Indian J. Hort. 68(2), June 2011: 240-245

Effect of different packaging films on storage life and quality of peach fruits under cold storage conditions

Alemwati Pongener*, B.V.C. Mahajan and Harminder Singh
Punjab Horticultural Post Harvest Technology Centre, Punjab Agricultural University, Ludhiana 141 004

ABSTRACT

Peach (*Prunus persica* L. Batsch) fruits cv. Shan-i-Punjab were harvested at physiologically mature, *i.e.* colour break stage and packed in small CFB trays, followed by over-wrapping in commercially available packaging films, *viz.* LDPE, HDPE, shrink and cling films. The film-packed fruits were then stored under cold storage conditions (0-1°C and 90-95% RH) and analysed for quality parameters at weekly intervals. Shrink film proved to be the best among the films in maintaining superior quality up to 28 days of storage as indicated by higher fruit firmness (7.55 lb force), total soluble solids (12.16%), total sugars (9.12%), titratable acidity (0.76%), and lower weight loss (0.93%). The control fruits maintained marketable quality up to 14 days.

Key words: Peach, packaging film, storage, quality.

INTRODUCTION

Peach (*Prunus persica* L. Batsch.) is an important fruit grown in the temperate zones of the world. 'Shan-i-Punjab' is a low chilling peach cultivar that grows well under sub-tropical conditions of Punjab and favoured for its attractive fruits possessing captivating taste and aroma. Under Punjab conditions the fruits attain physiological maturity during mid summer when the atmospheric temperature is high which interferes with postharvest quality of fruits. Owing to perishable nature of the fruit and lack of awareness about handling practices and unavailability of postharvest infrastructure the farmers are forced to sell their produce at throw-away prices. The peach fruits have shelf-life of 2-3 days under ambient conditions and about 2 weeks under cold storage conditions (Kader, 9). Increase in the shelf life of peach fruits would help the growers to supply their produce according to the market demand and fetch them better prices and also make the fruits available to the consumers over an extended period of time.

Storing 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, 17). 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 cold storage conditions.

*Corresponding author's: E-mail: alemwati@gmail.com

MATERIALS AND METHODS

The fruits of peach cv. Shan-i-Punjab were harvested at physiologically mature, *i.e.* colour break stage from the orchard of Punjab Agricultural University, Ludhiana. 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 *viz.*, low density polyethylene film (25 µ), high density polyethylene film (20 µ), shrink film (10 µ) and cling film (20 µ) were used for packaging of peach fruits. The fruits were packed in corrugated trays (22 cm × 13 cm) and tightly sealed in pouches of different packaging films. However, the shrink film wrapped packs were passed through a shrink wrapping machine (Model BS-450, Samrath Engineers, India) at 165°C for 10 sec. In each tray 10 fruits were packed. After packing, four small holes of 1 mm in diameter were made in all the packs to prevent condensation of water vapour inside the packages (Singh and Mandal, 12). Thereafter, the packed fruits as well as control (unpacked) fruits were stored at under cold storage conditions (0-1°C and 90-95% RH). The experiment consisted of five treatments and five storage intervals with three replications for each treatment and each storage interval.

Physico-chemical parameters were recorded at weekly interval for 35 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. The colour of the fruits was measured with colour difference meter (Mini Scan XE Plus, Hunter Lab, USA) and expressed as L, a, b Hunter colour values

(Hunter, 7). 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 flavour, making use of a 9-point Hedonic scale (Amerine *et al*., 2). 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°C. The total sugars and titratable acidity were estimated as per standard procedures (AOAC, 4). The data were analyzed statistically in completely randomized design.

RESULTS AND DISCUSSION

A steady increase in the physiological loss in weight (PLW) of the fruits was observed with the advancement of storage period (Table 1). Shrink film packaging registered the lowest mean PLW (0.85%) followed by LDPE packaging (0.88%). The control fruits, on the other hand, had high rate of PLW as compared to film wrapped fruits and registered average PLW of 6.51 per cent at the end of the storage period (35 days). The PLW of peach fruit during different storage intervals for shrink, LDPE, HDPE and cling film ranged between 0.65-1.04, 0.67-1.11, 0.69-1.23, and 1.34-2.44%, respectively, between 7 to 35 days of storage. The lower PLW in film-wrapped fruits may be attributed to the positive role of plastic covering played in preventing dehydration by creating a saturated micro-atmosphere around the fruits (Gonzalez *et al*., 6). The higher rate of PLW in control is probably due to higher moisture loss and increased respiration through uninterrupted atmospheric column and lower relative humidity in comparison to wrapped fruits. Lower PLW under polymeric film packaging has also been documented in citrus (Hussain *et al*., 8).

There was a continuous decline in the fruit firmness

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

Storage period (days)	LDPE	HDPE	Shrink	Cling	Control	Mean
			PLW (%)			
7	0.67	0.69	0.65	1.34	2.50	1.17
14	0.77	0.89	0.76	1.64	4.52	1.71
21	0.89	0.99	0.87	2.01	7.86	2.52
28	0.97	1.05	0.93	2.26	8.74	2.59
35	1.11	1.23	1.04	2.44	8.97	2.95
Mean	0.88	0.97	0.85	1.93	6.51	
$CD_{0.05}$	Treatment = 0.13		Storage = 0.15		Treatment x storage = 0.35	
			Firmness (lb force)			
7	11.08	10.40	11.34	9.20	8.35	10.07
14	9.64	9.22	10.45	8.25	6.50	8.81
21	8.68	8.28	9.55	7.35	4.24	7.62
28	7.30	6.65	7.55	6.05	3.73	6.25
35	4.30	4.05	4.87	3.26	2.84	3.86
Mean	8.20	7.72	8.57	6.82	5.13	
$CD_{0.05}$	Treatment = 0.13		Storage = 0.15		Treatment x storage = 0.35	
			Organoleptic rating (1-9)			
7	7.35	7.42	7.40	7.25	7.84	7.45
14	7.66	7.60	7.75	7.50	8.65	7.83
21	8.28	8.15	8.56	8.05	6.61	7.93
28	8.45	8.35	8.70	8.20	5.65	7.87
35	6.49	6.12	6.76	6.02	4.45	5.96
Mean	7.64	7.52	7.83	7.40	6.64	
$CD_{0.05}$	Treatment = 0.20		Storage = 0.21		Treatment x storage = 0.48	

with the advancement of storage period irrespective of different films (Table 1). The maximum average fruits firmness (8.75 lb force) was observed with shrink film packaging, followed by LDPE (8.20 lb force) and HDPE film (7.72 lb force). The control fruits recorded the minimum average fruit firmness (5.13 lb force). During different storage intervals from 7 to 35 days, the shrink film packed fruits recorded maximum fruit firmness which ranged between 11.34-4.87 lb force, closely followed by LDPE film (11.08-4.30 lb force). The slower declines in firmness of film packed fruits have also been documented by Kupferman and Sanderson (10) in cherries, and Ali *et al.* (1) in carambola. The lower rate of softening in polythene 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; which was not the case in the control fruits thus leading to a quicker decrease in fruit firmness in control fruits. Peach fruits attained best eating quality at 7 lb force firmness (Crisosto, 5) and this level of firmness was observed in shrink and LDPE film wrapped fruits after 28 days of storage in the present studies.

The film packed peach fruits showed a gradual and steady increase in the sensory quality attributes up to 28 days after which a sharp decline was observed (Table 1). Whereas, in control fruits, the sensory score increased up to 14 days of storage and thereafter declined at faster pace. The shrink wrapped fruits were rated as extremely desirable after 28 days and thereafter acceptability declined. The control fruits attained the highest organoleptic score after 14 days of storage and decline thereafter. Peach flavour depends on a delicate balance of sugars, acids, phenolics, and aromatic compounds, with a number of additional factors, such as pulp texture and visual appearance also influence the perceived quality and consumer acceptance and appreciation (Predieri *et al*., 11). 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*., 16).

The packaging film delayed the loss of green colour in peach fruits. In the polythene packed fruits

Table 2. Effect of different packaging films on Hunter colour values of peach fruits during storage.

Storage period (days)	LDPE	HDPE	Shrink	Cling	Control
			Hunter L value		
7	57.11	58.42	58.06	58.84	59.92
14	60.46	56.11	57.59	57.47	59.26
21	60.45	55.93	56.76	60.23	59.07
28	62.32	59.81	57.85	58.31	59.62
35	53.39	62.01	62.42	51.13	60.60
$CD_{0.05}$	Treatment = 0.08		Storage = 0.09	Treatment x storage = 0.18	
			Hunter a value		
7	5.33	5.00	6.71	4.28	7.64
14	8.40	8.10	8.90	7.20	9.85
21	9.31	9.22	9.60	7.72	9.65
28	10.30	10.04	10.56	8.85	7.70
35	9.45	9.19	9.64	7.73	6.70
$CD_{0.05}$	Treatment = 0.11		Storage = 0.12	Treatment x storage = 0.25	
			Hunter b value		
7	24.07	24.28	24.10	23.77	26.07
14	25.37	24.60	24.40	24.70	28.96
21	25.29	25.15	25.34	25.17	26.30
28	26.50	25.32	26.59	25.21	23.75
35	24.52	24.40	24.96	24.67	22.66
$CD_{0.05}$	Treatment = 0.21		Storage = 0.23	Treatment x storage = 0.49	

yellow colour (b value) showed a continuous increasing trend with the increase in storage period and attained maximum value after 28 days of storage (Table 2). The highest 'b' value (26.59) was recorded in the fruits packed in shrink films, followed by LDPE film wrapped fruits (26.50). There was better yellow colour development in the control fruits up to 14 days of storage after which a declining trend in 'b' value was observed leading to unpleasant colour of the fruit. Similarly, there was a continuous increase in the 'a' value of film wrapped peach fruits with the advancement of storage period. The highest 'a' value was recorded in shrink wrapped fruits which ranged from 6.71 on the 7th day to 10.56 after 28 days; thereafter, a reduction in the value was observed. In control maximum redness on the peel colour was obtained after 14 days after which a steady decline in the 'a' value was recorded. 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. Sonkar *et al*. (13) and An *et al*. (3) have observed better colour development of kinnow mandarin and honey peach fruits, respectively, under stretch cling film and polythene wrapping.

The TSS content in peach fruits increased slowly and steadily up to 28 days in all the polythene films wrapped fruits, after which a sharp decline was recorded by the end of 35 days of storage (Table 3). The highest mean TSS (10.86%) was recorded in peach fruits packed in shrink films, followed by LDPE film (10.64%), cling film (10.39%) and HDPE film (10.28%). On the other hand, control fruits recorded increase in TSS up to 14 days and then declined sharply afterwards. Interestingly, the fruits in control recorded higher TSS content up to 2 weeks of storage as compared to the film wrapped fruits, but later on the film wrapped fruits maintained higher TSS as compared to control fruits. The delayed increase in TSS over a longer period of time in film wrapped peach fruits might be due to retarded ripening and

Table 3. Effect of different packaging films on TSS, titratable acidity and total sugars of peach fruits during storage.

Storage period (days)	LDPE	HDPE	Shrink	Cling	Control	Mean
			TSS (%)			
7	10.43	10.10	10.40	10.50	10.86	10.45
14	10.67	10.38	10.74	10.74	11.80	10.86
21	11.36	11.06	11.76	11.13	10.53	11.16
28	11.66	11.23	12.16	11.04	9.00	11.01
35	9.11	8.63	9.26	8.56	7.30	8.57
Mean	10.64	10.28	10.86	10.39	9.89	
$CD_{0.05}$		Treatment = 0.17	Storage = 0.16	Treatment x storage = 0.37		
			Titratable acidity (%)			
7	0.80	0.79	0.86	0.79	0.72	0.78
14	0.78	0.77	0.79	0.76	0.69	0.75
21	0.76	0.75	0.77	0.72	0.66	0.73
28	0.73	0.71	0.76	0.69	0.64	0.70
35	0.72	0.67	0.74	0.66	0.61	0.68
Mean	0.75	0.73	0.77	0.72	0.66	
$CD_{0.05}$		Treatment = 0.02	Storage = 0.02	Treatment x storage = NS		
			Total sugars (%)			
7	7.57	7.32	7.66	7.73	8.25	7.70
14	7.82	7.76	8.10	8.34	8.85	8.17
21	8.52	8.04	8.83	8.45	7.74	8.31
28	8.73	8.12	9.12	7.16	6.77	7.98
35	6.83	6.45	6.93	6.42	5.56	6.43
Mean	7.89	7.53	8.12	7.62	7.43	
$CD_{0.05}$		Treatment = 0.13	Storage = 0.15	Treatment x storage = 0.35		

senescence processes which reduced the conversion of starch into sugars.

The titratable acidity of peach fruits packed under polythene films showed a linear declining trend with the advancement of storage period (Table 3). The packaging films helped in better retention of acidity as compared to control. The highest mean titratable acidity (0.77%) was recorded in the fruits wrapped in shrink films, followed by LDPE packed peach fruits (0.75%). The lowest mean titratable acidity (0.66%) was recorded in control fruits. 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. The delay in the reduction of acidity in film wrapped peach fruits confirms the similar findings of Venkatesha and Reddy (14) on guava fruits.

The total sugars showed a progressive increasing trend up to 28 days in storage in the fruits packed in different polythene films and up to 14 days in the control fruits (Table 3). Thereafter, a decline in the total sugars was recorded. In the first 2 weeks of storage, the total sugars content was low in the film wrapped fruits as compared to the fruits in control, but afterwards, the sugar content increased steadily up to 28 days in the polythene film wrapped fruits and recorded the highest values compared to control, and thereafter, gradually declined but even then the level of total sugars was higher in the film wrapped peach fruits. The highest mean total sugars was recorded in the fruits packed in shrink film (8.12%), followed by LDPE (7.89%), Cling films (7.62%) and HDPE (7.53%); whereas, the lowest mean total sugars (7.43%) was observed in the control fruits. The increase in total sugars during storage may possibly be due to breakdown of complex organic metabolites into simple molecules or due to hydrolysis of starch into sugars. The decline in the sugar content at the later stages of storage may be attributed to the fact that after the completion of hydrolysis of starch, no further increase in sugars occurred and subsequently a decline in these parameters is predictable as they along with other organic acids are primary substrate for respiration (Wills *et al*., 15).

From the present study it can be concluded that Shan-i-Punjab peach fruits packed in small CFB trays followed by wrapping with shrink or LDPE film can be stored for 28 days under cold storage conditions (0-1°C and 90-95% RH) with highly acceptable quality, whereas, control (unwrapped) fruits could maintain marketable life for 14 days only.

REFERENCES

1. Ali, Z.M., Chin, L.H., Marimuthu, M. and Lazan, H. 2004. Low temperature storage and modified atmosphere packaging of carambola fruit and their effects on ripening related texture changes, wall modification and chilling injury symptoms. *Postharvest Biol. Technol.* **33**: 181-92.
2. Amerine, M.A., Pangborn, R.M. and Roessler, E.B. 1965. *Principles of Sensory Evaluation of Food.* Academic Press, London, pp. 5.
3. An, J., Zhang, M. and Zhan, Z. 2007. Effect of packaging films on the quality of 'Chaoyang' honey peach fruit in modified atmospheric packages. *Packaging Technol. Sci.* **20**: 71-76.
4. A.O.A.C. 1990. *Official Methods of Analysis* (14th Edn.). Association of Official Analytical Chemists, Washington, D.C.
5. Crisosto, C.H. 1994. Optimum procedure for ripening of stone fruits. *Perishables Handling Newslett*. **90**: 22-23.
6. Gonzalez, A.G., Vasquez, C., Felix, L. and Baez, R. 1997. Low oxygen treatment before storage in normal or modified atmosphere packaging of mango. *J. Food. Sci. Tech.* **34**: 399-404.
7. Hunter, S. 1975. *The Measurement of Appearance.* John Wiley and Sons. New York, pp. 304-5.
8. Hussain, I., Asif, M., Ahmed, M., Khan, M. and Shakir, I. 2004. Effect of uni-packaging on the post harvest behavior of citrus fruits in N.W.F.P. *Pakistan J. Nutr.* **3**: 336-39.
9. Kader, A.A. 2001. *Postharvest Technology of Horticultural Crops.* University of California special publication 3311.
10. Kupferman, E. and Sanderson, P. 2001. Temperature management and modified atmosphere packing to preserve sweet cherry quality. *Tree Fruit Research and Extension Center, Washington State University,* July 2001, pp. 1-9.
11. Predieri, S., Ragazzini, P. and Rondelli, R. 2006. Sensory evaluation and peach fruit quality. *Acta Hort.* **713**: 429-34.
12. Singh, D. and Mandal, G. 2006. Post-harvest quality and spoilage of peach fruits stored in perforated poly bags. *Indian J. Hort*. **63**: 390-92.

13. Sonkar, R.K., Sarnaik, D.A., Dikshit, S.N. and Saxena, R.R. 2009. Individually stretch cling film wrapped Kinnow mandarin under ambient storage. *Indian J. Hort*. **66**: 22-27.

14. Venkatesha, M. and Reddy, T.V. 1994. Extension of storage life of guava (*Psidium guajava* L.) fruits. *Indian Food Packer*, **48**: 5-10.

15. Wills, R.B.H., Bembridga, P.A. and Scott, K.J. 1980. Use of flesh firmness and other objective test to determine consumer acceptability of 'Delicious' apples. *Australian J. Exp. Agric. Anim. Husb.* **20**: 252-69.

16. Yang, D.S., René, R., Quintana, B., Ruiz, C. F., Toledo, R.T. and Kays, S.J. 2009. Effect of hyperbaric, controlled atmosphere and UV treatments on peach volatiles. *Postharvest Biol. Technol.* **51**: 334-41.

17. Zagory, D. and Kader, A.A. 1988. Modified atmosphere packaging of fresh produce. *Food Technol.* **42**: 70-77.

Received: December, 2009; Revised: October, 2010; Accepted : January, 2011