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Effect of Cold Room Storage on the Shelf Life of Brinjal (*Solanum melongena* 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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Short Research Article

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ABSTRACT

This comparative study aimed to evaluate the effectiveness of cold storage in reducing post-harvest losses and maintaining the quality and shelf life of brinjal under controlled conditions. Brinjal (*Solanum melongena* L.) is a highly perishable vegetable that undergoes rapid weight loss, wilting, and spoilage during post-harvest handling, leading to significant economic losses for farmers. Proper storage methods, especially cold storage, play a crucial role in extending its

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marketable life and reducing wastage. In the present study, fresh and firm brinjal was purchased from the local market in Newasa (MH) and stored under two conditions: cold storage at 10 °C and 94% RH, and room temperature. Results showed that brinjal stored in cold storage exhibited reduced weight loss and maintained freshness without any chilling injury or disease symptoms throughout the storage period. The storage life of brinjal was observed to be 8 days in the cold room, while the shelf life at room temperature was limited to only 2 days. The study demonstrates that once brinjals are removed from cold storage, their shelf life and quality begin to decline quickly due to accelerated moisture loss and physiological activity. It highlights the importance of maintaining the cold chain until the point of sale or consumption to minimize post-harvest losses. These findings highlight the effectiveness of cold storage in prolonging the post-harvest life and marketability of brinjal compared to ambient conditions.

Keywords: Brinjal; temperature; relative humidity; cold storage; shelf life; post storage life.

1. INTRODUCTION

Brinjal (*Solanum melongena* L.) is an important and indigenous vegetable crop of India. It contributes 9% of the total vegetable production of the country (Sidhu & Dhatt, 2006). Eggplant, brinjal, or aubergine (*Solanum melongena* L.) is, together with tomato, among the most widely known edible fruits of the Solanaceae family (Daunay, 2008). Brinjals are thought to be derived from the wild African species, Solanum incanum. The scarlet brinjal (*Solanum aethiopicum* L.) and the gboma brinjal (*Solanum macrocarpon* L.) are grown and consumed in Africa and represent an important source of genetic variation (Daunay et al. 2001). Brinjals were already domesticated in Southeast Asia, particularly in Northeast India and Southeast China, more than 2000 years ago (Jadhav & Gurav NP, 2018).

Brinjal is a good source of dietary fiber, antioxidants such as nasunin and chlorogenic acid, and important vitamins like Vitamin C, Vitamin K, folate (Vitamin B9), and Vitamin B6. It also provides essential minerals, including potassium, manganese, magnesium, and copper, while being low in calories, fat, and cholesterol (Maurya et al. 2019). Brinjal fruit (unripe) is primarily consumed as cooked vegetable in various ways. India ranks second in the world in terms of brinjal production after China. Maharashtra ranks 9th in brinjal production in all Indian states.

Cold storage is the one widely practiced method for bulk handling of the perishables between the production and marketing processes. It is one of the methods of preserving perishable commodities in a fresh and wholesome state for a longer period by controlling temperature and humidity within the storage system. Maintaining an adequately low temperature is critical, as otherwise it will cause chilling injury to the produce. Cold storage is necessary for brinjal to slow down spoilage by decreasing its physiological processes, preventing moisture loss and weight reduction, preserving its texture and flavor, and reducing the risk of infection from harmful microorganisms. By maintaining controlled temperature and humidity, cold storage extends the shelf life of brinjal, helping it stay fresh and suitable for sale much longer than it would under normal room conditions (Gurav & Sharma, 2019). Commodities stored together should be capable of tolerating the same temperature, relative humidity and level of ethylene in the storage environment. High ethylene producers (such as ripe bananas, mangoes, and apples) can stimulate physiological changes in ethylene-sensitive commodities (such as capsicum, lettuce, cucumbers, carrots, bottle gourd, potatoes, and sweet potatoes), leading to often undesirable colour, flavour and texture changes (Krishnakumar & Dayanandakumar 2002). However, the wholesalers, retailers or producers are seldom to afford the above-mentioned practices for increasing the shelf life of eggplants after harvest (Najafi et al. 2021).

2. MATERIALS AND METHODS

Freshly harvested brinjals were collected in the morning from the Newasa vegetable market and transported within 1 hour to the cold storage facility of New Leaf Dynamic Technologies Pvt. Ltd., located in Newasa, Ahilyanagar, Maharashtra. Upon arrival, the produce underwent sorting and grading to remove damaged or unfit samples. The selected brinjals were then placed in cold storage maintained at a temperature of 10°C and 94% relative humidity (RH) to ensure optimal preservation conditions. A

1 kg sample of the fresh produce was kept separately at room temperature to serve as a control for comparison. The rest of the brinjals were stored under cold conditions. During the storage period, the following parameters were monitored under both conditions: Weight loss to determine moisture loss and shrinkage, Visual quality, including: Shriveling percentage, Colour changes, Signs of disease and Chilling injury symptoms. This comparative study aimed to evaluate the effectiveness of cold storage in reducing post-harvest losses and maintaining the quality and shelf life of brinjal under controlled conditions.

3. RESULTS AND DISCUSSION

3.1 Visual Observations Recorded

1. **Shrivelling percentage:** Shrivelling percentage was increased with advance storage time in the commodities. Initially less shrivelling was recorded in earlier stage as compared to later stage of storage. From the 8th day onwards, higher shrivelling was observed in the Brinjal at cold storage conditions. The relation of Shrivelling is inversely proportional to shelf life. Fruit quality was lost gradually as shrivelling started in both conditions. Shrivelling percentage varies from commodity to commodity (Gurav & Sharma, 2019). The increase in water loss and rapid shrinkage of peel due to physiological disorders during storage are most common adverse effects during storage of eggplants (Jha et al. 2002)

2. **Colour appearance percentage:** In the early days of storage, brinjals maintained a higher colour appearance percentage, with all samples appearing fresh and visually appealing. However, as the storage period progressed, colour deterioration became evident in both cold storage and room temperature conditions, particularly after the brinjals were removed from the cold room. This gradual loss of vibrant colour is associated with the natural degradation of pigments and is a key indicator of declining freshness and market quality. These observations are in line with the findings of Gurav & Sharma (2019).

3. **Disease development and the chilling injury inside cold storage:** During the experimental storage period, no symptoms of disease development or chilling injury were observed in the brinjals stored under cold storage conditions. This indicates that the storage environment, maintained at 10°C and 94% relative humidity, was suitable for preserving the quality of the brinjal without inducing physiological stress or microbial infection. These findings are consistent with previous research by Gurav & Sharma (2019), which also reported the absence of chilling injury and disease symptoms in brinjal under similar storage conditions.

3.2 Actual Observations Recorded

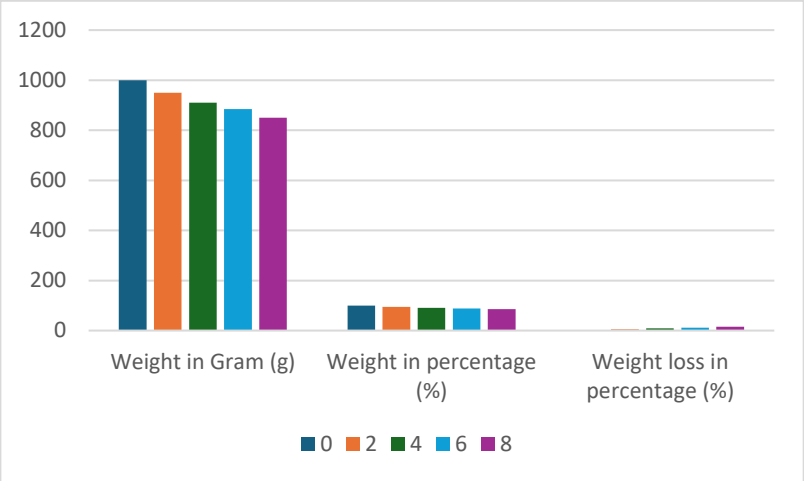
3.2.1 Weight loss percentage of Brinjals in cold storage conditions and room temperature conditions

Table 1 shows the gradual weight loss of brinjal over an 8-day period, likely under cold storage conditions. On Day 0, the initial weight is 1000 grams, considered as 100%. As days progress, the weight of the brinjal decreases due to moisture loss and respiration. By Day 2, the weight drops slightly to 989g (1.10% weight loss), and by Day 8, it decreases to 940g, resulting in a total weight loss of 6.00%. The minimum water loss was observed in cold room condition and maximum water loss was observed at room/ ambient temperature conditions (Jadhav et al. 2018; Fallik et al. 1995).

This steady decline indicates that even under cold storage, brinjal undergoes physiological changes that lead to weight reduction. However, the controlled environment helps slow down this process compared to ambient conditions, thus preserving its market quality for a longer time.

Table 1. Weight loss percentage of Brinjals in cold storage conditions (10°C & 94% relative humidity)

Days	Weight in Gram (g)	Weight in percentage (%)	Weight loss in percentage (%)
0	1000	100.00	0.00
2	989	98.90	1.10
4	962	96.20	3.80
6	954	95.40	4.60
8	940	94.00	6.00



Graph 1. Weight loss percentage of Brinjals in cold storage conditions (10°C & 94% relative humidity)

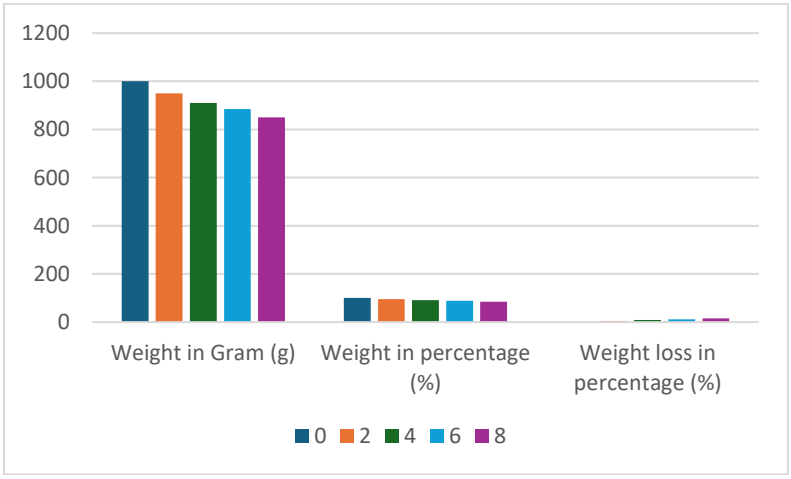
3.2.2 Weight loss of fresh Brinjals at room temperature

Table 2 presents the weight loss pattern of fresh brinjals stored at room temperature over an 8-day period. The initial weight on Day 0 is 1000 grams, which serves as the baseline (100%). As time progresses, the weight decreases significantly due to faster moisture loss and increased physiological activity in the absence of temperature control. By Day 2, the brinjals lose 5% of their weight. By Day 4, the loss increases to 9%. By Day 8, there is a substantial 15% weight loss, with the brinjal weighing only 850g. The minimum water loss was observed in cold room conditions and maximum water loss was observed at room/ ambient temperature conditions (Jadhav et al. 2018; Fallik et al. 1995).

This data clearly shows that brinjals stored at room temperature deteriorate more rapidly compared to those kept in cold storage. The higher rate of weight loss affects the freshness, texture, and marketability of the produce.

Table 2. Weight loss of fresh Brinjals at room temperature

Days	Weight in Gram (g)	Weight in percentage (%)	Weight loss in percentage (%)
0	1000	100.00	0.00
2	950	95.00	5.00
4	910	91.00	9.00
6	885	88.50	11.50
8	850	85.00	15.00



Graph 2. Weight loss of fresh Brinjals at room temperature

3.2.3 Weight Loss of Brinjal at ambient conditions after taken out of cold room

Table 3 illustrates the weight loss of brinjals after being removed from cold storage and kept under ambient (room temperature) conditions for 2 days. Brinjals initially stored under cold conditions start losing weight rapidly once exposed to room temperature. On Day 2, the weight loss is 4.00%, indicating a quick response to ambient exposure. By Day 6, the loss increases to 7.20%, even though each measurement reflects only 2 days of ambient storage. The maximum water loss and reduce the post storage life of brinjal outside the cold room. Similar results was found in fig storage (Jadhav & Gurav, 2018).

This data demonstrates that once brinjals are removed from cold storage, their shelf life and quality begin to decline quickly due to accelerated moisture loss and physiological activity. It highlights the importance of maintaining the cold chain until the point of sale or consumption to minimize post-harvest losses.

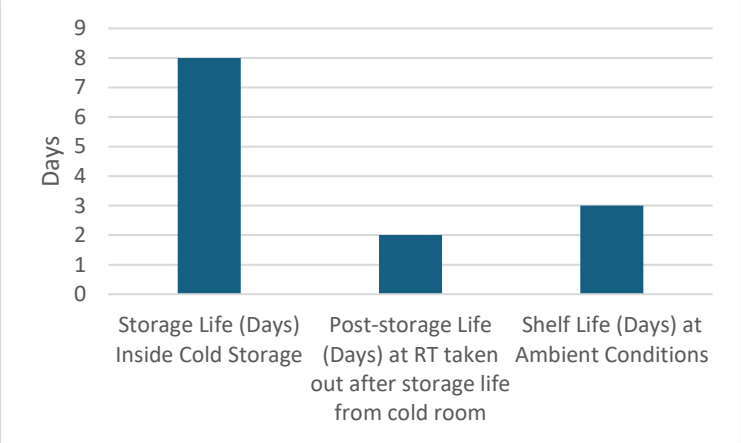
3.2.4 Storage and post storage life

Table 4 shows the Storage Life in cold storage (10°C, 93% RH) was observed to be 8 days, during which brinjals maintained quality without signs of disease or chilling injury. After removal from cold storage, the post-storage life at room temperature was 2 days, beyond which noticeable deterioration occurred. When stored directly under ambient conditions, the shelf life of brinjal was only 3 days, indicating a rapid decline in quality without refrigeration. Similar results was found in Capsicum, Eggplant and Bottle Gourd storage (Gurav & Sharma, 2019). Storage of brinjal fruits should not be done with other ethylene producing fruits (Mangal et al. 2001). Eggplants have limited shelf life of 3 days during ambient storage temperature (Singh et al. 2005)

This comparison highlights the effectiveness of cold storage in significantly extending the storage and marketable life of brinjal compared to room temperature conditions.

Table 3. Weight Loss of Brinjal at ambient conditions after taken out of cold room

Cold storage (Fruit taken out from Cold Storage) Days	Brinjals		Weight loss in percentage (%)
	Initial Weight (gm)	Final weight (gm) after 2 days of storage	
2	1000	960	4.00
4	1000	945	5.55
6	1000	928	7.20

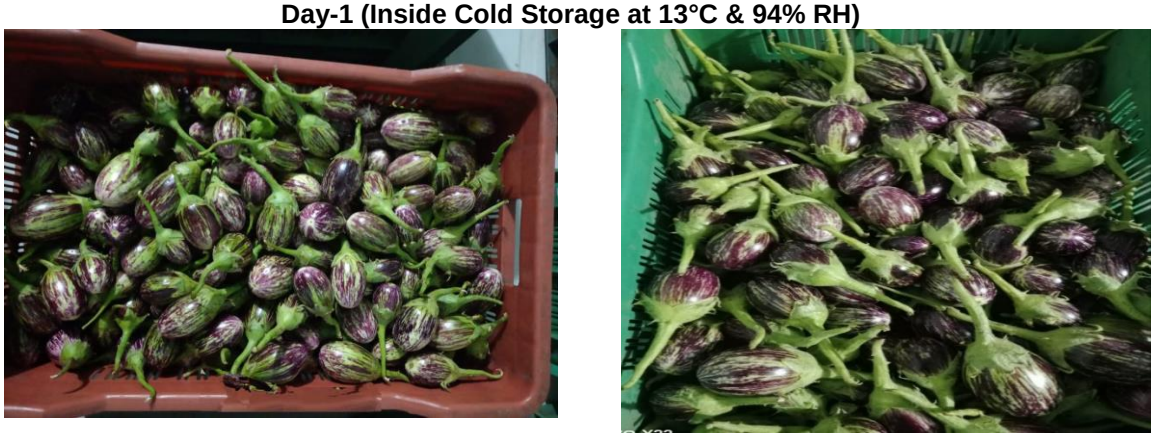


Graph 3. Storage and post-storage life of commodities inside cold storage (10°C and 93% RH) and ambient storage life

Table 4. Storage and post-storage life of commodities inside cold storage (10°c and 93% rh) and ambient storage life

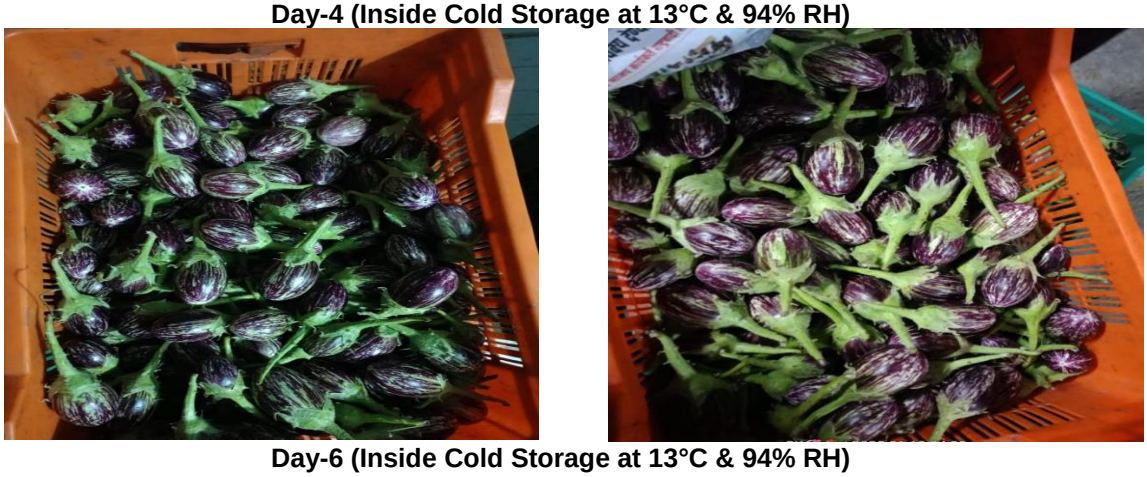
Commodity	Storage Life (Days) Inside Cold Storage	Post-storage Life (Days) at RT taken out after storage life from cold room	Shelf Life (Days) at Ambient Conditions
Brinjal	8	2	3

Day-1 (Inside Cold Storage at 13°C & 94% RH)



Day-2 (Inside Cold Storage at 13°C & 94% RH)

Day-4 (Inside Cold Storage at 13°C & 94% RH)



Day-6 (Inside Cold Storage at 13°C & 94% RH)

Day-8 (Inside Cold Storage at 13°C & 94% RH)

Fig. 1. Interval day-wise photographs

Fig. 2. Photographs of stored Brinjal in the cold room

4. CONCLUSION

The storage life of brinjal was observed to be 8 days under cold storage conditions maintained at 10°C temperature and 94% relative humidity (RH). Under these conditions, no signs of chilling injury or disease symptoms were detected throughout the storage period. Brinjals remained in good physical and physiological condition, with minimal weight loss. This indicates that cold storage at 10°C and 94% RH is effective in preserving the freshness, texture, and marketability of brinjal for up to 8 days, making it a suitable post-harvest handling practice.

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 this manuscript.

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COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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