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EFFECT OF PACKAGING FILMS ON SHELF LIFE OF PEACH FRUITS UNDER SUPERMARKET CONDITIONS

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ABSTRACT

Peach (*Prunus persica* L. Batsch) fruits cv. Shan-i-Punjab were harvested at colour break stage, packed in paper moulded tray and tightly stretch wrapped with different packaging films *viz*. low density polyethylene (LDPE), high density polyethylene (HDPE), shrink and cling films. The film-packed fruits and control (without film packaging) were stored under super-market conditions *i.e.* 20-21°C and 90-95% RH and analysed for physico-chemical parameters after every 2 days interval. Shrink film proved to be the most effective in extending the storage life of peach fruits upto 8 days and maintained superior quality as indicated by higher organoleptic rating and desirable fruit firmness, total soluble solids, total sugars, acidity, colour development, lower weight loss. The control maintained marketable quality for 4 days only.

Keywords: Cling film, HDPE film, LDPE film, Peach, Quality, Shrink film, Storage

PEACH (*Prunus persica* L. Batsch) is one of the most important fruits grown in the temperate zones of the world. In India, it is grown in the mid hill zone of the Himalayas in the states of Jammu & Kashmir, Himachal Pradesh, Uttaranchal and in North eastern region. The low chilling cultivars of peach are becoming popular in Punjab as these come in the market early and growers get better price. In Punjab the cultivation of peach is distributed throughout the state on an area of 1596 ha, with an annual production of 23940 MT (Anonymous, 2007). Shan-i-Punjab is a low chilling cultivar of peach that grows well under sub tropical conditions of Punjab and it attains physiological maturity during mid summer at a time when the atmospheric temperature is high, which leads to shrinkage, decay and heavy post harvest losses. Owing to perishable nature of the fruit and lack of awareness about handling practices and unavailability of post harvest infrastructure, the farmers are forced to sell their produce at throw-away prices, which creates glut in the market.

The role of cold chain is very important in post harvest operations of horticultural crops but its role is still underestimated in the country. However, with the increasing purchasing power and the consumer driven market scenario, the concept of super market is fast gearing up and small quantity of select Indian and exotic fruits are being displayed in the super markets for attracting high end consumers. Packing of fruits in polymeric films creates modified atmospheric conditions around the produce inside the package allowing lower degree of control of gases and can interplay with physiological processes of commodity resulting in reduced rate of respiration, transpiration and other metabolic processes of fruits (Zagory and Kader, 1988). With these view points, the present investigation was conducted to study the effect of different packaging films on storage life and quality of peach fruits cv. 'Shan-i-Punjab' under super-market conditions.

MATERIALS AND METHODS

The fruits of peach *cv*. 'Shan-i-Punjab' were harvested at colour break stage. The bruised and diseased fruits were sorted out and only healthy and uniform sized fruits were selected for the study. Four types of packaging films commercially available in the market viz low density polyethylene film (LDPE 25 µ), high density polyethylene film (HDPE 20 µ), shrink film (10 µ) and cling film (20 µ) were used for packaging of peach fruits in paper moulded trays (22 cm × 13 cm). Peach fruits were packed in trays and tightly sealed with different packaging films. After packing, four pin holes were made in all the packs to prevent condensation of water vapour inside the packages. Thereafter, the packed fruits as well as control (non-packed) fruits were stored at 20-21°C and 90-95 per cent RH (super-market conditions). The experiment consisted of 5 treatments and 5 storage intervals and laid out in completely randomized design with three replications for each treatment and each storage interval.

Physical and chemical parameters were recorded at 2 days interval for 10 days. The physiological loss in weight (PLW) after each interval of storage was calculated by subtracting final weight from the initial weight of the fruits and expressed in per cent loss. The fruit firmness was measured with the help of a penetrometer (Model FT- 327, USA) using 8 mm stainless steel probe and expressed in terms of pound force pressure (lb force).The overall organoleptic rating of the fruits was done by a panel of five judges on the basis of external appearance of fruits, texture, taste, and flavor, making use of a 9-point Hedonic scale (Amerine *et al*., 1965). The total soluble solids (TSS) of the fruit juice were determined using a hand refractometer and expressed as per cent TSS after making the temperature correction at 20 ºC. The total sugars

and titratable acidity were estimated as per standard procedure (AOAC, 1990). The colour of the fruits was measured with colour difference meter (Model: Mini Scan XE Plus, Made: Hunter Lab, USA) and expressed as L, a, b Hunter colour values (Hunter, 1975).

RESULTS AND DISCUSSION

Physiological loss in weight (PLW)

The PLW increased with the advancement of storage period but the packaging films significantly reduced the PLW as compared to control (Table 1). Shrink film registered the lowest mean PLW (2.70%), whereas the highest PLW (10.29%) was recorded in control. The PLW of peach fruit for Shrink, LDPE, HDPE and Cling film ranged between 1.28-4.89 per cent, 1.36-5.23 per cent, 1.58-5.41 per cent, and 1.63-7.07 per cent, respectively, during the stipulated storage period of 10 days. Shrink and LDPE film packaging resulted in acceptable weight loss upto 8 days while control fruits registered acceptable PLW upto 4 days. In case of peach fruits the acceptable level of weight loss is 5 per cent (Crisosto *et al*, 2004), above which the fruits show symptoms of shriveling and wilting and are liable to fetch lower price in the market or even become unsaleable in high end super markets. The reduction in weight loss in film-packed fruits may be attributed to lower moisture loss due to maintenance of higher humidity inside the packaging films. (Ben Yehoshua *et al.* 1979). The positive role of shrink film in reducing the PLW of papaya has been reported by Singh and Sudhakar (2005)

Firmness

The fruit firmness showed a decreasing trend as the storage period advanced (Table 1). The packaging films displayed significant delay in the reduction of fruit firmness. The highest mean fruit firmness (8.15 lb force) was recorded in shrink film packed fruits, followed by LDPE film (7.35 lb force) and HDPE film (6.50 lb force); while the lowest mean fruit firmness (4.20 lb force) was recorded in case of control.

Table 1. Effect of different packaging films on PLW, firmness and organoleptic quality of peach during storage

Storage period (Days)	*LDPE*	*HDPE*	*Shrink*	*Cling*	*Control*	*Mean*
			PLW (%)			
2	1.36	1.58	1.28	1.63	2.50	1.67
4	1.72	1.92	1.66	2.26	4.52	2.41
6	2.13	2.30	2.21	3.83	7.86	3.67
8	3.59	3.70	3.47	5.62	8.74	5.02
10	5.23	5.41	4.89	7.07	8.97	6.31
Mean	2.80	2.98	2.70	4.08	6.51	
CD (P=0.05)	Treatment (T) =0.19, Storage (S) =0.21, T×S=0.47					
			Firmness (lb force)			
0	11.5	11.5	11.5	11.5	11.5	11.5
2	10.67	9.26	11.17	8.86	7.40	9.47
4	8.66	7.93	9.13	7.33	6.20	7.85
6	7.50	6.65	8.75	6.60	3.43	6.58
8	6.42	5.50	7.35	5.20	2.0	5.29
10	3.53	3.16	4.35	2.27	2.0	3.06
Mean	7.35	6.50	8.15	6.05	4.20	
CD (P=0.05)	Treatment (T) =0.22, Storage (S) =0.23, T×S=0.50					
			Organoleptic quality			
0	6.0	6.0	6.0	6.0	6.0	6.0
2	7.50	7.42	7.75	7.84	8.24	7.75
4	8.25	8.15	8.35	8.05	8.47	8.25
6	8.35	8.28	8.45	8.25	6.50	7.96
8	8.45	8.35	8.70	8.30	5.46	7.83
10	7.02	6.82	7.20	6.12	4.35	6.30
Mean	7.91	7.80	8.09	7.69	6.60	
CD (P=0.05)	Treatment (T) =0.21, Storage (S)=0.20, T×S= 0.46					

The progressive decrease in the fruit firmness with the advancement of storage may be due to the breakdown of insoluble protopectins into soluble pectin or by hydrolysis of starch (Mattoo *et al.,* 1975). The lower rate of softening in packaging film packed fruits might be due to the effect of the films in lowering the rate of respiration, delaying the ripening process and reduction in moisture loss (Zagory and Kader,1988) . The maintenance of higher firmness with polymeric film packaging has been reported in sapota fruits (Jindal *et al.,* 2005).

Organoleptic rating

There was a gradual increase in the organoleptic rating of film packed peach fruits up to 8 days of storage, whereas in case of non-packed fruits the increase in the score was observed up to 4 days, after which a sharp decline was recorded (Table 1). The maximum mean sensory rating (8.09) was recorded in shrink film wrapped fruits. The fruits packed in shrink films were rated as extremely desirable after 8 days. The gradual increase in the sensory quality of peach fruits during storage has been attributed to the increase in the concentration of total volatiles and esters, with compounds ethyl butanoate, ethyl hexanoate and ethyl heptanoate contributing to the typical peach aroma (Yang *et al.,* 2009). Apple fruits cv. Star Crimson showed acceptable qualities for a period of 38 weeks when stored in shrink wrap packaging (Heaton *et al.,* 1990).

Total soluble solids (TSS)

The polymeric film packaging resulted in gradual and steady increase in the TSS of peach fruits upto 8 days of storage (Table 2). The highest TSS (12.86%) was recorded in shrink film wrapped peach fruits after 8 days in storage, followed by LDPE (12.76%), HDPE (12.66%) and Cling film (12.33%). Thereafter, a decline in the TSS was observed on the 10th day in storage. The unwrapped fruits recorded the

Table 2. Effect of different packaging films on TSS, total sugars and titratable acidity of peach during storage

Storage period (Days)	*LDPE*	*HDPE*	*Shrink*	*Cling*	*Control*	*Mean*
			TSS (%)			
0	9.53	9.53	9.53	9.53	9.53	9.53
2	10.62	10.46	10.75	10.34	11.36	10.70
4	11.16	11.03	11.26	10.60	12.70	11.35
6	11.57	11.38	11.74	11.89	11.53	11.62
8	12.76	12.66	12.86	12.33	9.20	11.96
10	8.27	8.21	9.43	8.76	7.35	8.46
Mean	10.87	10.74	11.20	10.78	10.42	
CD (P=0.05)	Treatment (T) =0.20, Storage (S)=0.21, T×S= 0.46					
			Total sugars (%)			
0	6.93	6.93	6.93	6.93	6.93	6.93
2	7.64	7.53	7.77	7.63	8.29	7.77
4	8.00	7.80	8.10	8.56	8.89	8.27
6	8.33	8.18	8.54	8.75	8.07	8.37
8	9.18	8.86	9.25	7.23	6.24	8.15
10	6.20	6.15	7.07	6.83	5.74	6.39
Mean	7.87	7.70	8.14	7.80	7.44	
CD (P=0.05)	Treatment (T) =0.23, Storage (S) =0.22, T×S= 0.49					
			Titratable acidity (%)			
0	0.82	0.82	0.82	0.82	0.82	0.82
2	0.79	0.76	0.81	0.73	0.71	0.76
4	0.77	0.74	0.77	0.71	0.67	0.73
6	0.74	0.71	0.75	0.69	0.65	0.70
8	0.70	0.68	0.71	0.66	0.62	0.67
10	0.69	0.66	0.70	0.63	0.59	0.65
Mean	0.73	0.71	0.74	0.68	0.64	
CD (P=0.05)	Treatment (T) =0.03, Storage (S) =0.02, T×S= NS					

highest TSS (12.70%) after 4 days of storage and registered a sharp decline in the TSS with advancement of storage period. The increase in TSS during storage period could be attributed to the water loss and hydrolysis of starch and other polysaccharides to soluble form of sugar (Wills *et al.,* 1980). The gradual increase in TSS over a longer period of time in film wrapped peach fruits may be possibly due to retarded ripening and senescence processes which simultaneously delayed the conversion of starch into sugars. Singh and Mandal (2006) have reported a delayed and sustained increase in the total soluble solids in polythene packed peach fruits.

Total sugars

The film wrapped peach fruits showed a steady rise in the total sugars content up to 8 days of storage and up to 4 days in control fruits and thereafter, a decline in total sugar was noticed (Table 2). Shrink film packed fruits registered the highest mean total sugars (8.14%) while the lowest was recorded in control (7.44%). The delayed increase in the sugar content under film packaging may be attributed to the inherent property of films in delaying the metabolic activities of fruits during storage due to delay in ethylene production and respiration rate (Abeles *et al.,* 1992). Increase in total sugars with the advancement of storage interval in Sand pear as a result of different packaging materials have been reported by Mohla *et al* (2005).

Titratable acidity

The titratable acidity of peach fruits showed a linear declining trend with the advancement of storage period and resulted in better retention of acidity in packed fruits as compared to non packed fruits (Table 2). The highest mean titratable acidity (0.74%) was recorded in shrink film wrapped peach fruits, followed by LDPE film (0.73%), HDPE film (0.71%) and Cling film (0.68%), whereas, the lowest (0.64%) was recorded in non wrapped fruits. The progressive reduction in the acidity with advancement of storage period might be due to the increased catabolism of organic acids present in fruit through the process of respiration. The maintenance of higher acidity in the film wrapped peach fruits may be due to the decreased hydrolysis of organic acids and subsequent accumulation of organic acids which were oxidized at a slow rate because of decreased respiration (Lau and Looney, 1982). The delay in the reduction of acidity with packaging film has been reported by McCollum *et al.* (1992) in mango fruits.

Colour

The packaging film resulted in better colour development in peach fruits as compared to control (Table 3). Among the various packaging films, shrink film recorded the highest yellow colour as indicated by 'b' value (27.46) after 8 days of storage, followed by LDPE film packaging (27.35). The fruits in control exhibited the highest 'b' value (27.44) after 4 days of storage. A decline in the yellow colour values was observed in both control as well as the film packed peach fruits after 4 days and 8 days of storage, respectively. Similarly, the highest red colour 'a' value was recorded in shrink wrapped fruits which ranged from 6.75 on the 2nd day to 14.10 after 8 days; thereafter a reduction in the 'a' value was observed. In control, maximum redness on the peel colour was obtained after 4 days (12.42) after which a steady decline in the 'a' value was recorded until the end of storage period. The improvement in colour during storage might be due to the degradation of the chlorophyll pigments of the fruits and increased synthesis of carotenoids and anthocyanin pigments during ripening (Wankier *et al.,* 1970). The increase in fruit colour during storage and ripening have also been reported in 'Baby Gold-7' and 'Florda Gold' peach fruits (Villanueva *et al.,* 1999)

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Table 3. Effect of different packaging films on development of colour of peach during storage

Storage period (Days)	*LDPE*	*HDPE*	*Shrink*	*Cling*	*Control*	*Mean*
			Hunter L (Lightness)			
0	56.51	56.51	56.51	56.51	56.51	56.51
2	53.52	60.40	60.28	58.11	56.48	57.76
4	59.24	60.72	60.72	60.83	53.98	59.10
6	56.46	59.29	58.96	56.08	59.63	58.08
8	59.12	61.63	58.54	49.97	61.15	58.08
10	61.38	58.27	59.77	60.34	56.94	59.34
Mean	57.74	59.55	59.20	56.98	57.47	
CD (P=0.05)	Treatment (T) =0.08, Storage (S) =0.09, T×S= 0.18					
			Hunter a (Hue)			
0	4.21	4.21	4.21	4.21	4.21	4.21
2	6.56	6.28	6.75	6.12	7.24	6.59
4	10.61	10.36	10.94	9.89	12.42	10.84
6	11.94	11.51	12.54	11.45	11.83	11.85
8	13.88	13.40	14.10	13.11	11.26	13.15
10	12.20	11.86	12.87	10.92	8.22	11.21
Mean	9.9	9.60	10.23	9.28	9.20	
CD (P=0.05)	Treatment (T) =0.07, Storage (S) =0.08, T×S= 0.17					
			Hunter b (Chroma)			
0	23.63	23.63	23.63	23.63	23.63	23.63
2	24.34	25.78	24.02	25.38	26.92	25.29
4	25.66	26.26	25.55	26.76	27.44	26.33
6	26.91	26.91	26.68	26.86	26.56	26.78
8	27.35	26.57	27.46	25.77	25.45	26.52
10	25.40	25.24	25.57	23.50	22.16	24.37
Mean	25.55	25.73	25.49	25.32	25.36	
CD (P=0.05)	Treatment (T) =0.14, Storage (S) =0.15, T×S= 0.33					

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