

## Effect of Various Oil Coatings on the Quality and Shelf Life of Mandarin cv. Daisy

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### ABSTRACT

To assess the effect of various oil coatings on quality and shelf life of mandarin cv. Daisy a research trial was conducted at Department of Horticulture, Khalsa College, Amritsar during the year 2019-2020. Laboratory experiment was carried out under Complete Randomised Design (CRD) with eight treatments  $T_1$  (Rice bran oil),  $T_2$  (Olive oil),  $T_3$  (Coconut oil),  $T_4$  (Mustard oil),  $T_5$  (Cinnamon oil),  $T_6$  (Palm oil),  $T_7$  (Sesame oil) and  $T_8$  (Control) replicated thrice. After coating with various oils, the fruits were stored under ambient conditions (14.4°C; 80% RH). The fruits were then analyzed periodically for various quality attributes. Results of the study revealed that the coconut oil coated fruits had an immense effect on the reduction of physiological loss of weight (0.74%) and preserved firmness (7.33 lb force), TSS (12.45%), total sugars (7.83%) and ascorbic acid (10.83 mg/100ml juice) and non detection of microbes and their growth up to 21 days of storage. Hence, coconut oil coated fruits proved quite effective in prolonging the shelf-life and maintaining the quality of Daisy mandarin fruits for 21 days compared to only 7 days in untreated fruits.

**Keywords:** Ambient conditions, Daisy mandarin, Oil coatings, Quality attributes, Storage, Shelf life.

### INTRODUCTION

Citrus is considered as the most popular fruit occupying an important place in the tropical and subtropical fruit growing area all over the world. Citrus is a group of evergreen fruits which belongs to family Rutaceae, order Geraniales and sub family Aurantioidae (Zahani & Khaledi, 2018). Botanically, mandarins are known as *Citrus reticulata* Blanco originated

from China. It is a group name for a class of oranges belonging to family Rutaceae with bright coloured peel and pulp; excellent flavor, easy to peel rind and segments that separate easily (Joshi et al., 2019). Among all cultivated varieties of mandarin, Daisy is the one which is common after kinnow under Punjab conditions.

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Daisy Mandarin is a cross between Fortune mandarin and Fremont mandarin and is considered to be better than either of its parent. It produces a medium-large, mid-season mandarin with attractive large orange rind. It is moderately seedy with 1-3 seeds per section and is considered as early maturing variety (Bal, 2014). Mandarins are acknowledged for their high juice content, flavor and delicious taste and as a rich source of vitamin-C, A, B, B<sub>6</sub>, minerals like calcium, folic acid, iron, magnesium and potassium (Turner & Burri, 2013). Mandarin is a non-climacteric and perishable fruit due to which it cannot be kept for a long time during transportation and storage. Depending on temperature and humidity its shelf-life is hardly 1-2 weeks. Qualitative losses, in sense of caloric and nutritive value with non-preference by consumers, are more difficult to measure than quantitative losses. The preponderance of high inoculums of pathogen in orchards due to poor plant protection measures besides non-adoption of scientific harvesting, handling, storage and antimicrobial treatments leads to heavy losses of fruits after harvest (Sonkar et al., 2008). Edible coatings are being traditionally used to improve fruit appearance and their preservation. The replacement of traditional chemical fungicides by edible oils and other coatings is favorable factor for the acceptance agricultural products in the international market due to the strict regulations on the chemical use for food production. Coating of fruits with oils may reduce physical weight loss, retains better fruit quality for a longer time due to the inhibition of the ethylene action which delays ripening and senescence (Kamboj & Kaur, 2018). Hence there is a need to study the effect of various edible coatings in mandarin for increasing its shelf life and maintaining its quality during storage.

## MATERIALS AND METHODS

The present investigation entitled “**Effect of various oil coatings on the quality and shelf life of mandarin cv. Daisy**” was conducted in the Department of Horticulture, Khalsa College, Amritsar during the year 2019-20. The material used for the present experiment were freshly harvested mature mandarin fruits of cv. Daisy. The mandarin fruits of uniform size, disease and bruise free were picked randomly from all the four directions of the plants with the help of secateurs at physiological mature stage and collected in plastic crates from the daisy mandarin orchard of Dhillon Farm, Patiarian, Hoshiarpur and were transferred to the laboratory of Department of Horticulture, Khalsa College Amritsar. In the laboratory, the fruits were sorted, graded and washed with water. Thereafter fruits were divided into requisite lot for further handling. In the present study, seven types of coatings viz. Rice bran oil, olive oil, coconut oil, mustard oil, cinnamon oil, palm oil and sesame oil were used for application on mandarin fruits. In control the fruits were treated with distilled water. Present experiment was laid out in Complete Randomized Design (CRD factorial) with eight treatments replicated three times viz. T<sub>1</sub> (Rice bran oil), T<sub>2</sub> (Olive oil), T<sub>3</sub> (Coconut oil), T<sub>4</sub> (Mustard oil), T<sub>5</sub> (Cinnamon oil), T<sub>6</sub> (Palm oil), T<sub>7</sub> (Sesame oil) and T<sub>8</sub> (Control). The fruits were analyzed after every 7 days up to the last stage of shelf life of fruits for different physical and biochemical constituents. Fruits were coated with edible coatings of rice bran oil, olive oil, coconut oil, mustard oil, cinnamon oil, palm oil, sesame oil and control were kept on trays. For the application of coatings on the fruits, a piece of foam pad was drenched with particular coating material and coating was applied gently on the surface of fruits. Thereafter fruits were air dried. The edible coated mandarin fruits were stored at ambient storage condition. Changes in different parameters namely weight loss,

total soluble solids, reducing sugars, total sugars and acidity were examined.

## RESULTS AND DISCUSSION

### Physiological loss in weight (%)

The data clearly showed that the fruits which were given post harvest treatments of edible oils significantly decreased the physiological loss in weight as compared to untreated fruits in 7, 14, 21, 28 and 35 days after storage of daisy fruits. The weight loss of Daisy fruits under all treatments, in general increased with the advancement in storage period. The coatings affected strongly in reduction of the physiological weight loss throughout the study with mean minimum loss (1.20%) and maximum (24.07%) throughout the storage of 35 days. Observations indicated that the fruits under treatment T<sub>3</sub> (coconut oil) exhibited minimum (0.15%) mean physiological loss in weight on 7th day of storage while the maximum (15.45 %) loss was found in T<sub>5</sub> (cinnamon oil) treatment . At 35 days of storage the observations revealed that the minimum physiological loss in weight (3.49 percent) was calculated in the same treatment T<sub>3</sub> (coconut oil). In rest of the treatments, no fruits were found to be retained for observation except T<sub>6</sub> (palm oil) in which 4.72 per cent of physiological loss in weight was found. It might be due to the fact that the fruit weight loss is connected with respiration and transpiration through the skin. The rate at which water is lost depends on the water pressure gradient between the fruit tissue and the surrounding atmosphere and storage temperature. Dehydration also causes an increase in surface wounding of fruits. Edible coatings act as barrier, thereby restricting water transfer and protecting fruit skin from mechanical injuries, as well as sealing small wounds and thus delaying dehydration (Nasrin et al., 2018). The coating treatments had strong influence on the reduction of weight loss of mandarin. Fruits coated with coconut oil

recorded the minimum weight loss which might be due to the anti-senescence property present in pure coconut oil which help to slow storage break down associated with slow respiration rate, transpiration rate and binding of the ethylene biosynthesis process. It might have served as semi permeable membrane around fruit surface and prevented cellular disintegration by maintaining protein and nucleic acid synthesis thus delaying senescence. The present results are in support with the findings of Pandey et al. (2010) in guava and Bisen et al. (2012) in kagzi lime who reported that the fruits coated with coconut oil reduced PLW along with highest consumer acceptability. Wijewardane (2013) and Kamboj and Kaur also reported minimum weight losses with the coatings of edible oils in guava.

### Organoleptic rating (1-9 scale)

According to the results a gradual decline in organoleptic rating during storage was noticed in oil coated fruits as compared to control where decline was sharp. The maximum average organoleptic rating (8.21) was shown by the fruits coated with coconut oil. On the other hand, the cinnamon oil coated fruits registered the minimum (3.72) organoleptic rating. The score of 7.0 is considered as moderately desirable and below this value, the quality starts deteriorating (Mahajan et al., 2015). Considering this, the coconut and palm oil coated fruits maintained the quality upto 28days of storage as against 7 days in untreated fruits. At 7 days of storage T<sub>3</sub>, T<sub>2</sub> and T<sub>6</sub> retained the maximum organoleptic rating of 9.00 and 8.75 followed by T<sub>1</sub> with 8.62 whereas, the minimum 7.37 in cinnamon oil. After 35 days of storage no fruits were found to be retained for observation of all the treatments. The acceptability of coconut oil coated fruits might be more due to the reason that coating maintains the cosmetic appearance of the fruits and their acceptability which also might be due to the retarded rates of ripening,

uniformity in colour development in later period of storage. Similar results were observed by (Pandey et al., 2010) who observed that maximum acceptability in terms of taste was retained by coconut oil coating without any objectionable change up to 8 days of storage in guava. Mahajan et al. (2005), Nasrin et al. (2018) in kinnow and Bisen et al. (2012) also reported the same in kagzi lime.

#### **Firmness (lbs)**

The results of the study revealed that initially the firmness of the Daisy fruits was 8.00 lbs which decreased gradually with the storage intervals with different ranges for different oil coatings. Out of all the treatments coconut oil coated fruits (T<sub>3</sub>) was the most firm (7.83 lbs) after 7 days of storage which lost about 39.5 per cent showing (3.16 lbs) firmness after 35 days of storage. Minimum firmness (7.03 lbs) was recorded in T<sub>8</sub> after 7 days. Except T<sub>3</sub> and T<sub>6</sub> no other fruit from the rest of the treatments was retained after 35 days of storage. The consumer acceptability of the fresh fruits can be judged from the texture or firmness of fruits which is gradually lost during its storage. It in turn reduces the shelf life of the fruits with deterioration of their quality by exposure to fungal contamination. The cell turgidity along with the structure and composition of the cell wall polysaccharides is affected due to the action of enzymes resulting in fruit softening. The enzyme mediated alterations in the structure and composition of cell walls lead to partial or complete solubilization, de-esterification, and depolymerization of cell wall polysaccharides, accompanied by a loss of neutral sugars and galacturonic acid (Rosli et al., 2004). Edible oils positively influence the conservation of firmness in fruits by decreasing water lose and fruit senescence and reducing cell wall degradation through inhibition of microbial activities. The present results are in agreement with the findings of Nasrin et al. (2018) who reported that coconut oil coated mandarin fruits were the most firm

during the storage period. Bisen et al. (2012) also reported the same in kagzi lime.

#### **Total soluble solids (°brix)**

It is apparent from the data that the fruits when given post harvest treatments had significantly, higher mean TSS than control to a certain limit of storage period being the highest 11.47° brix in coconut treated fruits followed by 11.26° brix in palm coating. The fruits treated with cinnamon oil (T<sub>5</sub>) coating registered the lowest TSS (4.52° brix). After 7 days of storage the treatment (T<sub>3</sub>) retained maximum TSS (11.81°brix) at par with T<sub>6</sub> having (11.65°brix). The minimum TSS (8.46°brix) was recorded in cinnamon oil coating (T<sub>6</sub>). On 35<sup>th</sup> day of storage only fruits under treatment T<sub>3</sub> and T<sub>6</sub> retained fruits for observation with TSS (9.96 and 9.67 °brix). The faster rate in total soluble solids in coconut oil coating might be due to faster metabolic activities through respiration and transpiration than other coatings. The metabolic breakdown of organic acid into carbon dioxide and polysaccharides into water soluble sugar might also be a reason for an increase in the sugar content (Singh et al., 2017). The findings of Miri et al. (2018) also indicated that TSS in citrus increases for a time during post harvest storage, which can be attributed to a concurrent increase in sucrose content due to hydrolysis of insoluble polysaccharides into sugars. The present results are in collaboration with the findings of Nasrin et al. (2018) who reported that coconut oil coated mandarin fruits recorded the highest TSS during the storage period. Bisen et al. (2012) also reported the same in kagzi lime. Present investigations are also in agreement with those of Panday et al. (2010) who observed that maximum TSS was recorded in coconut oil coating and was found to be significantly superior to control.

#### **Titrateable acidity (%)**

It is clear from the results that the titrateable acidity significantly decreased with the advancement of the storage period. It is

evident from the results that the mean lowest acidity (0.56%) was shown by the fruits treated with coconut oil (T<sub>3</sub>). After 7 days of storage the fruits treated with coconut oil (T<sub>3</sub>) recorded the minimum acidity (0.65%) which was lowered to 0.40 per cent on 35<sup>th</sup> day followed by T<sub>6</sub> with 0.69 and 0.44 per cent. The decrease in acidity trend during the storage period might be due to the utilization of organic acid in the tricarboxylic acid cycle during the respiration process (Kamboj & Kaur, 2018). The present results corroborates the findings of Sanjay et al. (2013), Keditsu et al. (2003) and Wijewardane (2013) with a view of a general decline in the coated fruits with the prolonged storage period. The research findings of Bisen et al. (2012) in kagzi lime are also in support with the present results.

#### **Total sugars (%)**

According to the data the fruits coated with coconut oil (T<sub>3</sub>) registered maximum average total sugars content (6.66%) after 35 days of storage. On the other hand, the fruits under T<sub>5</sub> registered the lowest mean sugar content of 2.70 per cent which was greater than untreated fruits with 3.42 per cent of total sugars. Maximum total sugars (5.77 %) was noticed in T<sub>3</sub> on 7<sup>th</sup> day of storage at par with T<sub>6</sub> showing 5.69 per cent of sugars while minimum percentage (5.42) was found in untreated fruits. It was seen that a continuous increase in total sugars up to 21 days was observed in oil coated fruits which thereafter declined slowly and steadily, whereas control fruits recorded the highest total sugars (5.42%) after 7 days of storage as compared to treated fruits and thereafter declined at a faster rate resulted in development of flat taste. On 35<sup>th</sup> day of storage no fruit was retained for observation except in T<sub>3</sub> and T<sub>6</sub> with 7.38 and 7.03 per cent of total sugars. The maximum value for sugars might be due to conversion of polysaccharides into soluble sugars, dehydration and transformation of certain cell wall materials

like hemicelluloses and pectin and also due to decrease in ascorbic acid content. The lowest percent of sugars in some treatments might be due to delayed transpiration, respiration and ripening processes and also delayed activity in the conversion of polysaccharides into soluble sugars and ascorbic acid into dehydro ascorbic acid in the fruits.

The present findings are supported by Pandey et al. (2010) and Mahajan et al. (2005), El-Monem et al. (2003) in custard apple and Kamboj and Kaur (2018) in guava, Bisen et al. (2012) in kagzi lime and Nasrin et al. (2018) in mandarin fruits.

#### **Ascorbic acid (mg/100ml juice)**

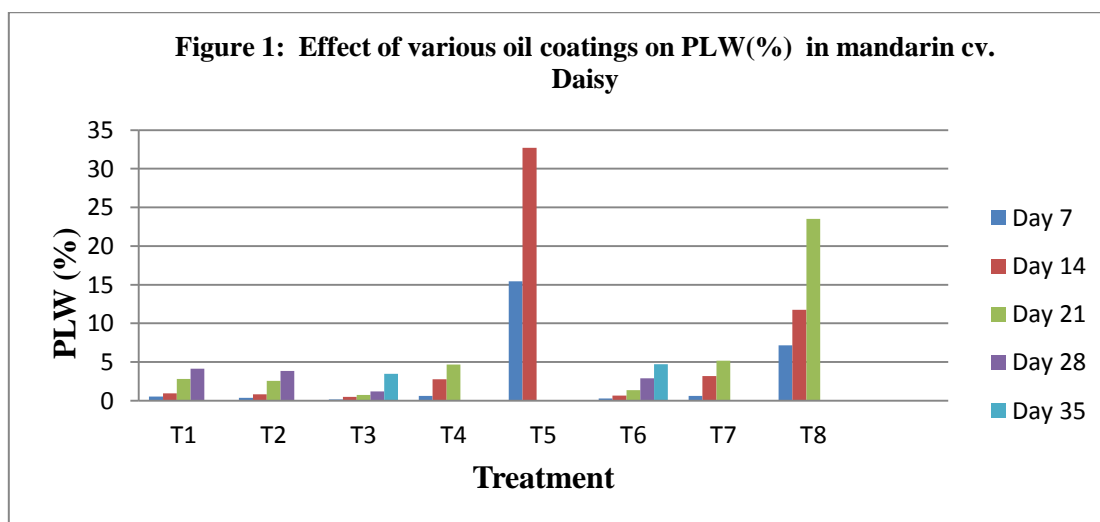
The various edible coating treatments showed a significant influenced in ascorbic acid. The ascorbic acid showed a decline with the advancement in storage intervals. After 35 days of storage, maximum mean ascorbic acid (11.04 mg/100ml) was found in T<sub>3</sub> *i.e.* coconut oil coating whereas minimum ascorbic acid (5.27 mg/100ml) was found in T<sub>5</sub> *i.e.* cinnamon oil coated daisy fruits. At 7<sup>th</sup> day of storage among the fruits under treatments T<sub>3</sub> and T<sub>6</sub> retained maximum ascorbic acid (11.81 and 11.63 mg/100ml). The minimum ascorbic acid (10.38 mg/100ml) was recorded in T<sub>5</sub> *i.e.* cinnamon treated fruits followed by (11.05 mg/100ml) in T<sub>8</sub> (control). No fruit of the treatments were retained for study on 35<sup>th</sup> day except under T<sub>3</sub> and T<sub>6</sub> with 9.88 and 9.46 mg/100ml of ascorbic acid content. The decrease in ascorbic acid content during storage possibly might be due to the utilization of organic acids during respiration or their conversion to sugars (Kader, 2002). It might also be due to the fact that ascorbic acid is very susceptible to oxidative deterioration (Piga et al. 2003), occurred at accelerated rate due to the presence of higher concentrations of O<sub>2</sub>. The results of this study are in line with Kohli and Bhambota (1966) who reported that ascorbic acid of acid lime and Kinnow decreased respectively with the increase of

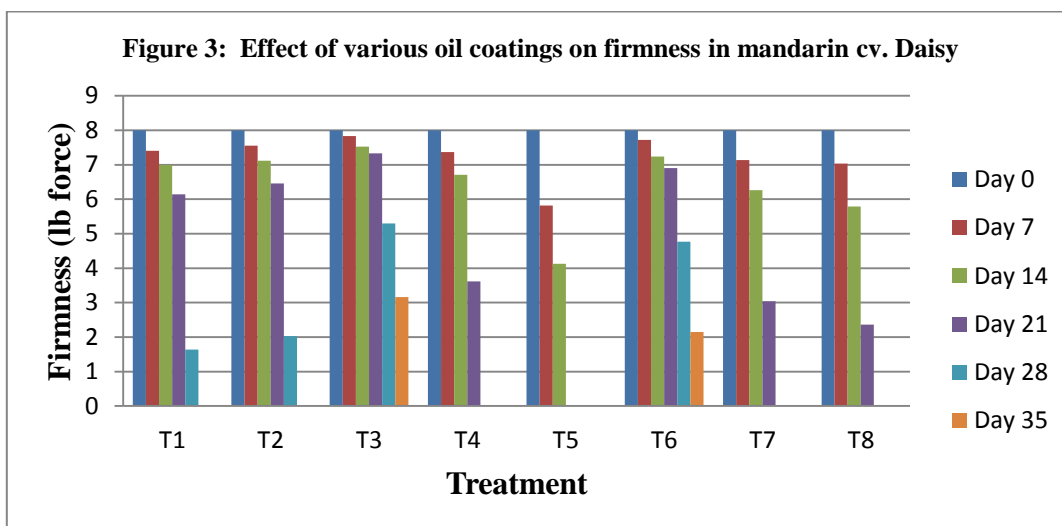
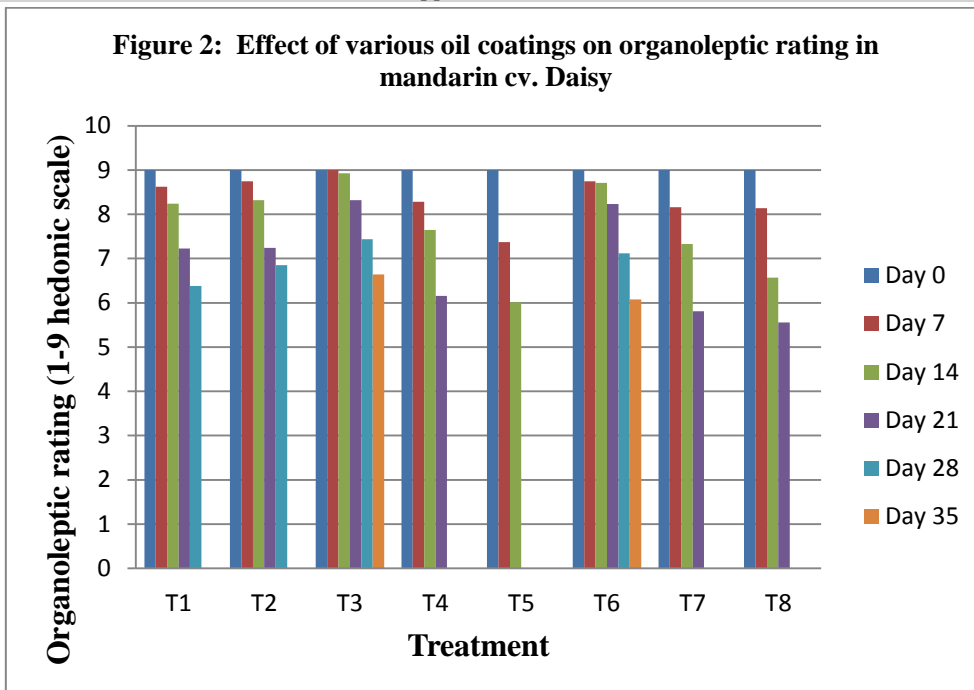
storage period because of oxidation of ascorbic acid. The present results are in line with the findings of Nasrin et al. (2018) who reported that coconut oil coated mandarin fruits registered reduction in ascorbic acid during the storage period. Bisen et al. (2012) also reported the same in kagzi lime.

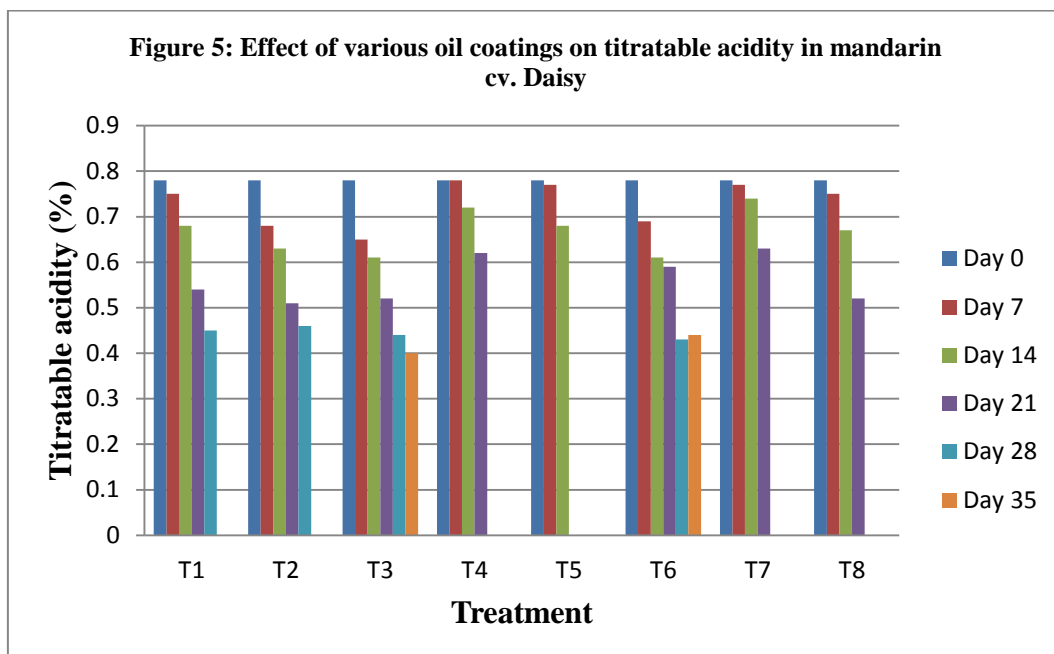
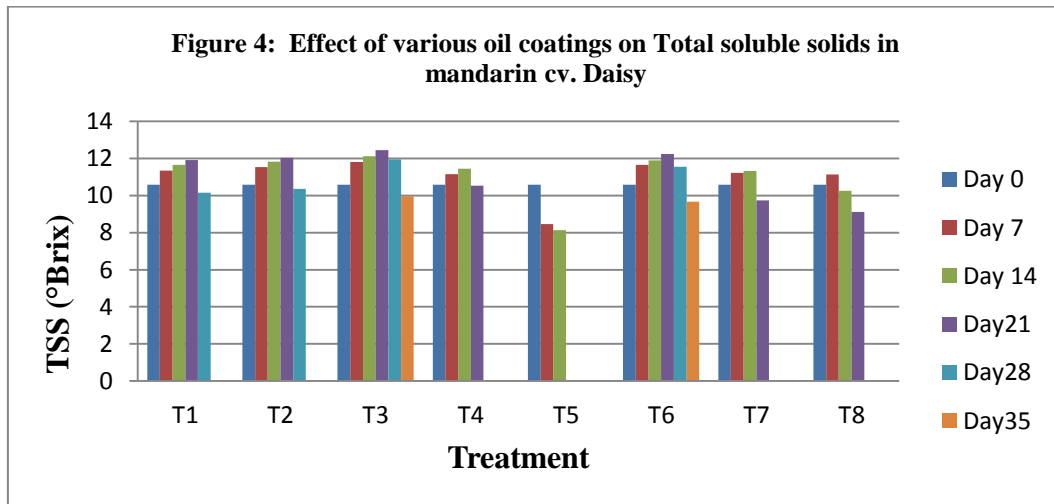
#### Shelf life (days)

Throughout the whole study the maximum shelf life (35 days) was retained by the fruits of Daisy coated with coconut oil (T<sub>3</sub>) and palm oil (T<sub>6</sub>) followed by olive oil and rice bran oil treatments for 28 days respectively. Minimum post harvest life was observed in cinnamon oil coated fruits (T<sub>5</sub>) with 14 days. This might be

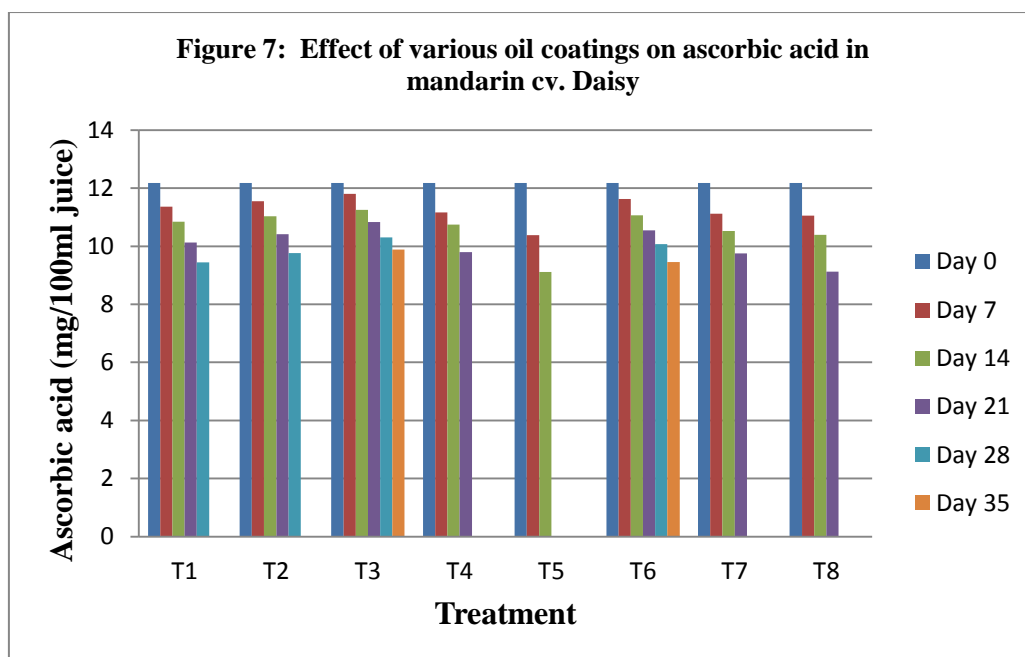
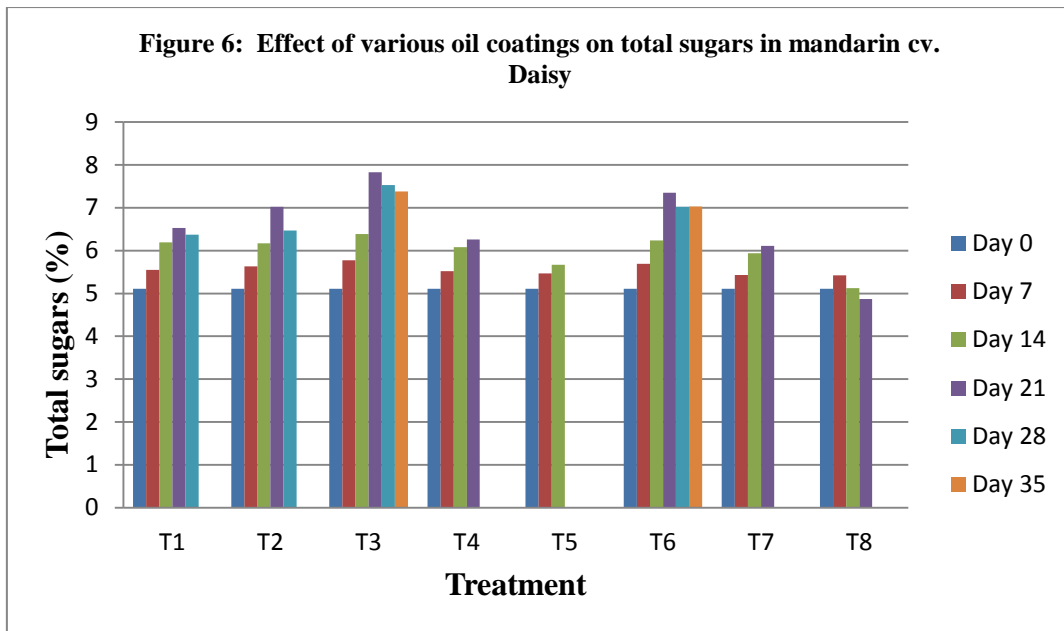
due to the fact that coconut oil and palm oil coatings might have closed the opening of stomata and lenticels results in the reduction of transpiration and respiration rate and also the microbial activity leading to an increase in shelf life with good acceptability (Das & Medhi, 1996). The research findings of Seehanam and Boonyakiat (2010) stated that the coated mandarin fruits stored at ambient conditions was decreased over uncoated fruits. The present results are in collaboration with the findings of Bisen et al. (2012) in kagzi lime and Nasrin et al. (2018) in mandarin fruits.

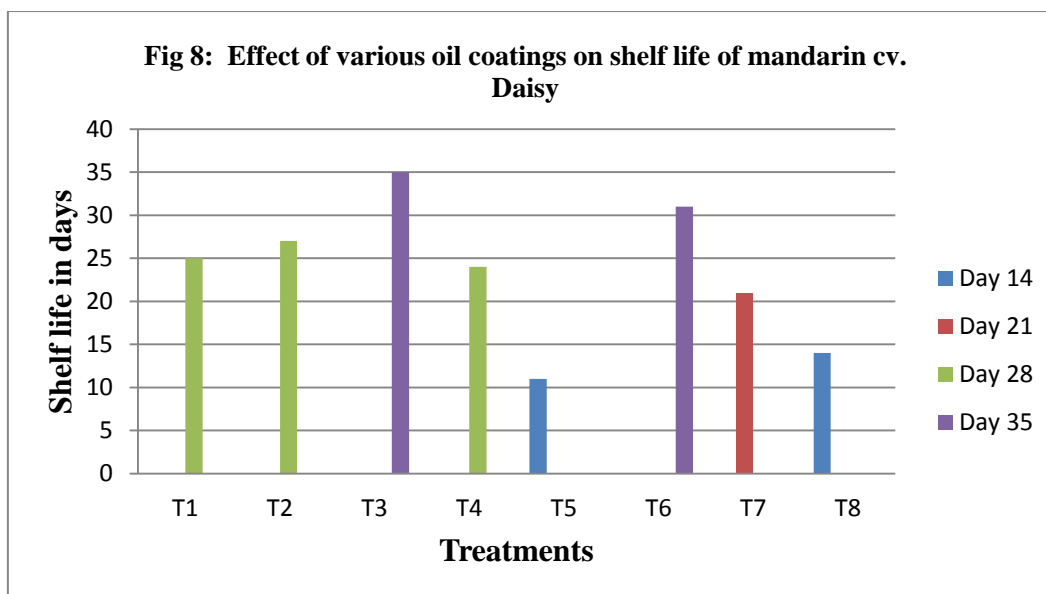












### CONCLUSION

The research study resulted that the physical and biochemical traits of Daisy mandarins were significantly influenced by oil coatings up to 35 days of storage at ambient condition. Hence it can be concluded that the prolongation of shelf life and quality of fruits could be better retained with coconut and palm oil coatings to ensure availability in national and international markets for a long span which will fetch good prices to commercial growers. Application of different edible oil coating not only improve the quality and the post harvest life of fruits but they are also eco-friendly. The present findings suggests that among the different edible oil coating treatments, the coconut oil coating treatment of mandarin fruits had minimum physiological loss in weight, better organoleptic quality and better biochemical characters of fruits as compared to control and other treatments up to 35 days of storage. Therefore, application of coconut oil coating on mandarin cv. Daisy considered the most benefit tested one in extending the shelf life and quality of mandarin.

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