

Response of Pear To Coatings During Ambient Storage

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Abstract

Coating of fruits is an easy and effective method to conserve the moisture loss after harvest and during storage. A study was conducted to evaluate the effect of various coating materials on the shelf life and quality of pear cv. Pathernakh stored under ambient conditions. Petroleum jelly when used as coating on fruits performed better than other coating treatments. Fruits coated with petroleum jelly showed minimum shrinkage (8.93 %) and PLW (8.43 %), it was also helpful to maintain firmness (10.86 lb/sq. cm) of the pear fruit. Similarly, maximum T.S.S. (12.47 °brix) and acidity (0.27 %) of the pear fruit was observed in fruits coated with petroleum jelly. Pear fruits coated with petroleum jelly also helped to maintain the pH, ascorbic acid content (2.97 mg/100 g pulp) and total sugar content (9.18 %). Petroleum jelly coating treatment was closely followed by chitosan coating. All the coating treatments were helpful to maintain the quality attributes of the fruit and also improved the shelf life of fruit up to 12 days. Highest antioxidant activity (75 %) was recorded in petroleum jelly coated pear fruits on the 12th day of storage.

Keywords: Pathernakh, pear, coating, postharvest, quality, shelf life

Introduction

Fruits are important for mankind as they are nutritive, refreshing and provide necessary elements for maintenance of good health. Fruits hold an immense value in formulating a balanced diet. India is bestowed with a wide variety of climate that holds good for cultivation of variety of fruits. Among fruit crops, pear (*Pyrus communis* L.) holds an important place. The fruit is rich in vitamins, juice content and is a wholesome fruit for consumption. Pear is liable to more post harvest losses as compared to other fruits due to high moisture content. Since pear is a climacteric fruit, any means that can check the respiration of the harvested fruits can cause an increment in the shelf life of the fruit, application of coatings on freshly harvested fruits have been tried with different concentrations. Coatings can significantly improve the longevity of the

harvest. The application of edible coating provides modified atmosphere which bring change in physiological or biochemical processes due to control of gaseous exchange and atmospheric condition around the fruits. This further reduces qualitative and quantitative loss of fruits by controlling the internal atmosphere composition and reducing respiration and transpiration rate of the individual fruit.

Materials and methods

The present investigations were conducted in Post graduate Laboratory, Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara during the year 2018. Freshly harvested fruit of pear cv. Patharnakh having uniform size, free from any kind of disease, scar or lesions were procured from Department of Horticulture, Punjab Agricultural University, Ludhiana. A total of 7 coating materials were used viz. T₁:Guar Gum, T₂: Chitosan, T₃: CaCl₂, T₄: Aloe vera, T₅: Pectin, T₆: Bee wax, T₇: Petroleum jelly and T₈: untreated (control). The experiment was laid out in CRD (Complete Randomized Block Design) with three replications. The fruits were stored in corrugated Fiber Board boxes with perforations and were stored at ambient conditions (room temperature 28-35°C and 60-67% RH) and data was recorded at 0, 4, 8 and 12 days in ambient storage.

Physiological loss in weight percent (PLW) was calculated by subtracting final weight of the fruit from the initial weight of fruit and expressed as percentage. Fruit firmness was noted with the help of Penetrometer and expressed as lbs/cm². Total soluble solids, acidity and ascorbic acid content were estimated as per A.O.A.C. (1990). Total and reducing sugars were estimated by the Lane and Eynon method, as explained by Ranganna (1986). The antioxidant activity of pears was estimated through DPPH method as described by Sánchez-Moreno *et al.* (2003).

The data were analyzed statistically using statistical analysis tool SPSS v. 21 to identify the homogenous subsets using Duncan's Multiple Range Test.

Results and discussion

Fruit shrinkage (%): Fruits coated with petroleum jelly (T₇) were able to maintain minimum fruit shrinkage (8.93%) as compared to the maximum shrinkage (14.73%) and minimum physiological loss in weight of pear fruits (8.43%) was recorded under the treatment T₇ (coating

with petroleum jelly). Coatings form an impregnable layer on the fruit surface which prevents the loss of moisture from the fruit. This in turn reflects in the minimum loss in fruit size as compared to untreated/uncoated fruits as was reflected as was reflected due to the application of petroleum jelly. Similar findings have been reported by Han *et al.* (2004), El-Anany *et al.* (2009) and Goncalves *et al.* (2010), who reported a reduced shrinkage incidence in strawberries, apple and plums, respectively on application of different surface coatings. Despite the difference in the nature of coating materials, all the coating materials were able to reduce the physiological weight loss in pear as compared to control. Again the hurdle effect of coatings can be attributed to this wherein a barrier is created between the fruit surface and the immediate environment of the fruit which enables the fruit to conserve the moisture thereby curtailing the weight loss. Similar observations have been reported by Navarro- Tarazaga *et al.* (2011) for plums, Zhou *et al.* (2008) for coated pears and Martinez- Romero *et al.* (2006) in coated sweet cherry.

Fruit firmness (lb/inch²): Fruit firmness was evaluated before the application of coating treatments and average value (17.15 lb/sq inch) was taken for calculation of change in fruit firmness at 4 days, 8 days and 12 days. Fruits with coating treatment T₇ (petroleum jelly) have highest fruit firmness (10.86 lb/sq inch) during 12 days of storage at ambient condition followed by treatment T₂ (chitosan) having fruit firmness (10.51 lb/sq inch), respectively. Coatings appeared to reduce the respiration rate of the fruit and delaying degradation of the cell wall polymers and thus improved firmness of the fruit. Previous studies have concluded a similar performance of delaying softness by shellac coatings (Bai *et al.*, 2002), Semperfresh (Yurdugul, 2005) and by chitosan (Chien *et al.*, 2007)

Bio-chemical Characters of the Fruits: The biochemical analysis of the fruit was carried out at the interval of 4 days from the beginning of the treatment application. On the first day, the biochemical parameters of the fruit were determined before application of treatment and the change in value was analyzed at 4 days, 8 days and 12 days. The average value of chemical parameters on very first day has been presented in table 3. Maximum T.S.S of pear fruits (12.47°Brix) was recorded at 8th day under treatment T₇ (petroleum jelly) which was at par with treatment T₂ (chitosan) having T.S.S of (12.36°Brix). However the TSS of pear fruits showed a decreasing Trend as the storage period extended beyond 8 days. On 12th day, maximum TSS (10.86°Brix) was recorded under treatment T₇ (petroleum jelly) whereas minimum TSS

(10.30°Brix) was recorded under treatment T₈ (uncoated/control). Increase in fruit TSS is a promising attribute as it makes the fruit more suitable for consumption. However, it also marks the progression towards spoilage. Maximum increase in TSS under petroleum jelly coating treatment is a testimony of the fact that this coating treatment was able to suppress the enzymatic changes inside the fruit in a better way as compared to other coating treatments. The results are in accordance with that reported by Zhou *et al.* (2008) in pears wherein compared with the control, Semperfresh and carboxymethyl chitosan coated fruits, the shellac coated pears retained higher total soluble solids.

Data pertaining to the effect of coatings on the fruit acidity (%) at ambient conditions is presented in. Initially the titrable acidity of the fruit is (0.43 %) and the data reveals that acidity percentage showed a gradual decrease with increase in storage period (Table 5). Minimum acidity (0.10%) were recorded at the end of 12th day under treatment T₈ (uncoated /untreated fruit) during storage at ambient conditions. Maximum acidity was observed at 12th day (0.27%) under treatment T₇ (petroleum jelly) followed by treatment T₂ (chitosan) wherein an acidity of (0.26%) during storage at ambient conditions was recorded. The decrease in acidity is maybe due to the loss of carboxylic groups in the form of carbon dioxide in process of respiration. The loss has been ascribed to its utilization along with sugars as a partial substrate for respiration (Kays, 1991). Similar finding are given earlier by Valero *et al.* (2013) and Martinez-Romero *et al.* (2006) also showed more retention of titratable acidity in coated plums and coated sweet cherry as compared to uncoated/untreated fruits. Mahajan *et al.* (2011) also reported same trend of acidity in pear fruit cv. Pathernakh by using different coating materials under supermarket conditions as well as ordinary market conditions.

Ascorbic acid (mg/100g): Data pertaining to the effect of different coatings on shelf life and quality of pear is presented in Table 4.6. Analysis of the data presented in the table reveals that the content of ascorbic acid in pear fruits gradually decreased as the storage period progressed. Maximum ascorbic acid content were recorded in treatment T₇ (petroleum jelly) is 2.97 mg/100g of pulp followed by treatment T₂ (chitosan) wherein ascorbic acid content of 2.88 mg/100g of pulp was recorded at 12th day of storage. Minimum ascorbic acid content (0.97mg/100g of pulp) was recorded in treatment T₈ (uncoated/untreated fruits) is during 12th day storage interval. Ascorbic acid is an important nutrient and plays very important role in human diet. The

maximum ascorbic acid content was observed in fruits treated with petroleum jelly followed by 1339 hitosan. The less decrease in ascorbic acid content in treated fruits might be due to slow degradation rate of ascorbic acid and reduced metabolic activities. However, the ascorbic acid content decreased at faster rate in untreated fruits. Similar decrease in ascorbic acid content during storage was observed by Dhoot *et al.* (1984) in guava fruits. Kropp and Bin (1985) reported that apple fruits showed slight decrease in ascorbic acid content when treated with different coating and packaging materials as compared to untreated fruits. The effect of waxing may be due to modification of atmosphere inside the fruit, as a result high CO₂ and low O₂ environment causes lower activity of peroxide enzyme, which plays an important role in enzymatic degradation of ascorbic acid (Baldwin *et al.*, 1995).

Total Sugars: Total and reducing sugars were measured by the Lane and Eynon method, as described by Ranganna (1995). Data pertaining to the effect of different coatings on quality and shelf life of pear is presented in Table 4.7. Analysis of the data presented in the table reveals that the content of total sugars in pear fruits gradually increase initially then decreased as the storage period progressed. Maximum total sugar content found in treatment T₇(Petroleum jelly) (9.18 %) in 8th day and minimum (8.07%) in treatment T₈ (uncoated/untreated fruits) in 8th day after that it starts decreasing. Maximum total sugars at day 12th is 8.03% in treatment T₇ (petroleum jelly) and minimum total sugars 7.21% observed in 12th day in treatment T₈ (uncoated/untreated fruits). A marked increase in total sugars level during the early days of storage might be because of the loss of water and hydrolysis of starch and other larger molecules into simpler and soluble compounds like simple sugars due to the increased metabolic activities during ripening of fruits. However the decrease in total sugar with the corresponding prolongation in the storage periods may be due to its faster utilization of carbohydrates in senescence and oxidation process through Krebs's cycle (Singh *et al.*, 1987). The increasing sugars level during storage may be associated with hydrolysis of starch into sugars or breakdown of complex organic matters into simple soluble molecules. The increase in sugars content of fruits could be due to ripening process that led to the transformation of some carbohydrates components as starch to sugars by the enzymatic activities. The increased level of total sugar was probably due to conversion of starch and pectin into simple sugar, which declined later on during storage due to their rate of consumption for

respiration and other energy sources. Such information has been reported by Patel *et al.* (2011) in custard apple.

Reducing sugars: Reducing sugars were analysed by the Lane and Eynon method, as described by Ranganna (1995). Data pertaining to the effect of different coatings on quality and shelf life of pear is presented in Table 4.8. Analysis of the data presented in the table reveals that the content of reducing sugars in pear fruits gradually increase initially then decreased as the storage period progressed. Maximum reducing sugar content found in treatment T₇ (Petroleum jelly 6.16 %) in 8th day and minimum (5.05%) in treatment T₈ (uncoated/untreated fruits) in 8th day after that it starts decreasing. Maximum reducing sugars at day 12th is (5.54%) in treatment T₇ (petroleum jelly) and minimum total sugars (4.01%) observed in 12th day in treatment T₈ (uncoated/untreated fruits), the sugars are gradually increases end may be due to hydrolysis of polysaccharides, and organic acids responsible for acidity of fruits during storage. Similar findings reported by the Hussein *et al.* (2001) who found that reducing and total sugar increased in Golden delicious apple during storage.

Non-Reducing sugars: Data pertaining to the effect of different coatings on shelf life and quality of pear is presented in Table 4.9. Analysis of the data presented in the table reveals that the content of reducing sugars in pear fruits gradually increase initially then decreased as the storage period progressed. Maximum non reducing sugar content found in treatment T₁ (Guar gum) (3.38 %) followed by T₈ (uncoated/untreated fruits) (3.06%) in 12th day and minimum (2.33%) in treatment T₇ (petroleum jelly) and T₂ (chitosan) in 12th day of fruit stored at ambient conditions. A non uniform trend in the non-reducing sugar content of the pear fruits. However, the better performance of the T₇ treatment was equally matched by treatment T₂ (chitosan coating) and was at par with treatment T₆ (Bee wax coating)

Active acidity (pH): pH of pear fruits under different coating treatments has been presented under Table 4.10. The maximum pH value was recorded in treatment T₈ (untreated/uncoated fruits) at 12th day of storage 4.89 and minimum observations was recorded T₇ (petroleum jelly) at 12th day of storage 4.38 followed by treatment T₂ (chitosan) at 12th day of storage wherein a pH of 4.41 was recorded. There was raise the pH value with passing of storage period of the fruits. The minimum pH value were recorded 4.07 at 0 day of storage and maximum pH value were recorded is 4.89 at 12th day of storage at ambient condition. Fruits during storage it might be due

to change in acidity through biochemical changes within the fruit. Increase in pH during storage period. Similar observations are in accordance with findings of Khalid (1974) who found that pH value of mango juices increased during storage intervals. The same trends of pH are followed in the apple fruit are reported by Wojick (2001).

Antioxidant Activity: The antioxidant activity of the pear fruit determined with the help of DPPH free Radical Scavenging Activity. The data revealed that the antioxidant activity of the fruit gradually decreases with increases the time of storage period. Maximum antioxidant activity (75%) was observed in treatment T₇ (petroleum jelly). Minimum was recorded in T₈ (untreated/uncoated fruits) is (56%) at 12th day of storage at ambient condition. This result may be due to the coatings form of a protective layer on the surface of fruit which act as barrier between the surface of the fruit and environment. This helps to reduce water evaporation, preserves antioxidant activity, decreases nutrient loss, and prevents growth of rot-inducing microorganism. Similar observations are in accordance with findings of Kou, Xiao-Hong, et al. (2014) who found that antioxidant activity of the pear fruit decreases during storage interval.

Conclusion

Reduction in post harvest losses is the need of the hour to provide sustained nutrition to the growing population and reduce the post harvest losses. Coatings provide a practical alternative to preserve the fruit for longer duration of time thus increasing the shelf life and enhancing the marketability of the fruits.

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Table 1: Effects of different coatings on fruit size (cm²)/shrinkage(%) in pear cv. Patharnakh under ambient storage conditions.

Treatments	0 days	4 days	8 days	12 days	% Shrinkage
T ₁	281.61 ^b	267.88 ^b	253.72 ^{abc}	243.78 ^{ab}	13.46
T ₂	272.26 ^{ab}	263.68 ^{ab}	253.66 ^{abc}	240.90 ^{ab}	11.51
T ₃	306.53 ^b	294.40 ^b	277.61 ^c	270.22 ^b	11.84

T ₄	275.04 ^b	265.67 ^b	252.27 ^{bc}	240.97 ^b	12.39
T ₅	273.16 ^{ab}	261.31 ^{ab}	245.56 ^{ab}	235.42 ^{ab}	13.82
T ₆	307.77 ^b	302.30 ^b	285.13 ^{bc}	268.82 ^b	12.66
T ₇	215.32 ^a	211.60 ^a	202.46 ^a	196.04 ^a	8.93
T ₈	316.22 ^b	309.46 ^b	283.96 ^{abc}	269.66 ^{ab}	14.73

T₁= Guar Gum (6%), T₂= Chitosan (1%), T₃=CaCl₂(2%), T₄=Aloe Vera (50%), T₅=Pectin (3%), T₆=Bee Wax, T₇=Petroleum Jelly, T₈=Control

*Values with same alphabets are non-significant among themselves.

Table 2: Average value of biochemical parameters of pear fruit before the application of treatments.

S.No.	Biochemical parameter	Average value
1.	TSS (⁰ Brix)	11.16
2.	Acidity (%)	0.43
3.	Ascorbic acid (mg/100g)	3.84
4.	Total sugars (%)	7.85
5.	Reducing sugars (%)	4.93
6.	Non reducing sugar (%)	2.77
7.	pH	4.07
8.	Antioxidant activity (%)	88

Table 3: Effects of different coatings on Physiological weight loss and fruit firmness in pear cv. Patharnakhunder ambient storage conditions.

Treatments	PLW (%)			Fruit firmness (lb/inch ²)		
	4days	8days	12days	4days	8days	12days
T ₁	2.83 ^a	5.74 ^{ab}	11.81 ^{bc}	15.46 ^c	13.01 ^c	8.70 ^c
T ₂	2.09 ^a	4.30 ^a	8.70 ^a	16.25 ^g	14.37 ^g	10.51 ^f
T ₃	2.45 ^a	4.88 ^{ab}	9.36 ^a	15.86 ^e	13.64 ^e	9.12 ^d

T ₄	2.33 ^a	4.69 ^{ab}	9.30 ^a	16.07 ^f	13.98 ^f	9.87 ^e
T ₅	2.88 ^a	6.80 ^{bc}	12.08 ^c	15.11 ^b	12.65 ^a	8.45 ^b
T ₆	2.68 ^a	5.13 ^{ab}	9.62 ^{ab}	15.57 ^d	13.17 ^d	8.74 ^c
T ₇	2.00 ^a	4.29 ^a	8.43 ^a	16.44 ^a	14.59 ^h	10.86 ^g
T ₈	3.69 ^a	8.33 ^c	15.41 ^d	14.82 ^h	12.81 ^b	8.27 ^a

T₁= Guar Gum (6%), T₂= Chitosan (1%), T₃=CaCl₂(2%), T₄=Aloe Vera (50%), T₅=Pectin (3%), T₆=Bee Wax
T₇=Petroleum Jelly, T₈=Control

*Values with same alphabets are non-significant among themselves.

Table 4: Effects of different coatings on T.S.S, titratable acidity and ascorbic acid in pear cv. Patharnakhunder ambient storage conditions.

Treatments	TSS (°Brix)			Titratable acidity (%)			Ascorbic acid (mg/100g pulp)		
	4days	8days	12days	4days	8days	12days	4days	8days	12days
T ₁	11.58 ^c	11.38 ^c	10.48 ^c	0.32 ^a	0.22 ^b	0.14 ^c	3.19 ^c	2.43 ^b	1.64 ^c
T ₂	11.82 ^e	12.36 ^f	10.78 ^f	0.37 ^c	0.30 ^d	0.26 ^e	3.72 ^g	3.22 ^f	2.88 ^g
T ₃	11.69 ^c	11.84 ^{de}	10.59 ^d	0.36 ^c	0.28 ^d	0.20 ^d	3.36 ^e	2.82 ^d	2.08 ^e
T ₄	11.74 ^d	11.88 ^e	10.64 ^e	0.34 ^b	0.26 ^c	0.21 ^d	3.57 ^f	2.96 ^e	2.24 ^f
T ₅	11.54 ^{ab}	11.33 ^b	10.42 ^b	0.31 ^a	0.24 ^c	0.13 ^b	3.04 ^b	2.47 ^b	1.34 ^b
T ₆	11.65 ^c	11.81 ^d	10.52 ^c	0.32 ^a	0.26 ^c	0.18 ^c	3.27 ^d	2.64 ^c	1.81 ^d
T ₇	11.86 ^e	12.47 ^g	10.86 ^g	0.38 ^c	0.32 ^e	0.27 ^e	3.78 ^h	3.32 ^g	2.92 ^g
T ₈	11.51 ^a	11.25 ^a	10.3 ^a	0.31 ^a	0.20 ^a	0.10 ^a	2.94 ^a	1.87 ^a	0.92 ^a

T₁= Guar Gum (6%), T₂= Chitosan (1%), T₃=CaCl₂(2%), T₄=Aloe Vera (50%), T₅=Pectin (3%), T₆=Bee Wax
T₇=Petroleum Jelly, T₈=Control*Values with same alphabets are non-significant among themselves.

Table 5: Effects of different coatings on total sugars, reducing and non-reducing sugars in pear cv. Patharnakhunder ambient storage conditions.

Treatments	Total sugars (%)			Reducing Sugars (%)			Non-reducing sugars (%)		
	4days	8days	12days	4days	8days	12days	4days	8days	12days
T ₁	8.1 ^b	8.56 ^d	7.42 ^f	5.4 ^b	5.69 ^c	4.86 ^c	2.57 ^b	2.73 ^c	3.38 ^f
T ₂	8.35 ^{de}	9.09 ^g	7.89 ^d	5.6 ^{ef}	6.02 ^g	5.43 ^g	2.61 ^{bc}	2.91 ^e	2.33 ^a
T ₃	8.24 ^c	8.89 ^e	7.76 ^c	5.52 ^d	5.86 ^e	5.06 ^e	2.59 ^b	2.88 ^d	2.54 ^d
T ₄	8.31 ^d	9.01 ^f	7.83 ^d	5.58 ^e	5.91 ^f	5.31 ^f	2.60 ^b	2.94 ^e	2.43 ^b
T ₅	8.01 ^a	8.41 ^b	7.32 ^b	5.46 ^c	5.63 ^b	4.72 ^b	2.42 ^a	2.64 ^b	2.53 ^c
T ₆	8.11 ^b	8.52 ^c	7.37 ^b	5.32 ^a	5.8 ^d	4.92 ^d	2.65 ^c	2.58 ^a	2.36 ^a
T ₇	8.38 ^e	9.18 ^h	8.03 ^e	5.64 ^f	6.16 ^h	5.54 ^h	2.60 ^b	2.80 ^d	2.33 ^{ab}
T ₈	8.44 ^g	8.07 ^a	7.21 ^a	5.72 ^g	5.05 ^a	4.01 ^a	2.58 ^b	2.87 ^d	3.02 ^e

T₁= Guar Gum (6%), T₂= Chitosan (1%), T₃=CaCl₂(2%), T₄=Aloe Vera (50%), T₅=Pectin (3%), T₆=Bee Wax
T₇=Petroleum Jelly, T₈=Control

*Values with same alphabets are non-significant among themselves.

Table 6: Effects of different coatings on pH and antioxidant activity in pear cv. Patharnakhunder ambient storage conditions.

Treatments	pH			Antioxidant activity (%)		
	4days	8days	12days	4days	8days	12days
T ₁	4.25 ^d	4.42 ^d	4.76 ^e	76 ^{bc}	68 ^c	62 ^c
T ₂	4.14 ^{ab}	4.29 ^b	4.41 ^a	85 ^e	79 ^f	73 ^g
T ₃	4.19 ^c	4.37 ^c	4.52 ^c	80 ^d	73 ^e	67 ^e
T ₄	4.17 ^{bc}	4.32 ^b	4.48 ^b	83 ^d	74 ^e	69 ^f
T ₅	4.28 ^e	4.46 ^e	4.78 ^e	74 ^b	66 ^b	60 ^b
T ₆	4.22 ^d	4.38 ^c	4.59 ^d	78 ^{cd}	70 ^d	64 ^d
T ₇	4.12 ^a	4.24 ^a	4.38 ^a	86 ^f	80 ^g	75 ^h
T ₈	4.34 ^f	4.58 ^f	4.89 ^f	71 ^a	64 ^a	56 ^a

T₁= Guar Gum (6%), T₂= Chitosan (1%), T₃=CaCl₂(2%), T₄=Aloe Vera (50%), T₅=Pectin (3%), T₆=Bee Wax
T₇=Petroleum Jelly, T₈=Control

*Values with same alphabets are non-significant among themselves.