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Original Research Article

Extending the Shelf-Life of Banana Cv. "Grande Naine" Using A Cold Room (Ecofrost)

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ABSTRACT

Storage at 13ºC with 95% RH was evaluated as the best condition to maintain the shelf-life of the Banana fruit cv. Grande Naine. Fruit at green stage-1 that were treated with 1% Alum and 1% Benomyl for 10 minutes simultaneously and then vacuum packed in LDPE bag and stored inside cold room of Ecofrost retained a maximum storage life upto 25 to 30 days and the post-storage life was recorded as 2 to 3.5 days. Shelf life was recorded to be 4 to 6 days in ordinary room condition. Chilling injury, decay, crown rot severity and stem rot were noted as zero percentage inside cold room since starting of the experiment.

Keywords: Banana, Grande Naine, Temperature, Ecofrost, Fruit, Storage, Alum, Benomyl.

INTRODUCTION

Bananas are a convenient way to add key nutrients to your diet. They are high in carbohydrates, vitamins, potassium, soluble fiber and protease inhibitors, which help to remove the stomach bacteria. Studies have proved that regularly eating banana fruit, help to maintain heart function, blood pressure levels, bone density, vision, digestion and kidney health.

Banana fruit (*Musa acuminata*) develops better colour, texture, aroma, and sweetness as it ripens after harvest. In summer, banana fruit may ripen more quickly, while their ripening is slower in the winter season. There are ways to speed up and slow down the ripening process. Once ripened, banana fruit has a shelf life of two days before it begins to decay.

Now-a-days, 'Grande Naine', 'Grand Naine' or 'G9' is the widely grown banana cultivar in India. Crown rot severity, one of the most drastic postharvest diseases of banana can cause severe postharvest loss. In this study, effect of Alum (potassium aluminium sulphate) + Benomyl in combination with vacuum packaging was investigated in banana cv. 'Grande Naine' at cold storage. The use of potassium alum in delatexing baths is important for the quality of bananas. It reduces fresh latex stains and prevents crown rot.

Latex secretes from the wounds where the clusters were cut. The clusters were washed in 'delatexing baths'. It is generally recommended to add potassium alum to the delatexing baths. [1,2] This helps to remove the latex, [1,3] controls pathogens in the wash water [1,2] which results in maintenance of cosmetic appearance of fruits [4] and promotes the proper healing of the cutting wounds. [3,4]

Fungal spores could go 5-7 mm deeper in to the crown tissue and establish

deep-seated infections which may be difficult even for fungicides to reach. [5]

By removing air around the banana, oxygen level in the packaging is reduced, impeding the metabolism of some pathogenic agents that can survive on the banana crown. The lack of oxygen also reduces the amount of spoilage due to oxidation, which could cause browning in banana. Vacuum packaging result decrease of fruit respiratory intensity and endogenous ethylene synthesis, and thereby increase the length of the pre-climacteric phase.

The lack of washing, sorting, packaging, chemical treatment and other postharvest handling practices are some of the reasons for the substantial amount of losses to banana fruit. Banana is among the highly perishable fruits which has a short shelf life and suffer severe postharvest losses. [6] Banana has an average market life of 1 to 10 days depending on genotype, maturity stage at harvest and storage and handling conditions. Use of Ethylene scrubbers is among the methods widely used to delay ripening of banana fruit.

The techniques used to delay and manage ripening includes: temperature control and relative humidity management, modified atmosphere (MA) storage, ethylene removal, or inhibition of ethylene action through chemical means. [7]

Storage temperature is very vital for safe storage of banana. High temperatures could result in off flavour and mushy flesh of banana while low temperatures below 11 ºC could result in chilling injury. Low temperature could slow down the growth of micro-organisms mainly fungi on banana fruits. Therefore, during the present study, sample was maintained at optimum level of 13°C.

MATERIALS AND METHODS

The fruits were collected from Bitergaon, Solapur, Maharashtra, India and harvested at stage-1 in the early morning. Harvesting was carried out manually. During harvesting, dehanding was done with the help of nylon wire and the hands were kept on banana leaves with crown facing the ground to allow the latex to ooze out. Once the latex stops oozing out, the hands were packaged inside plastic crates with the help of EPE foam to prevent bruising. These plastic crates were loaded onto the truck which was unloaded in Banana pack house. On Arrival at pack house, the hands were sorted based on visual defects, uniformity of weight and shape.

Fruit were handled carefully to reduce abrasion and bruising during transit. Such freshly harvested and selected bunches were placed under shady conditions for thirty minutes.

All hands were washed in running water to remove dirt and then with alum (1% w/v) for 10 minutes. Again, treated with 1% Benomyl solution for 10 minutes. Every crown of banana hand was wrapped in EPE foam sheet. Treated fruits were packed in low density polyethylene bags, air inside bags were removed using vacuum pump and placed in corrugated box ($40\times29\times19$ cm^3) (capacity around 7 kg) and stored in a cold room at 13ºC and 95% RH.

Parameters like TSS, stem rot, brown spot, chilling injury, crown rot severity and shelf-life at cold storage conditions were observed.

DISCUSSION

Table 1. Total soluble solids content inside cold storage

On days inside cold room	TSS °B
1	0.5
10	0.5
20	0.5
30	0.5
35	4.5

The fruit which were stored at 13°C (50°F) with 95% RH conditions, were recorded as 0.5 percentage TSS up to 30 days (Table 1).

The fruits which were stored at 13°C (50°F) with 95% RH conditions, observed zero percentage of stem rot up to 35 days (Table 2). Addition of Alum removes the latex from banana crown, promotes the proper healing of the wound at crown and controls pathogens in the washing water tank. [1]

Table 2. Stem rot percentage inside cold storage

On days inside cold room	Stem rot percentage
1	0
5	0
10	0
15	0
20	0
25	0
30	0
35	0

Table 3. Brown spot percentage inside cold storage

On days inside cold room	Brown spot percentage
1	0
5	0
10	0
15	0
20	0
25	0
30	0
35	0

The fruits which were stored at 13°C (50°F) with 95% RH conditions, observed zero percentage of brown spot up to 35 days (Table 3).

Table 4. Chilling injury percentage inside cold storage

On days inside cold room	Chilling injury percentage
1	0
5	0
10	0
15	0
20	0
25	0
30	0
35	0

For the fruits which were stored at 13°C (50°F) with 95% RH conditions, chilling injury was not observed up to 35 days (Table 4).

The fruits which were stored at 13°C (50°F) with 95% RH conditions, observed zero percentage of crown severity up to 35 days (Table 5). Crown rot is caused by a broad unspecific and opportunistic fungal parasitic complex including *Lasiodiplodia theobromae, Colletotrichum musae, Fusarium spp., Verticillium spp*. and *Cephalosporium spp.* [8]

Table 5. Crown rot severity (%) inside cold storage

On days inside cold room	Crown rot severity (%)
1	0
5	0
10	0
15	0
20	0
25	0
30	0
35	0

Table 6. Shelf-life of green stage 1

Shelf-life at Room Temperature	Shelf-life Inside Cold room
4 to 5 days (Green stage of Harvest)	25 - 30 days

The fruit which were stored at 13°C (50°F) with 95% RH conditions retained higher storage life upto 25 to 30 days, whereas shelf-life was recorded as 3 to 5 days in ordinary room conditions (Table 6). Visual appearance of banana fruit is shown in figure 1.

Optimum storage temperature for banana is 13 to 14°C. A slight delay in colour change was also observed in banana fruits kept in polyethylene bags. [9] The conversion of green colour of the peel into yellow because of chlorophyll degradation is an indicator of senescence that is enhanced by high rate of respiration which in turn is regulated by temperature, ethylene, O_2 and CO_2 gases. [10]

With polyethylene bags having more control over the gas exchange with the surrounding air, the levels of CO_2 and O_2 around the fruits might have further slowed down conversion of starch to sugars. [11]

Day-1 (Inside Cold Storage at 13°C & 95% RH)

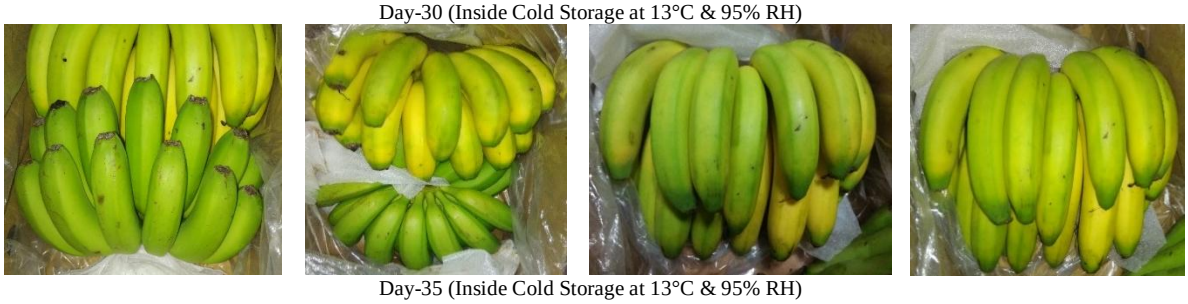
Day-10 (Inside Cold Storage at 13°C & 95% RH)

Day-15 (Inside Cold Storage at 13°C & 95% RH)

Day-20 (Inside Cold Storage at 13°C & 95% RH)

Day-25 (Inside Cold Storage at 13°C & 95% RH)

Day-30 (Inside Cold Storage at 13°C & 95% RH)



Day-35 (Inside Cold Storage at 13°C & 95% RH)

Fig 1. Photos of Bananas Testing taken Inside Cold Storage on different days:

Fruit stored in the cold conditions had maintained a greener colour, no chilling injury symptoms observed in the outer peel portion, no decay incidence, no symptoms of crown rot and stem rot. Storage at low temperatures reduces fruit metabolism, delay senescence, delay in pulp softening during storage of fruit.

CONCLUSION

In conclusion, the visual quality of the fruit is evident from the images collected at various stages of this experiment. This activity establishes that the selected storage conditions have high impact in terms of shelf-life of banana fruit. Alum in combination with 1% Benomyl treatment for 10 minutes individually with vacuum packaging significantly retains the quality of banana fruit. Post storage life was recorded as 2 - 3.5 days.

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