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Effect of Chemical Treatment, Wax Coating, Oil Dipping and Different Wrapping Materials on Physio-chemical Characteristics and Storage Behavior of Apple (*Malus domestica Borkh*)

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Abstract: Chemical treatment, wax coating, oil dipping and different wrapping materials have significant role in extending the shelf life of apple. The present investigation was therefore, carried out to extend the shelf life of Banky cultivars of apple by applying the above mentioned treatments. In physical characteristics general appearance (color and shape of fruit), weight loss percentage and organoleptic evaluation were studied during storage. Chemical treatment, 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 treatment had significant effect on the shelf life of fruits. However, Non-perforated polyethylene was reported superior to all other treatments. Non-perforated polyethylene materials proved very useful for reducing weight loss and shriveling and retained consumer acceptability even after 60 days of storage. Hydroxyquinoline and butter paper wrapping stood second and third positions after non perforated polyethylene wrapping.

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

Introduction

Apple the premier table fruit of the world, botanically called *Malus demestica Borkh* belongs to the family Rosaceae and sub family Pomoideae with a chromosome number of 17, but majority of the cultivated apples are diploid (2n = 34). It is a typical temperate tree fruit, more than 80% of the world's supply being produced in Europe (Asif, 2002). Apple is a very nutritious, aromatic and delicious fruit. It is very rich in Vitamin C, B and A. It contains about 11% sugar besides essential minerals in appreciable amounts. It has color appeal, appetite and is most refreshing (Anonymous, 2001). Apples are an alkaline food because they contain pectin. They are also an eliminative food as Pectin from apples takes in excess water in the intestines, making a soft bulk that creates a mild, nonirritating stimulant. This stimulant helps the peristaltic movement and assists in natural bowel elimination. Individually, apples are not particularly abundant in any particular vitamin; however, the fruit contains significant amounts of almost every kind of essential vitamin. Essentially, an apple is nature's perfect multi-vitamin. Apples are helpful for low blood pressure and the hardening of the arteries because they purify the blood. They are also beneficial to the lymphatic system. The peelings of the apple contain significant nutritive value, which is why when juicing is sure be include everything, peel and all (Anonymous, 2003). It can be used in many different ways. It is cooked, made into preserves, Jellies, candied, canned, prepared as fresh apple juice, and made into cider or vinegar. The peel is used for making pectin (Anonymous, 2001).

Total world Production of apples is 26,127,346 M. Tonnes and the total yield of apple in Pakistan is 600,000 M. Tonnes. Among different countries which export apple, China is on top, U.S.A. second, France third, Turkey fourth, Germany fifth, Italy sixth, Iran seventh and so on. Pakistan's share in the world is number eleven (Asif, 2002). Total yield of apple in Azad Jammu and Kashmir is 3735 Tonnes (Anonymous, 1999). If we really want to increase the export of fresh fruits we should improve our varieties, irrigation techniques, farmer product knowledge and government advice system. Moreover, product presentation needs to be improved by better caring at harvesting, grading facilities, washing and waxing techniques, better packing materials, boxes and educating people in produce handling techniques. The apples are usually harvested in the month of August and September. As the harvesting period of apple is short it is therefore, necessary to provide proper storage to regulate marketing. For this purpose study of post harvest physiology is of immense importance. Due to miss handling, lack of storage and transport facilities in the country most of the apple is wasted. If the apples are kept without any treatment these may spoil mainly due to dehydration, faster respiration rate, attack of microorganisms, development of physiological disorders like senescent break down, senescent blotch, water core, brown heart etc. To minimize these problems the fruits should be stored by giving different treatments at ordinary temperature. Application of chemical treatments, wax coating and various wrapping materials can be used to increase the shelf life of fruits

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

	SOV		
	Treatments	Storage	Treatments x Storage
F-value for general appearance of fruits	114.6038**	109145.5**	17.2676**
F-value for weight loss percentage	97676.198**	853060.058**	10745.046**
F-value for Total soluble solids	26000.457**	1076028.8**	6215.2301**
F-value for pH	339.344**	3657.19**	33.3824**
F-value for acidity	9.637**	2324.4**	1.4723**
F-value for Total sugar	104.156**	215800.8**	20.6873**
F-value for reducing sugar	114.60**	109145.5**	17.267**
F-value for ascorbic acid	1.3673*	32.385**	1.6396*
F-value for organoleptic evaluation	4.4124**	27.422**	1.9543*

**Highly significant at 5% *Significant at 5%

(Sadasivan *et al.*, 1974; Hamid *et al.*, 1987). The aim of the present study was to extend the shelf life of Banky fruits (Local variety) by using different treatments like wax coating, corn oil dipping 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 2002 and immediately brought to the laboratory. Apples were washed in running tap water and cleaned with muslin cloth. Apples were divided into 96 samples having 7 treatments with 3 replications.

Treatments

T_0 (Control): T_0 was selected as control.

T_1 (wax coating): Apples were coated with 10% Paraffin wax.

T_2 (Oil dipping): Apples were dipped in pure corn oil for 1hour.

T_3 (Chemical treatment): Apples were chemically treated with 1% Hydroxyquinoline

T_4 (Butter paper wrapping): Apples were wrapped in butter paper of thickness 0.1 cm for Preservation.

T_5 (Tissue paper wrapping): Apples were wrapped in tissue paper of thickness 0.05 cm.

T_6 (None Perforated Polyethylene wrapping): Apples were wrapped in None Perforated Polyethylene wrap of thickness 0.01 cm.

T_7 (Cellophane Paper): Cellophane paper of thickness 0.08 cm was used for Preservation.

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 1963. 10 ml of the extracted juice was diluted to 100 ml and titrated against 0.1 N NaOH to pH 8.1.

P^H: 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 (1990). 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 (1990). 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, 1984). 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 Land and Shapherd (1988).

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

The present investigation was carried out to enhance the

Table 2: Effect of treatments and storage intervals on general appearance of Banky fruits

Storage Intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	9.126[a]	9.126[a]	9.126[a]	9.126[a]	9.126[a]	9.126[a]	9.126[a]	9.126[a]	9.126[a]
15 days	9.033[b]	9.033[b]	9.050[c]	9.050[c]	9.046[d]	9.050[c]	9.044[e]	9.040[e]	9.045[b]
30 days	7.127[f]	8.150[g]	7.086[h]	8.123[i]	8.117[i]	7.313[j]	8.177[i]	8.093[k]	7.773[c]
45 days	4.107[L]	6.237[m]	6.340[n]	7.030[o]	7.013[p]	6.017[q]	7.133[r]	5.263[s]	6.142[d]
60 days	3.207[t]	4.107[u]	5.357[v]	6.147[w]	6.120[x]	4.320[y]	7.023[z]	4.017[1]	5.012[e]
Means	6.250[2]	7.330[3]	7.391[4]	7.895[5]	7.888[6]	7.165[7]	8.101[8]	7.108[9]	

Means sharing same letters are not significant at 5%

T_0= Control T_1= Wax coating T_2 = Oil dipping T_3 = Chemical treatment T_4 = Butter paper wrapping T_5 = Tissue paper wrapping T_6 = Non-perforated polyethylene wrapping T_7 = Cellophane wrapping

shelf life of apple through the application of chemical treatments, oil dipping, wax coating and different wrapping materials.

General appearance of Banky fruits: It is evident from Table 1 that all the treatments are highly significant (P<0.05) to each other. Non-perforated polyethylene showed better results as compared to the other treatments without any appropriate shriveling even after 60 days of storage (Table 2). The fruits which were wrapped in Non-perforated polyethylene got 8.101 marks and showed superiority to all other treatments. The skin remained firm but the skin color changed slightly as compared to the other treatments. These results are in line with the findings of Dhilon *et al.* (1979) and Golomb *et al.* (1984) who found that when Kinnow and grapes were wrapped in Non-perforated polyethylene and plastic bags remained fresh and maintained fruit firmness and color.

Weight loss percentage: It is evident from Table 1 that statistically all the treatments are highly significant (P<0.05) to each other. Maximum weight loss 13.56% was recorded in control while the lowest was reported in T_6 (Non-perforated polyethylene) as 5.48% (Table 3).These results are in line with the findings of Dhillon *et al.* (1979) on kinnow and Saftner (1999) on apples who found minimum weight loss when fruits were stored in air tight polyethylene bags. The second better treatment was T_3 (Chemical treatment) which depicted minimum weight loss of 5.65%. This was due to the blocking of transpiration from the skin of apple by giving layer of Hydroxyquinoline.

Total soluble solids (TSS): It is evident from Table 1 that statistically all the treatments are highly significant (P<0.05) to each other. Comparisons of means of treatments showed that maximum TSS percentage was observed in T_0 (Control) as 13.73 followed by T_7 (Cellophane paper) as 13.58% and minimum was observed in T_3 (Chemical treatment) as shown in Table 4. These results are in line with the findings of Gilfillan and Piner (1985) who noted that when oranges were wrapped in cellophane paper there was an increase in TSS contents. Data regarding storage intervals showed that there was gradual increase in TSS percentage as storage intervals were raised. Maximum TSS percentage of 16.32% was recorded after 60 days of storage as compared to 10.01% on the first day of storage. The apparent increase in TSS content may be due to dehydration or hydrolysis of polysaccharides.

pH: It is evident from Table 1 that all the treatments are highly significant (P<0.05) to each other. Maximum pH of 4.85 was observed in T_6 (Non-perforated polyethylene) followed by T_3 (Chemical treatment) as 4.55 and minimum pH of 4.38 was noted in T_7 (Cellophane wrapping) as shown in Table 5. Data regarding storage intervals showed that there was gradual increase in pH during storage. On the first day of storage the pH was recorded as 4.22 which increased to 4.71 after 60 days. These findings are in line with the findings of Khalid (1974) who found that pH value increased during storage.

Acidity: It is evident form Table 1 that all the treatments are highly significant (P<0.05) to each other. Table 6 shows that minimum acidity of 5.427% was reported in T_6 (Non-perforated polyethylene) as compared to untreated fruits where it was 5.904%. These results are in line with the study of Dhilon *et al.* (1979) and Yagi (1980). Data regarding storage intervals showed that there was decrease in acidity in all treatments during storage. On first day of storage the acidity was 8.253 which decreased to 3.495 after 60 days of storage.

Total sugar: It is evident from Table 1 that all the treatments are highly significant (P<0.05) to each other. Maximum sugar of 11.06% was reported in T_6 (Non-perforated polyethylene) and minimum in T_0 (control) as 10.91% (Table 7). This gradual increase in total sugar may be due to the hydrolysis of Polysaccharides or due the less acidity and ascorbic acid contents. These results were supported by the study of Gosh and Sen

Table 3: Effect of treatments and storage intervals on weight loss percentage of Banky fruits

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]
15 days	8.740[b]	7.437[c]	7.317[d]	3.250[e]	3.327[f]	7.537[g]	3.043[h]	8.690[b]	6.168[i]
30 days	15.530[j]	10.04[k]	13.33[l]	5.263[m]	9.493[n]	11.86[o]	5.220[m]	10.37[p]	10.14[q]
45 days	18.863[r]	18.56[s]	17.67[t]	8.240[u]	11.77[v]	16.09[w]	8.043[x]	18.36[y]	14.70[z]
60 days	24.67[1]	23.533[2]	21.33[3]	11.51[4]	15.423[5]	21.14[6]	11.13[7]	24.48[2]	19.15[9]
Means	13.56[\]	11.93[/]	11.93[/]	5.65[>]	8.00[<]	11.33"	5.48'	12.38[l]	

Means sharing same letters are not significant at 5%

Table 4: Effect of treatments and storage intervals on the percentage of total soluble solids of Banky fruits

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	10.01[a]	10.01[a]	10.01[a]	10.01[a]	10.01[a]	10.01[a]	10.01[a]	10.01[a]	10.01[a]
15 days	10.364[b]	10.273[c]	10.23[d]	10.22[d]	10.286[e]	10.164[f]	10.39[g]	10.256[h]	10.27[i]
30 days	13.36[j]	12.087[k]	13.057[l]	12.043[m]	12.043[m]	13.003[n]	13.029[o]	13.31[p]	12.74[q]
45 days	17.433[r]	15.12[s]	16.193[t]	14.127[u]	15.283[v]	14.52[w]	15.14[x]	17.127[y]	15.61[z]
60 days	17.503[1]	16.047[2]	17.247[3]	15.1[4]	16.193[5]	15.137[6]	16.120[7]	17.213[8]	16.32[1]
Means	13.73[/]	12.70[\]	13.35'	12.30"	12.76[)]	12.57[(]	12.93^	13.59[l]	

Means sharing same letters are not significant at 5%

Table 5: Effect of different treatments on pH values of Banky fruits

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	4.22[a]	4.22[a]	4.22[a]	4.22[a]	4.22[a]	4.22[a]	4.22[a]	4.22[a]	4.22[a]
15 days	4.31[b]	4.33[c]	4.34[c]	4.44[d]	4.37[e]	4.34[c]	4.42[f]	4.37[e]	4.36[g]
30 days	4.39[h]	4.41[i]	4.41[l]	4.52[j]	4.49[k]	4.41[l]	4.55[l]	4.37[m]	4.44[n]
45 days	4.48[o]	4.52[p]	4.63[q]	4.73[r]	4.66[s]	4.50[t]	4.78[u]	4.47[o]	4.60[v]
60 days	4.61[w]	4.64[x]	4.69[y]	4.87[z]	4.81[1]	4.62[2]	4.91[3]	4.54[4]	4.71[5]
Means	4.40[6]	4.42[7]	4.46[8]	4.55[9]	4.51[<]	4.41[>]	4.58"	4.38'	

Means sharing same letters are not significant at 5% level

Table 6: Effect of treatments and storage intervals on the percentage of acidity of Banky Cultivars

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	8.253[a]	8.253[a]	8.253[a]	8.253[a]	8.253[a]	8.253[a]	8.253[a]	8.253[a]	8.253[a]
15 days	6.577[b]	6.451[c]	6.470[d]	6.281[e]	6.317[f]	6.30[g]	6.243[h]	6.598[i]	6.404[l]
30 days	5.637[j]	5.837[k]	5.837[k]	5.443[l]	5.647[m]	5.91[n]	5.287[o]	5.92[p]	5.689[q]
45 days	5.393[r]	4.427[s]	4.453[t]	4.313[u]	4.353[v]	4.557[w]	4.10[x]	4.563[u]	4.519[y]
60 days	3.66[z]	3.537[1]	3.54[2]	3.373[3]	3.443[4]	3.517[5]	3.250[6]	3.640[7]	3.495[8]
Means	5.904[9]	5.701'	5.711"	5.533^	5.603[<]	5.711[>]	5.427[/]	5.795[)]	

Means sharing same letters are not significant at 5% level

(1984) on sweet orange. Data regarding storage intervals also showed significant results. There was continuous increase in sugar content up to 60 days of storage (Table 7).

Reducing sugar: It is evident from Table 1 that all the treatments are highly significant ($P<0.05$) to each other. Table 8 shows that maximum reducing sugar of 8.101% was reported in T_6 (Non-perforated polyethylene) and minimum 7.936% was reported in T_7 (Cellophane paper). Maximum reducing sugar in Non-perforated polyethylene may be due to the less acidity and Vitamin C. Storage period also caused an increase in reducing sugar from 6.157% to 9.369% (Table 8). These results

Table 7: Effect of treatments and storage intervals on the percentage of total sugar of Banky cultivars

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	8.44[a]	8.440[a]	8.440[a]	8.440[a]	8.440[a]	8.440[a]	8.440[a]	8.440[a]	8.440[a]
15 days	10.07[b]	10.07[b]	10.084[c]	10.107[d]	10.10[d]	10.079[e]	10.12[f]	10.079[e]	10.08[g]
30 days	11.05[h]	11.077[I]	11.08[I]	11.157[j]	11.130[k]	11.073[l]	11.223[m]	11.083[I]	11.11[n]
45 days	12.34[o]	12.41[p]	12.44[q]	12.527[r]	12.52[r]	12.357[s]	12.547[t]	12.543[t]	12.46[u]
60 days	12.67[v]	12.730[w]	12.70[x]	12.837[y]	12.78[z]	12.69[1]	12.953[2]	12.66[3]	12.75[4]
Mean	10.91[5]	10.94[6]	10.95[7]	11.01[8]	10.99[g]	10.93"	11.06'	10.96>	

Means sharing same letters are not significant at 5% level

Table 8: Effect of different treatments and storage intervals on the percentage of reducing sugar of Banky cultivars

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	6.157[a]	6.157[a]	6.157[a]	6.157[a]	6.157[a]	6.157[a]	6.157[a]	6.157[a]	6.157[a]
15 days	7.112[b]	7.067[c]	7.115[b]	7.126[d]	7.187[e]	7.073[f]	7.101[g]	7.073[f]	7.106[h]
30 days	8.023[I]	8.085[j]	8.097[J]	8.196[k]	8.193[k]	8.060[l]	8.21[m]	8.047[n]	8.123[o]
45 days	9.183[p]	9.233[q]	9.247[q]	9.34[r]	9.283[s]	9.190[t]	9.427[u]	9.113[v]	9.252[w]
60 days	9.287[x]	9.337[y]	9.357[z]	9.46[1]	9.413[2]	9.27[3]	9.54[4]	9.29[5]	9.369[4]
Mean	7.953[5]	7.976[6]	7.995[7]	8.056[8]	8.047[g]	7.95'	8.101>	7.936"	

Table 9: Effect of different treatments and storage intervals on ascorbic acid percentage of Banky cultivars

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	6.44[a]	6.44[a]	6.44[a]	6.44[a]	6.44[a]	6.44[a]	6.44[a]	6.44[a]	6.44[a]
15 days	6.37[b]	6.44[c]	6.07[d]	6.25[e]	6.27[f]	6.26[g]	6.04[h]	6.28[I]	6.25[e]
30 days	6.19[k]	6.13[l]	6.03[m]	6.03[m]	6.05[o]	6.14[p]	5.85[q]	6.11[r]	6.07[s]
45 days	6.04[t]	5.89[u]	5.90[v]	6.02[w]	5.73[x]	6.03[y]	5.72[z]	6.09[1]	5.93[2]
60 days	5.87[3]	5.52[4]	5.56[5]	5.86[6]	5.41[7]	5.80[8]	5.67[9]	5.97<	5.71>
Mean	6.18'	5.07"	6.0\	4.13/	4.98]	6.13[	5.14{	6.17'	

Means sharing same letters are not significant at 5% level

Table 10: Effect of treatments and storage intervals on organoleptic evaluation (taste and flavor) of Banky cultivars

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	8.134[a]	8.134[a]	8.134[a]	8.134[a]	8.134[a]	8.134[a]	8.134[a]	8.134[a]	8.134[a]
15 days	9.113[b]	9.150[c]	9.280[d]	9.120[b]	9.090[e]	9.150[c]	9.126[c]	9.103[d]	9.160[e]
30 days	8.157[f]	7.797[g]	8.199[h]	8.237[I]	8.157[f]	7.103[j]	8.027[k]	8.157[f]	7.979[l]
45 days	4.163[m]	6.250[n]	7.137[o]	8.187[p]	8.097[q]	6.073[r]	8.227[s]	5.163[t]	6.662[u]
60 days	3.710[v]	4.197[w]	5.130[x]	7.180[y]	7.113[z]	5.113[1]	7.043[2]	4.187[3]	5.459[4]
Mean	6.655[5]	7.105[6]	7.576[7]	8.171[8]	8.118[9]	7.115"	8.141'	6.949\	

Means sharing same letters are not significant at 5% level

are in line with the findings of Gilfillan and Piner (1985) who noted that there was an increase in reducing sugar of film wrapped oranges.

Ascorbic acid: It is evident from Table 1 that all the treatments are significant ($P<0.05$) to each other. Maximum ascorbic acid was recorded in T_0 (Control) as 6.44% followed by T_7 (Cellophane paper) as 6.28% (Table 9). Yagi (1980) also reported a slight decrease in Vitamin C content of fruits stored in Non-perforated polyethylene and Cellophane paper. Data regarding storage intervals showed that in all the treatments ascorbic acid content decreased as storage period was prolonged (Table 9).

Organoleptic evaluation: The data regarding

Table 11: Effect of treatments and storage intervals on acceptability of Banky cultivars

Storage intervals	Treatments								
	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Means
0 days	9.027[a]	9.027[a]	9.027[a]	9.027[a]	9.027[a]	9.027[a]	9.027[a]	9.027[a]	9.027[a]
15 days	8.167[b]	8.193[b]	8.160[b]	8.20[b]	8.160[b]	8.130[b]	8.237[b]	8.187[b]	8.175[c]
30 days	7.193[d]	8.153[b]	8.120[b]	8.147[b]	8.107[b]	8.097[b]	8.163[b]	7.493[b]	7.897[d]
45 days	5.160[e]	7.127[f]	6.253[g]	8.083[b]	8.013[b]	5.050[h]	8.140[b]	6.237[i]	6.757[j]
60 days	4.107[k]	5.283[l]	4.103[m]	7.093[n]	7.050[n]	4.057[o]	8.040[b]	4.123[p]	5.482[q]
Mean	6.078[r]	7.557[s]	7.132[t]	8.110[u]	8.071[u]	6.872[v]	8.321[w]	7.013[x]	

Means sharing same letters are not significant at 5% level

organoleptic evaluations shows significant variation ($P<0.05$) as shown in Table 1. However, in case of taste/flavor results showed significant superiority at T_3 (Chemical treatment) followed by T_6 (Non perforated polyethylene) as shown in Table 10. T_3 obtained 8.171 score and T_6 got 8.141 score. Minimum score of 6.655 was obtained in T_0 (Control). The fruits which were treated with Hydroxyquinoline and wrapped with Non-perforated polyethylene have good taste and flavor as compared to other treatments due to loss of moisture. These results are in line with the results of Golomb *et al*. (1984) on grape fruits who found that taste of Non-perforated polyethylene wrapped fruits were good. Regarding the storage intervals maximum score (9.160) was obtained after 15 days of treatments and minimum (5.459) after 60 days.

The comparisons of treatments reported maximum acceptability in T_6 (None perforated Polyethylene), followed by T_3 (Chemical treatment) and T_4 (Butter Paper) as compared to T_0 (Control) as shown in Table 11. These results are in line with the Golomb *et al*. (1984) and Hong *et al*. (1984) who reported that Florida lemons retained their firmness and general quality in none perforated polyethylene bags.

References

Anonymous, 1999. Azad Kashmir at glance.1999 statistics section Planning and development department of Azad Government of the state of Jammu and Kashmir.

Anonymous, 2001. Available from URL: http:// www.Pakissan_com.htm

Asif, A., 2002. Apple the sweet gold of Pakistan. Export Promotion Bureau of Pakistan.

Anonymous, 2003. Available from URL: http://www.betterjuice.com/features/apple.htm

AOAC, 1990. Official Methods of Analytical Chemists, 15th Edn. Virginia, Arlington.

AOAC, 1984. Vitamins and other nutrients. In. William S (ed) Official Methods of Analysis of the Association of Official Analytical Chemists (14th edn.). Association of Official Analytical Chemists, Virginia, pp: 838-841.

Dhilon, B., P.S. Bains and J.S. Ranhazwa, 1979. Studies on the storage behavior of Kinnow mandarins. J. Res. Ind., 14: 434-438.

Golomb, A., S.B. Yehoshus and Y. Sarig, 1984. High density polyethylene wrap improves wound healing and lengthen shelf life of mechanically harvested grape fruits. J. Amer. Soc. Hort. Sci., 109: 155-159.

Gosh, S.C. and S.K. Sen, 1984. Extension of storage life of sweet orange. Alosambi Sough Indian Hort., 32: 16-22.

Gilfillan, I.M. and G. Piner, 1985. Preliminary trails on polyethylene films wrap for South African citrus export fruits. Citrus and Subtropical fruit Jour, 56: 14-29.

Hamid, J., M.A. Chaudhary and M. Ahmed, 1987.Effect of waxing on the physio-chemical characteristics of Blood Red Oranges during storage. Sarhad J. Agri., 3: 51-60.

Hong, Q.Z., Z.J. Zie, H.Y. Cheng, L.T. Chen and J.F. Xue, 1984. A study on techniques of Satsuma storage. Faujian Agri. College Nongxueyuan-Xuebao, 13: 281-289.

Khalid, Z.M, 1974. Studies on the extension of storage life of some important mango varieties of Punjab. M.Sc (Hons.) Thesis Deptt. Of Horticulture., Univ. Agri., Faisalabad.

Land, D.G. and R. Shapherd, 1988. Scaling and Ranking Methods. In: Sensory Analysis of Foods. (Ed. J. R. Piggott). Elsevier Applied Sci., New York, pp: 155-185.

Ruck, J.A.,1963. Chemical methods for analysis of fruits and vegetables products. Station summer land Canadian Res. Board Dept. Agri. Canada.

Sadasivan, R., R.M. Subranian and N.V. Rama, 1974. Studies on the effect of polyethylene film packs on post harvest life of sweet orange. (C. Sinensis Osbeck) in storage. Ind. J. Agri. Sci.,43: 211-212.

Saftner, R.A.,1999. The potential of fruit coating and treatment for improving the storage and shelf life qualities of Gala and Golden delicious apples. J. Am. Soc. Hort. Sci., 124: 682-689.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: a biometrical approach. 2 ed. New York : Mc-Graw-Hill, pp: 631.

Yagi, M.I, 1980. Storage behavior of Baladi mandarin. Sudan Hort. Sci., 15: 300-301.