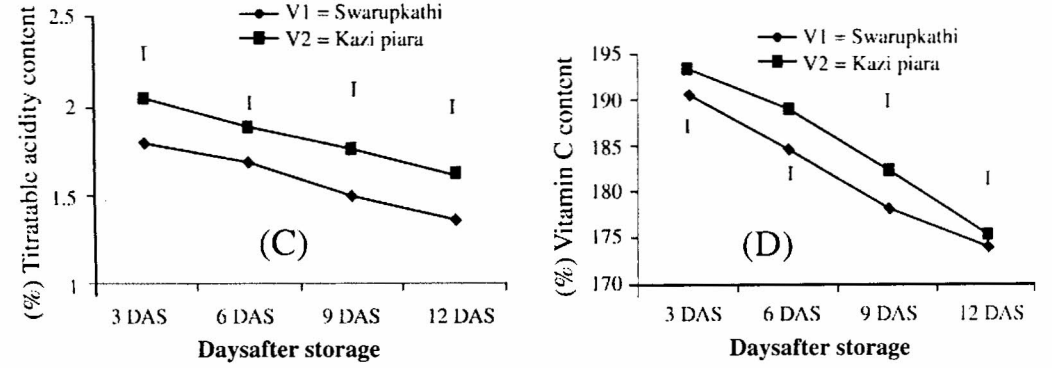

Fig. 1. Effect of variety on (C) titratable acidity (D) vitamin C contents of guava during storage. The vertical bars indicate LSD at 5% level of significance.

Titratable acidity decreased with the increase in storage period for both the varieties. Slowly decreasing trend in percent titratable acidity content was found from 3 DAS to 12 DAS (ripe stage). In the variety Kazi Piara, the highest (2.04%) and the lowest (1.62%) titratable acidity were obtained at 3

and 12 DAS (ripe stage), respectively. Similar trends were also observed in Swarupkathi, whereas the highest (1.80%) and the lowest (1.37%) titratable acidity were recorded at 3 and 12 DAS, respectively (Fig. 1C).

Rapid decreasing trend in percent vitamin C content was found from 3 DAS to 12 DAS. It was observed that Kazi Piara had higher ascorbic acid content than Swarupkathi over the storage period. The variety Kazi Piara had highest (193.40 mg/100g) and the lowest (175.25% mg/100g) ascorbic acid followed by the variety Swarupkathi, whereas the highest (190.48 mg/100g) and the lowest (174.03 mg/100g) ascorbic acid were found at 3 and 12 DAS (ripe stage), respectively (Fig. 1D). It was also observed that vitamin C (Ascorbic acid) drastically reduced in both varieties with the increasing of storage period of guava fruits.

Highly significant variation was found between two varieties in respect of shelf life of guava. The results showed that the shelf life of Kazi Piara (9.89 days) was higher than that of Swarupkathi (7.94 days) (Fig. 2).

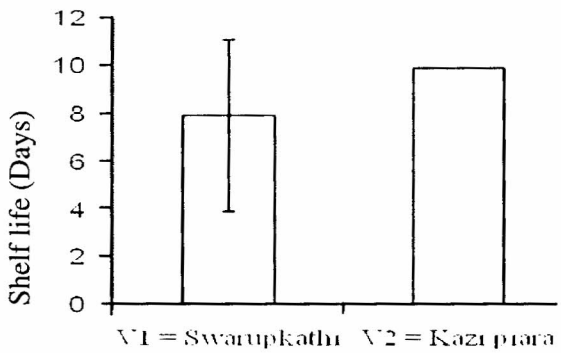

Fig. 2. Effect of variety on shelf life of guava during storage. The vertical bars indicate LSD at 5% level of significance.

Effect of postharvest treatments

There were significant variation was observed among the postharvest treatments in case of reducing sugar, non-reducing sugar, titratable acidity, vitamin C contents and shelf life of guava during 3, 6, 9 and 12 DAS (ripe stage). The maximum reducing sugar content (2.40%) was observed in the fruits kept in non-perforated white polythene bag followed by perforated white polythene bagged fruits (2.35%) and minimum reducing sugar content was recorded in control fruits (1.10%) at 3 DAS. At 6 DAS, the highest reducing sugar content (2.90 and 3.65%) was marked in perforated white polythene bagged fruits and the lowest reducing sugar content (1.39 and 1.99%) was noted in control fruits, respectively. On the other hand, the maximum reducing sugar (4.10%) was noticed in non-perforated white polythene bagged fruits and the minimum reducing sugar content (2.10%) was observed in control fruits at ripe stage (Table 1). It was observed that the reducing sugar content was sharply increased during storage period which is similar to the findings of Mawlah and Itoo (1982). They observed that reducing sugars were increased slowly during different stages and increased sharply at different storage period. It was also found that the highest range was from 2.80 to 5.00% which is similar to the findings of Phandis (1970), Chan and Kwok (1975) and Wilson (1980). Phandis (1970) found that guava fruits contained 4.45% reducing sugar. Chan and Kowk (1975) reported that the reducing sugars in guava to be 5.5%, whereas Wilson (1980) analyzed chemical composition of guava and stated that reducing sugar was 4.0%.

The postharvest treatments exhibited highly significant variation in respect of non-reducing sugar content during storage interval. The maximum (2.90%) non-reducing sugar content was observed in

non-perforated white polythene bagged fruits followed by the fruits kept in perforated white polythene bagged fruits (2.88%) and minimum (1.33%) was recorded in control fruits at 3 DAS. Similarly at 6, 9 and 12 DAS, the highest non-reducing sugar content was noticed (4.24, 5.75 and 6.13%) in non-perforated white polythene bag and the lowest was (2.64, 3.38 and 3.65%) in control fruits, respectively (Table 1).

Decreasing trend in percent titratable acidity was observed only on non-perforated white polythene bag treatment while slowly decreasing rate on percent titratable acidity was observed for other treatments especially in case of control. The maximum titratable acidity was obtained in non-perforated white polythene bagged fruits (2.34%) followed by those perforated white polythene bag (2.25%), whereas it was minimum (1.65%) in control fruits at 3 DAS. But at 6 DAS, the highest (2.29%) and the lowest (1.33%) titratable acidity were observed in non-perforated white polythene bag and control fruits, respectively. Similarly, at 9 DAS, the greatest (2.02%) and the smallest (0.95%) titratable acidity were also observed in fruits of non-perforated white polythene bag and control, respectively. But at ripe stage, the highest (2.12%) titratable acidity was in non-perforated white polythene bag followed by those of perforated white polythene bag (1.89%) and the minimum (0.69%) was noticed in fruits of control. It was observed that titratable acidity content declined sharply from 3 DAS to ripe stage for all the treatments (Table 1). In the present investigation, decreased in percent titratable acidity was observed during storage which was similar to the result of Jitender-Kumar *et al.* (2003). The decreased in titratable acidity may be attributed to increase rate of metabolic activities and conversion of different organic compounds into sugar during storage period.

Vitamin C (Ascorbic acid) content at different storage period was highly significant for different postharvest treatments. Rapid decreasing trend in percent vitamin C was found from 3 DAS to 12 DAS (ripe stage). The maximum vitamin C content (201.01, 196.77, 191.66 and 190.20 mg/100g) were recorded in non-perforated white polythene bagged fruits and minimum (182.09, 172.62, 162.47 and 156.64 mg/100g) were observed in untreated fruits at 3, 6, 9 and 12 DAS, respectively (Table 1). Vitamin C content was the maximum in Kazi Piara than Swarupkathi which is similar to the findings of Azad *et al.* (1987) and Nag (1998). The decrease in vitamin C content in all treatments and control during storage period may be due to the oxidation of ascorbic acid.

The postharvest treatments used in the present study exhibited pronounced effect on extending shelf life of guava during storage and it was statistically significant. The longest shelf life (11.33 days) was recorded in fruits with non-perforated white polythene bag followed by 10.00 days of the fruits kept in perforated white polythene bag treatment whereas minimum shelf life (6.33 days) was recorded in untreated fruits preceded by those of kept in hot water treated fruits (8.33 days), neem extract treated fruits (8.33 days) and brown wrapping paper bagged fruits (9.17 days), respectively (Fig. 3).

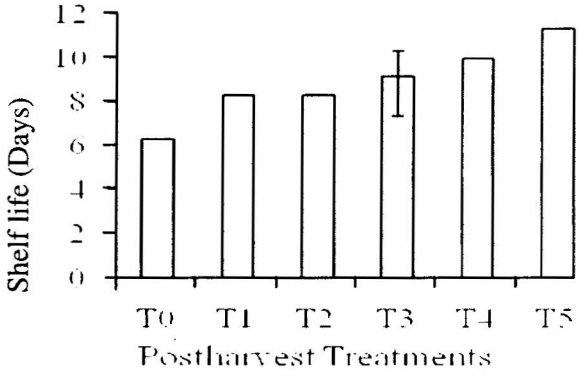

Fig. 3. Effect of postharvest treatments on shelf life of guava during storage. The vertical bars indicate LSD at 5% level of significance

Combined effects of variety and postharvest treatments

The combined effect between varieties and postharvest treatments in respect of reducing sugar content was significant during 3, 6 and 12 DAS (ripe stage) but non-significant at 9 DAS. At 3 DAS, it was the highest (2.80%) in V_2T_5 combination followed by V_1T_4 (2.38%), while it was the lowest (0.83%) in V_1T_0 combination. The maximum reducing sugar content was recorded in V_1T_4 (3.33%) and the minimum (1.36%) in V_1T_0 combination at 6 DAS. But at 9 DAS, the higher (3.86%) reducing sugar content was found in V_1T_5 and the lower (1.54%) was recorded in V_2T_0 combination. At ripe stage, the maximum (5.00%) and minimum (1.59%) reducing sugar content were present in V_2T_5 and V_1T_0 combinations, respectively (Table 2).

The combined effect of variety and postharvest treatments in respect of non-reducing sugar content was highly significant at 3, 6 and 12 DAS (ripe stage) but it was non-significant at 9 DAS. At 3 DAS, it was the highest (2.95%) in V_1T_5 combination followed by V_2T_4 (2.90%) while it was the lowest (1.26%) in V_1T_0 treatment combination. The highest non-reducing sugar content was noticed in V_2T_5 (4.53%) followed by V_1T_4 (4.21%) and the lowest was in V_1T_2 (2.90%) combination at 6 DAS. But at 9 DAS, the maximum non-reducing sugar content was observed (5.97%) in V_1T_5 followed by V_2T_5 (5.53%) and the minimum (3.37%) was noticed in V_1T_0 treatment combination preceded by V_2T_0 (3.38%). At ripe stage, the maximum (6.45%) was noted in V_2T_5 followed by V_2T_4 (6.24%) and minimum (3.28%) non-reducing sugar content was present in V_2T_0 preceded by V_1T_0 (4.01%) treatment combination (Table 2).

The combined effect between varieties and postharvest treatments in terms of titratable acidity was significant at 3, 9 and 12 DAS (ripe stage) but it was non-significant at 6 DAS. It was maximum in V_2T_5 (2.47%) followed by V_2T_4 (2.32%) and minimum in V_1T_2 (1.47%) at 3 DAS. Similarly at 6 DAS, the highest (2.41%) and the lowest (1.18%) titratable acidity were observed in V_2T_5 and V_1T_0 combination, respectively. At 9 DAS, the highest titratable acidity were observed in V_2T_5 (2.39%) and the lowest in V_1T_0 (0.54%) combination. But at ripe stage, the highest (2.18%) titratable acidity was found in V_2T_5 and the lowest (0.30%) titratable acidity was noticed in V_1T_0 combination (Table 2).

The combined effect of variety and postharvest treatments on vitamin C content was not significant at all stages of storage. The highest vitamin C content 205.69, 198.04, 192.19 and 190.39 mg/100g were recorded in V_2T_5 combination and the lowest 180.31, 170.87, 158.60 and 152.81 mg/100g in V_1T_0 combination at 3, 6, 9 and 12 DAS, respectively (Table 2).

The combined effects between the variety and postharvest treatments were significant in respect of shelf life. Considering the combined effect of varieties and postharvest treatments, the longest shelf life (13.00 days) was obtained in V_2T_5 followed by V_1T_5 (9.67 days) and shortest shelf life (5.67 days) was observed from V_1T_0 combination (Table 2). The above results lead to the conclusion that different postharvest treatments influenced in the shelf life of guava. The increase in shelf life was probably due to the changes in the concentration of various gasses (increased level of O_2 and reduced level of CO_2) as well as slowing down the process leading to delay ripening by different postharvest treatments. Shelf life was the highest in Kazi Piara than Swarupkathi which is similar to the findings of Azad *et al.* (1987) and reported that storing guava showed significantly increased shelf life in acceptable condition for 10 days during storage at room temperature. The above results showed that the postharvest treatments greatly influenced the physico-chemical changes during storage of guava.

Table 1. Effect of postharvest treatments on reducing sugar, non-reducing sugar, titratable acidity and vitamin C contents of guava during storage

Treatment combinations	Reducing sugar (%) at DAS				Non-reducing sugar (%) at DAS				Titratable acidity (%) at DAS				Vitamin C (mg/100g) at DAS			
	3	6	9	12 (Ripe)	3	6	9	12 (Ripe)	3	6	9	12 (Ripe)	3	6	9	12 (Ripe)
T_0	1.10	1.39	1.99	2.10	1.33	2.64	3.38	3.65	1.65	1.33	0.95	0.69	182.09	172.62	162.47	156.64
T_1	1.52	2.00	3.25	2.66	1.75	2.77	4.39	4.47	1.70	1.61	1.54	1.43	191.40	186.44	177.11	171.29
T_2	1.31	1.91	2.62	2.55	1.65	2.72	4.07	4.36	1.68	1.46	1.33	1.14	186.23	183.41	175.86	164.63
T_3	1.98	2.40	3.45	2.81	2.00	3.54	4.98	5.35	1.93	1.90	1.74	1.71	194.30	188.81	184.48	180.23
T_4	2.35	2.90	3.65	3.71	2.88	4.02	5.40	5.60	2.25	2.17	2.02	1.89	196.60	191.87	189.68	184.87
T_5	2.40	2.67	3.51	4.10	2.90	4.24	5.75	6.13	2.34	2.29	2.24	2.12	201.01	196.77	191.66	190.20
$LSD_{(0.05)}$	0.15	0.20	0.20	0.19	0.14	0.21	0.32	0.25	0.17	0.14	0.15	0.14	2.98	2.54	3.80	2.07

Table 2. Combined effects of variety and postharvest treatments on reducing sugar, non-reducing sugar, titratable acidity, vitamin C contents and shelf life of guava during storage

Variety × postharvest treatments	Reducing sugar (%) at DAS				Non-reducing sugar (%) at DAS				Titratable acidity (%) at DAS				Vitamin C (mg/100g) at DAS				Shelf life (DAS)
	3	6	9	12 (Ripe)	3	6	9	12 (Ripe)	3	6	9	12 (Ripe)	3	6	9	12 (Ripe)	
V_1T_o	0.83	1.36	2.44	1.59	1.26	2.18	3.37	4.01	1.61	1.18	0.54	0.30	180.31	170.87	158.60	152.81	5.67
V_1T_1	1.20	1.76	3.67	2.23	1.47	2.24	4.39	4.36	1.57	1.52	1.45	1.38	190.76	181.98	176.81	170.10	7.33
V_1T_2	1.56	1.67	3.13	2.35	1.57	2.09	3.96	4.39	1.47	1.41	1.19	0.95	185.75	182.75	170.25	166.84	8.00
V_1T_3	1.67	2.45	3.81	2.48	1.75	3.39	4.83	4.82	1.79	1.77	1.75	1.60	194.04	185.38	183.18	179.76	8.33
V_1T_4	2.38	3.33	3.82	3.04	2.86	4.21	5.33	4.95	2.17	2.11	2.02	1.94	195.66	190.40	188.93	184.68	8.67
V_1T_5	2.00	2.32	3.86	3.20	2.95	3.94	5.97	5.80	2.20	2.17	2.09	2.05	196.33	195.49	191.13	190.01	9.67
V_2T_o	1.36	1.41	1.54	2.61	1.40	3.09	3.38	3.28	1.68	1.48	1.36	1.08	183.87	174.37	166.33	160.46	7.00
V_2T_1	1.83	2.23	2.82	3.08	2.03	3.29	4.39	4.57	1.82	1.70	1.62	1.48	192.04	190.90	177.40	172.47	9.33
V_2T_2	1.05	2.15	2.11	2.75	1.72	3.34	4.18	4.32	1.90	1.51	1.46	1.32	186.70	184.07	181.47	162.42	8.67
V_2T_3	2.28	2.35	3.08	3.13	2.24	3.69	5.13	5.87	2.06	2.03	1.72	1.83	194.55	192.23	185.77	180.70	10.00
V_2T_4	2.31	2.47	3.47	4.38	2.90	3.83	5.47	6.24	2.32	2.23	2.02	1.84	197.54	193.47	190.42	185.08	11.33
V_2T_5	2.80	3.01	3.15	5.00	2.84	4.53	5.53	6.45	2.47	2.41	2.39	2.18	205.69	198.04	192.19	190.39	13.00
$LSD_{(0.05)}$	0.21	0.28	0.28	0.27	0.20	0.30	0.46	0.35	0.24	0.20	0.21	0.20	4.22	3.59	5.38	2.92	1.18

V_1: Swarupkathi, V_2: Kazi Piara, T_0: Control, T_1: Hot water, T_2: Neem extracts, T_3: Brown wrapping paper, T_4: Perforated white polythene bag, T_5: Non-perforated white polythene bag, DAS: Days after storage

REFERENCES

Azad, A.K., Hoque, A., Hossain, A.K.M. and Abdullah, A.M. 1987. Physico-chemical characteristics of fruits of some guava cultivars. *Bangladesh J. Agril. Res.*, 12(2): 43-49.

Bose, T.K. and Mitra, S.K. 1990. Guava, In: Fruits; Tropical and Subtropical, T.K. Bose (Ed.), Nayaprakash, India, pp: 280-303.

Chan, H.T. and Kwok, S.C.M. 1975. Identification and determination of sugars of some tropical fruit products. *J. Food Sci.*, 40:41-49.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. Intl. Rice Res. Inst., Jhon Wiley & Sons, NY.

Kumar, J., Sharma, R.K., Singh,R. and Goyal, R.K. 2003. Effect of different types of polythene on shelf life of summer guava. *Haryana J. Hort.Sci.*, 32(3/4): 201-202.

Mawlah, G. and Itoo, S. 1982. Guava *(Psidium guajava* L.*)* sugar components and related enzyme at stages of fruit development and ripening. *J. Jap. Soc. Food. Sci. Tech.*, 29(8): 472-476.

Miller, G.L. 1972. Use of Dinitro Salicylic acid reagent for determination of reducing sugar. Anal. Chem. 31:426-428.

Nag, A.R. 1998. Physico-chernical changes of four guava cultivars during different stages of ripening. MS Thesis, Dept. Hort., Bangladesh Agricultural University, Mymensingh. 75 p.

Phandis, N.A. 1970. Physico-chemical composition of guava fruits. *Indian J. Hort.*, 27: 417-433. [Cited from Hort. Abstr. 56: 4745, 1986]

Ranganna, S. 1979. Manual of Analysis of Fruit and Vegetable products. Tata MC Graw-Hill Pub. Co. Ltd., New Delhi, p. 634.

Wilson, C.W. 1980. Guava. *In:* Tropical and Sub-tropical Fruits; Composition. Properties and Nagy, Uses. S. Nagy and P.F. Shaw. Eds. AVI Publishing, Westport, Conn. p.279.

Yavada, U.T. 1996. Guava (*Psidium guajava* L.). An exotic tree fruit with potential in Southeastern United States. Hort. Sci. 31:789-794.