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# Effect of Edible oil coatings on Physical attributes, PLW and MFR of *Citrus sinensis* cv. Malta

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**ABSTRACT**
*Malta known for its excellent nutritional benefits and flavour. Various characteristics get affected during storage due to lack of knowledge & postharvest techniques. Therefore, an experiment was carried out to understand the effect of various edible oil coatings on physical attributes, physiological loss in weight (PLW) and marketable fruits retained (MFR) of malta during storage under ambient and refrigerated conditions. The experiment was conducted in completely randomized design having three replications and eleven treatments of different edible oil coatings. Results revealed that among various edible oil coatings, Coconut oil coating (3%) under refrigerated temperature i.e. (T8) found to be the most effective edible oil coating treatment in terms of fruit length (7.38cm), fruit circumference (21.1cm), fruit weight (98g), fruit volume (138ml), fruit firmness (4.95 lb/inch$^2$) , fruit shape index (1.01), number of seed per fruit (14.58), segment number (12.67), peel thickness (0.46mm) and marketable fruits retained (33.79 %). Whereas, treatment T2 i.e. (Mustard oil coating @3% under ambient temperature) was found to be the most effective in terms of specific gravity (1.71) and T7 (Mustard oil coating @3% under refrigerated temperature) reported best value for fruit diameter (7.29cm). However, in T1 (Control i.e. without oil coating under ambient temperature) there was maximum physiological loss of weight (12.77%) was recorded.*
***Keywords**: Malta, PLW, MFR, edible oil coating, oils, fruit firmness, specific gravity*

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## INTRODUCTION

Malta is popular seasonal citrus fruit in the hilly regions of Uttarakhand, India. The fruit's distinctive sweet-sour flavour is favoured by the locals of the Uttarakhand hills and it is nutritious, high in vitamins and typically eaten throughout the winter. 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 [1]**.** In the hilly regions of Uttarakhand, people can be seen consuming the slices of malta fruit marinated with homemade salt, sugar, honey or sometimes cream during the sunny winters. Studies have found out that malta contains 47 kcal energy, 0.94g protein, 0.12g fat, 2.4g dietary fibre, 53.2 mg vitamin C, 0.1-mg iron, 14-mg phosphorus, 10-mg magnesium. This fruit is also consumed and used in many forms like juice, squash, candy, jam, essential oil, peel powder etc.[2]**.** Malta fruit is distributed in Himalayan states of India like- Jammu & Kashmir, Himachal Pradesh, Uttarakhand and Sikkim [3]**.** It grows as a shrub and tree with white flowers and takes upto 5-6 years to reach the reproductive phase from the time of planting. Flowering on this tree occurs from March to May and the fruits are harvested in November – December. 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. 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. By reducing physiological losses, coating may be a key ingredient in extending the shelf life of malta. Although Glycerine

is helpful for shelf life when combined with various oils, such as almond oil, olive oil, walnut oil, coconut oil, and mustard oil, etc., their effects on the shelf life and quality of Malta may be researched. There is virtually little scientific literature in Uttarakhand about the effects of coating materials, particularly with reference to Malta and its postharvest quality. In addition, virtually little systematic research has been done in Uttrakhand to increase the shelf life of malta and decrease postharvest losses. Therefore, the purpose of the current study was to examine how the coating materials affected the physical characteristics and shelf life of malta.

**MATERIAL AND METHODS**

An experiment was under taken at Postharvest Technology laboratory, Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Pathri Bagh, Dehradun, Uttarakhand during the year 2022-2023 to study the effect of various edible oil coatings on physical attributes, physiological loss in weight (PLW) and marketable fruits retained (MFR) of Malta during storage under ambient and refrigerated conditions. The experiment comprised of 11 treatments and three replications designed under CRD at 5 per cent level of significance, includes various edible oil coating treatments viz. T1 : Without oil coating under ambient temperature (Control); T2 : Mustard oil coating (3%) under ambient temperature; T3: Coconut oil coating (3%) under ambient temperature; T4 : Olive oil coating (3%) under ambient temperature; T5 : Almond oil coating (3%) under ambient temperature; T6: Walnut oil coating (3%) under ambient temperature; T7: Mustard oil coating (3%) under refrigerated temperature ; T8: Coconut oil coating (3%) under refrigerated temperature ; T9: Olive oil coating (3%) under refrigerated temperature; T10: Almond oil coating (3%) under refrigerated temperature; T11: Walnut oil coating (3%) under refrigerated temperature. Fully matured, uniform fruits of Malta were harvested from the local orchard of Dhar Payankoti village, District Tehri Garhwal, Uttarakhand used for experiment. The fruits were brought to the Postharvest Technology laboratory of Department of Horticulture, School of Agricultural Sciences, SGRRU, Dehradun for conducting further experiments. Immature, damaged and off type fruits were discarded. The skin adherences, dots and latex were cleaned by gently wiping the fruits with moist and clean towel. Each replication consists of twenty fruits. The selected fruits were then individually coated with edible oils mixed in glycerine according to treatments with the help of tissue paper and stored at ambient and refrigerated conditions. Further, different studies were conducted to evaluate the effect of treatments on various physical attributes, physiological loss in weight (PLW) and marketable fruits retained (MFR) during the storage period of 0, 7, 14 and 21 days. Data were then subjected to various statistical analysis of variance as given by [4,5].

**RESULTS AND DISCUSSION**

The observations were recorded on 0 day, 7days, 14days and 21days after treatment application for physical attributes, physiological loss in weight (PLW) and marketable fruits retained (MFR)of malta. The results pertaining to the experiment are presented as follows:

**Fruit length (cm)**

The observation of fruit length was recorded at 0 day, 7 days, 14 days and 21 days interval and the result were significantly differed among the treatments. At 0 day, there was no significant difference was recorded in all treatments. After 7 days of treatment application, the maximum fruit length was recorded in $T_8$ (7.47 cm) with coconut oil coating (3%) under refrigerated temperature were as under ambient temperature fruit length in treatment $T_2$ (7.01cm) with mustard oil coating (3%) and $T_3$ (7.01cm) with coconut oil coating (3%) under ambient temperature were found in statistically at par with each other. Whereas, minimum fruit length was recorded at $T_6$ (4.02cm) with walnut oil coating (3%) under ambient temperature. After 14 days interval, the maximum fruit length was recorded in treatment $T_8$ (7.45cm) with coconut oil coating (3%) under refrigerated temperature. The significance difference was observed with the treatment $T_4$ (5.97cm) and $T_7$ (6.97cm) and minimum fruit length was recorded under the treatment $T_1$ (3.93cm) with Coconut oil coating (3%) under refrigerated temperature. After 21 days, the fruit length was maximum recorded in treatment $T_8$ (7.38cm). It was observed that treatment $T_4$ (5.92cm), $T_7$ (5.98cm) and $T_{11}$ (5.94cm) were at par with each other. While minimum fruit length was recorded under the treatment $T_1$ (3.87cm). Fruit length was significantly affected in all durations of interval with effect coconut oil coating (3%) under refrigerated temperature. Similar findings were reported by [6] in sweet orange cv. Blood Red.

**Fruit diameter (cm)**

The observation of fruit diameter was recorded at 0, 7, 14 and 21 days intervals after treatment application. The effects of oil coating are presented in the Table 2 and Fig. 2. As evident from table the different

treatments did not show any marked variation in fruit diameter. Hence, the whole observation shows non-significant effects of various edible oil coatings on fruit diameter.

**Fruit circumference (cm)**

The observations of fruit circumference (cm) are presented in the Table 2. and Fig. 3. As evident from table, during initial days of the observation shows that the treatment differences were significant. At 7 days after treatment, maximum fruit circumference was recorded in T3 (21.14cm) with coconut oil coating (3%) under ambient temperature, whereas under refrigerated temperature, fruit circumference in treatment T8 (20.98cm) with coconut oil coating (3%) and T7 (20.01cm) with mustard oil coating (3%) were found statistically at par. However, minimum fruit circumference was recorded in T5 (16.89cm) with almond oil coating (3%) under ambient temperature. At 14 days interval, the maximum fruit circumference was recorded in treatment T3 (21.12cm) with coconut oil coating (3%) under refrigerated temperature. There was no significant difference was observed with the treatment T7 (19.99cm) and T6 (19.17cm) and the minimum fruit circumference was recorded under the treatment T11(16.99cm). At 21 days after treatment application, the fruit circumference was recorded maximum in treatment T3 (21.1cm). However treatments T1 (18.97cm), T9 (18.92cm) and T6 (18.01cm) were at par with each other. While minimum fruit circumference was recorded under the treatment T11 (16.95cm).

**Fruit weight (g)**

As per data recorded at 7 days after treatment, maximum fruit weight was reported in T8 (110g) with coconut oil coating (3%) under refrigerated temperature. The fruit weight in treatment T7 (108g) with mustard oil coating (3%) under refrigerated temperature and T2 (107g) with mustard oil coating (3%) under ambient temperature were found statistically at par with each other. Whereas, minimum fruit weight was recorded in T1 (101g) without oil coating under ambient temperature. After 14 days, the maximum fruit weight was recorded in treatment T8 (106g) with coconut oil coating (3%) under refrigerated temperature followed by T7 (104g) which were at par with treatments T11 (103g) and T2 (102g). The minimum fruit weight was recorded under the treatment in T1 (101g) without oil coating under ambient temperature. After 21 days, the fruit weight was maximum in treatment T8 (98g) which were at par with T7 (97g) and T11 (97g). However, significance difference were observed in treatment T2 (94g), T3 (93g), T10 (93g) and T6 (92g). While, minimum fruit weight was recorded under the treatment in T1 (82g) without oil coating under ambient temperature. The significant reduction in fruit weight might be due to anti senescence property present in pure coconut oil help to slow storage break down associated with slow respiration rate, transpiration rate and binding of the ethylene biosynthesis process. The present findings were confirmed by [7] in mandarin and [8] in lemon.

**Fruit volume (ml)**

The data recorded on fruit volume at different intervals are presented in the Table 3 and Fig. 5. As evident from table, during initial days of observation shows the treatment differences were non-significant. At 7 days after treatment application, maximum fruit volume was recorded in T8 (161ml) with coconut oil coating (3%) under refrigerated temperature followed by T7 (114ml). Whereas, minimum fruit volume was recorded in T1 (86.09ml) without oil coating under ambient temperature. After 14 days interval, the maximum fruit volume was recorded in treatment T8 (140.67ml) with coconut oil coating (3%) under refrigerated temperature followed by T7 (134.33ml) and the minimum fruit volume was recorded under the treatment T1 (84.87ml) without oil coating under ambient temperature**.** Finally after 21 days, the fruit volume was recorded maximum in treatment T8 (138.33ml) However, no significant difference was observed with treatment T2(101 ml), T6 (99.87ml) and T9 (98.87ml).While minimum fruit volume was recorded under the treatment in T1 (75.76ml) without oil coating under ambient temperature. Fruit volume was significantly affected by the coating of coconut oil coating (3%) under refrigerated temperature. The results are in line with the experiment done in guava [9].

**Fruit shape index**

As evident from table, during initial 0 day observation shows the treatment differences were non-significant. After 7 days, maximum and same fruit shape index was recorded in T8 (1.01) with coconut oil coating (3%) under refrigerated temperature as well as in T2 (1.01). The fruit shape index in treatment T9 (0.96) with olive oil coating (3%) under refrigerated temperature and T3 (0.95) with mustard oil coating (3%) under ambient temperature were found statistically at par with each other. Whereas, minimum fruit shape index was recorded at T10 (0.24) with almond oil coating (3%) under refrigerated. After14 days interval, the maximum fruit shape index was recorded in treatment T8 (1.01) with coconut oil coating (3%) under refrigerated temperature followed by T9 (0.96) and T3 (0.95). The minimum fruit shape index was

recorded under the treatment in $T_1$ (0.74) without oil coating under ambient temperature. Finally, after 21 days, the fruit shape index was maximum observed in treatment $T_8$ (1.01) which was at par with $T_9$ (0.96) and $T_3$ (0.94). However significant difference was observed with treatment $T_4$ (0.92), $T_{11}$ (0.87) and $T_{10}$ (0.86). While minimum fruit shape index was recorded under the treatment in $T_1$ (0.72) without oil coating under ambient temperature. Fruit shape index was significantly affected by the coating of coconut oil coating (3%) under refrigerated temperature. The results are in line with grapes [10].

**Specific gravity**

The observation of specific gravity was recorded at 0 days, 7 days, 14 days and 21 days interval. Data pertaining to table 4 indicated that during initial day observation shows the treatment differences were non-significant. At 7 days after treatment, maximum specific gravity was recorded in $T_7$ (1.64) with mustard oil coating (3%) under refrigerated temperature followed by $T_8$ (1.62) and $T_2$ (1.50). The specific gravity in treatment $T_1$ (1.16) and $T_3$ (1.14) with mustard oil coating (3%) under ambient temperature were found in statistically at par whereas, minimum specific gravity was recorded at $T_6$(0.72) with walnut oil coating (3%) under ambient temperature. At 14 days interval, the maximum specific gravity was recorded in treatment $T_8$ (1.66) with coconut oil coating (3%) under refrigerated temperature which was at par with treatments$T_7$ (1.66) and minimum specific gravity was recorded under treatment $T_6$ (0.70) with walnut oil coating (3%) under ambient temperature. Finally, after 21 days, the specific gravity was recorded maximum in treatment $T_2$ (1.71) which was at par with $T_8$ (1.68) and $T_7$ (1.62). However, significance difference was observed in treatment $T_4$(1.51) and $T_{10}$ (1.25). While minimum specific gravity was recorded under the treatment $T_1$ (0.71) without oil coating under ambient temperature. The specific gravity of fruit was significantly affected by the coating of coconut oil coating (3%) under refrigerated temperature. The results are in line with the work done by [11].

**Fruit firmness (lb/inch$^2$)**

The data recorded on fruit firmness are presented in the Table 4 and Fig. 6. As evident from table**,** during initial day of treatment application and after 7 days, all observation shows the non-significant differences. After 14 days interval the maximum fruit firmness was recorded in treatment $T_8$ (5.71 lb/inch$^2$) with coconut oil coating (3%) under refrigerated temperature which was at par with treatments$T_7$ (5.32 lb/inch$^2$) and $T_{10}$ (5.19 lb/inch$^2$). The minimum fruit firmness was recorded under the treatment $T_2$ (4.12 lb/inch$^2$) with mustard oil coating (3%) under ambient temperature. After 21 days of treatment application, the fruit firmness was maximum recorded in treatment $T_8$(4.95 lb/inch$^2$) which were at par with $T_9$ (4.03 lb/inch$^2$) and $T_{10}$ (4.02 lb/inch$^2$). However no significant differences were also observed with the treatments $T_3$(3.54 lb/inch$^2$), $T_{11}$(3.24 lb/inch$^2$) and $T_2$(3.42 lb/inch$^2$ lb/inch$^2$). While minimum fruit firmness was recorded under the treatment in $T_1$ (3.21 lb/inch$^2$) without oil coating under ambient temperature. The significant reduction in fruit firmness may be due to the enzyme mediated alterations in the structure and composition of cell walls lead to partial or complete solubilisation and de-polymerization of cell wall polysaccharides, accompanied by a loss of neutral sugars and galacturonic acid similar results were also reported by [12].

**Peel thickness (cm)**

As evident from table 4, initial 0-day observations show non-significant differences among the treatments. Whereas after 7 days, maximum peel thickness was recorded in $T_3$ (0.53cm) with coconut oil coating (3%) under ambient temperature which was at par $T_8$ (0.50cm) with coconut oil coating (3%) under refrigerated temperature. The peel thickness in treatment $T_{10}$ (0.48cm) with almond oil coating (3%) under refrigerated temperature and $T_{11}$(0.44cm) with walnut oil coating (3%) under refrigerated temperature were found statistically at par with each other and minimum peel thickness was recorded at $T_6$ (0.26cm) with walnut oil coating (3%) under ambient temperature. After 14 days, the maximum peel thickness was recorded in treatment $T_8$ (0.47cm) with coconut oil coating (3%) under refrigerated temperature which was at par with treatments $T_3$ (0.46cm). The minimum peel thickness was recorded under the treatment in $T_6$ (0.17cm) with walnut oil coating (3%) under ambient temperature. Finally, after 21 days, the peel thickness was maximum in treatment $T_8$ (0.46cm) which were at par with $T_3$(0.41cm). However, significance difference was observed with treatment $T_{10}$ (0.32cm) and $T_2$(0.25cm). While minimum peel thickness was recorded under the treatment in $T_6$ (0.14cm) with walnut oil coating (3%) under ambient temperature. The peel thickness was significantly affected by the coating of coconut oil coating (3%) under refrigerated temperature. Similar results were also reported by [6] in sweet orange cv. Blood Red.

**Number of Segment**

Data pertaining to number of segments revealed that 0 day observations show non-significant differences among the treatments. After 7 days, maximum segment number (12.00) was recorded in $T_2$, $T_5$ and $T_9$ and

minimum (5.00) in treatment T8 i.e. coconut oil coating (3%) under refrigerated temperature. After 14 days interval, the maximum segment number was recorded in treatment T8 (12) with coconut oil coating (3%) under refrigerated temperature followed by T2(12.00) which was at par with treatments T9 (10) and T7 (10). The minimum segment number was recorded under the treatment in T1(8) without oil coating under ambient temperature. Finally, after 21 days, the segment number was recorded maximum in treatment T8 (12.67) which were at par with T7 (11), and T2 (10), T10 (10). However significant difference was observed with treatment inT4 (9), T3(8) and T5(07). While minimum segment number was recorded under the treatment inT1 (6) without oil coating under ambient temperature. The number of segments per fruits was significantly affected by the coating of coconut oil (3%) under refrigerated temperature The results are in line with the experiment done by [13].

**Physiological loss of weight (PLW %)**

The data recorded on physiological loss of weight (PLW) at different interval are presented in the Table 5 and Fig. 8. It was clear from data that 0 day observations show non-significant differences among the treatments. After 7 days of treatment application, maximum PLW (6.96 %) was recorded in T2 (mustard oil coating @3%+ambient temperature) which was at par with T6 (6.25%) and T4(6.36%). Whereas, minimum PLW was recorded in treatment T8 (4.35%) with coconut oil coating (3%) under refrigerated temperature. After 14 days intervals, the maximum PLW was recorded in treatment T4 (7.77%) with olive oil coating (3%) under ambient temperature followed by T1(6.93%) and T5(6.54%). The minimum PLW was recorded under the treatment in T8 (3.64%) with coconut oil coating (3%) under refrigerated temperature. Finally, after 21 days, the PLW was recorded maximum in T1(12.77%). However non-significant difference was observed with treatment T5(8.00%), T2 (7.84%) and T4 (7.37%). While minimum PLW was recorded under the treatment in T8(5.66%) with coconut oil coating (3%) under refrigerated temperature. The significantly reduce in Physiological loss of weight may be coconut oil was probably due to maintenance of maximum moisture content around the surface of the fruit etc. along with storage having high humidity and refrigerated conditions. Similar observation was also reported by [14].

**Marketable Fruits Retained (MRF %)**

The observation of Marketable Fruits Retained (MRF) was recorded at 0 days, 7 days, 14 days and 21 days interval and depicted in Table 5. and Fig. 8. As evident from table, during initial days observation shows the treatment differences were non-significant. After 7 days interval the maximum MRF was recorded in treatment T8 (95.98%) with coconut oil coating (3%) under refrigerated temperature followed by T6(95.23%). The minimum MRF was recorded in T1(12.09%) without oil coating under ambient temperature. After14 days interval the maximum MRF % was recorded in treatment T8 (96.89%) with coconut oil coating (3%) under refrigerated temperature followed by T10(93.01%) and minimum MRF was recorded in T1 (9.11%) without oil coating under ambient temperature. Finally, after 21 days, the MRF was maximum recorded in treatment T8 (33.79%) which was at par with T10 (32.99%). However, significance differences were observed with treatment in T7 (25.69%), T6 (24.32%) and T9 (23.15%). While minimum MRF was recorded under the treatment in T11 (11.5%) with walnut oil coating (3%) under refrigerated temperature. Marketable Fruits Retained (MRF) was significantly affected by the coating of coconut oil coating (3%) under refrigerated temperature. This might be due to the minimum loss of moisture from the surface of fruit because of edible coconut oil coating and low temperature conditions of refrigerated temperature. The results of the present investigations are in accordance with the findings of [15] in papaya.

**Table 1: Treatment combination**

| Symbol | Treatment doses |
|---|---|
| T1 | (Control) without oil coating under ambient temperature |
| T2 | Mustard oil coating (3%) under ambient temperature |
| T3 | Coconut oil coating (3%) under ambient temperature |
| T4 | Olive oil coating (3%) under ambient temperature |
| T5 | Almond oil coating (3%) under ambient temperature |
| T6 | Walnut oil coating (3%) under ambient temperature |
| T7 | Mustard oil coating (3%) under refrigerated temperature |
| T8 | Coconut oil coating (3%) under refrigerated temperature |
| T9 | Olive oil coating (3%) under refrigerated temperature |
| T10 | Almond oil coating (3%) under refrigerated temperature |
| T11 | Walnut oil coating (3%) under refrigerated temperature |

**Table 2: Effect of various edible oil coatings on Fruit length and diameter of malta at ambient and refrigerated temperature**

| Symbol | Treatments | Fruit Length (cm) | | | | Fruit Diameter (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 6.82 | 5.15 | 3.93 | 3.87 | 5.83 | 5.71 | 5.69 | 5.67 |
| $T_2$ | Mustard Oil + Ambient Temperature | 6.81 | 7.01 | 6.98 | 6.88 | 6.99 | 6.95 | 6.88 | 6.82 |
| $T_3$ | Coconut Oil + Ambient Temperature | 6.74 | 7.01 | 6.97 | 6.93 | 7.36 | 7.35 | 7.32 | 7.3 |
| $T_4$ | Olive Oil + Ambient Temperature | 6.32 | 6.01 | 5.97 | 5.92 | 6.53 | 6.49 | 6.48 | 6.42 |
| $T_5$ | Almond Oil + Ambient Temperature | 6.21 | 4.21 | 4.18 | 4.11 | 6.76 | 6.73 | 6.71 | 6.69 |
| T6 | Walnut Oil + Ambient Temperature | 6.20 | 4.32 | 4.29 | 4.1 | 6.73 | 6.71 | 6.67 | 6.65 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 6.66 | 6.88 | 6.01 | 5.98 | 7.36 | 7.34 | 7.31 | 7.29 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 6.67 | 7.47 | 7.45 | 7.38 | 7.48 | 7.33 | 7.32 | 7.25 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 6.78 | 6.81 | 6.75 | 6.71 | 7.09 | 7.05 | 7.01 | 6.97 |
| T10 | Almond Oil + Refrigerated Temperature | 6.89 | 5.99 | 5.87 | 5.85 | 6.82 | 6.79 | 6.75 | 6.7 |
| T11 | Walnut Oil + Refrigerated Temperature | 6.53 | 6.44 | 5.98 | 5.94 | 6.99 | 6.95 | 6.81 | 6.82 |
| S.Em± | | 0.11 | 0.21 | 0.20 | 0.10 | 0.31 | 0.22 | 0.25 | 0.41 |
| C.D. @ 5% | | NS | 1.08 | 1.01 | 0.50 | NS | NS | NS | NS |
| C.V.% | | 4.82 | 10.44 | 10.23 | 5.13 | 13.62 | 9.48 | 10.86 | 18.29 |

**Table 3: Effect of various edible oil coatings on Fruit weight, volume and circumference of malta in ambient and refrigerated temperature**

| Symbol | Treatments | Fruit weight (g) | | | | Fruit volume (ml) | | | | Fruit circumference (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 112.33 | 101 | 94 | 82 | 120.90 | 86.09 | 84.87 | 75.76 | 21.5 | 20.98 | 20.8 | 20.89 |
| $T_2$ | Mustard Oil + Ambient Temperature | 113.00 | 107 | 102 | 94 | 119.58 | 115.98 | 110.98 | 101.98 | 19.4 | 18.98 | 18.95 | 18.9 |
| $T_3$ | Coconut Oil + Ambient Temperature | 113.00 | 106 | 100 | 93 | 119.67 | 119.77 | 119.05 | 126.63 | 21.19 | 21.14 | 21.12 | 21.1 |
| $T_4$ | Olive Oil + Ambient Temperature | 111.00 | 103 | 95 | 88 | 120.09 | 99.08 | 98.06 | 93.87 | 18.15 | 18.02 | 17.98 | 17.95 |
| $T_5$ | Almond Oil + Ambient Temperature | 112.33 | 107 | 100 | 92 | 119.47 | 130.99 | 118.54 | 101.98 | 17.11 | 16.89 | 16.85 | 16.75 |
| T6 | Walnut Oil + Ambient Temperature | 113.00 | 105 | 100 | 92 | 120.05 | 110.89 | 103.76 | 99.87 | 20.5 | 19.88 | 19.17 | 18.01 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 111.67 | 108 | 104 | 97 | 120.55 | 144.81 | 134.33 | 130.33 | 20.09 | 20.01 | 19.99 | 19.97 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 111.00 | 104 | 99 | 98 | 120.98 | 161.07 | 140.67 | 138.33 | 19.05 | 19.04 | 18.99 | 18.97 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 112.00 | 110 | 106 | 92 | 119.76 | 114.98 | 110.89 | 98.87 | 19.03 | 18.99 | 18.95 | 18.92 |
| T10 | Almond Oil + Refrigerated Temperature | 112.00 | 106 | 100 | 93 | 120.07 | 100.99 | 95.32 | 82.01 | 18.05 | 17.98 | 17.95 | 17.9 |
| T11 | Walnut Oil + Refrigerated Temperature | 113.33 | 108 | 103 | 97 | 120.06 | 97.34 | 94.09 | 89.99 | 17.05 | 17.02 | 16.99 | 16.95 |
| S.Em± | | 0.31 | 0.45 | 0.48 | 0.67 | 0.22 | 1.01 | 1.08 | 0.63 | 0.23 | 0.48 | 0.30 | 0.33 |
| C.D. @ 5% | | NS | 2.27 | 2.45 | 3.39 | NS | 5.14 | 5.48 | 3.20 | 1.15 | 2.46 | 1.51 | 1.66 |
| C.V.% | | 0.82 | 1.27 | 1.44 | 2.16 | 0.55 | 2.60 | 2.94 | 1.82 | 3.54 | 7.63 | 4.71 | 5.23 |

**Table 4: Effect of various edible oil coatings on Fruit Shape index and Specific Gravity of malta in ambient and refrigerated temperature**

| Symbol | Treatments | Fruit Shape index | | | | Specific Gravity | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 0.98 | 0.94 | 0.75 | 0.72 | 1.06 | 1.16 | 1.14 | 1.13 |
| $T_2$ | Mustard Oil + Ambient Temperature | 1.02 | 1.01 | 0.83 | 0.84 | 1.48 | 1.50 | 1.56 | 1.71 |
| $T_3$ | Coconut Oil + Ambient Temperature | 0.97 | 0.95 | 0.95 | 0.94 | 1.16 | 1.14 | 1.13 | 0.71 |
| $T_4$ | Olive Oil + Ambient Temperature | 0.95 | 0.92 | 0.92 | 0.92 | 1.45 | 1.50 | 1.42 | 1.51 |
| $T_5$ | Almond Oil + Ambient Temperature | 0.71 | 0.62 | 0.62 | 0.61 | 0.88 | 0.92 | 1.06 | 1.24 |
| T6 | Walnut Oil + Ambient Temperature | 0.72 | 0.75 | 0.58 | 0.55 | 0.74 | 0.72 | 0.70 | 0.71 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 0.94 | 0.93 | 0.85 | 0.82 | 1.44 | 1.64 | 1.66 | 1.62 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 1.01 | 1.01 | 1.01 | 1.01 | 1.67 | 1.62 | 1.66 | 1.68 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 0.93 | 0.96 | 0.96 | 0.96 | 0.93 | 0.92 | 0.91 | 0.91 |
| $T_{10}$ | Almond Oil + Refrigerated Temperature | 0.97 | 0.24 | 0.86 | 0.86 | 0.95 | 1.05 | 1.08 | 1.25 |
| $T_{11}$ | Walnut Oil + Refrigerated Temperature | 0.98 | 0.92 | 0.87 | 0.87 | 1.11 | 1.10 | 1.13 | 1.23 |
| S.Em± | | 0.05 | 0.04 | 0.03 | 0.05 | 0.14 | 0.08 | 0.08 | 0.05 |
| C.D. @ 5% | | NS | 0.23 | 0.18 | 0.27 | NS | 0.40 | 0.41 | 0.25 |
| C.V.% | | 16.52 | 16.04 | 13.57 | 13.39 | 16.75 | 14.36 | 12.56 | 12.05 |

**Table 5: Effect of various edible oil coatings on Fruit firmness and Peel thickness of malta at ambient and refrigerated temperature**

| Symbol | Treatments | Fruit firmness (lb/inch$^2$ ) | | | | Peel Thickness (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 8.23 | 6.21 | 4.34 | 3.21 | 0.45 | 0.44 | 0.39 | 0.29 |
| $T_2$ | Mustard Oil + Ambient Temperature | 8.12 | 6.56 | 4.12 | 3.42 | 0.39 | 0.38 | 0.28 | 0.25 |
| $T_3$ | Coconut Oil + Ambient Temperature | 8.21 | 6.74 | 4.45 | 3.54 | 0.52 | 0.52 | 0.46 | 0.41 |
| $T_4$ | Olive Oil + Ambient Temperature | 8.11 | 6.43 | 4.21 | 3.41 | 0.49 | 0.37 | 0.29 | 0.24 |
| $T_5$ | Almond Oil + Ambient Temperature | 8.21 | 6.46 | 4.14 | 3.31 | 0.35 | 0.35 | 0.27 | 0.22 |
| T6 | Walnut Oil + Ambient Temperature | 7.98 | 6.52 | 4.15 | 3.24 | 0.28 | 0.26 | 0.17 | 0.14 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 7.98 | 6.48 | 5.32 | 3.52 | 0.48 | 0.36 | 0.32 | 0.29 |
| $T_8$ | Coconut Oil + Refrigerated Temperature | 8.09 | 6.52 | 5.71 | 4.95 | 0.51 | 0.50 | 0.47 | 0.46 |
| $T_9$ | Olive Oil + Refrigerated Temperature | 8.17 | 6.59 | 5.01 | 4.03 | 0.49 | 0.34 | 0.28 | 0.22 |
| $T_{10}$ | Almond Oil + Refrigerated Temperature | 8.6 | 6.79 | 5.19 | 4.02 | 0.51 | 0.48 | 0.34 | 0.32 |
| $T_{11}$ | Walnut Oil + Refrigerated Temperature | 8.35 | 5.96 | 4.21 | 3.24 | 0.45 | 0.44 | 0.34 | 0.22 |
| S.Em± | | 0.58 | 0.25 | 0.15 | 0.19 | 0.05 | 0.03 | 0.01 | 0.03 |
| C.D. @ 5% | | NS | NS | 0.76 | 0.97 | NS | 0.15 | 0.07 | 0.13 |
| C.V.% | | 11.38 | 11.58 | 9.73 | 15.72 | 12.54 | 12.00 | 12.33 | 18.20 |

**Table 6: Effect of various edible oil coatings on segment number, PLW % and MFR% at ambient and refrigerated temperature**

| Symbol | Treatments | Segment number | | | | Physiological loss in weight (%) | | | | Marketable Fruits Retained (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after Storage | | | | Days after Storage | | | | Days after Storage | | | |
| | | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| $T_1$ | Without Oil + Ambient Temperature | 9.75 | 10.00 | 8.00 | 6.00 | 0 | 8.18 | 6.93 | 12.77 | 86.323 | 12.09 | 9.11 | 0 |
| $T_2$ | Mustard Oil + Ambient Temperature | 11.00 | 12.00 | 12.00 | 10.00 | 0 | 6.96 | 4.67 | 7.84 | 87.306 | 45.06 | 32.33 | 0 |
| $T_3$ | Coconut Oil + Ambient Temperature | 10.00 | 11.00 | 9.00 | 8.00 | 0 | 5.36 | 5.66 | 7.00 | 85.857 | 45.02 | 30.82 | 0 |
| $T_4$ | Olive Oil + Ambient Temperature | 11.00 | 11.00 | 10.00 | 9.00 | 0 | 6.36 | 7.77 | 7.37 | 85.607 | 69.01 | 43.5 | 0 |
| $T_5$ | Almond Oil + Ambient Temperature | 11.25 | 12.00 | 9.00 | 7.00 | 0 | 5.31 | 6.54 | 8.00 | 85.291 | 52.02 | 42.3 | 0 |
| T6 | Walnut Oil + Ambient Temperature | 10.42 | 9.00 | 5.00 | 10.00 | 0 | 6.25 | 4.76 | 8.00 | 86.120 | 95.23 | 91.5 | 24.32 |
| $T_7$ | Mustard Oil + Refrigerated Temperature | 10.33 | 10.00 | 10.00 | 11.00 | 0 | 6.09 | 3.70 | 6.73 | 86.210 | 86.09 | 62.22 | 25.69 |
| $T_8$ | Coconut Oil + Refrigerated | 11.43 | 5.00 | 12.00 | 12.67 | 0 | 4.35 | 3.64 | 5.66 | 86.342 | 95.98 | 96.89 | 33.79 |

| | Temperature | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_9$ | Olive Oil + Refrigerated Temperature | 11.00 | 12.00 | 10.00 | 7.00 | 0 | 5.45 | 4.81 | 7.07 | 85.578 | 70.02 | 81.3 | 23.15 |
| $T_{10}$ | Almond Oil + Refrigerated Temperature | 9.33 | 11.00 | 7.00 | 10.00 | 0 | 5.36 | 5.66 | 7.00 | 86.338 | 92.05 | 93.01 | 32.99 |
| $T_{11}$ | Walnut Oil + Refrigerated Temperature | 9.92 | 10.00 | 6.00 | 9.00 | 0 | 6.09 | 4.63 | 5.83 | 85.691 | 88.01 | 53.27 | 11.5 |
| S.Em± | | 0.32 | 0.42 | 0.33 | 0.42 | NA | 0.08 | 0.09 | 0.09 | 0.226 | 0.24 | 0.26 | 0.80 |
| C.D. @ 5% | | NS | 2.12 | 1.69 | 2.12 | NA | 0.42 | 0.46 | 0.46 | NS | 1.24 | 1.32 | 4.06 |
| C.V.% | | 9.01 | 12.17 | 11.22 | 12.50 | NA | 4.18 | 5.05 | 3.57 | 0.79 | 1.09 | 1.39 | 1.43 |

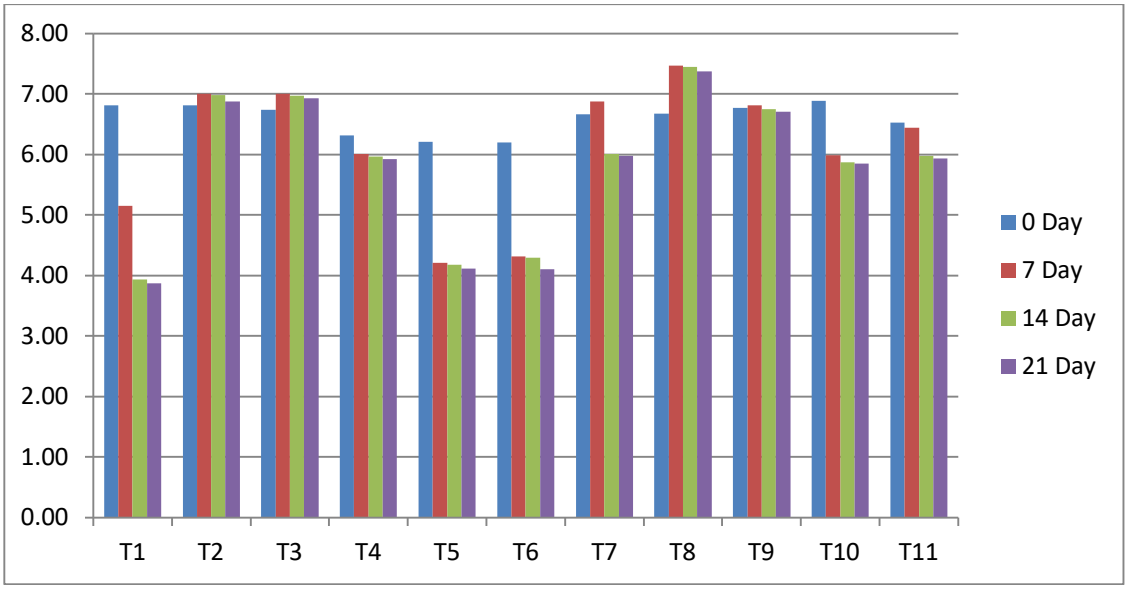


**Fig. 1: Effect of various edible oil coatings on fruit length of Malta at different storage intervals**

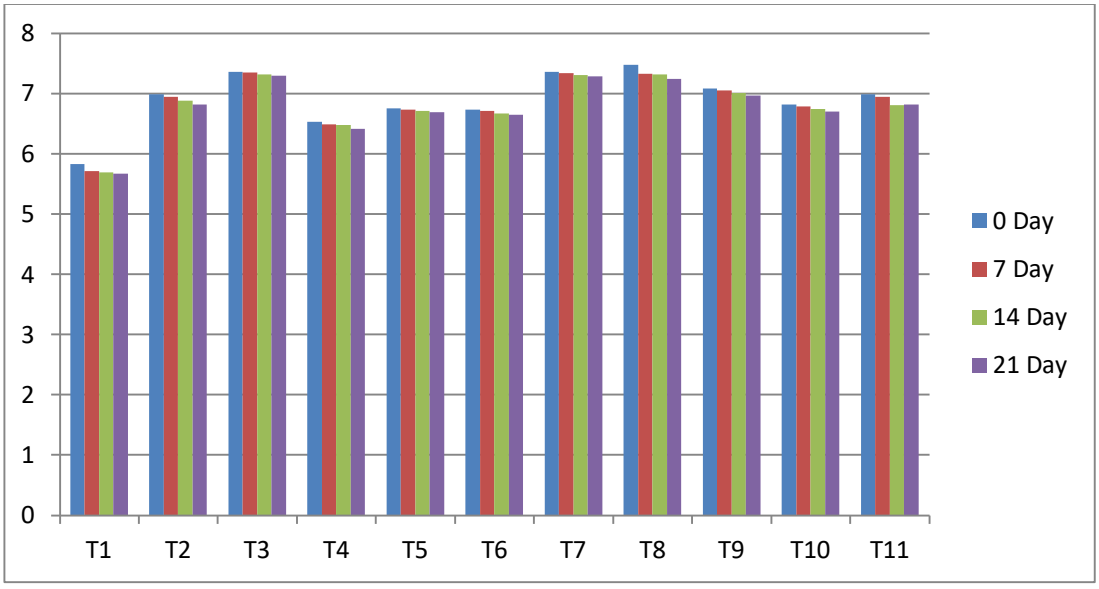


**Fig. 2: Effect of various edible oil coatings on fruit diameter of Malta at different storage intervals**

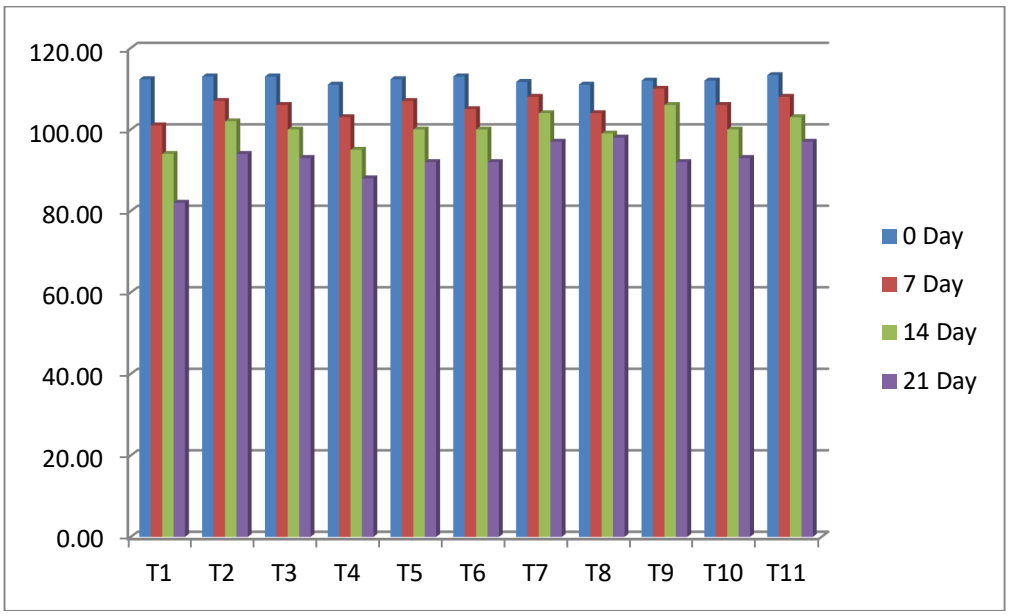


**Fig. 3: Effect of various edible oil coatings on fruit weight of Malta at different storage intervals**

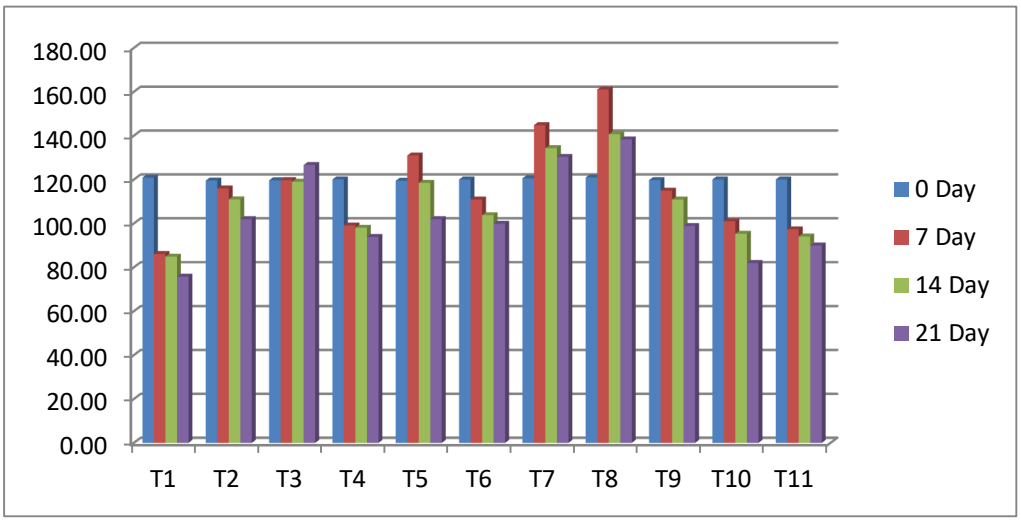


**Fig. 4: Effect of edible oil coatings on fruit volume of Malta at different storage intervals**

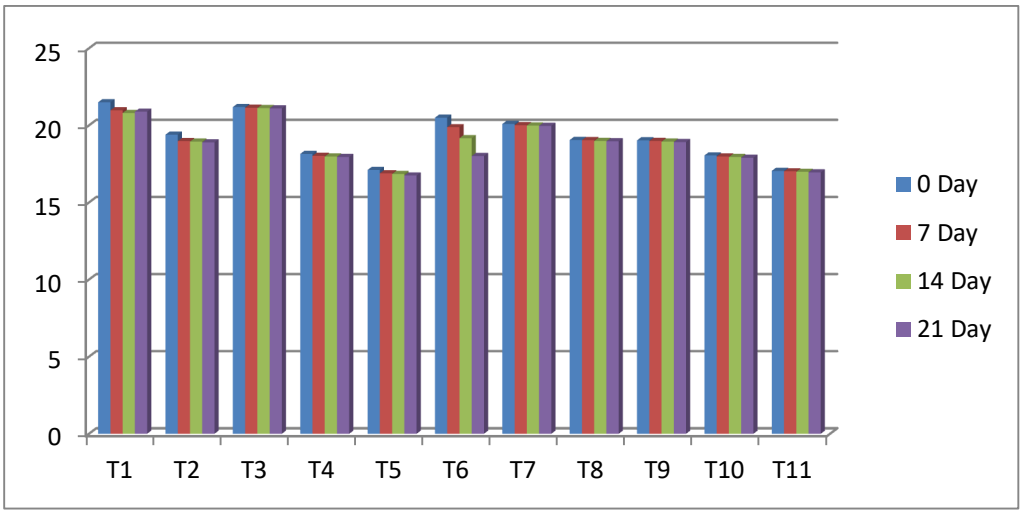


**Fig. 5: Effect of edible oil coatings on fruit circumference of Malta at different storage intervals**

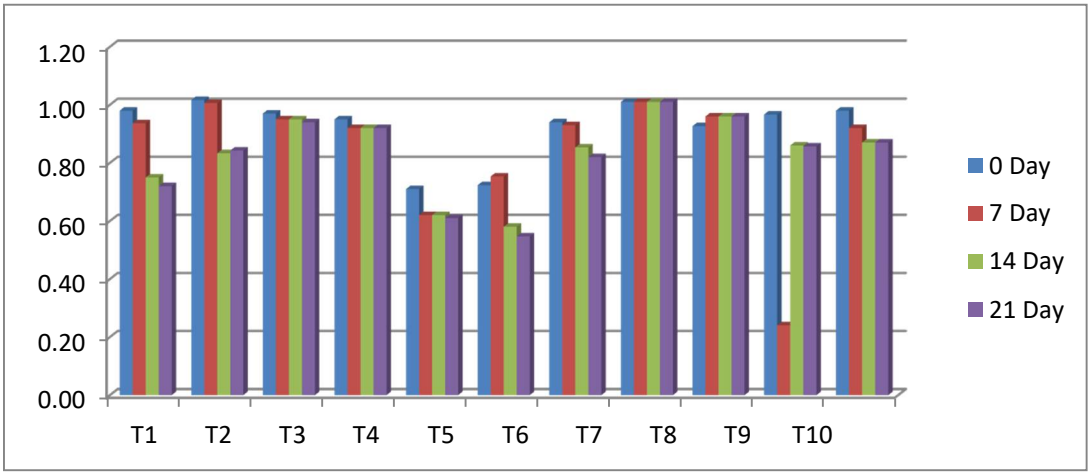


**Fig. 6: Effect of edible oil coatings on fruit shape index of Malta at different storage intervals**

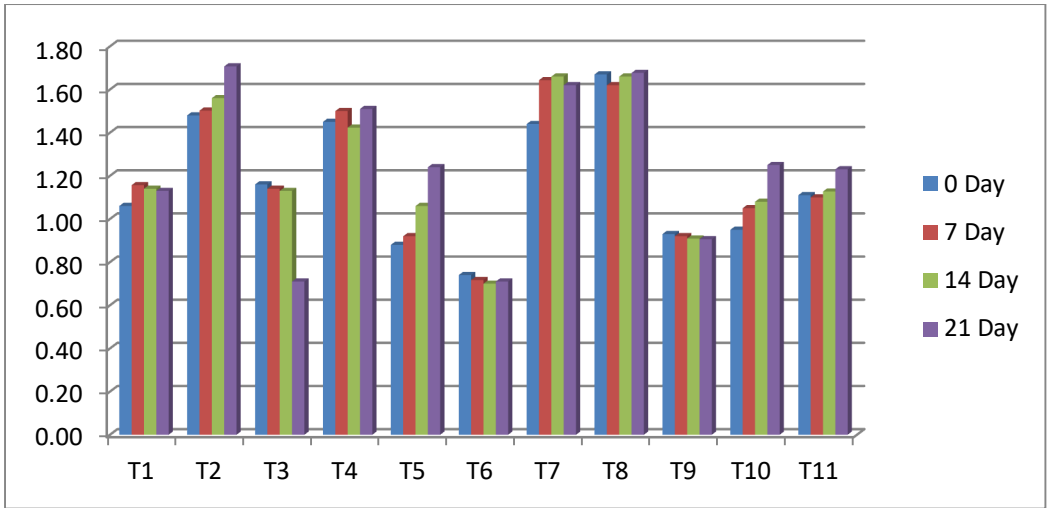


**Fig. 7: Effect of edible oil coatings on specific gravity of Malta at different storage intervals**

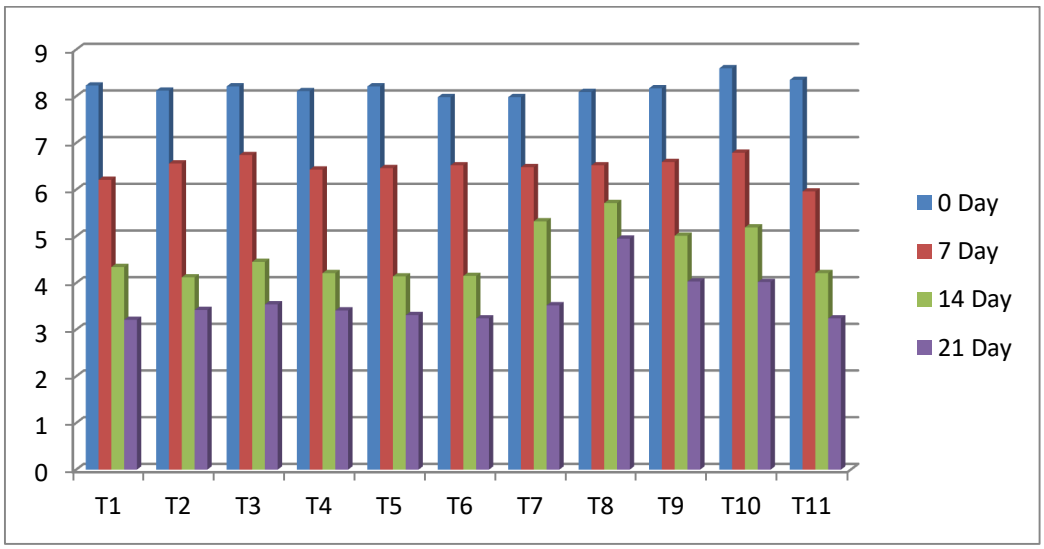


**Fig. 8: Effect of edible oil coatings on fruit firmness of Malta at different storage intervals**

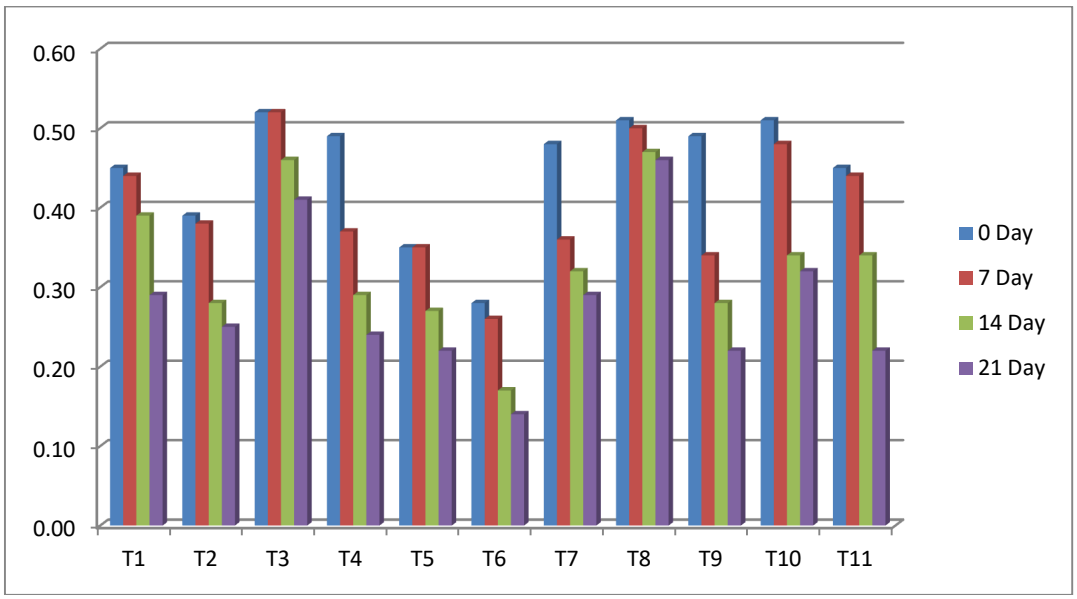


**Fig. 9: Effect of edible oil coatings on peel thickness of Malta at different storage intervals**

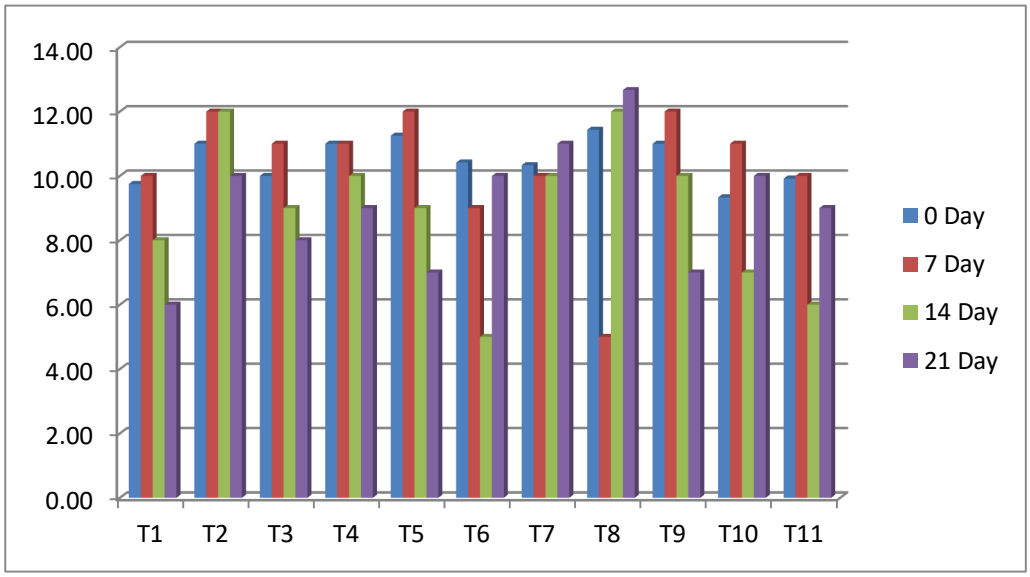


**Fig. 10: Effect of edible oil coatings on segment number of Malta at different storage intervals**

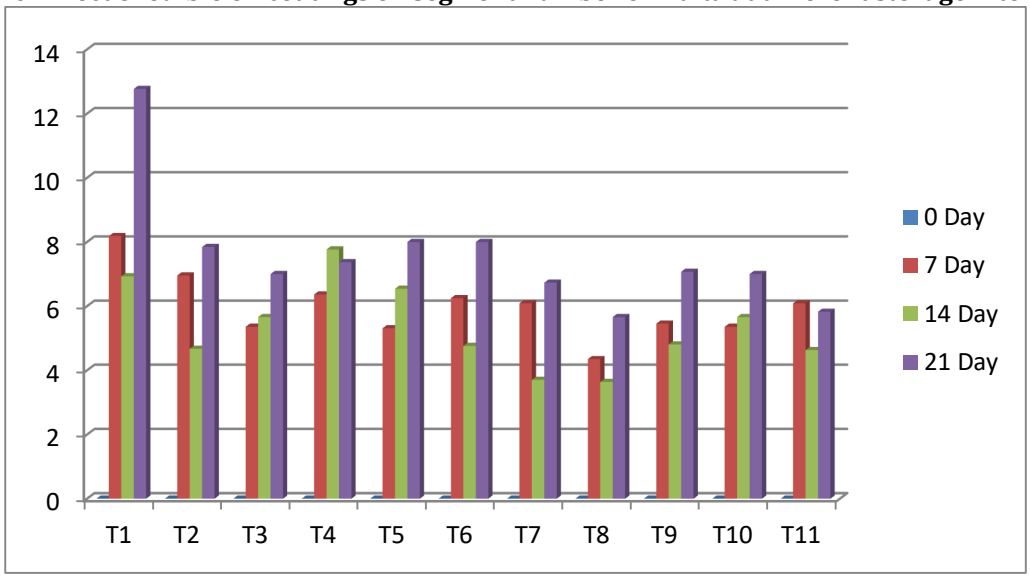

**Fig. 11: Effect of edible oil coatings on PLW % of Malta at different storage intervals**

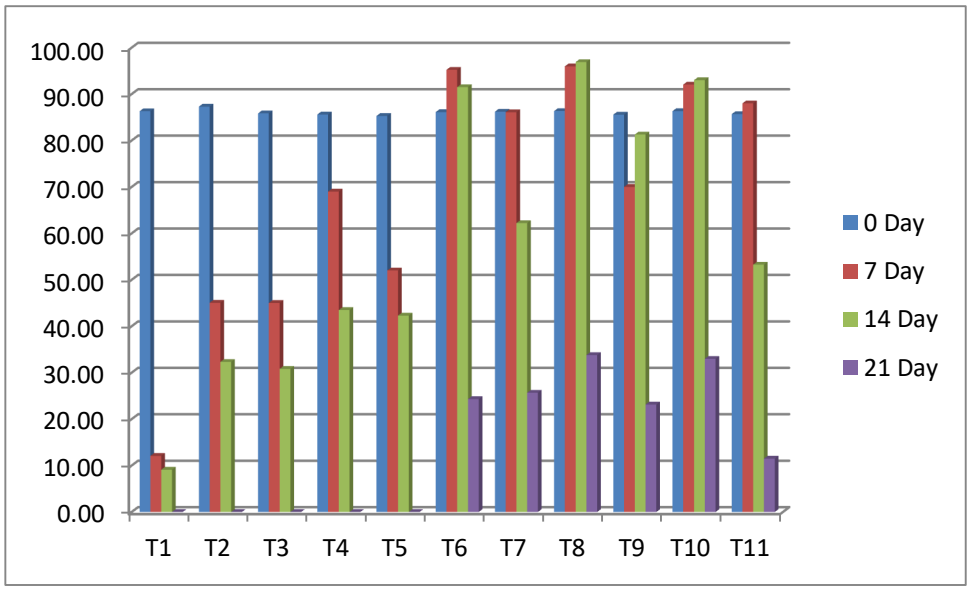


**Fig.12 : Effect of edible oil coatings on MFR % of Malta at different storage intervals**

## CONCLUSION

It can be concluded that among various edible oil coatings, after 21 days of storage, coconut oil coating (3%) under refrigerated temperature (T8) found to be the most effective edible oil coating treatment in terms of fruit length (cm), fruit circumference (cm), fruit weight (g), fruit volume (ml), fruit firmness (lb/inch$^2$), fruit shape index, segment number, peel thickness (cm) and Marketable Fruits Retained (MRF %). Whereas, treatment T2 (mustard oil coating @3% under ambient temperature) was found to be the most effective edible oil coating treatment in terms of specific gravity. In T1 (control without oil coating under ambient temperature) there was maximum Physiological loss of weight %) recorded and T7 (mustard oil coating @3% under refrigerated temperature) reported best value for fruit diameter. Therefore, it can be concluded that edible coconut oil coating can be used to extend the physical attributes and shelf life of malta.

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