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Studies on the Effects of Polyethylene Liner on the Quality of Apples During Refrigerated Storage

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Abstract

The effects of polyethylene liner (0.03 mm thick) on the quality of apples (cvs. Golden Delicious and Spartan Spur) during refrigerated storage were studied. Polyethylene liner effectively ($p<0.01$) increased the shelf life of apples of both the cultivars. The shelf life of Golden delicious apples was 210 days whereas that of 'Spartan Spur' it was 180 days, When compared with control (unlined) the increase in shelf life was 30 days which is highly significant ($p = 0.01$). Bio-chemical changes in Spartan Spur' were found faster as compared to 'Golden Delicious' apples.

Introduction

Apple like other fruits does not cease its metabolic activities even after harvest i.e., it continues its respiratory activity leading to senescence. Post-harvest deterioration of apple is due to loss of water from fruit surface, transpiration and a little amount due to respiration. Loss of water from fruit results in its "shrivellage" which deteriorates market value of the fruit.

Better quality of packaging and as well as suitable lining material helps the produce to retain its water contents resulting in fresh look of the produce (Hall, 1975; Holt and Schoorl, 1984). Ahmad *et al*. (1979) and Farooqi *et al*. (1978, 1979) have shown a positive effect on the post-harvest quality of fruit especially significant reduction in the shrivellage.

An experiment was therefore designed to study the effects of the polyethylene film (0.03 mm thick) as a liner for two important varieties of apples grown in Balochistan.

Materials and Methods

Apples of two cultivars namely, 'Golden Delicious' (Locally known as Shin Kulu cultivar) and 'Spartan' (imported cultivar) were selected for comparison of shelf life in cold storage. Apples of uniform maturity and size were harvested from Deciduous Fruit Development Centre (DFDC), Quetta. The apples were held in card board trays lined with polyethylene film (0.03 mm) and stored in a cold storage (2 ± 1 °C and relative humidity of 70-75 per cent. The apples were randomly selected, marked and following data were recorded initially and then at monthly interval.

Change in appearance/shrivillage: Changes in external appearance was recorded by visually as 1-5 scale*.

Loss in Weight: The loss in weight was determined by the formula given as:-

$$W_3 = \frac{W_1 - W_2}{W_1} \times 100$$

Where
W1 = Initial weight
W2 = Weight after particular storage time
W3 = Loss in weight

Pressure Test: Pressure test was carried out by Magness-Taylor tester and expressed in lb/SqCm., it is the force required to puncture the pulp which depicts texture of the fruit.

Total Soluble Solids: Total soluble solids were determined by Abbe Refractometer and expressed as degree Brix (% sugar).

Organoleptic test: Organoleptic test was carried out by a panel of 10 judges using Hedonic Scale Rating (Lermond, 1970) and data were analysed statistically.

Results

Weight Loss: Fig. 1 reveals that there was a progressive decrease in weight during the storage period. The loss in weight was less ($p<0.01$) in apples linbed with polyethylene film. This loss in weight was however increased significantly ($p<0.01$) by the passage of time. The loss in weight of 'Golden Delicious' apples was greater ($p<0.01$) in initial storage period and slower at later stages, while 'Spartan Spur' showed reverse trend. The loss in weight of 'Spartan Spur' was 16.94% greater at 270th day of storage than 'Golden Delicious'. More or less the trend of loss in weight was observed in apples without lining (control) of both the cultivars, except the rate was higher.

Pressure Test: Fig. 2 shows that the fruit of both the cultivars i.e., 'Golden Delicious' and 'Spartan Spur' started losing stiffness significantly ($p<0.01$) from the day of storage in both the treatments. The loss in firmness was greater in apples without polyethylene liner of both the cultivars. The apples of cultivar ' Golden Delicious' become more soften than of 'Spartan Spur' at the end of the storage period i.e., 270 days. The loss in pressure in

'Golden Delicious' polyethylene lined apples was 14.71 per cent greater than that of 'Spartan Spur'. The figure of loss in pressure for apples without liner was 27.61 percent.

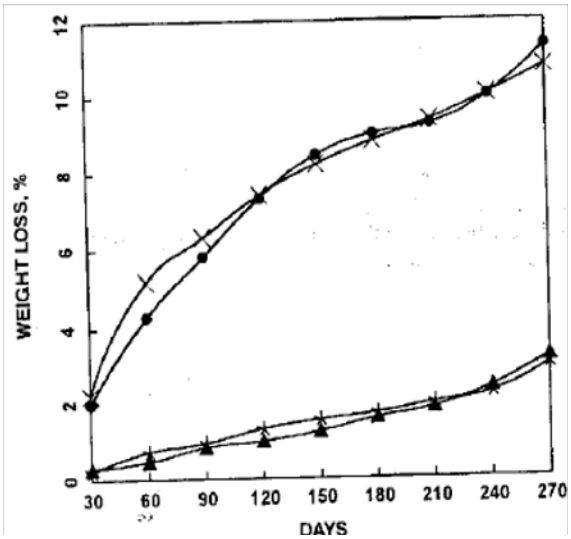

Fig. 1: Weight loss of apples during storage (CVS: Golden delicious & Spartan spur)

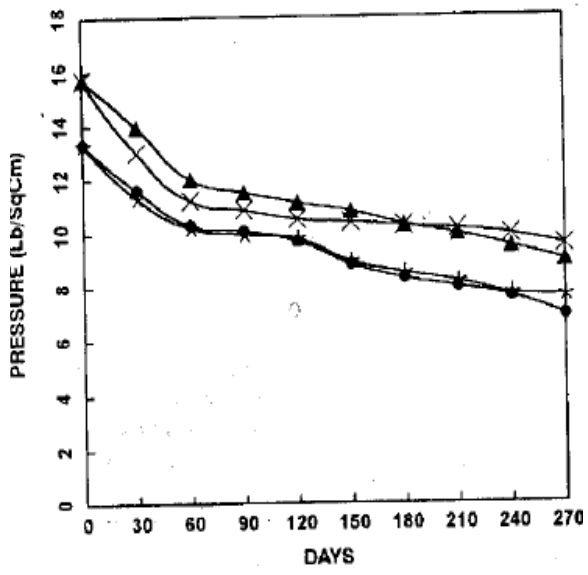

Fig. 2: Firmness of apples during storage (CVS: Golden delicious & Spartan spur)

Total Soluble Solids: The variation in total soluble solids during cold storage is shown in Fig. 3. The trend of increase or decrease, in total soluble solids was same in both the cultivars. The variations were much faster in 'Golden Delicious' than in 'Spartan Spur' in both, apples polyethylene lined and without liner. The increase in soluble solids at 150th day of storage was 3.53 and 17.69% in apples polyethylene lined and without liner of 'Golden Delicious', whereas 3.66 and 11.18% in cultivar 'Spartan Spur'.

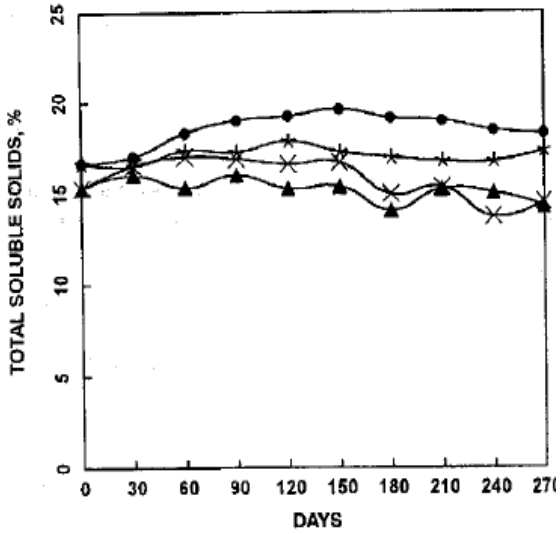

Fig. 3: Total soluble solids of apples during storage (CVS: Golden delicious & Spartan spur)

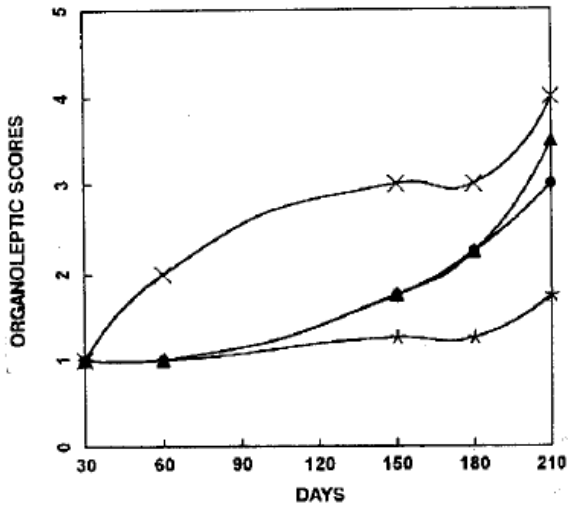

Fig. 4: Organoleptic scores of apples during storage (CVS: Golden delicious & Spartan spur)

Appearance: The appearance of apples lined with polyethylene remained good up to 210 and 180 days of 'Golden Delicious' and Spartan Spur', respectively. The polyethylene lining increased the acceptable appearance

period up to 30 days in cold storage than the apples without liner. The fruit of cultivar 'Golden Delicious' and Spartan Spur' without liner shriveled slightly in cold storage at 160th and 150th day of storage, respectively (Table 1).

Table 1: External appearance of apples (CV. Golden delicious and Spartan spur) during storage

Duration (days)	Golden delicious		Spartan spur	
	1	2	1	2
30	G	G	G	G
60	G	G	G	G
150	G	G	SS	G
180	SS	G	SS	G
210	SS	G	SS	SS
240	SS	SS	SS	SS

G = Good; SS = Slightly shriveled; 1 = Cold storage; 2 = Cold storage with polyethylene liner.

Organoleptic Test: The organoleptic scores (Fig. 4) showed that the apples were acceptable up to 210th and 180th day of 'Golden Delicious' and Spartan Spur', respectively, in polyethylene liner whereas the average rating was 2.0 and 2.5. The average scores were much higher i.e., marginal for apples without polyethylene liner.

Discussion

The loss in weight of fruit is due to the surface evaporation, transpiration and respiration, which depends upon the environmental conditions to which the fruit is subjected. Temperature and humidity of the storage play an important role. The loss in moisture content was less in cv. 'Golden Delicious', because of its waxy skin and thick cuticle. The polyethylene lining also play an important role in the checking the transpiration rate. In refrigerated storage polyethylene lining build up certain type of atmosphere which slows down the transpiration rate, resulted in minimum loss in weight. The loss in weight may not only be due to the transpiration, it may be due to respiration, however, the loss due to respiration is too little.

The firmness of fruit depends upon the biochemical activities that persists after fruit harvest. In refrigerated storage the biochemical activities are checked by low temperatures and the polyethylene wrapping improves the conditions more by increasing humidity as well as CO_2 level which decreased the respiration thus the biochemical reactions slows down. When apples are covered with material like wax emulsion or with a plastic material like profilm, there usually result a build up in CO_2 and lessening of the O_2. In fact the polyethylene lining is used to build CO_2 level produced during the respiration to retard the ripening process, which creates an atmosphere of modified storage (Paull and Chen, 1989; Polderdijk *et al*., 1996; Yeshoshua *et al*., 1993).

Hydrolysis of starch is one of the biochemical reaction that dominate in fruits after picking, This biochemical reaction is probably triggered by ethylene (C_2H_4), a growth hormone. It has been found that one 'Apple' produce about one cubic centimeter of (C_2H_4) during its life time. This amount is obviously vary in different varieties and with different size of fruits. In some instances ethylene is known to accumulate in storage in qualities to injure apples. It is speculated that (C_2H_4), is an auto-stimulant' for respiration. When all the starchy material is converted to sugars, there is gradual decrease in soluble solids which is a net loss of sugars due to respiration. In cold storage the polyethylene wrapping played an important role in slowing down of respiration process by increasing carbon dioxide level and humidity, so the increase in soluble solids observed still after 270 days of storage.

The appearance of most of the living elements in the universe is because of water. Water is a main constituent of apples, which is about 84 percent. Smock and Naubert (1950) reported that the apples shriveled at a loss of 5-6 per cent water. This problem is well solved by storage of apples in cold storage with polyethylene liner. The polyethylene liner reduced the transpiration rate by decreasing the vapour pressure of the moisture in fruit which is the driving force for the transpiration and evaporation.

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