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Influence of Various Edible Oil Coatings on the Shelf Life of Cape Gooseberry (*Physalis peruviana* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted to examine the effects of different edible oil treatments on the shelf life and quality of cape gooseberry fruits. The study was carried out at the Horticulture Research Laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology, and Sciences (SHUATS), Prayagraj, from February to March 2024. The experiment employed a Completely Randomized Design (CRD) with 12 treatments and 3 replications, using various edible oils, including rice bran oil, olive oil, coconut oil, cinnamon oil, and mustard oil, under both ambient and cold storage conditions. Key findings include that, treatments

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T_9 (olive oil + cold storage) and T_{10} (coconut oil + cold storage) were most effective in extending shelf life to 20 and 19 days, respectively, compared to the untreated control (14 days). Minimum postharvest loss (10.0%) was observed in T_9 (Olive oil + Cold storage) followed by T_{10} (Coconut oil + Cold storage) which was stored in Cold storage. To minimize postharvest losses and to maintain maximum quality during storage, a lower temperature is needed than a higher temperature. The financial analysis revealed T_{10} (coconut oil + cold storage) as the most profitable treatment with the highest B:C ratio (1.19). The study concludes that the application of edible oils, particularly olive oil and rice bran oil, in combination with cold storage, can significantly enhance the shelf life and quality of cape gooseberry fruits, facilitating better marketability and export potential.

Keywords: Physalis peruviana L; shelf life; cold storage; olive oil; coconut oil.

1. INTRODUCTION

"The Cape gooseberry (*Physalis peruviana L.*), is also referred to as Mokai, Rasbhari, Tepari, or Husk Cherry, in India. It is a member of the family Solanaceae. This fruit stands out for its high content of antioxidants (ascorbic acid and A provitamin), phosphorus, iron, protein and fibre" [1]. It is extensively cultivated throughout India, with predominant cultivation occurring in Uttar Pradesh, Punjab, and Rajasthan. The annual herbaceous, erect-growing, self-pollinated, small crop of tropical fruits was cultivated in India. It is possible to use the crop as a nutraceutical as reported by Ramadan and Morsel, [2]. "The fruit is a small berry with smooth, waxy, orange-yellow skin. Fruits are covered in a papery husk that is bitter and inedible, and is formed from calyxes, whose function is to protect fruit during harvest and postharvest. The fruit is a small round berry 1.25-2 cm wide, 4-5 g in weight, with smooth, glossy, orange-yellow skin and juicy pulp containing 100-300 very small yellowish seeds, discoid up to 2 mm long, and structure similar to a cherry tomato. Usually, calyx and skin colour can be used to indicate maturity. When fully ripe, the fruit is sweet but has pleasing grape-like tang" [3]. "The fruit of cape gooseberry belongs to the group of climacteric fruits" [4]. "Additionally, it is classified as a highly perishable food" (Balaguera et al*.,* 2016). "When the calyx is removed from the cape gooseberries, the fruits have higher respiration rates, generating higher levels of ethylene and accelerating their decay. They are not adequately stored. In addition to some contamination during the production stage, goldenberry suffers from post-harvest diseases caused by several fungi. Fruits harvested at the immature stage or advanced maturity are more likely to suffer physiological damage during postharvest and have lower quality than fruits harvested at the proper maturity stage" [5]. "The shelf life of cape gooseberry fruit with calyx is estimated at 30 days, while that without calyx can be decreased to 5 days when stored at room temperature. Coating fruits with some safe coating materials or some oils may reduce physical weight loss (PLW), loss of moisture and retention better quality for a long time". Falguera et al., [6] Concluded that edible oils such as coconut oil and olive oil have gained concern due to their superiority against bacteria, yeast, and moulds, as well as their safety for the environment and consumer health. Singh et al*.,* [7] reported that the edible oil coating of olive oil is more effective than others in retaining the colour of the fruits by inhibiting the degradation of chlorophyll in the fruits and increasing the synthesis of carotenoids and anthocyanin pigments, or probably has senescence delaying action by blocking the point of attack by ethylene.

2. MATERIALS AND METHODS

The present investigation was conducted in the Horticulture Research Laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology, and Sciences (SHUATS), Prayagraj, from February to March 2024.

2.1 Fruit Materials

The materials used for the present experiment were freshly harvested, mature cape gooseberry. The cape gooseberries fruits of uniform size, disease-free and bruise-free were purchased from the fruit market (mandi) were immediately transferred to the laboratory of Department of Horticulture, SHUATS, Prayagraj. In the laboratory, the fruits were sorted, graded and washed with distilled water. Thereafter, fruits were air-dried and divided into the requisite lot for further handling.

2.2 Coating Materials

This methodology was based on Muley and Singhal., [8]. In the present study, five types of coatings viz. rice bran oil, olive oil, coconut oil, cinnamon oil, and mustard oil, were used for application on cape gooseberry fruits.

2.3 Application of Edible Coatings

Fruits were coated with edible coatings of rice bran oil, olive oil, coconut oil, cinnamon oil, mustard oil and control were kept on trays. For the application of coatings on the fruits, brushing and dipping of fruits were done very perfectly, in particular the coating material and coating were applied gently to the surface of the fruits.

2.4 Storage

The edible oil-coated cape gooseberry fruits were stored at two storage conditions, i.e. ambient (22℃ - 25℃) and in cold (refrigerated) conditions (6℃).

2.5 Statistical Analysis

The present experiment was laid out in a Factorial a Completely Randomized Design (CRD factorial) with 12 treatments replicated three times, viz.

Table 1. Treatment combinations for the experiment

T	Treatments
T_1	Control (Untreated + Ambient condition)
T_2	Rice bran oil + Ambient condition
T_3	Olive oil + Ambient condition
T_4	Coconut oil + Ambient condition
T_5	Cinnamon oil + Ambient condition
T_6	Mustard oil + Ambient condition
T_7	Untreated + Cold storage
T_8	Rice bran oil + Cold storage
T_9	Olive oil + Cold storage
T_{10}	Coconut oil + Cold storage
T_{11}	Cinnamon oil + Cold storage
T_{12}	Mustard oil + Cold storage

3. RESULTS

"The fruits were analyzed after every 4 days up to the last stage of their shelf life for different physical and biochemical constituents. Changes in different parameters namely physiological loss in weight (%), titratable acidity, total soluble solids (^{0}Brix), and ascorbic acid (mg / 100 g) (Vitamin C) content, were investigated. Different studies indicate that ethylene can be associated with different processes during the ripening of cape gooseberry fruits such as softening, antioxidant activity, and colour change" Gutiérrez et al., [9], Valdenegro et al., 2012.

3.1 Fruit Physical Parameters

Fruit Weight (g): The treatments T_{10} (coconut oil + cold storage) and T_9 (olive oil + cold storage) showed significantly influenced loss in weight of fruit, with weights initial weights (11.35g and11.06g) and final weight (11.26g and 10.99g) respectively, after 16 days of storage. This indicates that the combination of edible oils and cold storage effectively maintains fruit weight over an extended period.

Gharezi et al*.,* [10] indicated that the cold storage retained minimum weight loss which is in agreement with the findings of this study. It has been reported that coating process on fruits reduces weight loss.

Fruit Diameter (cm): The maximum change in diameter (length) of fruit after 16 days of storage was observed in T_5 (cinnamon oil + ambient condition) coated fruits, which gave the highest change in fruit diameter (2.32cm at 0 DAS) and (2.10cm at 16 DAS) among treatments. The edible oil coated fruits stored in refrigerated condition showed no significant change in fruit diameter among treatments. The maximum change in diameter (width) of fruit after 16 days of storage was observed in T_1 (control) uncoated fruits (2.50cm at 0 DAS) and (2.25cm at 16 DAS) among treatments. The edible oil coated fruits stored in refrigerated conditions showed no significant change in fruit diameter among treatments.

Pulp weight (g): The maximum fresh pulp weight (g) (10.63g and 9.86g) was observed in T_8 and T_{10}. However, minimum pulp weight (g) (6.96g and 7.33g) in T_{12} and T_{11}.

Fruit colour: "It was observed that the maximum mean retention of excellent fruit colour (7.8) was found in fruits treated with olive oil (T_9) followed by (T_{10}), (T_7) and (T_8) with 7.4, 4.85 and 4.29 hedonic ratings with the minimum colour rating of 3.86 in cinnamon oil coating (T_5 and T_{11}) which proved to be inferior to untreated conditions accounting for 3.23 ratings. Edible oil coatings of olive oil proved more effective than others in retaining the colour of the fruits by inhibiting degradation the chlorophyll in the fruits and increasing the synthesis of carotenoids and anthocyanin pigments or probably by senescence delaying action by blocking the point of attack by ethylene. The present findings were supported" by Singh et al [7].

Table 2. Effect of different edible oil coatings on physical parameters of fruits stored for 16 days

T	Treatment Details	Fruit Weight (gm)					Pulp Weight (gm)					Physiological Loss in Weight (%)				
		0	4	8	12	16	0	4	8	12	16	0	4	8	12	16
T1	Control (Untreated + Ambient condition)	9.4	8.97	8.32	8.06	7.92	8.76	8.35	7.82	7.34	7.04	-	4.56	11.49	14.25	15.71
T2	Rice bran oil + Ambient condition	9.4	9.1	8.69	8.2	7.82	7.83	7.51	7.24	7.02	6.82	-	3.24	7.55	12.76	16.84
T3	Olive oil + Ambient condition	11.1	10.76	10.29	9.77	8.9	9.5	9.1	8.42	8.14	7.81	-	3.04	7.26	11.97	19.83
T4	Coconut oil + Ambient condition	9.67	9.36	9	8.49	8.18	8.4	8.2	7.95	7.65	7.35	-	3.12	6.84	12.09	15.31
T5	Cinnamon oil + Ambient condition	9.63	9.16	8.81	8.26	7.07	8.67	8.38	8.13	7.69	7.33	-	3.84	8.56	14.23	26.58
T6	Mustard oil + Ambient condition	11.03	10.65	10.16	9.53	9.02	9.3	9	8.82	8.62	8.23	-	3.47	7.87	13.59	18.23
T7	Untreated + Cold storage	9.33	9.31	9.29	9.26	9.24	8.23	7.93	7.76	7.7	7.62	-	0.21	0.45	0.73	0.93
T8	Rice bran oil + Cold storage	12.13	11.91	11.29	11.27	11.24	10.63	10.39	10.21	10.08	9.94	-	0.18	0.35	0.52	0.79
T9	Olive oil + Cold storage	11.06	11.05	11.03	11.01	10.99	9.3	9.05	8.95	8.75	8.64	-	0.12	0.25	0.47	0.62
T10	Coconut oil + Cold storage	11.35	11.32	11.3	11.28	11.26	9.86	9.55	9.34	9.15	9.02	-	0.11	0.27	0.45	0.59
T11	Cinnamon oil + Cold storage	8.78	8.61	8.58	8.56	8.54	7.33	7.08	7.05	6.95	6.65	-	0.23	0.56	0.73	0.97
T12	Mustard oil + Cold storage	8.13	7.86	7.8	7.78	7.77	6.96	6.67	6.41	6.39	6.19	-	0.19	0.34	0.66	0.81

Table 3. Effect of different edible oil coatings on Bio-chemical parameters of fruits stored for 16 days

T	Treatment details	Total Soluble Solids (TSS)					Ascorbic Acid (mg / 100 g)					Titratable Acidity					Fruit Acidity (pH)				
		0	4	8	12	16	0	4	8	12	16	0	4	8	12	16	0	4	8	12	16
T1	Control (Untreated + Ambient condition)	13.2	14.1	12.5	14.3	15.1	22.88	28.23	30.85	26.76	27.83	1.66	0.97	1.02	1.1	1.04	3.4	3.45	3.52	3.6	3.67
T2	Rice bran oil + Ambient condition	13.8	13.6	13.8	14.2	14.4	20.93	24.23	29.45	33.63	31.53	1.56	0.96	0.94	1.07	0.99	3.5	3.56	3.6	3.65	3.77
T3	Olive oil + Ambient condition	12.8	13.2	13.5	14.4	14.3	21.6	27.33	30.15	31.22	33.66	1.65	1.06	0.91	1.06	1.11	3.55	3.6	3.64	3.7	3.75
T4	Coconut oil + Ambient condition	13.5	13.7	13.8	14.17	14.7	23.22	26.66	29.8	31.36	32.18	1.54	1.12	0.97	1.15	1.1	3.47	3.55	3.68	3.75	3.77
T5	Cinnamon oil + Ambient condition	12.9	13.9	13.6	14.3	14.9	21.3	24.68	28.37	30.8	32.67	1.66	0.92	0.97	1.15	1.17	3.67	3.76	3.86	3.84	3.98
T6	Mustard oil + Ambient condition	13.2	13.6	13.3	14.4	14.8	20.88	24.67	29.32	30.89	32.67	1.56	0.96	1.1	0.97	1.08	3.48	3.59	3.75	3.87	3.99
T7	Untreated + Cold storage	13.4	13.4	14.2	14.2	14.5	23.2	27.66	30.39	29.33	32.88	1.63	1.19	1.24	1.17	1.04	3.45	3.52	3.57	3.65	3.68
T8	Rice bran oil + Cold storage	13.2	13.1	13.7	14.1	13.9	22.66	25.67	28.93	30.2	33.44	1.23	1.12	1.37	1.05	0.97	3.17	3.61	3.78	3.91	4.02
T9	Olive oil + Cold storage	12.7	13.4	13.3	13.3	13.9	22.18	25.78	28.86	31.18	34.36	1.42	1.23	1.19	0.96	0.92	3.65	3.91	4.17	3.97	4.2
T10	Coconut oil + Cold storage	13.1	13.6	13.5	14	14.2	23.66	26.78	29.97	32.48	34.67	1.66	1.51	1.37	1.08	0.92	3.64	3.76	3.87	3.96	4.1
T11	Cinnamon oil + Cold storage	13.3	13.8	13.1	13.23	14.4	22.18	25.6	27.38	31.14	33.18	1.52	1.37	1.23	1.08	0.96	3.53	3.6	3.67	3.75	3.8
T12	Mustard oil + Cold storage	13.5	12.6	13.4	14.3	14.3	20.18	24.89	28.24	30.86	33.4	1.57	1.43	1.22	1.11	0.94	3.67	3.73	3.9	3.98	4.06

Table 4. Effect of different edible oil coatings on organoleptic ratings of fruits stored for 16 days

T	Treatment Details	Overall Organoleptic Rating				
		0	4	8	12	16
T_1	Control (Untreated + Ambient condition)	9	8	6	4	3
T_2	Rice bran oil + Ambient condition	9	8	7	6	5
T_3	Olive oil + Ambient condition	9	8	6	6	5
T_4	Coconut oil + Ambient condition	9	8	7	6	5
T_5	Cinnamon oil + Ambient condition	9	8	6	5	4
T_6	Mustard oil + Ambient condition	9	8	7	6	5
T_7	Untreated + Cold storage	9	8	8	7	6
T_8	Rice bran oil + Cold storage	9	8	7	7	6
T_9	Olive oil + Cold storage	9	9	8	7	7
T_{10}	Coconut oil + Cold storage	9	9	8	8	7
T_{11}	Cinnamon oil + Cold storage	9	8	6	5	4
T_{12}	Mustard oil + Cold storage	9	8	7	7	5

Table 5. Benefit cost ratio of edible oil coating treatments on fruits stored for 16 days

T	Treatment Details	Benefit Cost Ratio		
		Cost of Treatment (Rs.)	Profit (Rs.)	Benefit Cost Ratio (B:C Ratio)
T1	Control (Untreated + Ambient condition)	Rs. 75	Rs. 50	0.66
T2	Rice bran oil + Ambient condition	Rs. 82	Rs. 75	0.91
T3	Olive oil + Ambient condition	Rs. 109	Rs. 100	0.92
T4	Coconut oil + Ambient condition	Rs. 95	Rs. 88	0.93
T5	Cinnamon oil + Ambient condition	Rs. 125	Rs. 50	0.4
T6	Mustard oil + Ambient condition	Rs. 85	Rs. 88	1.03
T7	Untreated + Cold storage	Rs. 75	Rs. 75	1
T8	Rice bran oil + Cold storage	Rs. 82	Rs. 88	1.07
T9	Olive oil + Cold storage	Rs. 109	Rs. 113	1.04
T10	Coconut oil + Cold storage	Rs. 95	Rs. 113	1.19
T11	Cinnamon oil + Cold storage	Rs. 125	Rs. 75	0.6
T12	Mustard oil + Cold storage	Rs. 85	Rs. 88	1.03

Physiological loss in weight (PLW) (%): The maximum physiological weight loss (%) (26.58%) and (19.83%) was recorded under T_5 (cinnamon oil + ambient condition) and T_3 (olive oil + ambient condition). However, the minimum physiological weight loss (PLW) (%) (0.59%) and (0.62%) was recorded with T_9 (olive oil + cold storage) and T_{10} (coconut oil + cold storage). Morillon et al. (2002) explained that, the main cause of weight loss in fruit is due to migration of water from the fruit to the environment during storage. Gharezi et al*.,* [10] "indicated that the cold storage retained minimum weight loss which is in agreement with the finding of this study. It has been reported that coating process on fruits led to reduce weight loss". López et al. [11] reported a significant weight loss reduction from 23% to 15% in cape gooseberry samples stored for 15 days at 17 ºC, with the use of a whey and beeswax-based coating. The present findings are supported by Wijewardane [12], who stated that the coatings consisting of edible oil were found effective in reducing the PLW. "The minimum reduction in PLW of cape gooseberry coated with olive coating was probably due to maintenance of maximum moisture content around the surface of the fruit etc. along with storage having high humidity and cold storage conditions. The composite oil coating preserves the quality of fruit retarding ethylene emission and hence reduces PLW in pineapple fruits. Similar results were also reported" by Jagadeesh et al. [13] in guava fruits.

3.2 Fruit Bio-Chemical Parameters

Total soluble solid (^{0}Brix): The level of total soluble solids (ºBrix) of control and coated cape gooseberry fruits showed a significant (P>0.05) difference (Table 3). The maximum soluble solids (TSS) after 16 days of storage (15.10 T.S.S. ^{0}Brix) and (14.90 T.S.S. ^{0}Brix) were recorded under T_1 Control (untreated + ambient condition) and T_5 (cinnamon oil + ambient condition). However, the minimum soluble solids (13.90 T.S.S. ^{0}Brix) and (13.90 T.S.S. ^{0}Brix) were recorded with T_9 (olive oil + cold storage) and T_{10} (coconut oil + cold storage). Overall, a gradual increase in TSS was observed during the entire storage period. In this regard, Debeaufort et al. [14] "explained that the edible coatings are selective barriers to O_2 and CO_2 modifying internal atmospheres and slowing down the respiration rate of fruit". Muñoz et al. [15] "were able to prolong cape gooseberries stored from 9 to 11 days while maintaining a weight loss of less than 10% with the use of a chitosan and aloe vera based coating". According to what was reported by Pinzón et al. [16], when the samples exceed losses greater than 10% of their weight, the freshness of fruits and vegetables disappears.

Ascorbic acid (mg / 100 g): The maximum ascorbic acid after 16 days of storage (34.67) and (34.36) were recorded under T_{10} (coconut oil + cold storage) and T_9 (olive oil + cold storage). However, the minimum amount of ascorbic acid (27.83) was recorded with T_1 (control) untreated + ambient condition. In this case, it has been reported that ascorbic acid is a precursor to the production of brown pigments, and the change in the amount of ascorbic acid causes browning of the tissue, which ultimately causes the loss of the quality of berries [17]. The change in colour to brown (browning) occurs in T_5 (cinnamon oil + ambient condition) and T_{11} (cinnamon oil +cold storage) after the 8^{th} day of storage. The occurrence of high acidity in fruits can contribute to a relatively stable ascorbic acid content during post-harvest storage [18]. It has been reported that the decrease in vitamin C can be attributed to the decrease in the antioxidant capacity of berries during storage [19]. Researchers also believe that decreasing vitamin C levels at the end of storage may be due to a reduction in water content that leads to the oxidation of vitamin C [20]. Vitamin C content, coating treatments led to higher vitamin C values than the control fruit; it is a protective barrier against permeability to O_2 and CO_2, thus decreasing vitamin autooxidation [21].

Fruit acidity (pH): The pH values for uncoated and coated fresh goldenberries stored in ambient conditions as well as those stored in cold storage are presented in Table 3. The maximum amount of ascorbic acid levels after 16 days of storage (34.67) and (34.36) were recorded under T_{10} (coconut oil + cold storage) and T_9 (olive oil + cold storage). However, the minimum amount of ascorbic acid (27.83) were recorded in the T_1 (control) untreated + ambient condition. "pH values of the coated and uncoated goldenberries placed in ambient condition did not show significant changes (p > 0.05) from the 4th day of storage; however, the pH values of all samples increased during the storage time. The pH rise is explained by the fruit ripening and decomposition processes caused by hydrolysis, oxidation, or fermentation that modify the concentration of hydrogen ions" [22]. On the other hand, the fruits stored at 4 °C and 95% RH maintained the pH values constant through the storage days, except for the uncoated goldenberries, in which the pH values increased. Results suggest that the coatings helped to maintain the initial pH values when the fruits were kept in cold storage for 16 days of storage, delaying the fruit ripening and ensuring controlled microbial growth. This behaviour is explained by the fact that the coated fruits maintained a more acidic pH, which is favourable to inhibiting bacterial growth.

Titratable Acidity: The minimum acidity after 16 days of storage (0.92) was recorded under T_8 (rice bran oil + cold storage) and T_{10} (coconut oil + cold storage). However, the maximum acidity (1.17) was recorded with T_5 (cinnamon oil + ambient condition). In addition, increasing the temperature during different time of the storage actually increased the respiration rate, so it can be concluded that a high storage temperature reduces the titratable acidity [23]. The reduction in total acid content in the berries with coating was less than the decrease in berries without coating, which can be due to the fact that the berries continue to derive carbohydrates and nutrients from the calyx coating after harvest.

3.3 Organoleptic Rating

The maximum overall organoleptic rating (7) and (7) was recorded under T_9 (olive oil + cold storage) and T_{10} (coconut oil + cold storage). However, the minimum overall organoleptic rating (3.4) was recorded with T_1 (control) Untreated + Ambient conditions during 16 days of storage. The decreased organoleptic rating might be ascribed to certain bio-chemical changes in pear pulp which increased after prolonged storage. The buttery and juicy textures of the ripened pear fruits point out a possible involvement of cell wall substances and their degrading enzymes (pectin-esterase and poly galacturonans) in the ripening process during storage, as viewed by Singh et al., [7]. Similar results were observed by 12 who observed that maximum acceptability in terms of taste was retained by coconut oil coating without any objectionable change up to 6-8 days of storage.

3.4 Economy of the Treatments

Cost of treatment: The lowest cost of treatment (INR 75) was observed in T_1 control (untreated + ambient condition) and T_7 (untreated + cold storage) while highest (INR 125) in T_5 (cinnamon oil + ambient condition) and T_{11} (cinnamon oil + cold storage).

Post harvest loss: The minimum postharvest loss (10.0%) was observed in T_9 (olive oil + cold storage) followed by T_{10} (coconut oil + cold storage) while maximum (60.0%) was observed in T_1 control (untreated + ambient condition) and T_5 (cinnamon oil + ambient condition). The postharvest storage of fruits is one of the main drivers of the food industry. Fruit loss can occur quantitatively and qualitatively between harvest and consumption [22]. On the other hand, berry harvesting at the full maturity stage helps maintain fruit quality because the berries usually show high acidity at their peak of maturity [24].

Marketable fruit (%): The minimum marketable fruit left after 16 days of storage was (40%) in T_1 control (untreated + ambient condition) and T_5 (cinnamon oil + ambient condition) and maximum (90%) in T_9 (olive oil + cold storage), followed by T_{10} (coconut oil + cold storage) [25].

Net return: The lowest net return (INR 50) was observed in T_1 Control (untreated + ambient condition) and T_5 (cinnamon oil + ambient condition) while highest (INR 113) in T_9 (olive oil + cold storage), and T_{10} (coconut oil + cold storage).

Benefit-cost ratio: The maximum benefit-cost ratio (B:C) of present investigation was (1.19) observed in T_{10} (coconut oil + cold storage) followed by T_8 (rice bran oil + cold storage) (1.07), while the minimum BCR was (0.4) observed in T_5 (cinnamon oil + ambient condition).

4. CONCLUSION

Considering the result of the present investigation, it is concluded that treatment T_9 (olive oil + cold storage) and T_{10} (coconut oil + cold storage) was the best treatments for extending shelf life of cape gooseberry. The maximum shelf life (20 days) and (19 days) was observed under treatment T_9 (olive oil + cold storage) and T_{10} (coconut oil + cold storage). The minimum postharvest loss (10.0%) was observed in T_9 (olive oil + cold storage) followed by T_{10} (coconut oil + cold storage) which was stored in refrigerated condition. To minimize postharvest losses and for keeping maximum quality during storage, a lower temperature is needed than a higher temperature. The maximum benefit-cost ratio (B:C) was recorded in treatment T_{10} (coconut oil + cold storage) (1.19) in cape gooseberry.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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