Scientific Research Council
International Journal of Agricultural and Environmental Research
FREE AND OPEN ACCESS
Available online at www.ijaaer.com
ISSN 2414-8245 (Online)
ISSN 2518-6116 (Print)
IJAER

RESPONSE OF COATING OF EDIBLE OIL AND STORAGE DURATION ON THE POST-HARVEST QUALITY ATTRIBUTES OF PEAR CV. LECONTE

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Abstract

A research on "Response of coating of edible oil and storage duration on the post-harvest quality attributes of pear cv. Leconte" was performed. The design of experiment used was Completely Randomized Design (CRD) with two factors and replicated three times. Edible oils i.e. Olive oil, Sunflower oil, Canola oil with control while storage durations i-e. 0 day, 8 day, 16 day, 24 day and 32 day were kept in the experiment. A significant result was observed regarding all the quality attributes of pear fruit with the application of edible oils coating and storage durations and their interaction was also recorded significant. Olive oil treated fruits showed the optimal results, maintained the pH of fruit juice (4.34), TSS (15.77 ^{0}Brix), titratable acidity (0.31%), ascorbic acid (8.39 mg.100g^{-1}), fruit firmness (3.76 kg.cm^{-2}) and juice content (64.97%). Among storage duration, extreme titratable acidity (0.37%), ascorbic acid (9.65mg.100g^{-1}), fruit firmness (4.39kg.cm^{-2}) and juice content (83.08%) was observed in 0 day of storage. The maximum fruit juice pH (5.06), TSS (23.23^{0}Brix) and weight loss (6.38%) was noted in 32 days of storage. Interactions between coating materials and storage durations also significantly influenced the quality parameters. Maximum pH of fruit juice (5.26), TSS (26.32^{0}Brix) and weight loss (7.76%) was noted in control pears at 32 day of storage. On the basis of findings it is recommended that pear fruits should be treated with olive oil and can be kept for 32 days for the improved quality and prolonged shelf life.

Key words: Pear fruit, Storage duration, Edible oil emulsion and Post-harvest.

INTRODUCTION

A famous fruit in Pomes called Pear (*Pyrus communis* L. cv. Leconte) having very thin skin, crispy flesh, rich juice and good taste. These characters make them very delicate and vulnerable to deterioration, characterized by shriveling, softening and decay (Hassan and Nurhan, 2004). Approximate area under pear cultivation in Pakistan is 2.0 thousands hectare with estimated production of 19.0 thousand tons, while in KP it is cultivated on 1.8 thousand hectare with the total production of 18.4 thousand tons (MINFAL, 2012). Pear is a delicious and nutritional fruit. Hundred grams of pear contain 83.2% water, 15.3g carbohydrates, 20 IU vitamin A, 0.4 vitamin C and 0.16g vitamin B (Westwood, 1978).

Pear fruits are highly perishable due to the quick softening and ripening bounds and are vulnerable to low temperature (Mailer, 2004). Due to poor post-harvest handling, inappropriate packing, management and storage of pear, producers and merchants in Pakistan face 19-32% losses in pear production (Leblanc *et al.*, 1996). During transportation and handling, the perishable nature of pear is also a serious limitation. Therefore, certain practices are required for maintenance of pears to enhance its shelf life (Hassan and Nurhan, 2004). The post-harvest life of fruits can be maximized by selecting the best adopted cultivars, coating with edible oil and storage at optimum temperature (Strief, 1996). Pear harvested at yellow color, ripen stage are more expose to mechanical damages, little storage life due to more moisture content and greater chance to pathogens attack. It is a big challenge to prevent pear fruit harvested at mature stage and increase its post-harvest life (Hribar *et al.*, 1996).

Edible coating stuffs are natural substances like polysaccharides, proteins and wax etc (Moldao-Martins *et al.*, 2003). Edible oils are best storage coating material for fresh agricultural produce having no side effect on health (Ozden and Bayindirli, 2002). Edible oil coatings have the ability to decrease decay percentage, extend shelf life and retain all the quality attributes of horticulture commodity (Baldwin *et al.*, 1999). Coating inhibits respiration, reduce water loss, maintain texture, retain flavor and decline pathogen attack and growth in fruits and vegetables which ultimately increase its shelf life quality (Han *et al*., 2004). Pear is highly perishable and has reduced shelf life due to rapid respiration rate after harvest. This leads pear fruits to consume oxygen and produce water and carbon dioxide. To keep pears fruit fresh for a longer period of time, its respiration speed should be decreased without damaging the fruit by application of appropriate and suitable edible oil coating, low temperature and control atmosphere (Akhtar *et al*., 2010). In this study different edible oil coating materials on *Pyrus communis* (Pear) fruits at control atmosphere storage of refrigerator was used to reduce the post-harvest losses. For this reason the use of coating materials i-e. olive oil, sunflower oil and canola oil were compared with control (without coating) with the objectives to observe the best covering material to keep the quality of Pear, to study the influence of various storage durations on quality of pear fruit and to determine the interactive effect of coating material and storage duration on pear fruits.

MATERIALS AND METHODS

The experiment was carried out in Horticulture Post-Harvest Lab at the Department of Horticulture, The University of Agriculture, Peshawar-Pakistan during 2016. The fruits were harvested from Newly Developmental Farm, The University of Agriculture Peshawar at physiological maturity stage and stored at temperature of $8\text{-}10\pm1C^0$ with relative humidity 80-90%. Total numbers of fruits collected were 300 and each treatment was comprised of 60 fruits.

Experimental Design and treatment combination: The experiment was laid down as Completely Randomized Design, with two factors A and B. Factor A constitute different coating material i-e olive oil, sunflower oil, canola oil and control, while factor B was different storage durations i-e. 0 day, 8 day, 16 day, 24 day and 32 day.

Emulsion method: Pear fruits of each replication were treated with different oils including canola, olive and sunflower with muslin cloth and one treatment was kept control. Then fruits were stored for further studies.

Percent fruit weight loss: Digital balance was used to measure the fresh weight and after 8, 16, 24, 32 storage days of interval. Moreover, the weight loss (%) was estimated by removing present weight from the fresh weight by the following formula.

$$\text{Weight loss (\%)} = \frac{\text{fresh fruits weight (g)} - \text{weight after storage interval (g)}}{\text{fresh fruits Weight (g)}} \times 100$$

Fruit firmness (kg.cm^{-2}): Hand held penetrometer (Effigi, FT-011) with 8mm probe was used to measure the pear fruit firmness. The fruit was grasped in a hand and a section of skin was removed to expose the edible pulpy part. The readings were noted in kg.cm^{-2} and then averages were figured out (Pocharski *et al*., 2000).

Percent juice content (%): Through electronic balance pear fruits were weighted. The juice was taken out from the pears and was then weighed. Using the equation given below, juice contents (%) were determined (Bisen *et al*., 2012).

$$\text{Percent juice (\%)} = \frac{\text{Average juice weight (g)}}{\text{Average fruit weight (g)}} \times 100$$

pH of the fruit juice: The pH of unsystematic chooses pear fruit was determined, using pH meter (Model No. INOLAB. pH 720). To standardize the pH meter, a buffer solution was used before sample analysis. pH meter was dipped in sample of pear juice and reading was noted on the scale of pH meter (Jan *et al*., 2012).

Total soluble solids (°Brix): For the determination of total soluble solids an instrument called refractometer. Sample of pear juice was placed on a clean prism of refractometer and flap was closed. Through the eyepiece the result was noted from the scale (Iqbal *et al*., 2012).

Titratable acidity (%): Percent titratable acidity was evaluated by neutralizing the acids present in pear juice using a standard base. For titration, the end point was changed in color of pH sensitive dye (phenolphthalein) according to AOAC (2005) procedure.

Procedure: The titratable acidity of pear fruit juice was measured by treating the juice sample with base sodium hydroxide (NaOH) to a chosen end point. 10ml juice sample was taken with the help of pipette and was transferred to beaker. Volume was raised upto 100ml with distilled water. Sample of 10ml juice was collected and poured into beaker. Phenolphthalein 2 drops were added and then stirred. The sample was then titrated against the base (NaOH) solution. After the appearance of pink color, the titration was stopped. The final burette reading was noted and percentage of titratable acidity was calculated using the equation given below.

$$\text{Percent titratable acidity (\%)} = \frac{N \times T \times F \times 10}{D \times S} \times 100$$

Where N = Normality of NaOH, T = ml of 0.1 N NaOH used, F = contant acid factor 0.0067 (citric acid), D = ml of sample taken of pear juice, S = ml of diluted sample taken for titration.

Ascorbic Acid content (mg. 100g^{-1})

For the evaluation of ascorbic acids content, dye method was followed as described by Bisen *et al*. (2012). The data analysis was expressed as 100ml^{-1}.

Procedure:10ml pear juice sample was extracted and poured into a beaker. Volume was raised to 100ml with help of oxalic acid.10 percent solution was formed. From that solution 10ml sample was taken and was titrated against dye placed in a burette. The titration was stopped after the appearance of pinkish color. The vitamin C contents were figured with the formula given.

$$\text{Ascorbic acid content (mg/100g)} = \frac{F \times T \times 100}{D \times S} \times 100$$

Statistical Analysis:

Samples data was analyzed statistically by using CR design. Results were analyzed using ANOVA and means were compared by applying LS design as reported by Jawandha *et al.*, 2017 at 5% probability level.

RESULTS AND DISCUSSION

Weight loss (%): A significant variation for weight loss (%) was found among edible coating oil, storage duration as well as in their interaction. Interaction of coating materials and storage durations shows significant effect on the fruit weight loss (figure-1). At first day of storage there is no weight loss observed in all untreated and treated fruits, while the maximum weight loss (7.76%) was recorded in untreated fruits at 32 day of storage.

Respiration, transpiration and metabolic activities regulate the weight loss in fruits (Veravrbeke *et al.*, 2003). Weight loss of the fruit occurs due to the evaporation from the fruit surface, for this purpose olive oil coating acts as a barrier to stop evaporation from fruit surface. Thus minimum weight loss occurs with lower evaporation rate. To decrease the loss of fruit weight, strong coatings contribute to maintain the fruit weight and maximize the storage life (Baldwin *et al.*, 1999). Wills *et al.* (1998) investigations are in line with our outcomes who showed that membrane permeability and degradation of cell wall during ripening time causes evaporation from the surface of the fruit therefore in order to maximize the shelf life of horticulture commodity, coating is the best way to sustain the fruit weight. Similarly weight loss also depends upon the nature of coating as well as the fruit skin.

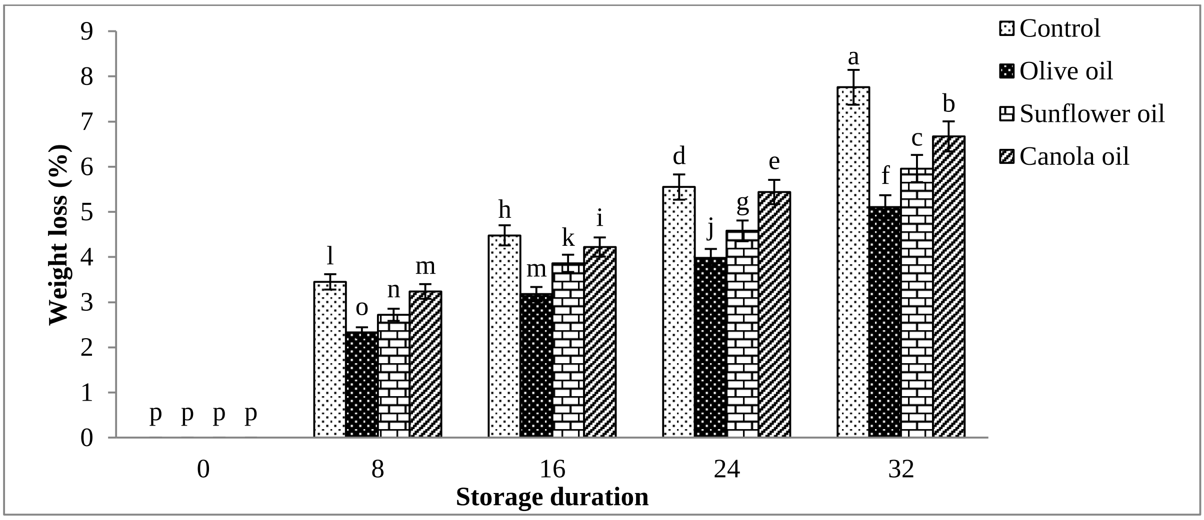

Figure 1- Interaction effect of covering materials and storage durations on the weight loss of pear fruit

Fruit firmness ($kg.cm^{-2}$): A significant interaction of various coating materials and storage durations on fruit firmness is presented in figure-2. Highest fruit firmness ($4.45 kg.cm^{-2}$) was observed in olive oil treated fruits at 0 day storage, however lowest fruit firmness (1.63 $kg.cm^{-2}$) was observed in untreated fruits on 32 day of storage.

The postharvest respiration of the fruits is slow down by the application of olive oil coating, which also contribute in controlling the catabolic action and sustaining the firmness of the fruit. The conversion of the insoluble protopectins into soluble pectin and pectic acid decreases the fruit firmness, also the de polymerization of the pectin chain during the fruit ripening and poly galacturonase degradation decreases the fruit firmness (Arowora *et al.*, 2013). Findings of our experiment are similar with Zhu *et al.* (2008) who reported that maintaining fruit firmness, thick coat application is quite useful which maximize the storage life of mango fruit. Similarly, Sumnu and Bayindirli (1995) reported that the decrease in the process of fruit firmness may be due to the existence of oxygen which causes the formation of de hydro ascorbic acid from ascorbic acid. Likewise, transpiration from the fruits surface also reduced firmness of fruits.

Juice Content (%): Juice content (%) of the fruits is demonstrated in Figure-3. Our findings displayed that covering material, storage duration and their interactions had significant effect on juice content (%) of pear fruits. Data of interactions among storage duration and coating types significantly affected the juice content of the fruit. Maximum juice content (83.12 %) was noted in sunflower oil treated fruits at 0 day of storage, however minimum juice content (32.27%) was noted in untreated fruits at 32 day of storage (figure-3). Juice contents in pear fruits significantly decreases due to the increase in storage durations. High losses in the juice content occur due to the damage to the natural surface coating (Dang *et al.*, 2008). The senescence and ripening process in fruits causes many qualitative changes, like firmness, decrease in aroma, total acidity and color development

(Wills *et al*., 1981). Olive oil significantly retained percent juice content by lowering the rates of respiration and transpiration from the fruit surface. Robertson *et al*., (1990) stated that the application of different coatings may help in retaining the moisture content in horticultural commodity and also maintained the fruit juice content. Similar findings were also reported by Park (1999) who published that thick coating on fruits are capable to retain the fruits water content.

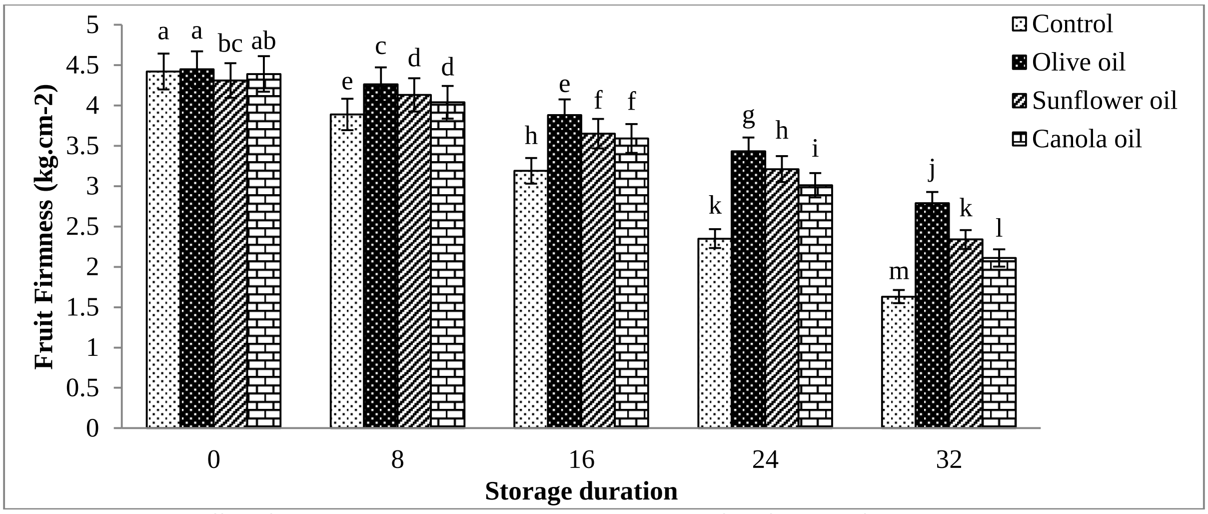

Figure-2. Interaction effect of covering materials and storage durations on the fruit firmness of pear.

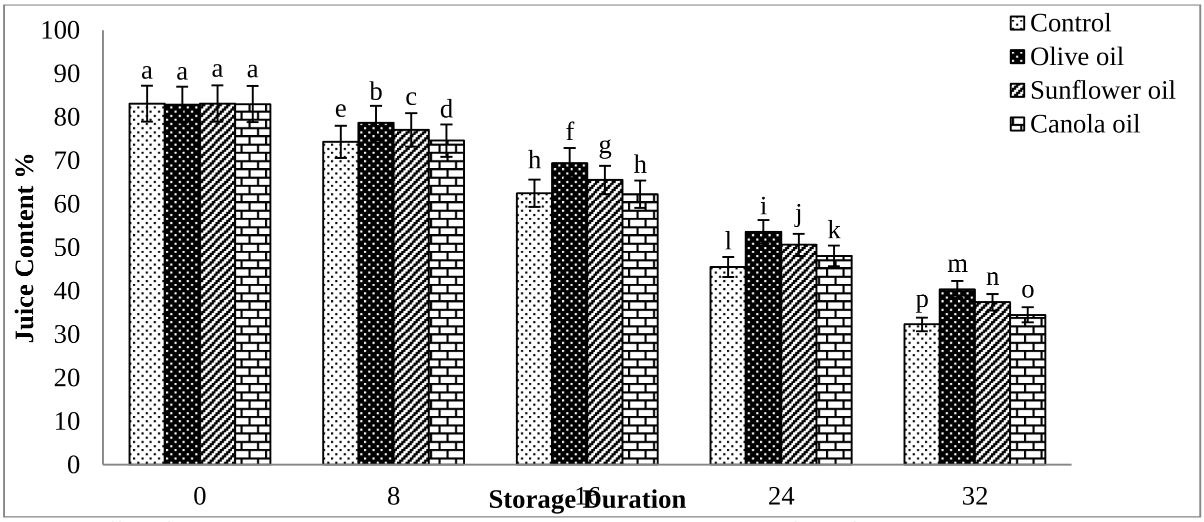

Figure 3- Effect of covering materials and storage durations on the juice content (%) of pear fruits.

Total soluble solids (^{0}Brix): Covering material, storage durations and their interaction significantly influenced total soluble solids (^{0}Brix) of the pear fruits. Interaction data (figure-4) shows that different covering materials and storage durations had significantly affected total soluble solids of pear fruits. Highest total soluble solids (26.32^{0}Brix) was recorded in untreated fruits at 32 day of storage, while the lowest total soluble solid (12.27^{0}Brix) was inspected in fruits treated with canola oil at 0 day of storage. With the increase in duration of storage the total soluble solids also rises because the starch is converted into sugar and also because of the hydrolysis of polysaccharide of cell wall. The key factor to determine the fruit quality is soluble solids (Baldwin, 1994). A negative co-relation was found between storage life and total soluble solids in fruits treated with olive oil, the reason behind this is the increase in the respiration process after harvesting but the thick coat reduces the process of respiration and hence results in reducing the production of ethylene and respiration process (Mailer, 2004). These findings are much similar with Rojas-Grau *et al*. (2007) who declared that prolonging the fruit ripening, the reduction in the post-harvest process of respiration occurs, which might also lower the process of starch conversion to sugars which is useful in maintaining the total soluble solids of the fruits.

pH of fruit juice: Storage durations, different covering materials and their interactions had a significant influence on pH of the pear fruits (figure-5). Interaction data revealed that at 0 day storage pH of fruit juice of all fruits were statistically same. The collected data demonstrated that the maximum pH (5.26) was noticed in untreated fruits juice at 32 day of storage, while the minimum pH (3.80) was scrutinized in fruits juice treated with olive oil at 0 day of storage.

Fruit ripening process is slow down by the coatings of fruits that results in sustaining the color, aroma, taste along with high shelf life of the commodity (Dang *et al*., 2008). There are several reasons responsible for changing the pH during the storage conditions which include changes in the fruit biochemical conditions by the application of treatments, reduced respiration rate as well as the metabolic process. During the last storage periods an increase in the pH occurs but with lower rate, due to the water vapors inside the pack that causes saturation of the pack atmosphere (Elham *et al*., 2013). Raese and Drake (1993) also reported similar results, who stated that the application of edible oil coating delays the ripening process of the fruits, as olive oil coating lower the process of respiration and hence acid consumption is reduced during the respiration process. Imran *et al.* (2000) also reported that it is the development of free acids as well as hydrolysis of pectin that causes an increase in the pH.

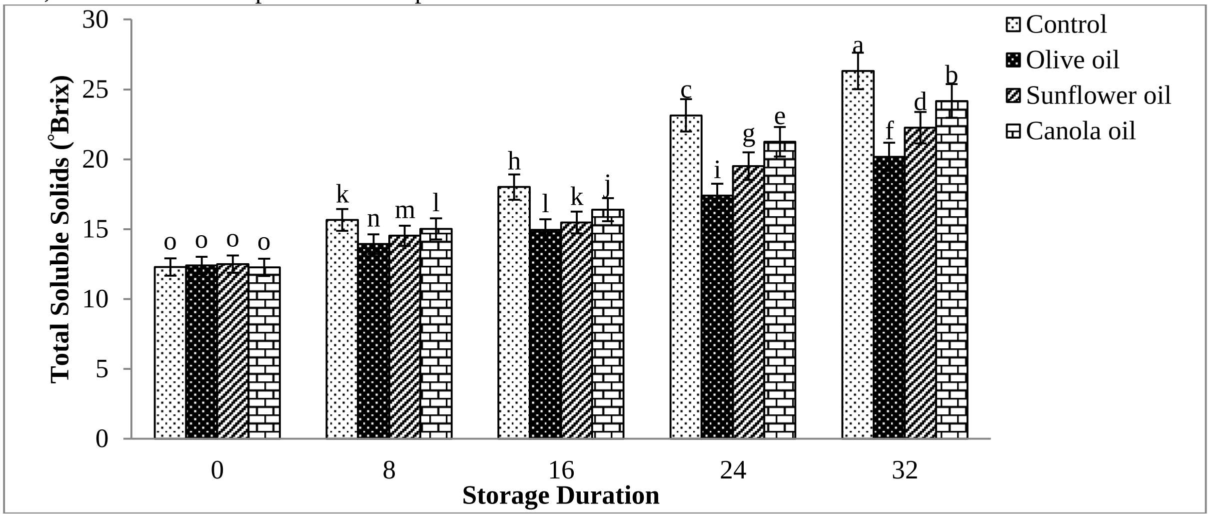

Figure 4- Effect of covering materials and storage durations on the total soluble solids (°Brix) of pear fruits

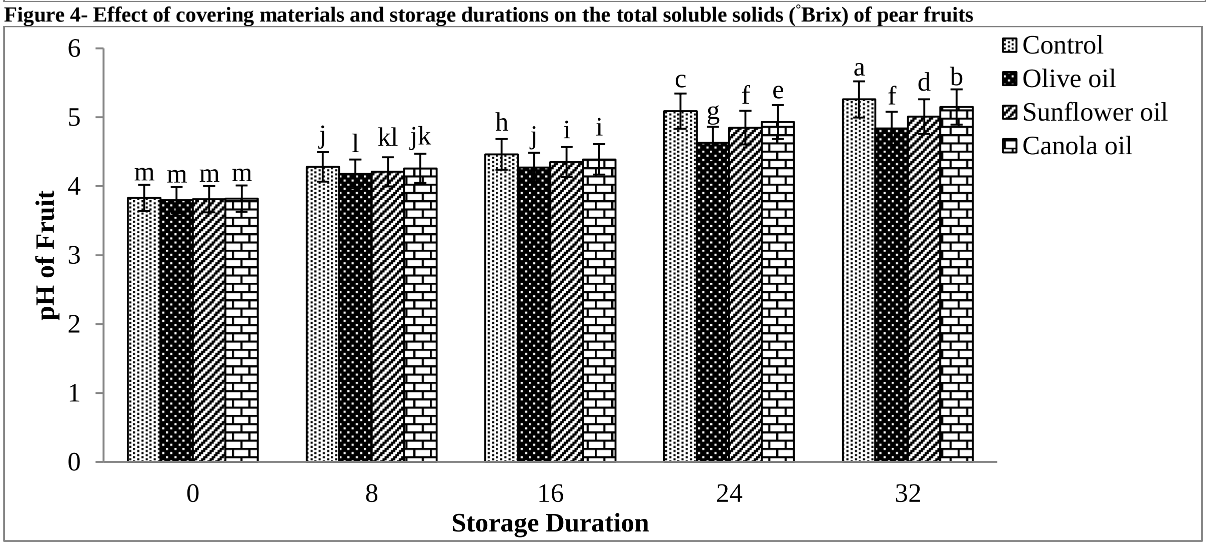

Figure 5- Effect of covering materials and storage durations on the pH of pear fruits.

Titratable acidity (%): Storage durations, types of covering material and their interaction significantly influenced titratable acidity (figure-6). The data concerning interaction clearly revealed that at 0 day of the storage period titratable acidity of all tested fruits were statistically same. Whereas, fruits untreated were noticed with the highest decrease of titratable acidity during storage interval. Maximum titratable acidity (0.38%) was recorded in canola oil treated fruits at 0 day of storage period, however lowest titratable acidity (0.11%) was noted in fruits untreated on 32 day of storage period.

Titratable acidity reduced when storage duration increases, as with increasing storage duration the organic acids present in the fruits is decomposed and converted to soluble sugars due to which acidity is decreased and TSS and sugar is increased (Robertson *et al*., 1990). The reason for minimal decrease in titratable acidity is the slow process of respiration and water loss from the fruits due to the olive oil coating. The findings of our work are also reported by Bai *et al*. (1988) who stated that water loss and respiration process is reduced with the help of coatings. Coatings acts as a barriers that alters the exchange of gases which causes more CO_2 accumulation inside the fruit and decreases titratable acidity during storage conditions, which leads to a slow ripening process. **Ascorbic acid (mg.100g^{-1}):** Storage duration, covering materials, and their interactions show a significant effect on ascorbic acid of the pear fruits (figure-7). Data refer to interaction showed that the maximum ascorbic acid (9.66 mg.100g^{-1}) was noted in sunflower oil and canola oil treated fruits at initial day of storage, while the minimum ascorbic acid (4.23 mg.100g^{-1}) was recorded in fruits which were untreated on 32 day of storage. The most challenging vitamin to preserve at storage duration is ascorbic acid. Due to its less stability, it is mostly affected at storage conditions. However, storage at low temperature slows down the reduction in ascorbic acid concentration (Akhtar *et al*., 2010). In storage durations, the contents of ascorbic acid were declined with the passage of time. Coatings slow down the process of ripening in fruits and hence improves ascorbic acid content for prolong durations (Park, 1999). Our findings are in harmony with Herianus *et al*. (2003) who stated that fruit coating sustain color, aroma, taste and ascorbic acid content.

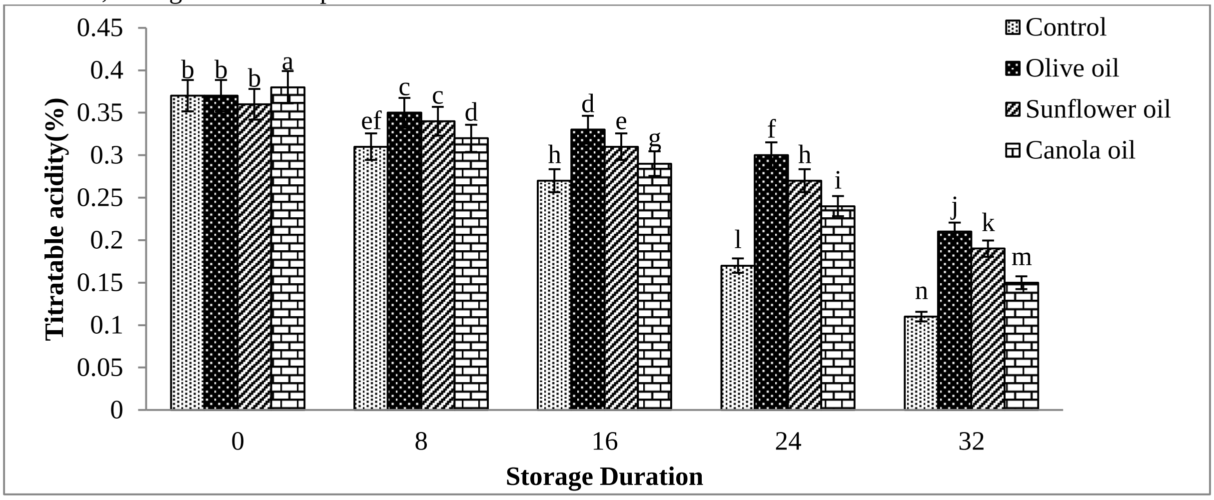

Figure 6- Effect of covering materials and storage durations on the titratable acidity (%) of pear fruits.

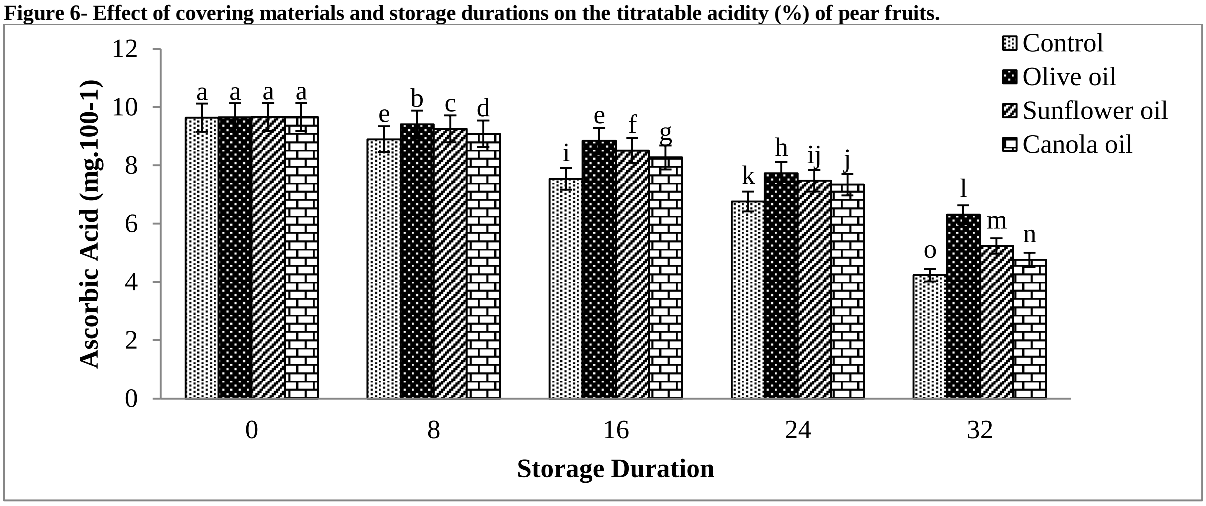

Figure 7- Effect of covering materials and storage durations on the ascorbic acid (mg.100-1) of pear fruits.

CONCLUSION

Fruits treated with olive oil retain all the quality attributes like fruit firmness (kg.cm^{-2}), juice content (%), titratable acidity (%), ascorbic acid (mg.100g^{-1}), pH of fruits juice and total soluble solids (^{0}Brix) with minimum weight loss at control atmosphere of 8-10±1 ^{0}C and RH 80-90% up to 32 day of storage duration, while untreated fruits did not maintain all the quality aspects in storage. Therefore, Pear fruits may be treated with olive oil and stored for 32 day at control temperature of 8-10±1 ^{0}C and RH 80-90% without deteriorating its quality attributes.

ACKNOWLEDGEMENT

The authors wish to thank Prof. Dr. Han Mingyu, and Dr. Xing Libo, College of Horticulture, Northwest Agriculture and Forestry University, Yangling, Shaanxi 712100, China, for designing the experiment and help in paper writing. The author also wants to thank Prof. Dr. Abdur rab, Dr. Imran Ahmad for their supervision on experiment and providing all their steadfast support and assistance in the conduct of all the necessary field and laboratory activities.

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