**Bulletin of Environment, Pharmacology and Life Sciences**
Bull. Env. Pharmacol. Life Sci., Vol 13 [5] April 2024: 43-54

Online ISSN 2277-1808
Journal's URL: http://www.bepls.com
CODEN: BEPLAD


**ORIGINAL ARTICLE** **OPEN ACCESS**

# Effect of edible oil coatings on chemical and sensory attributes of *Citrus sinensis* cv. Malta under ambient and refrigerated conditions

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**ABSTRACT**
*An experiment was carried to assess the influence of various edible oil coatings on chemical and sensory quality of malta after 0,7,14 and 21 days of storage under ambient and refrigerated conditions. The experiment was conducted at Postharvest Technology laboratory of Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Pathri Bagh, Dehradun, Uttarakhand during the year 2022-2023. The experiment consists of three replication and eleven treatments of different edible oil coatings. Results revealed that among various edible oil coatings, coconut oil coating (3%) under refrigerated temperature (T8) found to be the most suitable edible oil coating material for malta fruits in terms of chemical properties such as Total soluble solids (13.09 $^0$Brix), TSS: Acid ratio (62.33), Fruit juice (48.0 ml), Juice (65.71%) as well as sensory attributes viz. Fruit Color (8.05), Fruit Taste (8.25), Fruit texture(8.25), Fruit Flavour(7.94) and Overall acceptability (7.96). Whereas, treatment T2 i.e. (Mustard oil coating @3% under ambient temperature) was found to be the most effective edible oil coating in terms of pH(3.82). However, treatment T10 (Almond oil coating @3% under refrigerated temperature) was recorded maximum titratable acidity (0.28%). Therefore, it can be concluded that edible coconut oil coating can be used to extend the chemical and sensory parameters of Malta.*
***Keywords**: Edible oil coating, Total soluble solids, titratable acidity Colour, Taste, Texture, Overall acceptability*

Received 20.01.2024 Revised 11.03.2024 Accepted 12.04.2024

## INTRODUCTION

Malta, a variety of sweet orange, scientifically known as *Citrus sinensis* (L.) Osbeck, is a significant seasonal citrus fruit popular in hills of Uttarakhand, India. The fruit is nutritious, abundant in vitamins, and loved because of its distinctive sweet-sour flavour. This fruit tree is frequently found in a dispersed fashion in home gardens and kitchen gardens, but it was unable to establish a strong position in urban or regional markets, which decreased its appeal as a commercial fruit crop. This fruit is sold in the Indian Himalayan states of Sikkim, Jammu & Kashmir, Himachal Pradesh and Uttarakhand [1]. Scientifically about Malta From the time of planting, it takes up to 5–6 years to enter the reproductive phase and grows as a shrub. This tree produces white flowers in March to May and in November to December, the fruits are plucked. During the warm winters, it's common to observe people in Uttarakhand's mountainous districts eating slices of Malta fruit marinated with homemade salt, sugar, honey, or occasionally cream. Studies have find out that this fruit contains 47 kcal energy, 0.94g protein, 0.12g fat, 2.4g dietary fibre, 53.2 mg vitamin C, 0.1mg iron, 14 mg phosphorus and 10 mg magnesium. This fruit is also consumed and used in many forms like juice, squash, candy, jam, essential oil, peel powder etc. Every 100 g of malta squash and ready to serve (RTS) drinks contain about total soluble solids (10°Brix), 88.4 g water, 0.6 g protein, 10.5 g carbohydrates, 0.12g fibers and 0.3g ash with 0.41% acidity [2]. Edible coatings is the thin layer of material which can be consumed and provide a barrier to oxygen, microbes of external source, moisture and solute movement for food. In edible coating a semi permeable barrier is provided and is aimed to extend shelf life by decreasing moisture and solute migration, gas exchange, oxidative reaction rates and respiration as well as to reduce physiological disorders on fresh cut fruits. Edible coatings are used for extension of shelf life of fruits and vegetables. These can also be safely eaten as part of the product and do not add unfavourable properties to

the food stuff. Among various postharvest treatments, the application of edible coating like oil, wax and chemical to fruits is receiving more attention as these coatings are capable of maintaining quality even in ordinary storage conditions [3]. Edible coating of fruits blocks the pores within the fruits, reduces respiration and creates a modified atmosphere which helps to improve postharvest quality [4]. Edible coatings reduce respiration, improve textural quality, helps to retain volatile flavor, reduce microbial growth and protect from deterioration [5]. Edible coatings maintain structural integrity and protect against mechanical damages [6]. Edible coatings improve the firmness and minimize the weight loss of mandarin as compared to uncoated [7]. Prolongation of shelf life and maintenance of the quality of mandarin fruit could be obtained by using different surface coatings than without using surface coatings [8]. Edible coatings or films increase the shelf life of fruits and vegetables and are environment friendly. In recent years, new edible films and coatings have been developed with the addition of various and edible herbs, antimicrobial compounds to preserve fresh fruits and vegetables. The populations consuming diets high in coconut oil show no adverse effects on the health of the population. Coconut oil has >90% saturated fatty acids, hence is less attractive to consumers. Saturated fat is one that has no unsaturation or double bonds and tends to be solid at room temperature. Coconut oil is rich in short and medium chain fatty acids. Shorter chain length allows fatty acids to be metabolized without use of the carnitine transport system. Coconut oil contains a high proportion of glycerides of lower chain fatty acids .The oil is highly stable towards atmospheric oxidation. The oil is characterized by a low iodine value high saponification value, high saturated fatty acids content and is a liquid at room temperatures of 27°C [9]. Olive oil sensory uniqueness as well as its important nutritional properties has been the favourite of Mediterranean countries consumers and now throughout the world. Diverse varieties of olive fruits due to the variations in composition and overall properties have shown different behaviours in terms of quality loss when subjected to different temperatures.[10] Mustard oil can mean either the pressed oil used for pungent essential oil also known as volatile oil of mustard. The essential oil results from grinding mustard seed, mixing the grounds with water, and isolating the resulting volatile oil by distillation. It can also be produced by dry distillation of the seed. Walnuts contain kernels that have high content of glyceride oil. It varies widely (52-75%), depending on the variety, cultivation, place of growing and irrigation of walnut trees. Regarding the fatty acid composition unsaturated fatty acids are dominating oleic, linoleic and linolenic. Ratio of these acids determines the nutritional value of walnut oil. Monounsaturated fatty acids have a beneficial effect on human health [11]. Almonds from the Rosaceae family, have long been known as a source of essential nutrients; nowadays, they are in demand as a healthy food with increasing popularity for the general population and producers. Studies on the composition and characterization of almond macro- and micronutrients have shown that the nut has many nutritious ingredients such as fatty acids, lipids, amino acids, proteins, carbohydrates, vitamins and minerals, as well as secondary metabolites. Now a day's various chemicals are used to enhance the shelf life of fruits which is harmful for human health. However, some edible oil coating substances have enhanced their shelf life, reduce the spoilage and improved the fruit quality by delaying the senescence during storage. Therefore, the present study was done to find out the effect of various edible oil coating materials on chemical and sensory qualities of malta during storage.

## MATERIAL AND METHODS

### Experimental site

The experiment was performed from 1st December 2022 to 21st December 2022 in the Postharvest Technology laboratory of Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Pathri Bagh, Dehradun, Uttarakhand, India. Geographically, the experimental site is located in between 29º58 and 31º2°30° North latitude and 77º 34°45° and 78º18°30°East longitudes.

### Experimental details and materials

The experiment was laid out in Completely Randomized Design (CRD) with three replications having eleven treatments in each replication. The malta fruits were collected from a local orchard of Dhar Payankoti village, District Tehri Garhwal, Uttarakhand (India). The fruits were harvested at a mature stage. Malta fruits were sorted out to eliminate bruised, damaged, misshaped and punctured ones. Selected fruits having good quality were individually coated with prepared concentration of different edible coating materials according to treatments with the help of cotton (Table 1). The treated fruits were allowed to dry in fresh air. Then malta were kept in the locally available tray in an open lab condition at ambient room conditions (18±2°C and 52.41±14.35% RH) and in refrigerator conditions at (5±2°C and 62.45±10.55% RH).

**Table 1: Treatment combination**

| Symbol | Treatment doses |
|---|---|
| T1 | (Control) without oil coating + Ambient condition |
| T2 | Mustard oil coating (3%) + Ambient condition |
| T3 | Coconut oil coating (3%) + Ambient condition |
| T4 | Olive oil coating (3%) + Ambient condition |
| T5 | Almond oil coating (3%) + Ambient condition |
| T6 | Walnut oil coating (3%) + Ambient condition |
| T7 | Mustard oil coating (3%) + Refrigerated condition |
| T8 | Coconut oil coating (3%) + Refrigerated condition |
| T9 | Olive oil coating (3%) + Refrigerated condition |
| T10 | Almond oil coating (3%) + Refrigerated condition |
| T11 | Walnut oil coating (3%) + Refrigerated condition |

**Data collection**

In this experiment the following parameters were studied:

**Chemical attributes:**

**Total soluble solids (ºBrix)**

The total soluble solids (TSS) were recorded in ˚Brix by using digital refractometer on the 0, 7, 14 & 21 days of storage.

**pH**

pH is the equilibrium measure of hydrogen ion concentration in a juice. It was measuredwith Digital pH meter. First pH meter was calibrated with the three standard buffer solution, after calibration, pH of juice was determined. The fruit juice prepared was used for pH measurement too and expressed as a unitless number.

**Titratable acidity (%)**

The acidity was estimated as per titrimetric method [12]. A total of 10 ml of the clear juice of a fruit from each treatment was taken and titrated against standard 0.1 N of sodium hydroxide (NaOH) solution using phenolphthalein as an indicator. Then the titratable acidity of the fruit was expressed in percentage using the following formula:

$$\text{Acidity\%} = \frac{\text{Titre value} \times \text{Normality of alkali} \times \text{Equivalent weight of acid} \times \text{Volume made} \times 100}{\text{Volume of sample taken} \times \text{Weight of sample} \times 100}$$

**Juice content (%)**

The juice was extracted by squeezing manually. The volume of juice was measured (ml/fruit) with the help of a measuring cylinder. The average juice percentage per fruit was calculated by the following formula:

$$\text{Juice percentage} = \frac{\text{Juice Weight}}{\text{Fruit Weight}} \times 100$$

**Juice (ml)**

**Juice after extraction was measured in the measuring cylinder and average wascalculated in ml.**

**TSS: Acid ratio**

This was done by simply dividing the amount of TSS result of every day to theTitratable acidity of the same day and data was pool for analysis.

$$\text{TSS: Acid ratio} = \frac{\text{Total soluble solids}}{\text{Titrable acidity}}$$

**Sensory attributes:**

Sensory evaluation of malta was performed by 20 semi trained panelists. The 9-point hedonic scale and composite scoring tests were used to carry out sensory evaluation. They assessed malta in terms of Colour, Taste, Texture and Flavour properties. Overall acceptability score was calculated as average of the whole sensory attributes.

**Statistical analysis**

The edible oil coated fruits were evaluated by a panel of 20 semi-trained members using 9 point Hedonic scale for colour, taste, texture and overall acceptability i.e. like extremely 9, like very much 8, like moderately 7, like slightly 6, neither like nor dislike 5, dislike slightly 4, dislike moderately 3, dislike very

much 2, dislike extremely 1 [13]. Statistical analysis of the data pertaining to the sensory evaluation of osmotically preserve fruits were analysed according to randomized block design [14] while, that on physico-chemical characteristics by factorial completely randomized design [15]. The values were compared at 5% level of significance.

**RESULTS AND DISCUSSION**

The data were recorded at regular intervals on 0, 7, 14 and 21days after treatment for chemical and sensory attributes of Malta.

**Total Soluble Solids**

The data recorded on Total soluble solids (TSS) at different intervals. The effect of edible oil coatings are presented in the Table 2 and Fig.1. As evident from table, during initial days observation shows the treatment differences were non-significant. After 7 days, the maximum TSS was recorded in treatment T8 (11.01ºBrix) with coconut oil coating (3%) under refrigerated temperature followed by T9(9.89 ºBrix) which was at par with treatments T6 (9.61 ºBrix), T11 (9.49 ºBrix) and T5(9.09 ºBrix). The minimum TSS was recorded in T10(8.85 ºBrix) with almond oil coating (3%) under refrigerated temperature. After14 days interval, maximum TSS was recorded in treatment T8 (12.04 ºBrix) with coconut oil coating (3%) under refrigerated temperature whereas minimum TSS was recorded under the treatment in T10( 9.09) with almond oil coating (3%) under refrigerated temperature. Finally after 21 Days, the TSS was recorded maximum in treatment T8 (13.09) which were at par with T4(.11.76), T3 (11.75) and T11 (11.65). However significance difference was observed with treatment in T6 (11.12), T9(10.15) and T7(10.09).While minimum Total soluble Solids (TSS) was recorded under the treatment in T5 ( 9.50) with Almond oil coating (3%) under ambient temperature. The above findings are in line with the findings of [16].

**pH**

The observation of pH was recorded at 0, 7, 14 and 21 days interval. The effects of oil coatings on pH are presented in the Table 2 and Fig.2. As evident from table the different treatments did not show any marked variation in pH. During the whole observation shows the treatments were non- significant.

**Titratable acidity (%)**

The observation of titratable acidity was recorded at 0, 7, 14 and at 21 days interval. The effects of oil coatings on titratable acidity are presented in the Table 2. and Fig.3. As evident from table the different treatments did not show any marked variation in titratable acidity. During the whole observation shows the treatments were non- significant.

**Fruit Juice (%)**

The data recorded on fruit juice (%) at different intervals. The effect of edible oil coatings are presented in the Table 4 and Fig.4.The maximum fruit juice (%) was recorded in treatment T8 (65.71) which were at par with T5 (65.71) and T3 (64.38). While fruit juice (%) was minimum recorded under the treatment in T1 (57.69) without oil coating under ambient temperature. Fruit juice (%) was significantly affected in all days of interval with effect Coconut oil coating (3%) under refrigerated temperature. The percentage of juice content showed increase in all treatments during storage. Only coconut oil and kept in refrigerated temperature had gained gradual increment of juice content. Juice content is one of the important characters of mandarin oranges. Customers prefer those mandarin oranges which have more juice content and such mandarin oranges get high market price also. There is a decrease in the juice percentage of mandarin during the storage due to the moisture loss from the surface of fruits [15](Rokaya et al., 2016; Joshi et al., 2020). So to know the effect of different edible coatings on the juice content of the mandarin this parameter was observed. The above findings are in line with the findings of [17] in mandarin.

**Juice (ml)**

The observation of fruit juice (ml) was recorded at 0, 7, 14 and 21 days interval. The effects of oil coatings on juice in ml are presented in the Table 2 and Fig.5. As evident from table the different treatments did not show any marked variation in juice (ml). During the whole experiment, the treatments were non-significant effects of various edible oil coatings on fruit juice (ml).

**TSS: Acid ratio**

The data recorded on fruit TSS: Acid ratio are presented in the Table 3 and Fig. 6.The observation of fruit TSS : Acid ratio was recorded at 0, 7, 14 and 21 days interval. As evident from table, during initial days observation shows the treatment differences were non-significant. At 7 days maximum fruit TSS: Acid ratio was recorded in T8 (34.41) with Coconut oil coating (3%) under refrigerated temperature. The fruit TSS: Acid ratio in treatment T6 (28.26) with Walnut oil coating (3%) under ambient temperature and T7(27.33) with Mustard oil coating (3%) under refrigerated temperature were found in statistically at per whereas, minimum fruit TSS: Acid ratio was recorded in treatment T1 (29.32) Without oil coating under ambient

temperature. In 14 days interval the maximum TSS: Acid ratio was recorded in treatment T8 (46.31) with Coconut oil coating (3%) under refrigerated temperature. Which was at par with treatments T11 (37.86) and T9 (36.33). The minimum TSS: Acid ratio was recorded under the Treatment in T1 (29.32) without oil coating under ambient temperature. In 21 Days, the TSS: Acid ratio was maximum in treatment T8 (62.33) which were at with T2 (52.27). However significance difference was observed with treatment in T4(49.00), T3 (48.96), and T10(42.29). While minimum TSS: Acid ratio was recorded under the treatment in T1 (36.52) without oil coating under ambient temperature. The above findings are in line with the findings of [18] in acid lime.

**Fruit Color**

The observation of fruit color was recorded at 0, 7 , 14 and 21 days interval. The data recorded on fruit color at different days of interval are presented in the Table 5. As evident from table, during initial days observation shows the treatment differences were non-significant. In 7 days interval the maximum Fruit color was recorded in treatment T8 (8.68) with Coconut oil coating (3%) under refrigerated temperature flowed by T9 (8.58 ). Which was at par with treatments T10(7.89) T11 (7.94), T2 (7.71) and T6 (7.34). The minimum Fruit color was recorded under the Treatment in T1 (5.54) with without oil coating under ambient temperature. In 14 days interval the maximum Fruit color was recorded in treatment T8 (7.92) with Coconut oil coating (3%) under refrigerated temperature flowed by T9(7.86). The minimum Fruit color was recorded under the Treatment in T1 (6.37) with without oil coating under ambient temperature. In 21 Days, the Fruit color was maximum in treatment T8 (8.05) which were at par with T9 (7.83) and T10 (7.77). T11 (7.38). However significance difference was observed with treatment in T7 (7.22), and T5 (7.05). While Fruit color was minimum recorded underthe treatment in T1( 6.00) without oil coating under ambient temperature. Similar results were also reported by [19] in lemon.

**Fruit Taste**

In 7 days interval the maximum fruit taste was recorded in treatment T8 (8.73) with Coconut oil coating (3%) under refrigerated temperature flowed by T10 (8.66). Which was at par with treatments T4 (8.66) and T10 (8.04). The minimum fruit taste was recorded under the Treatment in T1 (5.77) with without oil coating under ambient temperature. In 14 days interval the maximum fruit taste was recorded in treatment T8 (8.05) with Coconut oil coating (3%) under refrigerated temperature which was equal at T10 (8.05), .The minimum fruit taste was recorded under the Treatment in T1 (5.88) with without oil coating under ambient temperature. In 21 Days, the maximum fruit taste was recorded in treatment T8 (8.05) with Coconut oil coating (3%) under refrigerated temperature which was equal at T10 (8.05). The minimum fruit taste was recorded under the Treatment in T1 (5.88) with without oil coating under ambient temperature. The fruit taste was significantly affected by the Coating of Coconut oil coating (3%) under refrigerated temperature. Similar results were also reported by [20].

**Fruit texture**

In 7 days interval the maximum fruit texture was recorded in treatment T8 (8.37) with Coconut oil coating (3%) under refrigerated temperature flowed by T3 ( 8.14). Which was at par with treatments T5 (7.91), T7 (7.49) and T10 (7.34). The fruit texture was recorded under the Treatment in T1 (6.06) with without oil coating under ambient temperature. In 14 days and 21 Days, the maximum fruit texture was recorded in treatment T8 (8.25) with Coconut oil coating (3%) under refrigerated temperature flowed by T5( 8.05). The minimum fruit texture was recorded under the Treatment in T1( 6.5) with without oil coating under ambient temperature.The fruit texture was significantly affected by the coating of Coconut oil coating (3%) under refrigerated temperature. Similar results were also reported by [21].

**Fruit Flavour**

In 7 days interval the maximum fruit Flavor was recorded in treatment T8 (8.65) with Coconut oil coating (3%) under refrigerated temperature flowed by T7(8.60). Which was at par with treatments T10 (8.42) T4(7.61) and T9(7.34). The minimum fruit Flavour was recorded underthe Treatment in T1 (5.82) with without oil coating under ambient temperature. In 14 days interval and 21 Days, the maximum fruit Flavour was recorded in treatment T8 (7.94) with Coconut oil coating (3%) under refrigerated temperature flowed by T9 (7.86). The minimum fruit Flavour was recorded under the Treatment in T1 (6.81) with without oil coating under ambient temperature. The fruit Flavour was significantly affected by the Coating of Coconut oil coating (3%) under refrigerated temperature. Similar results were also reported by [21].

**Fruit Overall acceptability**

In 7 days interval the maximum fruit Overall acceptability was recorded in treatment T8 (8.53) with Coconut oil coating (3%) under refrigerated temperature flowed by T6( 8.06) and T5 (8.05). Which was at

par with treatments $T_3$ (7.99) $T_{10}$ (7.79) and $T_{11}$(7.32).The minimum fruit Overall acceptability was recorded under the Treatment in $T_1$ (5.8) with without oil coating under ambient temperature. In 14 days interval and 21 Days, the maximum Overall acceptability was recorded in treatment $T_8$ (7.9) with Coconut oil coating (3%) under refrigerated temperature flowed by T4 (7.81). The minimum fruit Overall acceptability was recorded under the Treatment in $T_1$ (6.72) with without oil coating under ambient temperature. The Overall acceptability was significantly affected by the Coating of Coconut oil coating (3%) under refrigerated temperature. The above findings are in line with the findings of [22].

**Table 2: Effect of various edible oil coatings on Total Soluble solids and pH at ambient temperature and Refrigerated temperature**

| Symbol | Treatments | Total Soluble solids ( ºBrix) | | | | pH | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 8.7 | 9.09 | 9.89 | 10.86 | 2.860 | 3.17 | 3.41 | 3.76 |
| $T_2$ | Mustard Oil + Ambient Temperature | 8.2 | 8.99 | 9.15 | 11.50 | 2.820 | 3.21 | 3.45 | 3.82 |
| $T_3$ | Coconut Oil + Ambient Temperature | 8.27 | 8.95 | 9.36 | 11.75 | 2.750 | 3.22 | 3.51 | 3.81 |
| $T_4$ | Olive Oil + Ambient Temperature | 8.12 | 8.89 | 9.35 | 11.76 | 2.850 | 3.25 | 3.53 | 3.80 |
| $T_5$ | Almond Oil + Ambient Temperature | 8.09 | 9.09 | 9.24 | 9.50 | 2.890 | 3.21 | 3.51 | 3.76 |
| T6 | Walnut Oil + Ambient Temperature | 8.02 | 9.61 | 10.02 | 11.12 | 2.930 | 3.18 | 3.52 | 3.81 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 8.49 | 9.02 | 9.99 | 10.09 | 2.940 | 3.23 | 3.51 | 3.82 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 8.69 | 11.01 | 12.04 | 13.09 | 2.830 | 3.2 | 3.45 | 3.78 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 8.2 | 9.89 | 9.51 | 10.15 | 2.810 | 3.21 | 3.42 | 3.75 |
| $T_{10}$ | Almond Oil + Refrigerated Temperature | 7.85 | 8.85 | 9.09 | 9.86 | 2.830 | 3.22 | 3.45 | 3.81 |
| $T_{11}$ | Walnut Oil + Refrigerated Temperature | 8.67 | 9.49 | 10.60 | 11.65 | 2.910 | 3.18 | 3.41 | 3.78 |
| S.Em± | | 0.26 | 0.12 | 0.28 | 0.09 | 0.083 | 0.04 | 0.06 | 0.08 |
| C.D. @ 5% | | NS | 0.59 | 1.44 | 0.46 | NS | NS | NS | NS |

**Table 3: Effect of Various edible oil coatings on Titratable Acidity and TSS: Acid Ratio of Malta in ambient temperature and Refrigerated temperature**

| Symbol | Treatments | Titratable Acidity (%) | | | | TSS:Acid Ratio | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 0.41 | 0.377 | 0.27 | 0.217 | 19.15 | 23.29 | 29.72 | 36.52 |
| $T_2$ | Mustard Oil + Ambient Temperature | 0.40 | 0.363 | 0.28 | 0.227 | 20.00 | 25.69 | 31.55 | 52.27 |
| $T_3$ | Coconut Oil + Ambient Temperature | 0.43 | 0.370 | 0.28 | 0.247 | 18.80 | 24.86 | 31.20 | 48.96 |
| $T_4$ | Olive Oil + Ambient Temperature | 0.40 | 0.370 | 0.29 | 0.247 | 19.80 | 24.69 | 30.16 | 49.00 |
| $T_5$ | Almond Oil + Ambient Temperature | 0.46 | 0.363 | 0.29 | 0.257 | 17.21 | 25.97 | 29.81 | 38.00 |
| T6 | Walnut Oil + Ambient Temperature | 0.40 | 0.357 | 0.29 | 0.287 | 19.56 | 28.26 | 31.31 | 39.71 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 0.39 | 0.350 | 0.29 | 0.237 | 21.23 | 27.33 | 31.22 | 43.87 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 0.38 | 0.343 | 0.27 | 0.217 | 22.28 | 34.41 | 46.31 | 62.33 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 0.40 | 0.377 | 0.29 | 0.247 | 20.71 | 24.57 | 36.63 | 51.71 |
| $T_{10}$ | Almond Oil + Refrigerated Temperature | 0.40 | 0.383 | 0.29 | 0.277 | 20.00 | 26.73 | 29.72 | 42.29 |
| $T_{11}$ | Walnut Oil + Refrigerated Temperature | 0.38 | 0.343 | 0.28 | 0.227 | 22.23 | 29.66 | 37.86 | 52.95 |
| S.Em± | | 0.02 | 0.018 | 0.01 | 0.013 | 0.58 | 0.50 | 0.59 | 0.72 |
| C.D. @ 5% | | NS | NS | NS | NS | NS | 2.54 | 3.01 | 3.64 |

**Table 4: Effect of various edible oil coatings on Juice (%) and Juice (ml) of malta fruits in ambient temperature and Refrigerated temperature**

| Symbol | Treatments | Juice % | | | | Juice (ml) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 70.54 | 66.30 | 60.24 | 57.69 | 78 | 62 | 51 | 46.00 |
| $T_2$ | Mustard Oil + Ambient Temperature | 67.83 | 66.67 | 61.18 | 60.26 | 78 | 61 | 52 | 47.00 |
| $T_3$ | Coconut Oil + Ambient Temperature | 71.82 | 71.76 | 66.25 | 64.38 | 79 | 60 | 50 | 45.00 |
| $T_4$ | Olive Oil + Ambient Temperature | 69.09 | 68.89 | 61.45 | 61.33 | 79 | 61 | 53 | 47.00 |
| $T_5$ | Almond Oil + Ambient Temperature | 67.26 | 72.94 | 64.56 | 65.71 | 76 | 62 | 51 | 46.00 |
| T6 | Walnut Oil + Ambient Temperature | 68.75 | 72.62 | 65.38 | 62.67 | 77 | 61 | 52 | 46.00 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 68.70 | 70.45 | 64.20 | 63.89 | 79 | 62 | 52 | 47.00 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 70.91 | 72.94 | 70.27 | 65.71 | 76 | 62 | 51 | 46.00 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 67.83 | 66.30 | 60.47 | 60.00 | 78 | 61 | 52 | 48.00 |
| $T_{10}$ | Almond Oil + Refrigerated Temperature | 70.54 | 72.94 | 63.75 | 63.51 | 79 | 62 | 51 | 47.00 |
| $T_{11}$ | Walnut Oil + Refrigerated Temperature | 70.43 | 66.30 | 60.47 | 60.76 | 81 | 61 | 52 | 48.00 |
| S.Em± | | 0.78 | 0.58 | 0.42 | 0.43 | 1 | 0.83 | 0.58 | 0.92 |
| C.D. @ 5% | | NS | 2.96 | 2.12 | 2.17 | NS | NS | NS | NS |

**Table 5: Effect of various edible oil coatings on Color and Taste at ambient temperature and Refrigerated temperature**

| Symbol | Treatments | Color | | | | Taste | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 6.450 | 5.54 | 6.37 | 6 | 7.560 | 5.77 | 5.88 | 5.88 |
| $T_2$ | Mustard Oil + Ambient Temperature | 7.840 | 7.71 | 7.81 | 6.25 | 7.570 | 6.58 | 7.38 | 7.38 |
| $T_3$ | Coconut Oil + Ambient Temperature | 7.380 | 8.37 | 6.52 | 6.06 | 7.273 | 7.07 | 7.64 | 7.64 |
| $T_4$ | Olive Oil + Ambient Temperature | 6.270 | 6.61 | 6.97 | 6.81 | 7.690 | 8.50 | 7.33 | 7.33 |
| $T_5$ | Almond Oil + Ambient Temperature | 6.290 | 8.4 | 6.57 | 7.05 | 8.070 | 8.66 | 7.65 | 7.67 |
| T6 | Walnut Oil + Ambient Temperature | 7.090 | 7.34 | 7.08 | 6.8 | 6.947 | 8.04 | 7.65 | 8.05 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 6.490 | 6.75 | 7.46 | 7.22 | 7.563 | 7.32 | 7.16 | 7.16 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 8.770 | 8.68 | 7.92 | 8.05 | 7.810 | 8.73 | 8.05 | 8.05 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 8.230 | 8.58 | 7.86 | 7.83 | 7.623 | 6.19 | 7.26 | 7.26 |
| $T_{10}$ | Almond Oil + Refrigerated Temperature | 8.450 | 7.89 | 7.81 | 7.77 | 7.623 | 8.04 | 8.05 | 8.05 |
| $T_{11}$ | Walnut Oil + Refrigerated Temperature | 8.440 | 7.94 | 7.69 | 7.38 | 7.687 | 7.46 | 7.49 | 7.49 |
| S.Em± | | 0.417 | 0.08 | 0.08 | 0.08 | 0.125 | 0.083 | 0.08 | 0.07 |
| C.D. @ 5% | | NS | 0.41 | 0.41 | 0.42 | NS | 0.423 | 0.41 | 0.36 |

**Table 6: Effect of various edible oil coatings on Texture and Flavor at ambient temperature and Refrigerated temperature**

| Symbol | Treatments | Texture | | | | Flavor | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 6.93 | 6.06 | 6.5 | 6.5 | 7.23 | 5.82 | 6.81 | 6.81 |
| $T_2$ | Mustard Oil + Ambient Temperature | 7.19 | 7.87 | 7.94 | 7.94 | 7.17 | 6.85 | 7.94 | 7.94 |
| $T_3$ | Coconut Oil + Ambient Temperature | 7.74 | 8.14 | 6.72 | 6.72 | 7.41 | 6.87 | 7.16 | 7.16 |
| $T_4$ | Olive Oil + Ambient Temperature | 7.7 | 7.5 | 7.92 | 7.92 | 8.04 | 7.61 | 7.06 | 7.06 |
| $T_5$ | Almond Oil + Ambient Temperature | 7.38 | 7.91 | 8.05 | 8.05 | 8.01 | 7.22 | 7.51 | 7.51 |
| T6 | Walnut Oil + Ambient Temperature | 7.85 | 5.91 | 7.5 | 7.5 | 7.22 | 6.59 | 7.56 | 7.56 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 6.94 | 7.49 | 7.13 | 7.13 | 7.85 | 8.6 | 7.94 | 7.84 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 7.99 | 8.37 | 8.25 | 8.25 | 8.18 | 8.65 | 7.94 | 7.94 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 7.86 | 6.53 | 7.16 | 7.16 | 7.66 | 7.34 | 7.86 | 7.86 |
| T10 | Almond Oil + Refrigerated Temperature | 7.1 | 7.34 | 7.84 | 7.84 | 7.82 | 8.42 | 7.18 | 7.18 |
| T11 | Walnut Oil + Refrigerated Temperature | 7.64 | 6.98 | 7.83 | 7.83 | 7.4 | 6.93 | 7.19 | 7.19 |
| S.Em± | | 0.48 | 0.07 | 0.08 | 0.08 | 0.22 | 0.1 | 0.1 | 0.1 |
| C.D. @ 5% | | NS | 0.36 | 0.42 | 0.42 | NS | 0.4 | 0.5 | 0.5 |

**Table 7: Effect of various edible oil coatings on overall acceptability of malta at ambient temperature and Refrigerated temperature**

| Symbol | Treatments | Overall Acceptability | | | |
|---|---|---|---|---|---|
| | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 7.72 | 5.8 | 6.72 | 6.72 |
| $T_2$ | Mustard Oil + Ambient Temperature | 7.44 | 7.7 | 7.38 | 7.38 |
| $T_3$ | Coconut Oil + Ambient Temperature | 7.33 | 7.99 | 6.89 | 6.89 |
| $T_4$ | Olive Oil + Ambient Temperature | 7.5 | 8.05 | 7.81 | 7.81 |
| $T_5$ | Almond Oil + Ambient Temperature | 7.43 | 8.06 | 7.64 | 7.64 |
| T6 | Walnut Oil + Ambient Temperature | 7.07 | 6.68 | 7.28 | 7.28 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 7.65 | 7.1 | 7.35 | 7.35 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 8.24 | 8.53 | 7.96 | 7.96 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 8.23 | 6.53 | 7.49 | 7.49 |
| T10 | Almond Oil + Refrigerated Temperature | 7.68 | 7.79 | 7.53 | 7.53 |
| T11 | Walnut Oil + Refrigerated Temperature | 7.86 | 7.32 | 7.47 | 7.47 |
| S.Em± | | 0.40 | 0.07 | 0.08 | 0.08 |
| C.D. @ 5% | | NS | 0.36 | 0.41 | 0.41 |

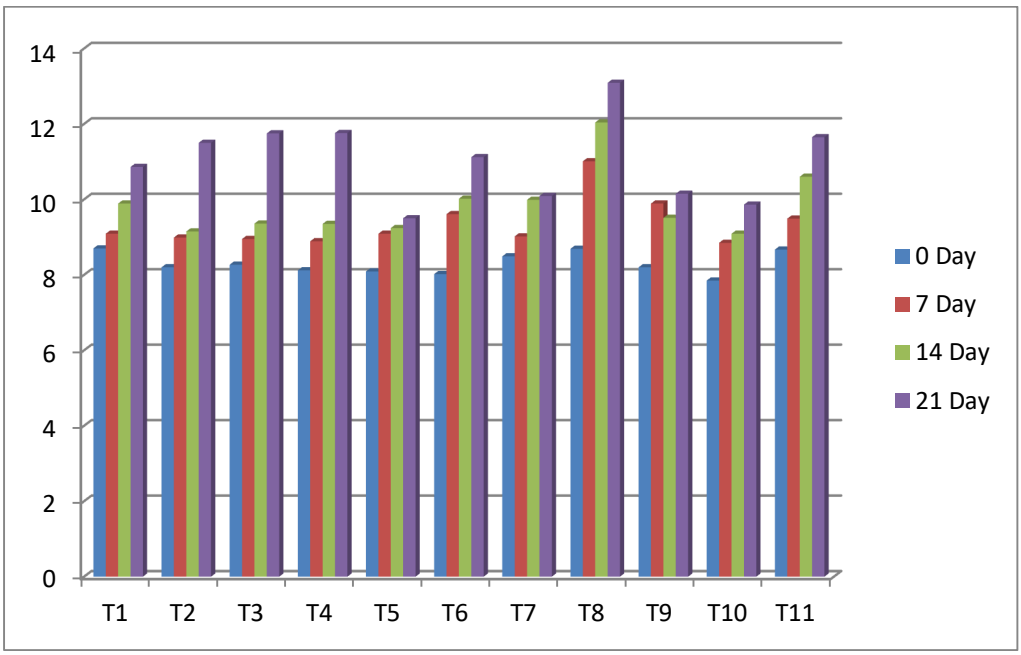


**Fig 1: Effect of various edible oil coatings on Total Soluble solids at ambient temperature and Refrigerated temperature**

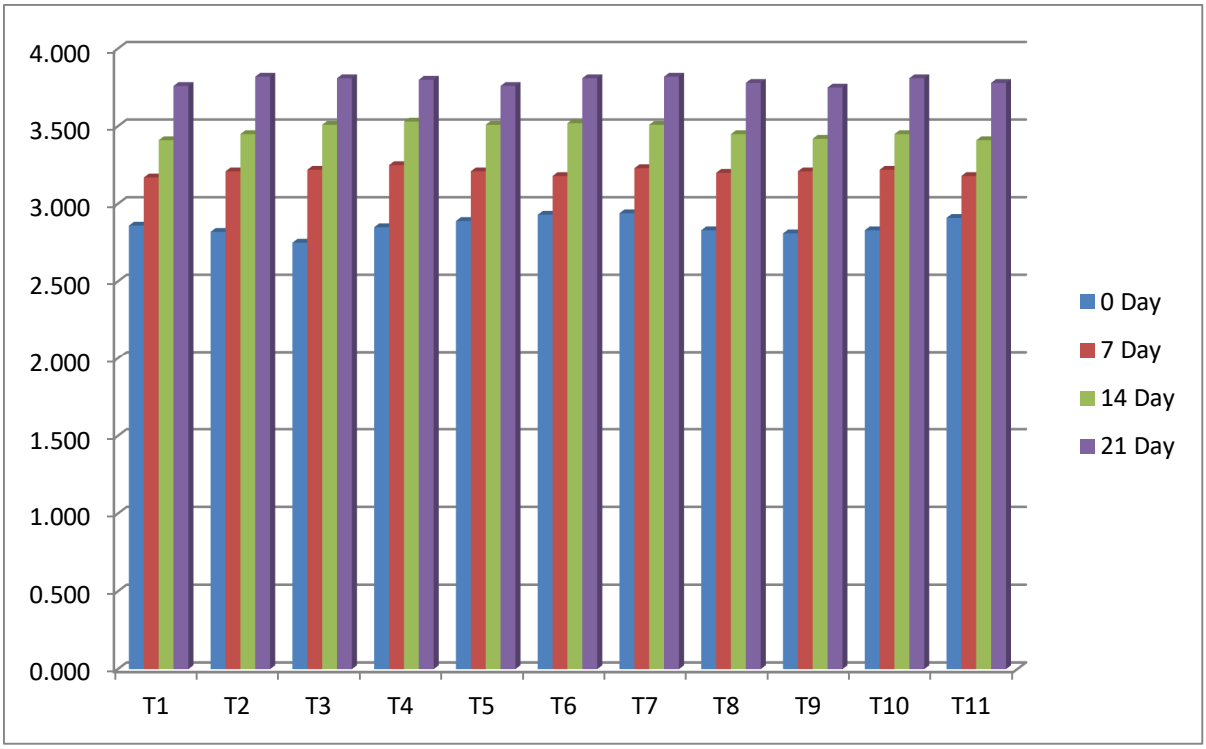


**Fig 2: Effect of various edible oil coatings on pH at ambient temperature and Refrigerated temperature**

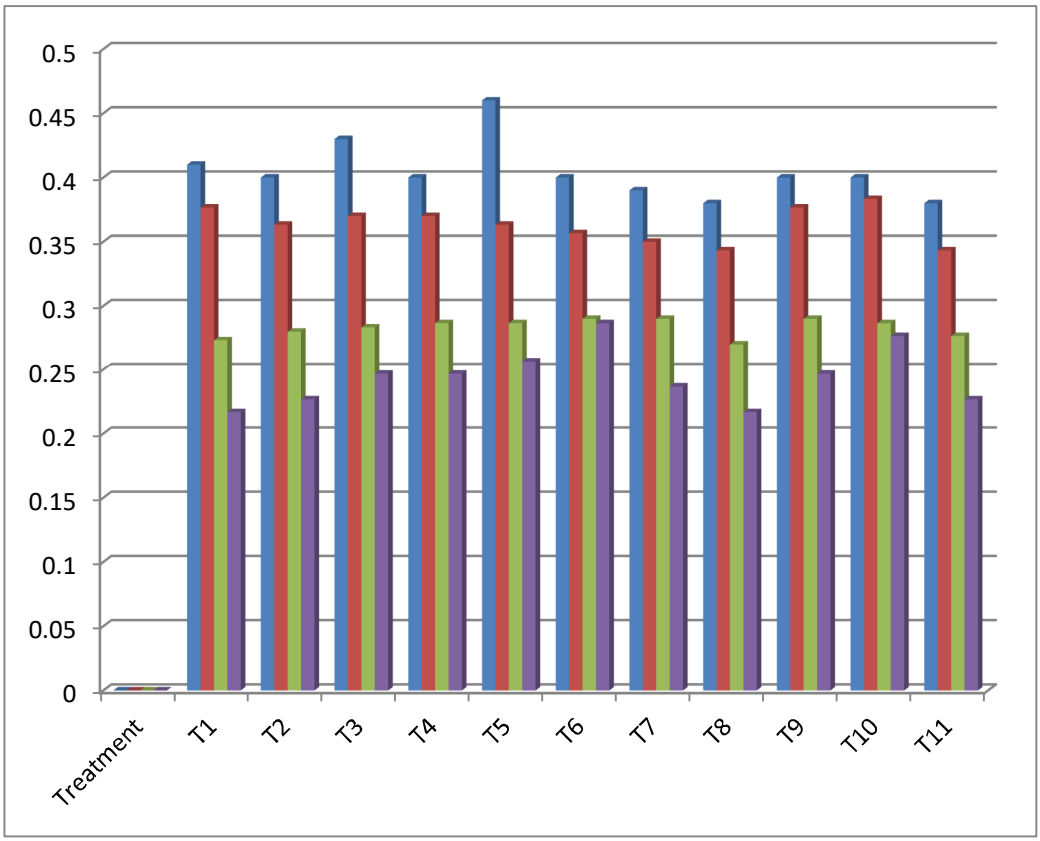


**Fig 3: Effect of various edible oil coatings on Titratable Acidity at ambient temperature and Refrigerated temperature**

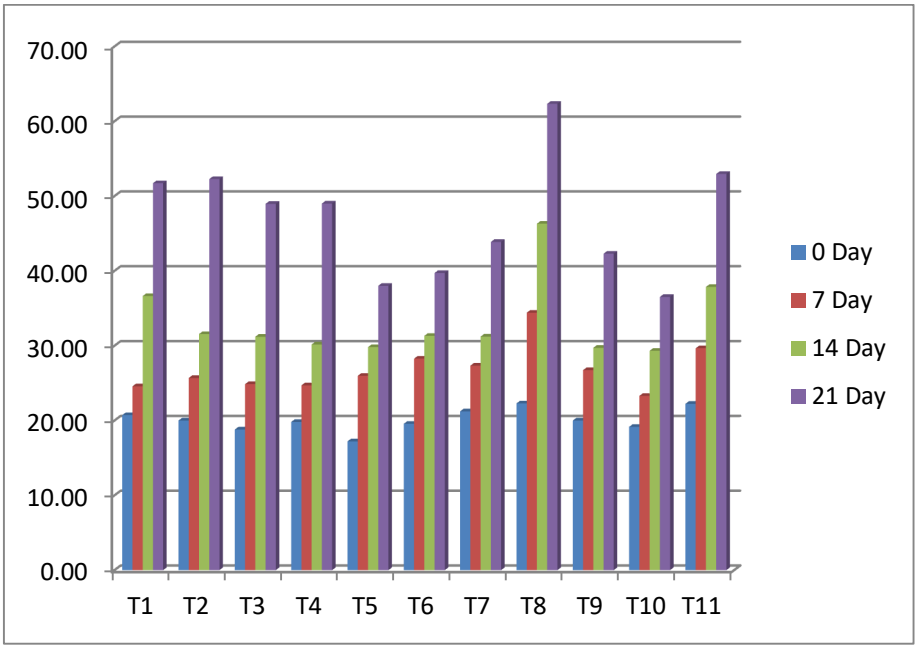


**Fig 4: Effect of various edible oil coatings on TSS:Acid ratio at ambient temperature and Refrigerated temperature**

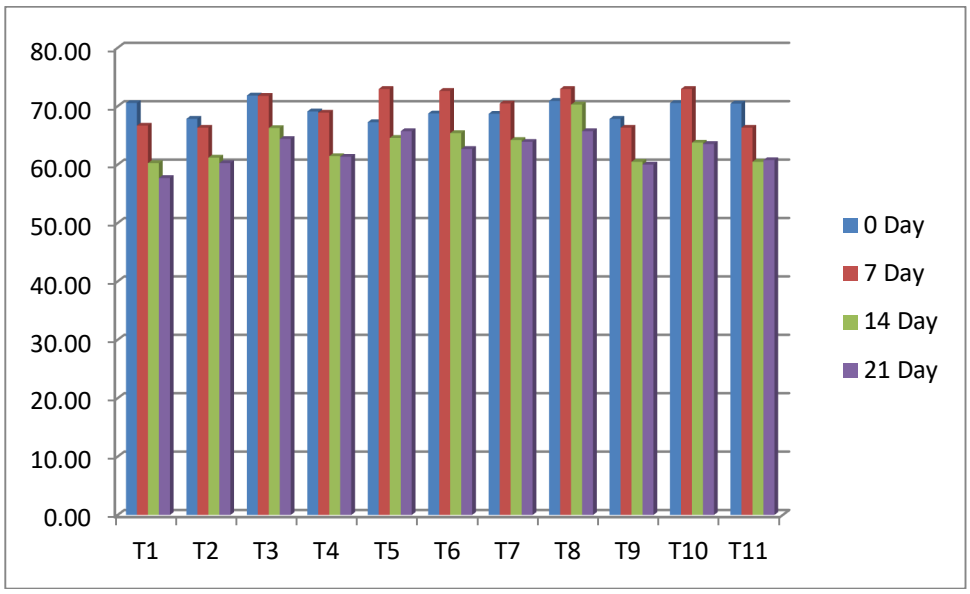


**Fig 5: Effect of various edible oil coatings on Juice (%) ratio at ambient temperature and Refrigerated temperature**

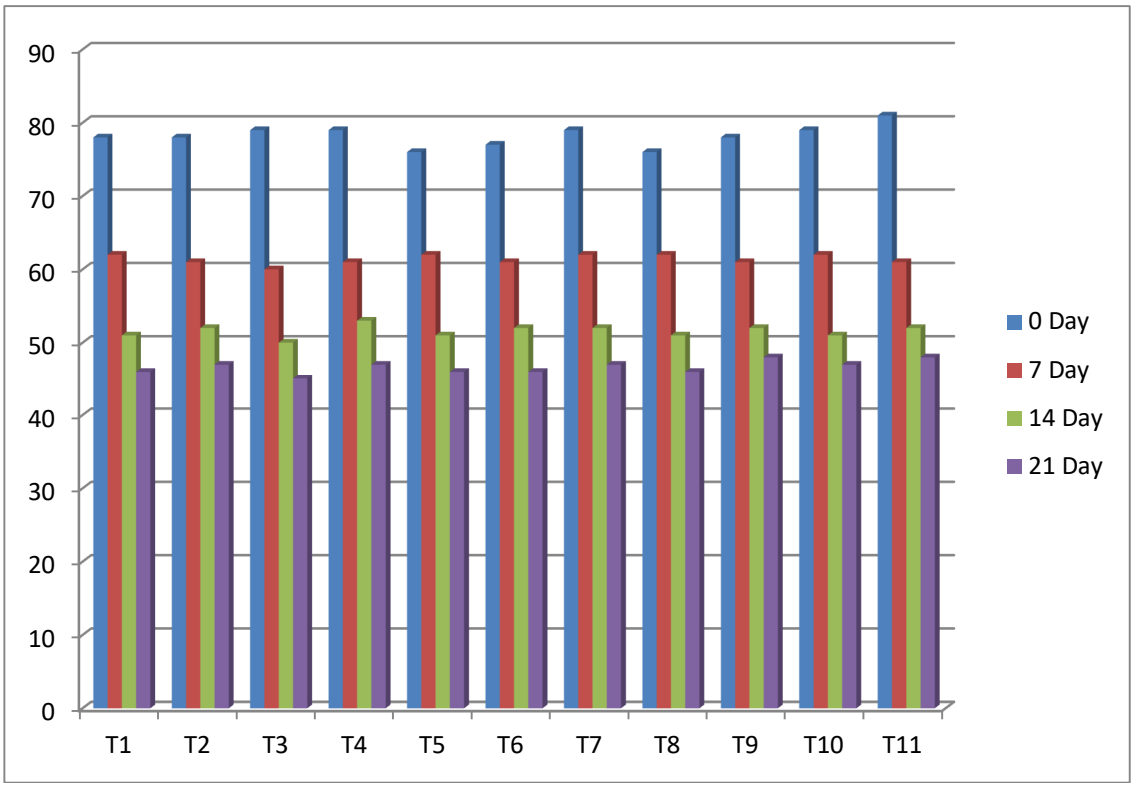


**Fig 6: Effect of various edible oil coatings on Juice (ml) ratio at ambient temperature and Refrigerated temperature**

## CONCLUSION

It can be concluded that among various edible oil coatings, coconut oil coating (3%) under refrigerated temperature (T8) found to be the most efficient edible oil coating treatment in terms of Total soluble solids ($^0$Brix), TSS: Acid ratio, Fruit juice (ml), Juice (%), Fruit color, Fruit taste, Fruit texture, Fruit flavour and Overall acceptability. Whereas, treatment T2 (Mustard oil coating @3% under ambient temperature) was found to be the most valuable edible oil coating treatment in terms of pH. However, treatment T10 (Almond oil coating @3% under refrigerated temperature) was found to be most effective in terms of Titratable

Acidity (%). Therefore, it can be concluded that edible coconut oil coating can be used to retain the chemical and sensory qualities of Malta.

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**CITATION OF THIS ARTICLE**

Manju Danu, Suneeta Singh and Anil Kumar Saxena. Effect of edible oil coatings on chemical and sensory attributes of Citrus sinensis cv. Malta under ambient and refrigerated conditions. Bull. Env.Pharmacol. Life Sci., Vol 13 [5] April 2024: 43-54