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Post Harvest Technologies for Enhancing the Profitability of Farming Communities

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Abstract

Post-harvest technology plays a pivotal role in boosting profitability of farming communities. A common storage structure serves multipurpose functions such as cold storage, dehydration and ripening. The aim is to make the commodity available in the off-season and get a good quality market as soon as possible. Dehydration prevents rotting and extends the shelf life of goods. While cold storage maintains freshness and allows for greater market flexibility, ripening rooms provide market access and enable better pricing. If we do value addition in this way, the farmer will get double his profit. We get more benefits at less cost. Value addition increases its market price and increases its quality.

Introduction

The phrase "Post Harvest Technology" refers to the methods used to handle agricultural produce after it has been harvested to safeguard its preservation, processing, packaging, marketing, distribution and use to satisfy the population's need for food and nourishment. The development of this technology needs to take into account the needs of each civilization to maximize agricultural productivity, minimize significant postharvest losses, enhance nutrition, and enhance produce quality. The smart advancement of postharvest technologies also holds prospects for lowering poverty, fostering jobs and promoting the expansion of other associated economic sectors (Faqeerzada et al., 2018).

Cold Storage

Mangoes have a short postharvest shelf life when stored at room temperature because of compositional, physiological and microbiological changes (Singh et al., 2012; Tian et al., 2010). Low temperatures are therefore frequently used during fruit storage to inhibit the fruit's quick metabolism,

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hinder ripening and senescence, minimize water loss, avoid or minimize disease and insect activity and ultimately preserve postharvest quality and extend its shelf life (Sudhakar Rao & Gopalakrishna Rao, 2008). The impact of low temperatures on the quality of mango fruit has been the subject of extensive investigation. Depending on the cultivar and fruit maturity, different temperatures are advised for storage, ranging from 5 to 15°C for two to three weeks (Singh et al., 2012; Singh et al., 2013; Watanawan et al., 2014). However, some cultivars at particular maturation stages can develop Chilling injury after a specific amount of time exposed to very low temperatures below 10 °C (Singh et al., 2012). According to reports, tree-ripe “Keitt” and “Tommy Atkins” mangos are less likely to develop CI when stored for two weeks at 5°C. On the other hand, mature green mangoes exposed to temperatures below 10°C may develop abnormal ripening, a skin discoloration that resembles scalding grey, skin pitting, a decrease in the amount of carotenoids, a reduction in aroma and flavor during ripening and a greater vulnerability to fungal decay (Singh et al., 2012; Singh et al., 2013) and freezing has been shown to cause plant tissue to produce anthocyanins (Pino & Mesa, 2006). When fruit is moved from cold storage to room temperature, these symptoms are said to get worse (Singh et al., 2013; Watanawan et al., 2014). The literature claims that climacteric fruit is particularly stimulated to produce autocatalytic ethylene by low temperatures and the chilling effect (Singh et al., 2013). The decline is related to the degree of Chilling Injurybrought on by low storage temperatures and durations; it is explained by the inhibition of the activities of many enzymes engaged in multiple metabolic pathways that convert acetyl CoA into volatile molecules (Nair & Singh, 2003). Low temperatures must be maintained in the fruit sector. However, the bulk of smallholder horticulturists cannot afford the high costs of conventional cool rooms. While 2-3 weeks of low-temperature storage is enough in the export supply chain, a mix of different measures is necessary to extend the shelf life of mangoes (Ntsoane et al., 2019).

Ripening Room

It is important to carefully regulate the ripening process of bananas by designing the conditions of the ripening chamber. Systems for air circulation, heating, and refrigeration should be installed in the ripening room. Sealing the room is also necessary to keep ripening-inducing chemicals like ethylene gas (C_2H_4) from escaping. Since the banana releases a lot of heat throughout the ripening process, there should be enough refrigeration installed to regulate temperature. A heating system is required in subtropical regions to keep a space at a comfortable temperature throughout the winter. Additionally, a sufficient air circulation system is required for the ripening room; uniform banana ripening is the result of optimal circulation and airflow pattern.

Figs. 1 (A) and (B) provide images of the banana ripening chamber in action as an illustration. The ripening room in the picture has a maximum processing capacity of 40 tons per chamber. To prevent air leakage, the wall side of the stack of banana boxes is placed along a sheet. Each hand-held hole and ventilation aperture is precisely aligned when the boxes are stacked. Fig. 1 (C) shows the direction of the airflow in this arrangement. The C_2H_4-filled air is drawn in by ceiling fans, blows out of the top of each side wall, and enters each banana box through the hand-hold opening. Uniform airflow through the box's ventilation ports is made possible by the static pressure produced by the air circulation fans. Usually, the chamber's temperature is adjusted at 20 °C on the first processing day and lowered to 15 °C over the course of 4 or 5 days. Depending on the desired level of ripeness and the operator's experience, the temperature is adjusted. The amount of carbon dioxide produced by the respiration of bananas in the chamber serves as an additional indicator of the degree of ripeness.

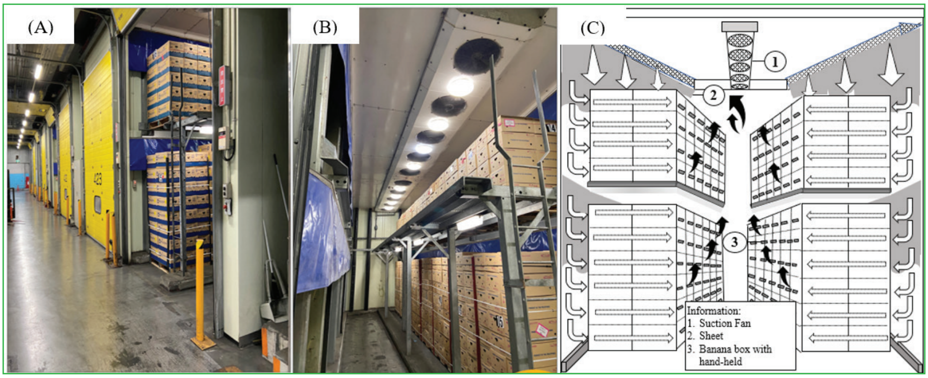

Figure 1: The exterior and interior of the banana ripening room. (A): Ripening chambers, (B): Ripening room condition (Pictures were taken by authors at Unifrutti Japan Corporation, Tokai, Ota-ku, Tokyo on 30 January 2020), (C): An illustration of airflow direction in the ripening room(Sugianti et al., 2022)

Particularly in the marketing and export of mango fruits, climate-controlled fruit and artificial mango ripening play a significant role. The main goal of early mango ripening is to speed up respiration, which aids in getting the fruits ready for early marketing and greater pricing for the mango growers. Since mangos are climacteric fruits, artificial ripening is crucial, particularly for mango exports. The overall goal of early mango ripening is to raise respiration rates, which aid in preparing the fruit for early marketing. Fetching higher prices, helps the mango growers double their income (Pujari et al., 2018). One kilogram of mango fruits needed to ripen at a cost of one cent each day. When calculating the ripening cost, the cost of a ripening chamber for 1000 kg of fruits was included, along with the daily interest and ethylene gas costs. It was found to cost Rs 0.89 per kg. It has been demonstrated that exposing Mango Cv. Alphanso to ethylene gas during the ripening chamber treatment starts the ripening process. Also, it was seen that the ripening process progressed more quickly the longer the mango cultivar cultivated in Alphanso was exposed to ethylene gas. This was demonstrated by the mango cultivar's notable increases in ripening time, color, TSS and shelf life. Mango fruits Cv. Alphansowas observed to ripen when exposed to 100 ppm ethylene gas in a ripening laboratory for 24 hrs. After being stored at room temperature, the maximum shelf life was recorded at 8 days and the fruits displayed improved overall acceptability (Chikkana, 2022).

Dehydration

Dehydration is the simplest technology for increasing the shelf life and adding value to fruits and vegetables by removing water until there is only around 5% moisture left. It is a method of eliminating moisture by applying artificial heat in regulated humidity, temperature, and airflow conditions. Trays are inserted into the dehydrator and a single layer of whole or chopped fruits and vegetables is put out on them. The dehydrator's starting temperature is 43°C, but for vegetables and fruits, it rises to 60–66°C and 66–71°C, respectively. To address this, mechanical driers must be installed in the rural areas. Due to the issue with energy supply, solar dryers can be applied to eliminate the moisture content of fresh produce. Nevertheless, residual moisture cannot be precisely adjusted by solar driers to a range of 5 to 8 percent (Kular & Brar, 2012). Figure 2 represents the process of dehydration in fruits and vegetables.

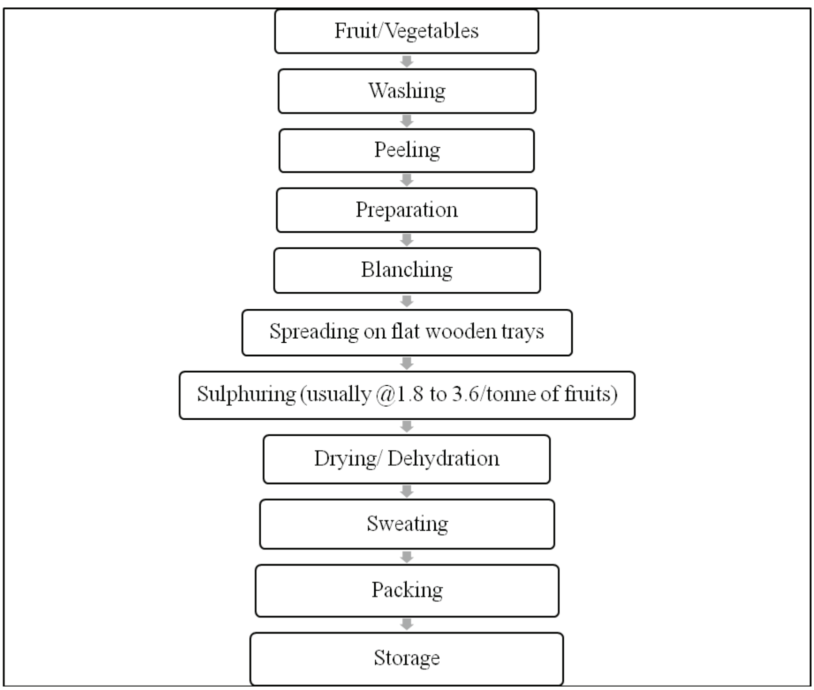

Figure 2: Flow chart of dehydration of fruits/vegetables

A cost-benefit analysis was carried out on the production of fresh and dehydrated products using specific fruits and vegetables. To generate 1 kilogram of dehydrated produce, several kg of fresh product is needed because dehydration causes produce to lose weight. This indicates how much fresh food is needed to generate 1 kilogram of dehydrated items. Dehydration is typically applied to excess products that are unsaleable in the regular market. Here, the price of the quantity of fresh produce needed to make one kilogram of dehydrated product was multiplied to determine the total cost of raw materials. Additionally, other expenses (such as labor, packaging and transportation costs) incurred in producing one kilogram of dehydrated product were added. For example, if the wood apples are 120 RS/kg then we require 10 kg of wood apples to get 1 kg of dehydrated product. The production cost for 1 kg dehydrated product is 150 RS, therefore the total cost of the dehydrated product is 1350 RS. So the selling price of dehydrated wood apple is 2200 RS /kg.

Table 1. Benefit-Cost analysis of selected food items

Product	**AI**	**PI**	**PI**	**AD**	**TC**	**SPD**
Papaya	10	200	2000	150	2150	4000
Wood Apple	10	120	1200	150	1350	2200
Jackfruit	8	150	1200	150	1350	3000
Pineapple	12	220	2640	150	2790	4800
Mango	8	150	1200	150	1350	4600
Curry leaves	10	80	800	100	900	1750
Banana	7	80	560	150	710	2500

AI: Amount of ingredient s (Kg) - make 1kg of dehydrated; PI: Price1Kg - ingredients (LKR); AD: Another PC1kg dehydrated (LKR); TC: TC- (1Kg) (LKR); SPD: SP Dehydrated 1kg (LKR)

The price of one kilogram of fresh produce for each product chosen is multiplied by the number of kilograms of fresh produce required to generate one kilogram of dehydrated produce to determine the overall worth of the fresh produce in cost-benefit analysis. It displays the amount of fresh produce overall in 1 kilogram of dehydrated, a substantial amount of fresh produce is needed to generate 1 kg of dehydrated produce since during the aforesaid dehydration process, the water in the fresh produce is eliminated and its weight is decreased. It was computed by deducting the selling price of one kilogram of dehydrated product from the total cost of that kilogram of dehydrated product. Table 2 compares the difference between the profit of dehydrated products and the total value of fresh products to calculate the cost benefits. According to this calculation, the value of each dehydrated product is greater than the value of the fresh product, which means that there is a profit for each dehydrated product (Maduwanthi et al., 2024).

Table 2. Benefits analysis of selected dehydrated food items

Product	Fresh Product Price (1Kg) (LKR)	Total value of fresh products (LKR)	Profitability of dehydrated products (LKR)	Cost - Benefits` (LKR)
Papaya	200	1600	3250	1650
Wood Apple	120	1200	1850	650
Jackfruit	150	1200	1650	450
Pineapple	250	1750	1790	40
Mango	150	1800	2010	210
Curry leaves	80	800	850	50
Banana	120	840	1790	950

Conclusion

We have access to cold storage and dehydration commodities throughout the off-season, which increases their market value and doubles the farmer's income. The mango in the ripening chamber ripens quickly, making it ready for export and selling and providing the farmer with double the cash.

References

Chikkanna, G. S. (2022). A low-cost ripening chamber is a boon to small and marginal farmers for ripening mangoes.*The Pharma Innovation Journal*, 11(9): 2823-2828

Kader, A. A. (2002). Postharvest technology of horticultural crops (Vol. 3311). University of California Agriculture and Natural Resources, 296.

Kular, I. K., & Brar, A. S. (2012). Transforming Indian agriculture through agripreneurs. *Indian Journal of Marketing*, 22-29.

Maduwanthi, W. H. T. R., Malkanthi, S. H. P., & Nilanthi, H. P. W. (2024). Dehydrated food production: case of Rathnapura district in Sri Lanka. In *12th YSF Symposium*, 278.

Nair, S., & Singh, Z. (2003). Pre-storage ethrel dip reduces chilling injury, enhances respiration rate, and ethylene production and improves the fruit quality of 'Kensington'mango. *Food, Agriculture & Environment*, *1*(2), 93-97.

Ntsoane, M. L., Zude-Sasse, M., Mahajan, P., & Sivakumar, D. (2019). Quality assessment and postharvest technology of mango: A review of its current status and future perspectives. *Scientia Horticulturae*, *249*, 77-85.

Pino, J. A., & Mesa, J. (2006). Contribution of volatile compounds to mango (Mangifera indica L.) aroma. *Flavor and fragrance journal*, *21*(2), 207-213.

Pujari, K.H., Relekar, P.P., Shedge, M.S., Patil, V.K., Rane, A.D., Haldankar, P.M. &Bhattacharyya, T., (2018). Low-Cost Ripening Chamber-A Technology for Marginal Mango-Growers. *Advanced Agricultural Resourceand Technology Journal,*2 (2),171-174.

Singh, N. P., Jerath, N., Singh, G. & Gill, P. P. S. (2012). Physico-chemical characterization of unexploited mango diversity in the sub-mountain zone of Northern India. *Indian journal of plant genetic resources*, *25*(03), 261-269.

Singh, Z., Singh, R. K., Sane, V. A. & Nath, P. (2013). Mango-postharvest biology and biotechnology. *Critical Reviews in Plant Sciences*, *32*(4), 217-236.https://doi.org/10.1080/07352689.2012.743399

Sudhakar Rao, D. V., & Gopalakrishna Rao, K. P. (2008). Controlled atmosphere storage of mango cultivars 'Alphonso and Banganapalli to extend storage life and maintain quality. *The Journal of Horticultural Science and Biotechnology*, *83*(3), 351-359.https://doi.org/10.1080/14620316.2008.11512391

Sugianti, C., Imaizumi, T., Thammawong, M. & Nakano, K. (2022). Recent postharvest technologies in the banana supply chain. *Reviews in Agricultural Science*, *10*, 123-137.https://doi.org/10.7831/ras.10.0_123

Tian, S. P., Liu, J., Zhang, C. F., & Meng, X. H. (2010). Quality properties of harvested mango fruits and regulating technologies. *New trends in postharvest management of fresh produce II. Fresh Produce*, *4*, 49-54.

Watanawan, C., Wasusri, T., Srilaong, V., Wongs-Aree, C., & Kanlayanarat, S. (2014). Near-infrared spectroscopic evaluation of fruit maturity and quality of export Thai mango (Mangifera indica L. var. Namdokmai). *International Food Research Journal*, *21*(3), 1073.