Pak. j. sci. ind. res., vol. 34, no. 10, October 1991

EFFECT OF FILM PACKAGING ON POST-HARVEST STORAGE OF FRESH PERSIMMON

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(Received September 16, 1990; revised November 17, 1991)

Effect of packaging materials such as newspaper (0.093 mm thick) and polyethylene (PE) of different thicknesses (0.013-0.043mm) on the quality of fresh persimmon during ambient storage for 6 weeks was studied. The tested quality parameters included weight loss, firmness (texture), ascorbic acid, acid content and sensoric tests. Packaging materials and storage time significantly influenced the tested parameters. The results revealed that storage mean losses in weight were highest in control (12.7%), intermediate in newspaper (9.5%) and lowest in PE packaged samples (less than 1%). Similarly, losses in ascorbic acid were greater in control samples (49.4%) followed by newspaper lining (47.7%) and PE lining (35.4-48.0%). Acidity was little affected with advanced storage. The PE lined fruits were rated best (6.8-7.2) followed by newspaper (4.8) and control persimmon (3.5) for overall acceptability scores. There was a strong negative correlation (r= -0.97) between weight-loss and firmness (texture) of the fruit. PE packaging was found significantly better ($P<0.05$) than newspaper and this extended the shelf-life of persimmon 2 weeks over the control.

Key words: Shelf-life, Film packaging, Ascorbic acid, Weight loss, Persimmon.

Introduction

Cultivation of persimmon (*Diospyres kaki*) in Pakistan has greatly increased during the recent past. It is grown on an area of 687 hectares with production of 8989 tonnes [1]. This fruit is nutritious and delicious with appreciable quantity of ascorbic acid, carotenoids and sugars in the form of glucose and fructose [2]. The agroclimatic conditions of this region are suitable for the profitable cultivation of this fruit. Post-harvest quality of this fruit is affected by astringent taste due to the presence of polyphenols especially water soluble tannins and short storage life. If properly handled during and after the harvest, this fruit can earn considerable profit for the growers and be exported for earning valuable foreign exchange. Use of polymeric films in the forms of bulk or unipackaging has been studied for several fresh fruits including persimmon [3-6]. In the earlier studies, polyethylene (PE) film was found to the best as compared to paper and cellophane in maintaining quality of persimmon [7] and oranges [8]. Presently news paper as a packaging materials is extensively used for marke-ting fresh fruits and vegetable in Pakistan. In view of the several post-harvest storage problems, this study was initiated to test the influence of various thicknesses of PE as well as newspaper on the quality of persimmon during ambient storage.

Materials and Methods

The fresh, mature but unripe persimmons were procured from a garden and brought to laboratory in plastic containers. The fruits were sorted, washed and extra moisture removed using fan under ambient room condition and subsequently bulk packed (100 fruits each case) in newspaper (0.093 mm) and PE of different thicknesses (0.013-0.043mm) keeping an unpackaged control as well. The samples were kept separately in fibre-board cartons with test packaging materials at room conditions (17.5-30°, 55-80% RH) for 6 weeks.

Physico-chemical assays. The quality of fruits during storage was evaluated by physical, biochemical and sensoric tests. For weight loss, 10 fruits from each treatment were employed and firmness (texture) during storage was measured by the Universal Hardness Tester using a plunger having 12 mm diameter and the value were recorded in Newtons. Ascorbic acid content and acidity were determined titrimetrically [9]. Sensory evaluation of control and packaged persimmon was carried out using the scoring method of Larmond [10], where 1 was disliked extremely and 9 was liked extremely.

Statistically analysis. The data were analysed statistically using Analysis of Variance and the least significant difference (LSD) computed. Coefficient of variation (CV) was determined and correlation between firmness and weight loss was also measured [11].

Results and Discussion

Physical measurements. Effect of packages on weight loss and hardness (texture) is shown in Table 1. The loss of moisture from the fruits was significantly influenced by storage period. The weight loss was highest in the control, intermediate in newspaper and least in the PE packed persimmons. Weight loss was significantly less with the PE wrappings when compared to newspaper and the control. The mean weight loss in control (unpackaged), newspaper lined, PE-1,

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PE-2, PE-3 and PE-4 lined fruits were 21.71, 9.54, 0.75, 0.91, 0.97 and 0.70% respectively. However, the differences in weight loss among the PE-lined samples were not significant. Again firmness of the fruits (texture) was greatly affected by storage time. The samples wrapped in PE were firmer than those in newspaper and the controls and the mean firmness values of unpackaged samples, newspaper lined and four PE-lined samples were 35.52, 36.58 and 38.57, 39.58, 39.79 and 39.91 Newtons, respectively. The PE-lined samples were not significantly different among themselves. The correlation between weight loss and firmness values was found to be negatively significant (r = -0.97). The regression equation between weight- loss and firmness was:

$$Y = 39.74 - 0.33\ X$$

where Y is the firmness (texture) in Newton and X the weight-loss of fruits. The correlation between appearance (scores) and weight- loss was also found to be negatively significant (r = -0.99) and the regression equation was:

$$Y = 7.36 - 0.28\ X$$

again Y is the appearance score and X the weight-loss of fruit as shown in Fig 1.

Film packages have been extensively reported to retain weight loss and maintenance of firmness in persimmon [12,13] and citrus [8,14]. Although diffusion of oxygen and carbon dioxide is reduced by the PE film, fruit respiration and quality are not adversely affected during storage [15,16]. Polyethylene (PE) thickness controls the respiration and transpiration of

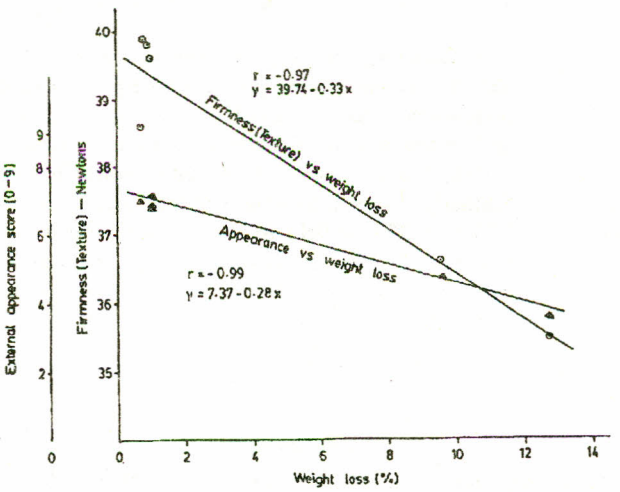

Fig. 1. Linear regression between weight loss and firmness as well as weight loss and appearance of persimmons on 6 weeks storage.

TABLE 1. EFFECT OF PACKAGING MATERIALS AND STORAGE ON WEIGHT LOSS AND FIRMNESS OF PERSIMMON FRUIT.

Treatment	Storage period-weeks						Mean
	1	2	3	4	5	6	
Weight loss %							
Control	4.26	7.23	10.53	14.23	18.56	21.46	12.71
Newspaper(0.003)	2.47	4.64	7.69	10.96	14.55	16.90	9.54
Polyethylene(PE)							
PE-1 (0.013mm)	0.11	0.33	0.56	0.71	1.21	1.58	0.75
PE-2 (0.025mm)	0.19	0.43	0.67	0.58	1.61	1.72	0.91
PE-3 (0.035mm)	0.15	0.39	0.68	0.98	1.62	2.00	0.97
PE-4 (0.043mm)	0.18	0.39	0.73	0.81	1.17	1.46	0.79
Mean	1.23	2.24	3.48	4.76	6.45	7.52	–
LSD at 5% level (0.393)							
Storage: 0.190							
Firmness (texture)-Newtons							
Control	41.85	40.47	36.85	32.44	29.69	24.30	35.52
Newspaper (0.03mm)	40.87	41.65	39.20	35.67	32.44	23.23	36.58
Polyethylene (PE)							
PE-1 (0.013mm)	42.43	42.14	40.38	39.10	34.40	29.79	38.57
PE-2 (0.025mm)	43.22	43.02	40.57	39.00	37.34	30.77	39.58
PE-3 (0.035mm)	43.12	43.71	42.14	39.40	34.30	32.83	39.79
PE-4 (0.043mm)	43.32	43.81	42.04	39.89	34.59	32.73	39.91
Mean	42.47	42.47	40.20	37.58	33.79	28.94	–
LSD at 5% level (1.724)							
Stoage (1.862)							

Initial value for firmness: 43.02 Newtons.

fruit. It was, therefore, desirable to find the optimum PE thickness, which gives the best results. Various thicknesses of PE used in the present study did not have any effect on weight loss and firmness during storage. Purvis [16] also considered film thickness less important as the weight loss in grape-fruit sealed in 21-40 μm PE films was similar throughout the storage period. Wrapping fresh fruits and vegetables in PE bags causes modification of the atmosphere due to respiration of the product which raises the CO_2 level at the expense of O_2 [17,18] thus retarding respiration during extended storage. Transpiration and/or evaporation are mainly responsible for weight loss of fruits and the rate of water loss is affected by vapour pressure differential (relative pressure exerted by water vapour within and outside fruits). The composition of the atmosphere produced within the bags can be controlled to some extent by the choice of the film used, as its permeability to gases in question will be determined by its density and thickness [19].

Biochemical constituents. Effect of packages on ascorbic acid and acidity is shown in Table 2. The fresh persimmon contained 47.8 mg/100 gm ascorbic acid which decreased during storage and the decrease was highest in the control followed by newspaper and PE packaged samples. The mean ascorbic acid values decreased from 47.8 to 27.25 mg/100gm during the 6 weeks period. Lesser loss of ascorbic acid in PE than other packages is attributed to slower ripening of the fruit. The difference in the loss of this vitamin among PE-lined samples was not significant. Different lining materials did not cause significant changes in acid content of persimmon. Although changes in the ascorbic acid and acids content of persimmon have not been studied locally [8,19,20]. Hale *et al.* [17] did not find any difference in solids, acid, pH or juice percentage due to waxing and film lining in Florida grapefruits. Purvis [16] found no differences in ascorbic acid and TSS/acid ratio as result of waxing or seal packaging of grapefruit in low density PE but total acidity slightly decreased during 82 days at 21°. Similar pattern was observed with high density PE in Marsh grape-fruit and shamouti oranges [21] and storage studies on Mandarins [8,22].

Sensory evaluation. The sample were subjectively evaluated for appearance, firmness, flavour and overall acceptability scores Table 3 after 6 weeks. The overall ratings for the

TABLE 2. EFFECT OF PACKAGING MATERIALS AND STORAGE ON ASCORBIC ACID AND ACIDITY OF PERSIMMON.

Treatments	Storage periods 1	2	3	4	5	6	Mean
Ascorbic acid-mg/100gm							
Control	34.0	41.2	34.7	29.0	25.4	24.19	33.76
Newspaper(0.093mm)	36.0	37.80	36.9	32.5	29.0	35.0	35.04
Polyethylene (PE)							
PE-1 (0.013mm)	44.0	40.10	40.8	34.1	30.2	24.73	37.82
PE-2 (0.025mm)	47.6	40.59	41.2	34.4	51.5	27.50	37.86
PE-3 (0.035mm)	44.0	41.60	40.3	34.1	29.0	28.24	38.66
PE-4 (0.043mm)	48.0	42.50	42.0	38.0	33.0	30.86	40.31
Mean	42.27	42.24	40.63	39.32	33.68	29.23	
LSD at 5% level (0.884)							
Storage (0.995)							
Acidity -gm/100g							
Control	0.19	0.22	0.24	0.24	0.23	0.20	0.23
Newspaper (0.093mm)	0.22	0.21	0.19	0.24	0.19	0.17	0.22
Polyethylene (PE)							
PE-1 (0.013 mm)	0.19	0.18	0.22	0.24	0.19	0.18	0.22
PE-2 (0.025 mm)	0.23	0.20	0.19	0.19	0.19	0.17	0.21
PE-3 (0.035mm)	0.20	0.22	0.19	0.19	0.19	0.17	0.21
PE-4 (0.43mm)	0.22	0.22	0.22	0.24	0.19	0.18	0.21
Mean	0.21	0.21	0.21	0.22	0.20	0.18	
LSD at 5% level (0.031)							
Storage (0.026)							

Initial value for ascorbic acid : 47.8 mg/100gm

Initial value for acidity: 0.30 gm/100gm

TABLE 3. EFFECT OF PACKAGING MATERIALS ON SENSORIC PROPERTIES OF PERSIMMON.

Treatments	Sensoric scores			
	Appearance	Firmness	Flavour	Overall acceptability(Mean)
Control	3.80	4.40	2.40	3.53
Newspaper (0.093mm)	4.70	5.50	4.30	4.83
Polyethylene (PE)				
PE-1 (0.013mm)	7.00	6.33	7.14	6.82
PE-2 (0.025mm)	7.00	6.33	7.10	6.81
PE-3 (0.035mm)	7.17	6.50	7.60	7.09
PE-4 (0.043mm)	7.33	6.60	7.66	7.20
Mean	6.17	5.94	6.03	6.13
CV.	24.58	14.32	36.08	26.07

Scoring scale: 1.Dislike extremely, 2.Dislike very much, 3.Dislike moderately, 4. Dislike slightly, 5. Neither like nor dislike, 6. Like slightly, 7. Like moderately, 8. Like very much, 9. Like extremely Values are mean of 8 judgements.

control, newspaper, PE-1, PE-2, PE-3 and PE-4 were 3.53, 4.83, 6.82, 6.81, 7.09 and 7.20 respectively. The control and newspaper lined samples received the minimum scores where as differences among the PE-lined fruits were marginal. The PE-lined fruits were relatively firmer than others while the control and newspaper wrapped were over-ripe and deformed after six weeks storage at room temperature. This showed that maintenance of fresh appearance and control of deformation during storage of fruits is dependent on retaining weight loss [8,23]. As fruit is a living entity, it respires and respiration is the major utilizer of nutrients in fruit. Low respiratory activity is generally related to lowered rates of deterioration in fruits. Maintenance of fruit quality, firmness and retention of ascorbic acid in persimmon with vacuum packaging in polyethylene bags has been reported by Kawada [12]. In similar studies using polyethylene bags (0.1 mm thick) for astringent varieties and 0.05 mm for non-astringent varieties, Young *et al.* [24] observed a shelf-life upto 70 days at ambient temperature and 90 days at 0-2° without losing their palatability. Pesis *et al.* [13] maintained high quality and firmness of persimmon by cold storage.

As a result of these studies it was concluded that low density PE-lining (irrespective of thickness) not only minimised weight loss and retained firmness (texture) but also maintained sensory characteristics of persimmon at room temperature for 6 weeks. Newspaper as packaging material for fresh persimmon is not suitable.

Acknowledgement. We are thankful to Dr. I. Khan, Director for providing facilities to carry out these studies.

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