The Pharma Innovation Journal 2023; 12(7): 3598-3601

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 3598-3601

www.thepharmajournal.com
Received: 12-04-2023
Accepted: 16-05-2023

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# Effect of different essential oil coating on qualitative character in shelf life of Indian jujube (*Ziziphus mauritiana*) fruit

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**Abstract**
To extend the shelf life of a range of fruits, edible coatings of natural oil and essential oils have been used. The efficiency of mustard oil (100%), mint oil (10%), Tulsi oil (5%), almond oil (100%), cinnamon oil (10%), olive oil (100%) and coconut oil (100%) glazing in preserving the quality and increasing the storage life of 'Apple' ber fruits was investigated in this study under ambient storage conditions. According to the study, the life span and overall quality of 'Apple' fruits were both considerably extended when coatings were applied at a different concentration. However, it was discovered that coconut oil 100% was the best coating out of all of them. Different physicochemical parameters, such as total soluble solids (TSS), PLW (Physiological loss in weight), total sugar, reducing sugar, organoleptic sensory attributes etc., were used to evaluate the quality of the coated fruits. These findings demonstrated that the coated fruits retained their shape better, lost less weight than the control fruits, and contained more TSS. This could be due to the barrier that the fruit's surface coatings have built. By restricting water molecule transport over the fruit's surface and lowering gaseous exchange of $O_2$ and $CO_2$, it dramatically decreases the fruit's water activity. By modifying the environment to stop the growth of rotting-causing microorganisms, this extended the life span of the coated fruits. An effective method to preserve the quality and extend the shelf life of 'Apple' ber fruits is to coat them with 100% coconut oil.

**Keywords:** Coconut oil, coating, olive oil, shelf life, ber fruit, post-harvest, mustard oil

## 1. Introduction

The fruit known as ber, or *Zizyphus mauritiana* Lamk is a major crop in dry and semi-arid areas. It belongs to the Rhamnaceae family and the Rhamnales order. It is a tetraploid plant with a chromosome count of 2n=48. The main cultivation areas for ber are India, as well as various countries in central Asia, China, and Taiwan. The ber fruit originated in India according to Barua *et al.*, (2018) [2]. The two main varieties of domesticated jujube are *Z. jujuba* Mill (Chinese or common jujube) and Z *Mauritiana* Lam. (Indian jujube or ber) and in which Z. *mauritiana* is one of these plants that is mostly grown in arid areas of South India and the northwest of India. As stated by Alsayari and Wahab 2021 [1]. It is commonly referred to as the "King of the arid zone" fruit and is also known as the "Poor man's fruit," as mentioned by Meena *et al.*, 2022 [9]. According to Das *et al.*, 2020 [4], ber can be effectively farmed even in the most vulnerable tropical and subtropical habitats. Ber has a long history of cultivation in India, dating back approximately 4000 years (Dagar *et al.*, 2023) [3]. While it is found all over the world, including in places like the Indian subcontinent, the Mediterranean area, Australia, South-east Asia, Africa, China the Mediterranean area, and the Americas, most of its cultivation takes place in drier regions of the world, mainly India. Haryana, Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh, Bihar, and Tamil Nadu are some of the main ber-growing states in India. s. India boasts around 125 varieties of ber, with some renowned for their taste, size, pulp content, and higher yields. Notably, Gola, Umran and Kathapal are the most promising varieties cultivated in North India. Ber fruits provide a challenge since they have a short life span and are extremely spoilable. Without any treatments, ber fruits can only be stored for a brief period of 2-4 days at room temperature. During peak season, when there is an excess of fruits in the local markets, significant quantities go to waste, resulting in substantial postharvest losses. Extensive research has been conducted to increase ber fruit production, but it necessitates proper handling throughout the pre-harvest, harvesting, and postharvest stages, as well as appropriate packaging, transportation, storage, postharvest pathology, and processing. Minimizing postharvest losses and enhancing shelf life are crucial for maximizing profits (Mahajan *et al.*, 2014) [8].

In place of the fruit's natural protective waxy covering, edible coatings are thin layers of edible ingredients that are placed on the fruit's surface. They can increase the life span of fresh fruits without compromising their quality, preserving freshness, flavor, aroma, texture, and nutritional value. Edible coatings are a cost-effective technique that can be implemented at the farm level.

Various edible materials, such as proteins, carbohydrates, lipids, resins, and products of animal/insect and plant origin, can be used as coating materials. Coated fruits exhibit different respiration behavior compared to uncoated fruits, indicating that coatings can reduce weight loss, maintain firmness, and slow down physicochemical changes associated with the ripening process. The key characteristics of edible coatings include protecting fruits from bruising and maintaining their natural gloss (Mahajan *et al.,* 2018) [7]. The exploit of edible oils as coating materials is being explored due to their antimicrobial properties and the ability to release oil slowly onto the food surface from the coating carriers, maintaining appropriate oil concentrations in the microenvironment. Coating with oils provides fruits with protection against bruising, a shiny appearance, and delays maturation (Das *et al.,* 2021) [5]. Fruits and vegetables' quality and nutritional worth are maintained as a result, contributing to their market value (Tomas *et al.,* 2005) [11]. Edible oils such as coconut oil and olive oil have gained concern due to their superior against bacteria, yeast, and molds, as well as their safety for the environment and consumer health (Falguera, 2011) [6].

## 2. Materials and Methods

The current study was conducted in the postharvest lab of the horticulture department at Lovely Professional University, Phagwara, during the academic year 2022-2023. From the neighborhoods market in Phagwara, Punjab, 300 fresh Apple Ber fruits were bought. To remove any diseased or damaged fruits, the fruits were taken to the lab for inspection. The fruits were rinsed with tap water first, then with chlorinated water (0.01%), to get rid of dirt and spray substance contamination. There was a total of 8 treatments i.e., $T_0$ (Control 0%), $T_1$ (Mustard oil 100%), $T_2$ (Mint oil 10%), $T_3$ (Tulsi oil 5%), $T_4$ (Almond oil 100%), $T_5$ (Cinnamon oil 10%), T6 (Olive oil 100%), $T_7$ (Coconut oil 100%) in this study, each with three replications. There are 30 fruits total in each treatment (ten fruits per repetition). Coated fruits were kept at ambient condition for twelve days while being frequently checked at intervals of days, or at 0, 3, 6, 9 and 12 days. To prepare the Tulsi oil coating, 5 ml of Tulsi oil was mixed with 0.5 ml of Tween 20. The distilled water was then added to make the final volume, which was 100 ml. By combining 10 ml of each ingredient in 0.5 ml individually, the coating of cinnamon and mint oil was made. After that, distilled water was used to provide the final volume of 100 ml for both oils. Fruit weight was recorded using an electronic weighing balance before storage as well as at intervals of 3 days up until the conclusion of the storage period to calculate the physiological loss in weight (PLW in %). Total soluble solids in pulp were calculated using an Erma hand refractometer (range 0-32 °Brix). The TSS was determined using a drop of homogenized pulp, and results were represented as °Brix. The Lane and Eynon method (Ranganna, 1986) [14] was used to determine the total sugar and reducing sugar content of fruit juice.

## 3. Results and Discussion

### 3.1 Physiological loss in weight (PLW %)

Current research showed a physiological loss in weight (PLW) of Apple ber fruit, and it shows that there was a substantial variation in PLW between the different edible coating concentrations as shown in (Table 1) which displays weight loss over a 12 days period under ambient storage. The results revealed statistically significant conclusions. In all treatments, the weight of the fruit gradually decreased during storage. With longer storage times, the PLW increased gradually in all treatments. All the treatments showed lowered PLW when measured compared to the control. Treatment (control) shows the greatest weight reduction (40.91%) at the end of the storage period, followed by mint oil (10%), cinnamon oil (10%) and Tulsi oil (5%). After twelve days of storage, treatment (Coconut oil) had the lowest PLW (24.089%), followed by treatments mustard oil (100%) and. The best results have been seen with higher concentrations of coconut oil, which may be connected almond oil (100%) to the solidification of coconut oil on the fruit surface at low storage temperatures (during the winter months), which may have clogged the peel's pores. By covering Kinnow mandarin with edible oil and wax, Randhawa *et al.* (2009) [17] and Rashid *et al.* (2020) [10] discovered similar results about PLW.

### 3.2 Total soluble solids (TSS)

The findings relating to TSS of Apple ber fruits after application of edible coatings were found significant (Table 1). It shows the change in the total amount of soluble solids (TSS) during 12 days of ambient storage. With an increase in storage time, the TSS gradually increased in all treatments. Total soluble solids increased more quickly in the (control) treatment than in the treated fruit while storage. The maximal TSS for control fruits at the end of the period of storage (after 12 days) was 12.46° Brix, followed by Tulsi oil (5%), almond oil (100%) and mint oil (10%). Conversely, across all the treatments, the fruits treated with coconut oil (100%) had the lowest total soluble solid concentration, or 9.6° Brix, followed by olive oil (100%), cinnamon oil (10%) and mustard oil (100%). Overall, maximal TSS rise was seen after 12 days, and minimal TSS increase was shown after 3 days of storage in all treatments. Coconut oil has a beneficial impact on reducing the pace at which TSS of fruits increases. Less hydrolysis of starch into sugars may be the cause of the reduced rise in TSS in coconut oil. The increase in TSS during storage is probably caused by increased carbohydrate hydrolysis into mono and disaccharides when fruits develop, as well as higher juice concentration because of dryness. This is consistent with past findings where increased TSS levels were noted in coated fruits such as in mango (Khaliq *et al.,* 2015) [130].

### 3.3 Total sugars (%)

Depending on the various treatments, the total sugar (%) content of the Apple ber fruits varied significantly as shown in (Table 2). However, a noticeable change was seen from the 10th day of storage to the 40th day. The Non-coated fruits had the highest rise in total sugar (%), which was 6.79% at the beginning of the storage period and grew to 8.95% until the 12th day followed by Tulsi oil (5%), mustard oil (100%) and mint oil (10%). As a result of carbohydrates being converted to sugars, more total sugars are created. (Coconut oil) fruits showed the smallest rise in total sugar (%), which was 6.79% at the start of storage and increased to 7.35% until the 12th day. These fruits were followed by olive oil (100%), almond oil (100%) and cinnamon oil (10%). According to Ullah *et al.* (2017) [12], coating stops fruit from ripening and keeps complex carbs from becoming simple sugars. In research by Hammam *et al.* (2021) [15], it was shown that while the total sugar in coated mango fruits steadily grew over the course of storage, uncoated mangoes had a sudden spike after 21 days of storage.

### 3.4 Reducing sugar (%)

Reducing sugar (%) showed a similar tendency with an increase in storage time despite coating with varying concentrations (Table 2). It was discovered that there was no significant interaction between the different coating materials and the storage times. As storage time increased from day 1 to day 12, the amount of decreasing sugar (%) was found to have increased in all treatments. However, after 12 days of storage, T0 control fruits had the greatest mean reducing sugars (5.75%), followed by Tulsi oil (5%), cinnamon oil (10%) and almond oil (100%). The maximal breakdown of starch and polysaccharides may account for the increase in the decreasing sugar percentage. However, after 12 days of storage, the lowest mean reducing sugars were found in coconut oil (4.47%), followed by olive oil (100%), mustard oil (100%) and mint oil (10%). As storage time increase, Yadav *et al.*, (2010) [16] also observed a rise in decreasing sugar levels in mandarin orange and passion fruit.

**Table 1:** Effect of different essential oil coating on physiological loss in weight (PLW %) and TSS of apple ber fruits in ambient storage.

| Treatments | | PLW (%) | | | | | TSS (°Brix) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3 Days | 6 Days | 9 Days | 12 Days | 0 Days | 3 Days | 6 Days | 9 Days | 12 Days |
| Control ($T_0$) | 12.53±0.77 | 22.25±0.38 | 31.03±1.41 | 40.91±0.16 | 6.4 | 8.25±0.2 | 10.3±017 | 11.3±0.04 | 12.46±08 |
| 100% Mustard oil ($T_1$) | 8.66±1.17 | 13.99±1.79 | 22.56±1.04 | 29.76±0.84 | 6.4 | 7.55±0.06 | 8.99±0.6 | 10.93±0.14 | 11.76±0.2 |
| 10% Mint oil ($T_2$) | 9.43±2.07 | 16.84±1.25 | 25.20±1.28 | 34.81±1.01 | 6.4 | 7.92±0.29 | 9.5±0.16 | 10.6±0.05 | 11.8±0.2 |
| 5% Tulsi oil ($T_3$) | 11.22±0.13 | 17.0±0.04 | 25.43±0.58 | 32.32±0.91 | 6.4 | 7.86±0.08 | 9.3±0.11 | 10.9±0.21 | 12.2±0.8 |
| 100% Almond oil ($T_4$) | 10.28±0.74 | 16.2±2.09 | 23.80±0.63 | 31.5±0.07 | 6.4 | 7.6±0.15 | 8.9±0.21 | 10.7±0.16 | 11.9±0.1 |
| 10% Cinnamon oil ($T_5$) | 7.47±0.53 | 14.91±0.48 | 21.03±0.78 | 28.90±1.51 | 6.4 | 7.3±0.09 | 8.1±0.31 | 9.2±0.12 | 10.22±0.2 |
| 100% Olive oil ($T_6$) | 10.92±1.2 | 17.38±1.97 | 25.29±0.81 | 34.61±1.39 | 6.4 | 7.4±0.1 | 8.7±0.06 | 9.6±0.05 | 10.8±0.1 |
| 100% Coconut oil ($T_7$) | 5.97±0.39 | 11.05±2.21 | 17.20±1.81 | 24.08±0.63 | 6.4 | 7.2±0.16 | 7.8±0.04 | 8.8±0.09 | 9.6±0.5 |
| C.D. (5%) | 3.163 | 4.535 | 3.388 | 2.88 | | 0.38 | 0.39 | 0.38 | 0.48 |
| S.Em± | 1.05 | 1.50 | 1.12 | 0.95 | | 0.13 | 0.13 | 0.13 | 0.16 |

**Table 2:** Effect of different essential oil coating on total sugar and reducing sugar of apple ber fruits in ambient storage.

| Treatments | | | Total sugar | | | | | Reducing sugar | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 Days | 3 Days | 6 Days | 9 Days | 12 Days | 0 Days | 3 Days | 6 Days | 9 Days | 12 Days |
| Control ($T_0$) | 6.79 | 7.75±0.2 | 8.12±0.17 | 8.55±0.04 | 8.95±0.8 | 4.21 | 4.6±0.09 | 4.95±0.08 | 5.42±0.09 | 5.75±0.1 |
| 100% Mustard oil ($T_1$) | 6.79 | 7.33±0.06 | 7.57±0.06 | 7.82±0.14 | 8.32±0.2 | 4.21 | 4.45±0.01 | 4.62±0.06 | 4.73±0.05 | 4.85±0.5 |
| 10% Mint oil ($T_2$) | 6.79 | 7.48±0.29 | 7.72±0.16 | 7.92±0.05 | 8.11±0.2 | 4.21 | 4.46±0.07 | 4.64±0.01 | 4.74±0.02 | 4.87±0.1 |
| 5% Tulsi oil ($T_3$) | 6.79 | 7.56±0.08 | 7.86±0.11 | 8.28±0.21 | 8.47±0.8 | 4.21 | 4.54±0.02 | 4.88±0.05 | 5.17±0.1 | 5.5±0.1 |
| 100% Almond oil ($T_4$) | 6.79 | 7.19±0.15 | 7.38±0.21 | 7.6±0.16 | 7.79±0.1 | 4.21 | 4.52±0.08 | 4.75±0.08 | 5.06±0.13 | 5.31±0.6 |
| 10% Cinnamon oil ($T_5$) | 6.79 | 7.44±0.09 | 7.74±0.03 | 7.91±0.12 | 8.04±0.2 | 4.21 | 4.5±0.02 | 4.72±0.03 | 5.05±0.08 | 5.38±0.1 |
| 100% Olive oil ($T_6$) | 6.79 | 6.97±0.11 | 7.08±0.06 | 7.22±0.05 | 7.37±0.1 | 4.21 | 4.34±0.04 | 4.43±0.03 | 4.51±0.06 | 4.61±0.1 |
| 100% Coconut oil ($T_7$) | 6.79 | 7.06±0.16 | 7.18±0.04 | 7.28±0.09 | 7.35±0.5 | 4.21 | 4.28±0.03 | 4.35±0.09 | 4.41±0.11 | 4.47±0.1 |
| C.D. (5%) | | 0.183 | 0.267 | 0.327 | 0.331 | | 0.177 | 0.2 | 0.232 | 0.2 |
| S.Em± | | 0.06 | 0.088 | 0.108 | 0.109 | | 0.059 | 0.066 | 0.077 | 0.066 |

## 4. Conclusion

The results of the research make it clear that all the coating treatments that were looked at successfully protected the fruit's quality. The coatings evaluated that performed the best under ambient storage conditions were the 100% coconut oil and 100% olive oil coatings. These coatings successfully decreased postharvest weight loss (PLW), and preserved the quality of 'Apple' ber fruit during ambient storage. The edible coatings may prove to be a healthy and environmentally friendly method of fruit preservation. There are numerous ways to build on these results and direct future study. These innovative methods more successfully increase the life span of fruits by providing extra barriers against moisture loss, microbial development, and oxidation. It would also be beneficial to research how these coatings affect the fruit's nutritional value and sensory qualities over time. Finally, investigating the use of these coatings outside of laboratory settings is crucial to determining how they affect a significant number of fruits. The best performance in terms of maintaining the quality of "Apple" ber fruit was shown by the coconut oil 100% coating, however further research and development in fruit coatings are still required.

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