Effect of Coating and Wrapping materials on the shelf life of apple (*Malus domestica* cv.Borkh)

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Abstract

The present investigation was carried out to study the effect of different concentrations of calcium chloride (1%, 1.5%, 2%), paraffin wax coating and different wrapping materials (polyethylene, carton paper) inorder to increase the shelf life and to avoid the postharvest losses of Banky cultivars of apple. In physical characteristics general appearance (color and shape of fruit), weight loss percentage and organoleptic evaluation were studied during storage. In chemical characteristics, total soluble solids, pH, acidity, total sugar, reducing sugar and Vitamin C were analyzed after 15, 30, 45 and 60 days of storage. All the treatments had significant effect on the shelf life of fruits. However, Calcium chloride (2%) was reported superior to all other treatments. Calcium chloride (2%) proved very useful for reducing weight loss and shriveling and retained consumer acceptability even after 60 days of storage. Polyethylene packaging stood second position after 2% calcium chloride treatment.

Key words: Banky fruits, Shelf life of apple, Storage intervals, organoleptic evaluation

Introduction:

Apple (*Malus demestica* cv.Borkh) is called “The king of deciduous fruit” due to its beautiful shape, attractive color and very good taste. Apple, the premier table fruit of the world, belongs to the family Rosaceae and sub family Pomoidae. It is a typical temperate tree fruit, more than 80% of the world’s supply being produced in Europe. In Europe the major apple producing countries are Italy, France and Germany. The other countries, which have a marketable production of apples, include USSR, China, India, Iran, Turkey etc. Total apple production in world is 4.0 million tons. Total yield of apple in Pakistan is 2017 thousand tons. Total yield of apple in A.J.K is 3735.00 tons (Anonymous, 2001).

From nutritional and medicinal point of view its importance in daily diet is evident from an old age “An apple a day keeps the doctor away”. It reduces the incidence of dental caries, helps to control obesity and supply extra energy for heavy exercise. Apple has been recognized by the “American medical council on foods” as a useful therapeutic agent in dietary management to reduce curd tension of milk used in infant feeding and concentrated apple juice lowers pH of milk and increase palatability (Barval, 1999). A 100gm of apple constitutes 37-74k cal energy, 84.32–85.6g water, 0.8-2.4g fiber, 0.3-0.4g starch, 9.22-11.8g sugar, 2.1-13.7m-equivalent total acidity, 0.17-0.4g ash, 0.2-0.4g fat, , 4.49mg ascorbic acid, 0.03-0.12mg carotene, 0.02-0.4mg thiamine, 0.01-0.06mg riboflavin, 0.1-0.7mg niacin, 1-4mg folic acid, 0.1-0.4g protein with 0.04-0.05g total N, 2 mg Na, 120mg P, 0.3-0.9mg Fe (Paul and Southgate, 1978).

Besides fresh consumption of apple fruit, it is used in many products like, jams, jellies, marmalades, muraba, salads, sandwich, filling, snacks, in many dishes, puddings, sweet meats, pickles and other preserves include pie filling, slices and sauces. In foreign countries fermented apple juice is used for alcholic purposes. Sour varieties of apple are used for the preparation of fermented apple juice as cider (Hulme, 1970).

The apples are usually harvested over a restricted period, it is therefore necessary to provide storage for the fruits to regulate marketing and provide high quality produce to fresh and processing outlets on a year round basis because due to miss handling, lack of storage and transport facilities in the country the most of the apple fruit is wasted. In the harvesting season there is a glut of fruit in the market. In these days farmers cannot get reasonable price, so it becomes imperative to prolong the shelf life of the fruit in the best interest of

farmer community and consumers as well (Duckworth, 1966).

For this purpose the study of the post harvest physiology is of immense importance. If the apple fruits are kept without any treatment, these may be spoiled mainly due to loss of water from fruit surface, faster respiration rate, attack of microorganisms, developing physiological disorders like senescent break down, senescent blotch, water core, brown heart etc. The black spots are also developed on the surface of apple due to which it becomes unattractive. To minimize the post harvest losses of apples, application of chemical treatment, wax coating, and various wrapping materials can be used. Present research studies was carried out to enhance the shelf life of local variety (Banky) fruits to improve quality of fruits in storage, to increase the consumption period and to make the fruits more attractive through the use of wax coating, calcium chloride treatments and different wrapping materials under ordinary conditions.

Materials and Methods:

The present investigation was carried on the Banky cultivars harvested from Rawalakot Azad Kashmir. The fruits were harvested in September 2003 and immediately brought to the laboratory. Apples were washed in running tap water and cleaned with muslin cloth. Apples were divided into 84 samples having 7 treatments with 3 replications.

Treatments

T_0 (Control): T_0 was selected as control.

T_1 (Polyethylene packaging): Apples were wrapped in polyethylene wrap of thickness 0.01 cm.

T_2 (Carton paper packaging): Apples were packed in carton paper of thickness 0.5 cm.

T_3 (Paraffin wax coating): Apples were coated with 10% Paraffin wax.

T_4 (1% $CaCl_2$ coating): Apples were chemically treated with 1% calcium chloride.

T_5 (1.5% $CaCl_2$) Coating: Apples were chemically treated with 1.5% calcium chloride.

T_6 (2% $CaCl_2$ coating): Apples were chemically treated with 2% calcium chloride.

Physiochemical analysis: Chemical analysis was carried out at 0, 15, 30, 45 and 60 days as given below.

Total soluble solids: Total soluble solids (T.S.S) were determined using Atago RX 1000 digital Refractometer. A drop of juice was extracted and placed on clean prism of Refractometer and the lid was closed. Reading was taken directly from the scale at room temperature.

Acidity: Acidity was determined by method as described by Ruck 1969. 10 ml of extracted juice was diluted to 100 ml and titrated against 0.1N NaOH to pH 8.1.

pH: pH was determined with the help of a pH meter(Model No. HANNA B 417).

Total sugar: Total sugar was determined by the method given in AOAC (1994). 25 ml of filtered juice was neutralized to pH 7.5 to 8.0 with 1 N NaOH and 2 ml of lead acetate was added along with few drops of potassium oxalate and diluted. 5 g of citric acid was added to the filtrate and neutralized using phenolphthalein as an indicator with 20% NaOH until pink color is obtained. The end point of titration was colorless.

Reducing sugar: Reducing sugar was determined by the method given in AOAC (1994). 100 ml of diluted juice was titrated against Fehling, s Solution till the appearance of brick red precipitates.

Ascorbic acid: Ascorbic acid was determined using phenol indophenol dye method (AOAC, 1994). 10 g of the fresh samples were blended with metaphosphoric acetic acid extracting solution to homogenous slurry. 5 ml of the filtrate extract were then titrated with standard indophenol to pink end point.

Organoleptic evaluation: Different fruit samples were evaluated organoleptically for color, taste, flavor and overall acceptability by five semi-trained judges as described by Larmond (1977).

Statistical analysis: The data was subjected to analysis as described by Steel and Torrie (1980). Treatments were compared by applying Least significant difference (LSD) test at 5% level of significance.

Results and discussion

Analysis of variance for all the treatments, storage intervals and their interaction depicted highly significant ($P<0.05$) values for all parameters of study as indicated in Table-1.

1.) General appearance of Banky fruits: Analysis of variance showed highly significant results ($P<0.05$) among different treatments and storage intervals as shown in Table-1. T6 (2% CaCl2) showed better results as compared to the other treatments without any appropriate shriveling even after 60 days of storage (Table-2). The fruits treated with 2% CaCl2 got 7.8 marks as compared to the untreated fruits which got 5.1 marks. The calcium treated fruits remained firm, however skin color changed slightly as compared to the other treatments. These results are inline with the finding of Bartiya *et al* (1998) who found that apples when treated with calcium chloride maintained the most intense color/appearance. Data regarding storage intervals showed gradual decline in appearance as the storage period prolonged. Maximum score (8.8) was recorded on 1st days of storage and minimum score (4.8) was noted after 60 days. This may be due to the loss of moisture, which inturn affected the quality of fruits.

2.) Weight loss percentage: Analysis of variance showed highly significant results ($P<0.05$) among different treatments and storage intervals as shown in Table-1. Comparison of treatment means showed that maximum weight loss (13.57%) was observed in T_0 (control) whereas the lowest (5.65%) was noted in T_6 (2% calcium chloride) (Table-3). The possible reason may be that calcium chloride served as a semi permeable membrane around fruit surface which resulted in reduction of evapo-transpiration and rate of respiration. These results are similar to the findings of Tomola *et al* (1998) and Tabatabaie and Malakouti (1998) who found minimum weight loss when apple fruits were treated with different concentrations of calcium chloride. Data regarding storage intervals showed that there was a gradual increase in weight loss percentage during storage. The maximum weight loss (15.59%) was found after 60 days of storage in all the treatments as compared to 1st day of storage i.e., 0.0%. These results are inline with the findings of Bidabe (1970) who found that there was a weight loss in apple fruits as the storage period was further prolonged

3.) Total soluble solids: Comparison of treatment means showed that maximum T.S.S. percentage (16.46%) was found in T_0 (Control) and minimum (14%) was observed in T_6 (2% $CaCl_2$) followed by T1 (Polyethylene packaging) i.e., 13.66% (Table-4). This might be due to the fact that more concentration of calcium chloride (2%) formed a thin layer on the surface of fruits which delayed degradation process and also reduced evaporation from the fruits. Similarly airtight polyethylene bags reduced loss of moisture and hydrolysis of polysaccharides resulting in less increase in T.S.S. There was a non significant difference between T_0 and T_2. This may be due to the fact that in T_2, carton paper did not produce enough permeability resulting in more loss of water from fruits. Furthermore, the results of T_2 and T_4 were also found non significant. The possible reason may be that in T_4, the low strength (1%) of calcium chloride was unable to produce desirable permeability resulting in an increase in T.S.S. The results are similar to the findings of Badshah *et al* (1994) and Hussain *et al* (2001). Data regarding storage intervals means depicted that there was gradual increase in TSS percentage as storage interval increased. Maximum TSS percentage (19.00%) was found after 60 days of storage as compared with (12.00%) on the 1st day of storage. as shown in Fig-5. This increasing TSS in response to prolonged storage was probably due to hydrolysis of polysaccharides and concentrated juice content as a result of dehydration. These results are in accordance with the finding of Farooqi *et al* (1973) and Wills *et al* (1980) on apple fruits who reported that TSS of apple fruits increased during storage period.

4.) Acidity: Data pertaining to treatment means showed that T_6 (2% $CaCl_2$) have highest value (5.98%) whereas lowest acidity value (5.42%) was observed in T_0 (control) as indicated in Table-5. This might be due to less oxidation of the fruits, confirming the finding of Drake and Spayed (1983) who found that Golden delicious apples when treated with CaCl2 contained more titratable acidity than untreated apples. Calcium decreased the degradation of acids thus maintaining the integrity of cells. The table further revealed non significant difference between T_3 and T_5 with respect to each other. The possible reason may be that in T_5, the lower concentration of calcium

chloride was unable to delay the metabolic changes in fruits. Similarly, in T_3, wax coating also proved less effective in reducing the oxidation of fruits as compared to T_1 and T_6. These results are in accordance with the findings of Hussain et al (2001) and Wojcik (2001). Data regarding storage intervals showed that there was a decrease in acidity in all treatments during storage.On 1st day of storage the acidity value was 8.25%, which was decreased upto 3.25% after 60 days of storage. These results are in accordance with the finding of Wills *et al* (1980) who found that acidity percentage decreased as storage period increased.

5) pH: Comparison of treatment means showed an increasing trend of pH in all treatments during storage. Maximum pH value was found in T_0 (Control) followed by T_2 (Carton paper packaging) i.e., 4.60 and 4.56 and minimum pH values were noted in T_6 (2% $CaCl_2$) and T_1 (polyethylene packaging i.e., 4.40 and 4.42 respectively as shown in Table-6. There was a non significant difference between T_1 and T_6 with respect to each other. This may be due to the fact that in T_6, higher concentration of calcium chloride prevented decrease in acidity and biochemical changes resulting in less increase in pH. Similarly, in T_1 as the polythene bags were sealed so air was not available for various biochemical reactions resulting in less increase in pH. The table further revealed non significant difference between T_3 and T_5. The possible reason might be due to the fact that lower strengths of both calcium chloride and wax coating were proved less effective to prevent the conversion of acids into sugars as compared to T_1 and T_6. The results are inline with the findings of Wojick (2001) and Dris and Niskanen (1999). Data regarding storage intervals means depicted the gradual increase in pH during storage. The pH (4.22) value was noted on first day of storage whereas after 60 days pH value increased upto 4.78. It might be due to decrease in acidity through the biochemical changes within the fruits during storage. These observations are in accordance with findings of Khalid (1974) who found that pH value of apple juice increased during storage intervals.

6.) Total sugars: The results of the table-7 showed an increasing trend of total sugars in all treatments. The maximum sugar percentage (11.77%) was found in T_0 (control) and minimum (10.31%) was noted in T_6 (2% $CaCl_2$). Calcium pectate is an important component of cell wall so adequate amount of calcium may reduce the conversion of acids into sugars. As the concentration of calcium decreases, the conversion of acids into sugars increases resulting in more increase in total sugars as observed in T_5 and T_4 respectively. The similar effects observed in other treatments might be due to slightly increased metabolic activities occurring in fruits than T_6. These results are supported by study of Bhadra and Sen (1997) on custard apple who reported a gradual increase in sugar contents and decrease in acidity when fruits were treated with different coating and packaging materials. Data regarding storage interval means showed that there was continuous increase in total sugar upto 60 days of storage. On 1st day of storage the total sugar value was 8.44% and after 60 days the value was 12.95%. This gradual increase in total sugar percentage might be due to increase dehydration in fruits, which resulted more concentrated juice. These results are supported by Badshah *et al* (1994) who found that sugar content of apples increased with storage.

7.) Reducing sugars: Comparison of treatment means showed that the highest value (8.57%) for reducing sugar was found in T_0 (control) where as the lowest value (7.78%) was found in T_6 (2% $CaCl_2$) followed by T_1 (polyethylene packaging) i.e., 7.95% (Table-8). This might be due to the fact that in T_6, higher concentration of calcium chloride delayed the hydrolysis of polysaccharide and other physiological changes in fruits. As the concentration of calcium chloride decreased, more hydrolysis of starch and dehydration occurred as in T_4 and T5 respectively. The similar effects of other treatments may be due to more hydrolysis of polysaccharides resulting in increased reducing sugar content as compared to T_6. The results are inline with the findings of Kropp and Ben (1985) who found that when apples were coated and wrapped in polyethylene bags there was less increase in reducing sugars as compared to control. Comparison of the interval means illustrated that reducing sugar percentage was increased as the

storage period was prolonged. Reducing sugar percentage on 1st day of storage was 6.15% and after 60 days the value was increased upto 9.52%. The gradual increase in reducing sugars might be due to hydrolysis of polysaccharides, dehydration as a result of moisture loss and decrease in acidity by physiological changes during storage. These results are in accordance with the findings of Hussein et *al* (2001) who found that reducing and total sugar increased in Golden delicious apple during storage.

8.) Ascorbic acid: Analysis of variance showed highly significant results ($P<0.05$) among different treatments and storage intervals as shown in Table-1. Comparison of treatment means showed that the highest value (6.37) for ascorbic acid content was found in T_6 (2% $CaCl_2$) followed by T_1 (polyethylene packaging) i.e.,6.21 whereas the lowest value (5.48) was found in T_0 (control) (Table-9). The possible reason may be that both calcium chloride and sealed polythene bags delayed the oxidation of fruits resulting in more ascorbic acid content. The results are in accordance with the findings of Kropp and Bin (1985) on apples who found slight decrease in ascorbic acid content of fruits treated with different coating and packaging materials. Data regarding storage intervals showed that in all the treatments ascorbic acid contents decreased as the storage period was prolonged. During the first day of storage the ascorbic acid contents of different treatments were 7.52, which were decreased up to 4.34 after 60 days of storage. These results are confirmed by Rana *et al* (1992) who reported that juice and ascorbic acid contents of apples decreased with storage.

Organoleptic evaluation: Table 10 indicates highly significant result with respect to treatment means. All the treatments differ significantly in respect of taste/flavor. However results showed significant superiority of T_1 (polyethylene packaging) followed by T_6 (2% $CaCl_2$), while minimum score (6.16) was obtained by T_0 (Control). These results are in accordance with the studies carried by Tabatabaie and Malakouti (1998) ,who found that apples treated with calcium have better taste after storage. Golomb *et al* (1984) also found that the taste of grape fruits wrapped in polyethylene was very good. Data regarding storage interval means indicates that. Maximum score (8.8) was obtained at 0 days of storage and minimum was observed after 60 days of storage i.e., 4.48. This may be due to moisture loss, which inturn affected the taste and flavor of fruits. These results are in accordance with the studies carried by Srivastava *et al* (1975) on oranges who reported that taste continued to change as storage period was prolonged.

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Table 1: Analysis of variance for different treatments and storage behavior of Banky fruits.

F-values of different parameters	Treatments	Intervals	Treatments X Intervals
General appearance	219.5539**	490.4632**	17.2676**
Weight loss %	383.0247**	2033.5657**	34.6137**
TSS	20.6738**	248.9675**	2.8291**
Acidity	87.7711**	1094.4128**	16.9864**
pH	8.9516**	107.8487**	1.1111**
Total sugars	3.2659**	72.8242**	2.2880**
Reducing sugars	2.5777**	102.9617**	1.2417**
Ascorbic acid	124.0439**	2744.2141**	8.3051**
Organoleptic evaluation	4.4124**	27.422**	1.9543**

Table-2 Effect of treatments and intervals on general appearance of Banky fruits.

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	8.8 a	8.8 a	8.8 a	8.8 a	8.8 a	8.8 a	8.8 a	8.8 a
15 days	6.2 gh	7.2 e	7 e	8.2 bc	7.8 cd	8 cd	8.5 ab	7.27 b
30 days	5 j	6.8 ef	6.2 gh	7.8 cd	7 e	7.6 d	8 cd	6.70 c
45 days	3.8 k	6 h	5.5 i	7 e	6.2 gh	6.8 ef	7.2 e	5.67 d
60 days	2.7 l	5.5 i	4.8 j	6.5 fg	5.2 ij	6 h	6.5 fg	4.85 e
Means	5.12 g	6.68 e	6.28 f	7.62 b	6.88 d	7.38 c	7.80 a	

Means sharing same letters are not significant at 5% level.

Table-3 Effect of treatments and intervals on weight loss percentages.

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**

0 days	0.00 n	0.00 n	0.00 n	0.00 n	0.00 n	0.00 n	0.00 n	0.00 e
15 days	8.740 jk	3.04 m	7.71 k	4.54 l	5.02 l	4.71 l	3.25 m	5.29 d
30 days	15.56 d	5.22 l	13.33 e	7.65 k	9.74 ij	7.98 k	5.26 l	9.25 c
45 days	18.86 c	8.04 k	16.46 d	9.64 ij	12.12 fg	10.21 hi	8.24 k	11.94 b
60 days	24.67 a	11.13 gh	20.98 b	12.72 ef	15.42 d	12.72 ef	11.51 g	15.59 a
Means	13.57 a	5.848 e	11.70 b	6.911 d	8.462 c	7.12 d	5.65 e	

Means sharing same letters are not significant at 5% level.

Table-4 Effect of treatments and intervals on total soluble solids.

Intervals	**Treatments**							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	12.00 o	12.00 o	12.00 o	12.00 o	12.00 o	12.00 o	12.00 o	12.00 e
15 days	13.80 klm	12.30 no	13.50 klmn	12.50 mno	13.00 mno	12.80 mno	12.50 mno	12.91 d
30 days	15.50 hij	13.00 lmn	14.80 jk	14.00 jklm	14.50 jkl	13.80 klm	13.50 lmn	14.16 c
45 days	19.50 bcd	14.50 jkl	18.50 cdef	17.50 efg	18.00 defg	16.50 ghi	15.00 ijk	17.04 b
60 days	21.50 a	16.50 ghi	20.50 ab	19.00 bcd	20.00 bc	18.50 cdef	17.00 fgh	19.00 a
Means	16.46 a	13.66 e	15.86 ab	15.00 cd	15.50 bc	14.72 d	14.00 e	

Means sharing same letters are not significant at 5% level

Table-5 Effect of treatments and intervals on titratable acidity.

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	Z	8.25 a	8.25 a	8.25 a	8.25 a	8.25 a	8.25 a	8.25 a
15 days	6.24 c	6.58 b	6.28 c	6.51 b	6.47 b	6.53 b	6.58 b	6.46 1b
30 days	5.28 f	5.89 d	5.44 e	5.86 d	5.82 d	5.88 d	5.92 d	5.73 c
45 days	4.10 k	5.10 g	4.31 j	4.60 hi	4.55 i	4.72 h	5.49 e	4.70 d
60 days	3.25 o	3.54 lm	3.37 no	3.49 mn	3.44 mn	3.53 lm	3.66 l	3.47 e
Means	5.42 f	5.87 b	5.53 e	5.74 cd	5.71 e	5.78 c	5.98 a	

Means sharing same letters are not significant at 5% level of significance

Table-6 Effect of treatments and intervals on pH values of Banky fruits.

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	4.22 m	4.22 m	4.22 m	4.22 m	4.22 m	4.22 m	4.22 m	4.22 e
15 days	4.44 ghij	4.33 klm	4.42 hijk	4.37 jklm	4.40 ijkl	4.35 jklm	4.31 lm	4.37 d
30 days	4.56 efgh	4.41 jkl	4.52 ghij	4.45 ijkl	4.49 fghi	4.43 ijkl	4.39 ijkl	4.46 c
45 days	4.78 bcd	4.50 fghi	4.73 cde	4.59 efgh	4.66 def	4.56 efgh	4.48f ghi	4.61 b
60 days	5.01 a	4.64 def	4.91 ab	4.72 cde		4.87 abc	4.73 cde	4.61 defg	4.78 a
Means	4.60 a	4.42 d	4.56 ab	4.47 cd	4.52 bc	4.45 cd	4.40 d	

Means sharing same letters are not significant at 5% level.

Table-7 Effect of treatments and intervals on total sugar percentage.

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	8.44 h	8.44 h	8.44 h	8.44 h	8.44 h	8.44 h	8.44 h	8.44 d
15 days	10.52 efg	10.07 fgh	10.70 fgh	10.08 fgh	10.58 efg	10.08 fgh	9.07 gh	10.16 c
30 days	12.22 abcd	11.07 def	11.69 cdef	11.08 def	11.48 cdef	11.08 def	10.65 efg	11.32 b
45 days	13.55 ab	12.36 bcde	12.93 abcd	12.41 bcde	12.84 abcd	12.72 abcd	11.54 cdef	12.62 a
60 days	14.10 a	12.67 abcd	13.35 abc	12.71 abcd	13.28 abc	12.69 abcd	11.83 bcde	12.95 a
Means	11.77 a	10.92 bc	11.42 ab	10.94 bc	11.32 ab	11.00 abc	10.31 c	

Means sharing same letters are not significant at 5% level.

Table-8 Effect of treatments and intervals on reducing sugar percentage.

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	6.15 i	6.15 i	6.15 i	6.15 i	6.15 i	6.15 i	6.15 i	6.15 d
15 days	7.68 gh	7.10 hi	7.34 hi	7.11 hi	7.22 hi	7.10 hi	7.00 hi	7.22 c
30 days	8.78 bcde	8.04 efgh	8.59 defg	8.09 efgh	8.11 efgh	8.06 efgh	7.85 fgh	8.22 b
45 days	9.82 ab	9.19 abcd	9.64 ab	9.21 bcde	9.12 ab	9.20 bcde	8.88 defg	9.34 a
60 days	10.44 a	9.28 bcde	9.86 ab	9.33 abcd	9.35 abc	9.31 abcd	9.05 bcde	9.52 a
Means	8.57 a	7.95 bc	8.31 ab	7.98 bc	8.05 bc	7.96 bc	7.78 c	

Means sharing same letters are not significant at 5% level.

Table-9 Effect of treatments and intervals on ascorbic acid content.

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	7.52 a	7.52 a	7.52 a	7.52 a	7.52 a	7.52 a	7.52 a	7.52 a
15 days	6.01 ij	6.99 bc	6.17 hi	6.79 de	6.42 g	6.87 cd	7.13 b	6.62 b
30 days	5.64 k	6.53 fg	5.92 j	6.24 h	6.03 ij	6.47 g	6.66 ef	6.21 c
45 days	4.51 pq	5.36 l	4.79 no	5.16 m	4.91 n	5.29 m	5.70 k	5.10 d
60 days	3.76 t	4.67 op	3.98 s	4.36 qr	4.20 r	4.59 p	4.85 no	4.34 e
Means	5.488 f	6.21 b	5.67 e	6.10 c	5.81 d	6.14 b	6.37 a	

Means sharing same letters are not significant at 5% level.

Table-10 Effect of treatments and intervals on organoleptic evaluation (taste / flavor).

Intervals	Treatments							
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Means**
0 days	9 a	9 a	9 a	9 a	9 a	9 a	9 a	9.0 a
15 days	7.5 ef	8.5 b	7.8 de	8 cd	7.8 de	8.2 bc	8.5 b	8.02 b
30 days	6.3 jk	8 cd	6.8 hi	7.2 fg	7 gh	7.5 ef	8 cd	7.25 c
45 days	4.80 p	6.8 hi	5 op	5.8 lm	5.5 mn	6 kl	6.5 ij	5.77 d
60 days	3.2 r	5.5 mn	3.8 q	4.8 p	4 q	4.8 p	5.3 no	4.48 e
Means	6.16 e	7.56 a	6.48 d	6.96 b	6.66 c	7.10 b	7.46 a	

Means sharing same letters are not significant at 5% level.