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Effect of active packaging on quality and shelf life of peach fruits

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Abstract
Peaches are known for their palatable flavour and abundant nutrients. However, peaches are perishable, and the existing preservation techniques for peaches are still immature. Therefore, the present study was carried out to find out the effect of active packaging and different levels of ventilation on quality of peach fruits under refrigerated storage conditions. Peach (*Prunus persica* L. Batch) fruits of cultivar "Shan-e-Punjab" were harvested at colour break stage and packed in thermocol trays wrapped with LDPE bags comprising the following treatments: T_1 (control), T_2 (ethylene absorber + 0 perforation), T_3 (ethylene absorber + 4 perforations), T_4 (ethylene absorber + 8 perforations), T_5 (oxygen absorber + 0 perforation), T_6 (oxygen absorber + 4 perforations), T_7 (oxygen absorber + 8 perforations), respectively. The packed fruits were stored under refrigerated conditions and analysed at regular interval of 7 days to ascertain the changes occurring in physical, chemical, and sensory quality parameters. Treatment T_3 (ethylene absorber + 4 perforations) recorded the lowest mean physiological loss in weight of 3.06 per cent. During initial days of storage no signs of decay were observed however, with the advancement of storage period the highest mean decay percentage of 11.09 per cent was recorded in T_1 (control). Highest retention of ascorbic acid (9.73 mg/100g) was observed in T_3 (ethylene absorber + 4 perforations). Total phenolic content decreased with the progression of the storage period. Sensory evaluation of actively packaged peach fruits revealed that T_3 (ethylene absorber + 4 perforations) recorded the highest mean score for overall acceptability (7.50). Overall, T_3 (ethylene absorber + 4 perforations) was best suited active packaging to retain quality as well as reduce the spoilage of peach fruits during storage under refrigerated conditions.

Keywords: Peach, ethylene absorber, oxygen absorber, antioxidants, phenol, sensory parameters, LDPE

1. Introduction

Peach (*Prunus persica* L. Batsch.) is an important stone fruit grown under temperate and sub-tropical climate. It is a delicious but highly perishable fruit and has a short shelf life under ambient conditions. Shan-i-Punjab is a low chilling cultivar of peach that grows well under subtropical conditions and attains physiological maturity in the months of May–June, when the atmospheric temperature is high, which leads to fruit softening, shrinkage, decay and heavy post harvest losses (Pongener *et al*., 2011) [1]. Immediately after harvest, the nutritional and organoleptic quality of fresh produce start to declining as a result of altered plant metabolism. This quality deterioration is the result of produce transpiration, senescence, ripening associated processes and development of postharvest disorder (Gorris and Peppelenbos, 2007) [2].

Active packaging is one of the most relevant approaches to increase the shelf life of fresh horticultural produce. Active packaging can be defined as a system in which the product packaging material and environment interacts in a positive way to extend the shelf life of food. Many different active agents can be incorporated into the packaging material to improve its functionality (Ramos *et al*., 2013) [3].

Ethylene is a plant hormone responsible for the ripening of fruit. During storage, ascending concentration of ethylene could result in significant quality loss. Therefore, ethylene inhibition or its removal should be used to maintain post-harvest quality. Among different postharvest management strategies of fresh fruit handling, use of ethylene absorbents has been reported to be very useful (Thakur *et al*., 2005) [4]. Ethylene absorbents usually contain potassium permanganate which, when placed inside a packaging box, oxidises ethylene to CO_2 and water. As a result, the deleterious effects of ethylene on fruit ripening, softening or postharvest quality are delayed, and ultimately the postharvest shelf or storage life of fruits is increased drastically, which helps in extending the marketability of fruits for a longer time (Glahan, 2006) [5].

Oxygen can cause changes in colour, flavour and odour (Suppakul *et al*., 2003) [6] and encourages growth of aerobic bacteria and moulds (Guynot *et al*., 2003) [7]. Hence, oxygen scavengers are used to minimize quality changes and prevent deterioration due to oxidation and growth of microorganisms (Charles *et al*., 2005) [8]. Iron, sodium hydrosulfite, and ascorbic acid are the most used oxygen scavengers in food packaging (Yeh *et al*., 2008) [9]. Theoretically, 1 g iron-based scavenger absorbs 300 cc oxygen, forming non-toxic iron oxide (Miltz and Perry, 2005) [10]. Several studies have been published on the use of oxygen absorbers and their beneficial effects with fruit and vegetables. According to Charles *et al*. (2008) [11], oxygen absorbers delay greening and browning of endives and reduce the transient period by 50% compared with passive MAP. Charles *et al*. (2005) [8] observed that oxygen absorbers did not modify the gas equilibrium composition and improved the quality of fresh endives. Bolin and Huxsoll (1989) [12] showed that oxygen scavengers improve firmness of peaches, and Tarr and Clingeleffer (2005) [13] have reported that oxygen absorbers minimize colour changes of dried vine fruit. The present studies were, therefore, undertaken to investigate the effect of active packaging on physico-chemical characteristics of stored peach.

2. Material and method

The peach fruits of cultivar Shan-e-Punjab were harvested at physiologically mature, i.e. colour break stage from the Research orchards of Division of Fruit Science, Faculty of Agriculture, SKUAST – J, Udheywalla campus. The bruised and diseased fruits were sorted out and only healthy and uniform sized fruits were selected for the study. The selected fruits were washed by treating with chlorine solution (200 ppm) for 10 minutes and were then air dried for further use. The air dried peach fruits were divided into seven lots containing 40 fruits with three replications each. The desired numbers of fruits were placed on thermocol trays and were wrapped with low density polyethylene (LDPE) bags. Inside each tray a sachet of ethylene absorber (Freppe ^{TN}) and oxygen absorber (O- buster ^{TN}) were kept and control with no sachets. For ventilation, on the basis of area of packaging material, 4 and 8 pin hole perforations (diameter 0.3mm) each were made which were equally distributed on the film surface. The packaged samples were stored under refrigerated conditions (4-7^{0}C) for 28 days and observations for various physico-chemical parameters were recorded at an interval of 7 days. The recorded data were subjected to statistical analysis by adopting factorial CRD.

2.1 Physical characteristics

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 decay or rotting of the stored tomato fruits were determined by their visual observations. The specific gravity of fruits was measured by the water displacement method. Volume of the fruit was measured by dipping fruit in a known volume of water in a cylinder and specific gravity worked out by dividing the weight of fruit by its volume. 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.

2.2 Chemical characteristics

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 titratable acidity was estimated as per standard procedures by treating against sodium hydroxide solution (Ranganna, 2008) [14]. Ascorbic acid content was determined by the procedure of Sadasivam and Manicham (2008) [15] using 2, 6-dichlorophenol indophenol dye.

Total phenols were determined as per McDonald *et al*. (2001) [16], using Folin Ciocalteu reagent. 1 g of peach was extracted with 10 ml of methanol: water (50:50, *v/v*). 0.5 ml of the diluted (1:10) extract or the standard phenolic compound (Gallic acid) was mixed with 5 ml of Folin Ciocalteu reagent (1:10 diluted with distilled water) and 4 ml of aqueous Na_2CO_3 (1M). The mixture was allowed to stand for 15 min and optical density of the mixture was determined against the blank at 765 nm with the help of UV-Vis spectrophotometer (Labtronics, Model No: 2800). The standard curve was prepared using gallic acid. Total phenol values were expressed in terms of the standard reference compound as gallic acid equivalent (mg/100 g).

Free radical scavenging activity was determined by DPPH (Di Phenyl Picryl Hydrazyl) method (Koga *et al*., 2007) [17]. The overall organoleptic rating of the fruits was done by a panel of ten judges on the basis of colour, flavour (taste + aroma), texture and overall quality rating was calculated making use of a nine point Hedonic scale (Amerine *et al*., 1965) [18]. The data were analyzed statistically in completely randomized design.

3. Results and discussion

3.1 Physical characteristics of packaged peach

Data presented in Table 1 revealed that physiological loss in weight in peach fruit showed significant differences for treatment and storage durations. Effect of treatments on physiological loss in weight showed that T_1(control) recorded highest physiological loss in weight of 4.98 per cent followed by T_5 (oxygen absorber + 0 perforation) having physiological loss in weight of 3.85 per cent after 7 days of storage. However, after 28 days of storage the highest physiological loss in weight having value 6.87 per cent in was recorded in T_1 (control) followed by T_5 (oxygen absorber + 0 perforation) having value of 4.87 per cent. The lower weight loss in fruits placed in packaging bags with perforation compared to those in non perforated ones could be due to removal of ethylene that has a catalytic role in increasing respiration (Jobling, 2000) [19] while also increasing relative humidity in package thus reducing water loss. The removal of ethylene or inhibition of its effect in storage environment is fundamental to maintaining post harvest quality of climacteric produce (Salteveit, 1999) [20]. The highest mean physiological loss in weight of 5.60 per cent in was recorded in T_1 (control) and lowest mean physiological loss in weight of 3.06 per cent was recorded in T_3 (ethylene absorber + 4 perforations). The physiological loss in weight increased from 3.32 to 4.72 per cent during 28 days of storage. The increase in PLW with storage might be due to continuous loss of moisture because of transpiration from fruits and respiration (Nath *et al*., 2011) [21].

Initially no decay was observed up to seven days of storage (Table 1). However, after 14 days of storage the maximum decay percentage of 8.65 per cent was observed in T_1 (control). T_3 (ethylene absorber + 4 perforations), T_4 (ethylene absorber + 8 perforations), T_6 (oxygen absorber + 4 perforation) and T_7 (oxygen absorber + 8 perforations) remained unaffected upto 14 days of storage. The highest mean decay percentage of 11.09 per cent was observed in T_1 (control). Among treatments, the decay percentage was observed to be higher in fruits packed in non perforated films as compared to fruits packed in perforated films. This might be due to condensation of water in surface of fruits, anaerobic conditions and breakdown of enzymes during storage which encourages the multiplication of microflora (Kaur *et al*., 2014) [22]. Likewise, Yamashita and Benassi (1998) [23] also observed higher spoilage in guava fruits packed in polyethylene films without ventilation. The decay percentage increased as the storage period advanced irrespective of treatments from 2.18 to 13.51 per cent. The increase in decay percentage with storage might be due to the continuous process of transpiration and respiration which results in cellular disintegration due to reduced synthesis of protein and nucleic acid which enhances senescence and spoilage of fruits. The results are in conformity to the findings of Singh *et al*. (2005) [24] in peach fruits.

At the beginning of the storage specific gravity of fresh peach was recorded as 1.025 (Table 2). Among treatments, highest specific gravity of 0.985 was recorded in T_1 (control) whereas, lowest specific gravity of 0.963 was observed in T_3 (ethylene absorber + 4 perforations) after 7 days of storage. However, after 28 days of storage T_3 (ethylene absorber + 4 perforations) recorded minimum specific gravity of 0.942 followed by T_4 (ethylene absorber + 8 perforations) having value of 0.948. The mean specific gravity was observed to be highest in T_1 (control) having value of 0.973. During 28 days of storage period the specific gravity decreased significantly from initial value of 1.025 to 0.952. The reduction in specific gravity during storage has also been documented by Suresh *et al*. (2008) [25] in guava fruits.

Colour is an important attribute for consumer acceptance and perception of peach quality. Changes in external colour of peach were analysed by measuring L^* (lightness), a* (redness) and b^* (yellowness) values during storage (Table 2 & 3). The highest mean L^* value of 57.25, a* value of 5.92 and b* value of 28.70 were observed in T_3 (ethylene absorber + 4 perforations). The less colour development in fruits packed in non-perforated bags have also been reported by Nath *et al*. (2011) [21] in pear fruits packed using different packaging materials. The colour values increased significantly with the advancement of storage period. The improvement in colour during storage might be due to the degradation of chlorophyll pigment of the fruit and increased synthesis of carotenoids and anthocyanin pigment (Wankier, 1970) [26]. The increase in fruit colour during storage has also been reported by Pongener *et al*. (2010) [27] in peach fruits. Kaur *et al*. (2014) [22] also reported similar changes in colour values during storage.

3.2 Chemical characteristics of packaged peach

At the beginning of the storage TSS content of 9.86 ^{0}B was recorded in peach. After 7 days of storage (Table 4), the highest TSS of 10.17 ^{0}B was recorded in T_1 (control). After 21 days of storage, the highest TSS content increased to 11.29 ^{0}B in T_1 (control) whereas, after 28 days of storage, respective TSS value decreased significantly to 10.76 ^{0}B (T_1 control). The minimum TSS value of 10.17 ^{0}B was observed in T_3 (ethylene absorber +4 perforations) after 28 days of storage. Higher TSS was observed in oxygen absorbers than ethylene absorbers which might be related to an intense reduction of respiration due to lower content of oxygen such reduction in respiration could also support the accumulation of free hexoses (Thompson, 1998) [28]. Significant differences were observed in TSS content with respect to storage. An increase in TSS content was observed up to 21 days from 9.86 to 10.98 ^{0}B and thereafter TSS content decreased to 10.44 ^{0}B. The increase in TSS content during storage might be due to moisture loss, hydrolysis of polysaccharides and conversion of juice as a result of degradation. The decline in TSS can be attributed to the fact that on complete hydrolysis of starch, no further increase in TSS occur and consequently a decline in TSS is predictable as they are the primary substrates for respiration (Wills *et al*., 1980) [29]. The results are in confirmation to the findings of Gill *et al*. (2015) [30], who also observed lower TSS in mango fruits packed in non perforated bags.

Highest mean titratable acidity of 0.81 per cent was observed in treatment T_3 (ethylene absorber + 4 perforations) whereas, the lowest mean titratable acidity of 0.74 per cent was observed in treatment T_1(control). The higher retention of acidity in T_3 (ethylene absorber + 4 perforations) might be due to the effect of packaging film in delaying the respiration and ripening process.

The progressive reduction in acidity was observed with the advancement of storage period from 0.81 to 0.74 per cent (Table 4). The decrease in acidity during storage might be due to the increasing catabolism of organic acids present in fruits through the process of respiration. The decrease in titratable acidity during storage may also be attributed to utilization of organic acids in pyruvate decarboxylation reaction occurring during the ripening process in fruits (Kaur *et al*., 2014) [22].

Initial value of ascorbic acid was recorded as 10.10 mg per 100 g in fresh peach (Table 5). Effect of treatments on ascorbic acid showed that T_3 (ethylene absorber + 4 perforations) recorded highest ascorbic acid content of 9.84 mg per 100 g followed by T_6 (oxygen absorber + 4 perforations) with ascorbic acid content of 9.79 mg per 100 g after 7 days of storage. However, after 28 days of storage the highest ascorbic acid of 9.57 mg per 100 g was recorded in T_3 (ethylene absorber + 4 perforations) followed by T_6 (oxygen absorber + 4 perforations) having value of 9.50 mg per 100 g. The maximum mean ascorbic acid content of 9.73 mg per 100 g in low density polyethylene was recorded in T_3 (ethylene absorber + 4 perforations). The higher retention of ascorbic acid in fruits packed in treatment T_3 (ethylene absorber + 4 perforation) might be due to the balance created by amount of escaped gases via perforated layer as well as gases entering the film (Singh *et al*., 2014) [31]. Storage period significantly influenced the ascorbic acid content and showed a decreasing trend. The ascorbic acid content decreased from initial value of 10.10 to 9.35 mg per 100 g during 28 days of storage. The decrease in ascorbic acid during storage might be due to oxidation of L - ascorbic acid into dehydro - ascorbic acid (Mapson, 1970) [32]. Singh and Mandal (2006) [33] also reported similar results with respect to ascorbic acid content during packaging and storage of peach fruits.

Among treatments, T_3 (ethylene absorber + 4 perforations) recorded maximum total phenols of 61.36 mg/100 g (Table 5) whereas, T_1 (control) recorded the minimum mean total phenol as 60.00 mg/100 g. Both perforated and non perforated treatments recorded higher total phenol than control which might be due to an increase in activity of phenyl propanoid pathway under stressful conditions as evident from synthesis and accumulation of phenolic compounds (Kang and Saltveit, 2002) [34]. The total phenol content decreased gradually with progression of storage period from 62.39 to 59.01 mg per 100 g. This reduction in total phenols was explained through research that showed that phenols might have been used as substrate for polyphenol oxidase enzyme (Janovitz- Klappy *et al*., 1990) [35]. The reduction in total phenols could also be explained by the conversion between free and bound phenolic substances (Ferrante and Maggiore, 2007) [36]. The results are in conformity to the findings of Rai *et al*. (2011) [37] who also reported a decrease in total phenols with storage in jamun.

Among treatments, T_1 (control) recorded minimum mean antioxidant activity of 16.87 per cent (Table 6). However, T_3 (ethylene absorber + 4 perforations) recorded highest antioxidant activity of 17.63 per cent. The antioxidant activity decreased slightly for non perforated samples which might be due to the higher level of head space CO_2 observed in these packages which might have prevented the action of antioxidant (Rai *et al*., 2011) [37]. During storage the antioxidant activity decreased significantly from 17.55 to 16.75 per cent. The decrease in content of antioxidants during storage was also reported by Utto *et al*. (2012) [38]. The antioxidant activity analysed for different treatments of peach stored at refrigerated conditions could be the result of synergetic influence of overall phenolic composition and it decreased simultaneously with total phenol content (Serea *et al*., 2014) [39].

Table 6 pertaining to mean score awarded to the overall acceptability of packed peach revealed that after 7 days of storage the maximum overall acceptability score of 7.27 was recorded in T_3 (ethylene absorber + 4 perforations) while as, minimum score of 6.87 was recorded in T_1 (control). However, after 21 days of storage the highest scores of 7.64 in low density polyethylene was recorded in treatment T_3 (ethylene absorber + 4 perforations) which then decreased to 7.55 after 28 days of storage, respectively. However, lowest scores of 6.81 was recorded for T_1 (control) after 28 days of storage. The overall acceptability scores increased significantly with the advancement of storage period upto 21 days of storage and then followed a decreasing trend. The overall acceptability increased from initial value of 6.37 to 7.45 after which the overall acceptability scores decreased to 7.28 after 28 days of storage. These results are in agreement with the findings of Sohail *et al*. (2015) [40] also observed similar trend in overall acceptability during storage.

Table 1: Effect of treatment and storage on physiological loss in weight (%) and decay percentage in peach during refrigerated storage

Treatment	Physiological loss in weight					Decay percentage				
	Storage period (Days)					Storage period (Days)				
	7	**14**	**21**	**28**	**Mean**	**7**	**14**	**21**	**28**	**Mean**
T_1 (Control)	4.98	5.26	6.28	6.87	5.60	-	8.65	15.07	20.62	11.09
T_2 (Ethylene absorber + 0 perforation)	2.61	3.24	3.96	4.34	3.40	-	3.15	6.47	12.81	5.61
T_3 (Ethylene absorber + 4 perforations)	2.29	2.87	3.56	4.03	3.06	-	-	2.96	7.50	2.62
T_4 (Ethylene absorber + 8 perforations)	2.53	2.99	3.75	4.12	3.21	-	-	4.19	10.68	3.72
T_5 (Oxygen absorber + 0 perforation)	3.85	4.19	4.65	4.87	4.21	-	3.44	9.11	17.90	7.61
T_6 (Oxygen absorber + 4 perforations)	3.31	3.56	3.95	4.29	3.63	-	-	4.28	11.34	3.91
T_7 (Oxygen absorber + 8 perforations)	3.68	3.92	4.28	4.50	3.93	-	-	7.33	13.75	5.27
Mean	3.32	3.72	4.35	4.72		-	2.18	7.06	13.51	

Initial value (0 day): -
$C.D_{0.05}$
Storage (A) = 0.03 Storage (A) = 0.01
Treatment (B) = 0.03 Treatment (B) = 0.02
A x B = 0.07 A x B = 0.03

Table 2: Effect of treatment and storage on specific gravity and L* value in peach during refrigerated storage

Treatment	Specific gravity					L^* value				
	Storage period (Days)					Storage period (Days)				
	7	**14**	**21**	**28**	**Mean**	**7**	**14**	**21**	**28**	**Mean**
T_1 (Control)	0.985	0.978	0.969	0.960	0.973	55.17	55.51	55.86	56.32	55.72
T_2 (Ethylene absorber + 0 perforation)	0.970	0.966	0.961	0.952	0.962	55.43	55.92	56.06	56.73	56.04
T_3 (Ethylene absorber + 4 perforations)	0.963	0.951	0.950	0.942	0.951	56.77	57.03	57.48	57.73	57.25
T_4 (Ethylene absorber + 8 perforations)	0.966	0.958	0.956	0.948	0.957	56.20	56.32	56.70	57.09	56.58
T_5 (Oxygen absorber + 0 perforation)	0.980	0.973	0.965	0.957	0.969	55.36	55.72	56.00	56.57	55.91
T_6 (Oxygen absorber + 4 perforations)	0.975	0.968	0.960	0.950	0.963	56.35	56.65	56.86	57.20	56.77
T_7 (Oxygen absorber + 8 perforations)	0.978	0.970	0.963	0.954	0.966	55.64	56.13	56.30	56.89	56.24
Mean	0.974	0.966	0.961	0.952		55.85	56.18	56.47	56.93	

Initial value (0 day): -
$C.D_{0.05}$
Storage (A) = 0.01 Storage (A) = 0.01
Treatment (B) = 0.01 Treatment (B) = 0.01
A x B = 0.02 A x B = 0.01

Table 3: Effect of treatment and storage on a* value and b * value in peach during refrigerated storage

Treatment	a* value					b * value				
	Storage period (Days)					Storage period (Days)				
	7	14	21	28	Mean	7	14	21	28	Mean
T_1 (Control)	4.69	5.25	5.74	6.23	5.48	24.68	25.38	26.10	26.73	25.72
T_2 (Ethylene absorber + 0 perforation)	4.76	5.37	5.93	6.47	5.63	25.15	26.06	27.35	28.45	26.75
T_3 (Ethylene absorber + 4 perforations)	5.04	5.60	6.28	6.75	5.92	27.88	28.10	28.97	29.85	28.70
T_4 (Ethylene absorber + 8 perforations)	4.82	5.43	6.12	6.62	5.75	26.65	27.47	28.01	29.61	27.94
T_5 (Oxygen absorber + 0 perforation)	4.71	5.16	5.86	6.38	5.53	24.75	25.29	26.62	27.22	25.97
T_6 (Oxygen absorber + 4 perforations)	4.89	5.43	6.19	6.67	5.80	27.55	27.86	28.70	29.71	28.46
T_7 (Oxygen absorber + 8 perforations)	4.78	5.37	6.02	6.55	5.68	26.21	27.05	27.9	28.93	27.52
Mean	4.81	5.37	6.02	6.52		26.12	26.74	27.66	28.64	
Initial value (0 day): - $C.D_{0.05}$ Storage (A) = 0.02 Storage (A) = 0.01 Treatment (B) = 0.03 Treatment (B) = 0.02 A x B = 0.02 A x B = 0.01										

Table 4: Effect of treatment and storage on total soluble solids (^{0}B) and titratable acidity (% citric acid) in peach during refrigerated storage

Treatment	TSS					Titratable acidity				
	Storage period (Days)					Storage period (Days)				
	7	14	21	28	Mean	7	14	21	28	Mean
T_1 (Control)	10.17	10.36	11.29	10.76	10.65	0.78	0.76	0.72	0.68	0.74
T_2 (Ethylene absorber + 0 perforation)	9.99	10.16	10.75	10.21	10.28	0.82	0.81	0.79	0.76	0.80
T_3 (Ethylene absorber + 4 perforations)	9.92	10.05	10.73	10.17	10.22	0.83	0.81	0.80	0.78	0.81
T_4 (Ethylene absorber + 8 perforations)	10.02	10.19	10.85	10.28	10.34	0.82	0.80	0.78	0.77	0.79
T_5 (Oxygen absorber + 0 perforation)	10.09	10.25	11.10	10.52	10.49	0.80	0.77	0.74	0.72	0.76
T_6 (Oxygen absorber + 4 perforations)	10.03	10.21	10.96	10.47	10.42	0.81	0.78	0.75	0.75	0.77
T_7 (Oxygen absorber + 8 perforations)	10.13	10.27	11.19	10.68	10.57	0.79	0.77	0.74	0.71	0.75
Mean	10.05	10.21	10.98	10.44		0.81	0.79	0.76	0.74	
Initial value (0 day): - $C.D_{0.05}$ Storage (A) = 0.01 Storage (A) = 0.01 Treatment (B) = 0.02 Treatment (B) = 0.02 A x B = 0.02 A x B = N.S										

Table 5: Effect of treatment and storage on ascorbic acid (mg/100g) and total phenol (mg/100g) in peach during refrigerated storage

Treatment	Ascorbic acid					Total phenol				
	Storage period (Days)					Storage period (Days)				
	7	14	21	28	Mean	7	14	21	28	Mean
T_1 (Control)	9.28	9.18	9.09	8.89	9.11	61.85	61.02	58.91	58.20	60.00
T_2 (Ethylene absorber + 0 perforation)	9.72	9.65	9.51	9.49	9.59	62.22	61.15	60.14	58.96	60.62
T_3 (Ethylene absorber + 4 perforations)	9.84	9.80	9.70	9.57	9.73	63.03	61.82	60.77	59.81	61.36
T_4 (Ethylene absorber + 8 perforations)	9.57	9.50	9.43	9.35	9.46	62.59	61.38	60.35	59.12	60.86
T_5 (Oxygen absorber + 0 perforation)	9.66	9.58	9.48	9.42	9.54	62.11	61.06	59.97	58.80	60.49
T_6 (Oxygen absorber + 4 perforations)	9.79	9.71	9.60	9.50	9.65	62.69	61.73	60.56	59.25	61.06
T_7 (Oxygen absorber + 8 perforations)	9.51	9.40	9.33	9.26	9.38	62.26	61.29	60.24	58.95	60.69
Mean	9.62	9.55	9.45	9.35		62.39	61.35	60.13	59.01	
Initial value (0 day): - $C.D_{0.05}$ Storage (A) = 0.01 Storage (A) = 0.02 Treatment (B) = 0.01 Treatment (B) = 0.04 A x B = 0.01 A x B = 0.05										

Table 6: Effect of treatment and storage on antioxidant activity (%) and overall acceptability (hedonic score) in peach during refrigerated storage

Treatment	Antioxidant activity					Overall acceptability				
	Storage period (Days)					Storage period (Days)				
	7	14	21	28	Mean	7	14	21	28	Mean
T_1 (Control)	17.23	17.05	16.92	16.26	16.87	6.87	7.12	7.12	6.81	6.98
T_2 (Ethylene absorber + 0 perforation)	17.51	17.45	17.25	16.84	17.26	7.04	7.39	7.51	7.36	7.33
T_3 (Ethylene absorber + 4 perforations)	18.01	17.90	17.56	17.03	17.63	7.27	7.55	7.64	7.55	7.50
T_4 (Ethylene absorber + 8 perforations)	17.79	17.60	17.48	16.92	17.45	7.16	7.50	7.58	7.45	7.42
T_5 (Oxygen absorber + 0 perforation)	17.31	17.20	17.03	16.59	17.03	6.90	7.26	7.34	7.15	7.16
T_6 (Oxygen absorber + 4 perforations)	17.55	17.46	17.34	16.90	17.31	7.05	7.35	7.51	7.37	7.32
T_7 (Oxygen absorber + 8 perforations)	17.48	17.36	17.14	16.72	17.18	6.99	7.33	7.42	7.28	7.26
Mean	17.55	17.43	17.25	16.75		7.04	7.36	7.45	7.28	
Initial value (0 day): - $C.D_{0.05}$ Storage (A) = 0.01 Storage (A) = 0.01 Treatment (B) = 0.02 Treatment (B) = 0.01 A x B = 0.02 A x B = 0.01										

4. Conclusion

It is therefore concluded that active packaging of peach fruits in LDPE bags containing sachet of ethylene absorber (@5g/kg) + 4 perforations was the most effective treatment for extension of shelf life and retention of storage quality of peach fruits under refrigerated conditions. Active packaging reduced PLW and decay in peach fruits and retained ascorbic acid, total phenols, antioxidants and colour of fruits during storage.

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