



Low cost, high impact solutions for improving the quality and shelf-life of mangoes in local markets

Mango (*Mangifera indica* L.) is one of the most important fruit crops produced in SAARC countries. The fruit has excellent overall eating characteristics. Ripe mangoes are consumed in the fresh form and are used as ingredients in the preparation of confectionery, ice cream, sherbets, and bakery products. Mango pulp is high in dietary fiber, vitamin C, provitamin A, carotenoids and a variety of phytochemicals. Aside from its nutritional value, mango fruit production and marketing offer many economic opportunities in the region, especially for smallholder farmers.

Like other fruits, fresh mangoes spoil rapidly because of their high moisture content and delicate nature. If not harvested at the correct stage of maturity and handled properly throughout the distribution chain from harvest to retail the produce suffers both quantitative and qualitative losses, resulting in reduced income for all involved in their production and post-harvest handling. Furthermore, improper handling shortens the market or shelf-life of mangoes, which limits sales volumes and returns to retailers.



Improvements in the traditional mango supply chain: use of improved harvesting pole (A), plastic crate as field container (B), trimming and delatexing of fruits (C), disease control using HWT (D).

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The importance of good post-harvest handling practice

Post-harvest begins where production ends, that is at harvest. Good practice in harvesting and in post-harvest handling is essential in maintaining quality (fresh appearance, flavor and nutritional value), extending shelf-life and in assuring the safety of mango fruits for the benefit of consumers. Post-harvest losses in mangoes result from poor harvesting techniques, careless handling and poor packaging and transport conditions. Efforts are, therefore required to prevent or minimize these losses throughout the mango supply chain, so that producers, marketers, and consumers alike can benefit.

Improving handling practice in mango supply chains

Under the FAO Technical Cooperation Project-TCP/RAS/3502, titled, *Reduction of Post-harvest Losses in Horticultural Chains in SAARC Countries*, technical improvements (Table 1) were piloted in Bangladesh with stakeholders in traditional banana supply chains. Qualitative and quantitative losses and shelf-life were assessed. The specific improvements introduced are summarized in Table 1.

Table 1: Traditional and improved practices in mangoes supply chains

| Operation | Traditional | Improved |
|-----------------|------------------------------|---|
| Harvesting | Farmer's picking pole | Improved picking pole |
| Field packaging | Bamboo basket | Stackable plastic crate |
| Trimming | Hand pulling of stem | Trimming of fruit stem with scissors and hand gloves |
| Delatexing | No delatexing | Trimmed fruit placed on delatexing tray with stem end down |
| Disease control | No hot water treatment (HWT) | Hot water treatment (HWT) 53 °C water, 5 min. dip, followed by hydrocooling in tap water for 5 min. and drying of the mango surface |

The results

1. Post-harvest loss reduction

Losses during the transportation of mangoes from the collection center to the wholesale market were minimal owing to the use of plastic crates for bulk packaging. At the retail level, losses were mainly due to fruit decay caused by latent post-harvest diseases

such as stem end rot, anthracnose and, to a lesser extent fruit rot. Over a 5-day retail period, the severity of disease infection increased daily, with mangoes handled using traditional practice (without HWT) showing a rapid increase in deterioration as compared to those handled using improved practice (with HWT).

Table 2: Losses at various stages of traditional and mango improved chains

| Parameter | Supply chain level | Handling practice | |
|-----------------|--------------------|-------------------|----------|
| | | Traditional | Improved |
| Total loss (%) | Wholesaler | 0.01 | 0 |
| | Retailer (Day 5) | 25.10 | 7.0 |
| System loss (%) | Farm to retail | 25.11 | 7.0 |

At the wholesale market, only one fruit infected with stem end rot was found in the case of traditionally handled mangoes, while stem end rot was absent from mangoes handled using improved practice. Since mangoes transported to the wholesale market were still unripe, disease symptoms that usually start to appear in ripening fruits were not yet apparent.

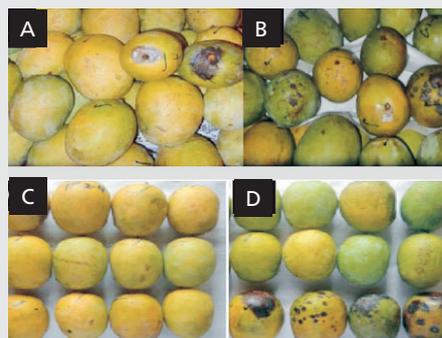
At the retail level, unmarketable fruits consisted of fruits with moderate to severe anthracnose and stem end rot infections. Since HWT was effective in reducing the incidence of fruit decay, the proportion of unmarketable fruits was comparably lower for mangoes handled using the improved practice. On the 3rd day of retail when mangoes were almost ripe, 11.4 percent of traditionally handled fruits were unmarketable as compared to 3.4 percent, for the fruit handled using improved practice. Extending the retail period to 5 days resulted in 25.1 percent unmarketable fruits for the traditionally handled produce, as compared to 7 percent for the improved practice. With the improved practice of using HWT, a reduction in losses ranging from 72 percent to 80 percent was achieved over the retail period of 5 days.

Since post-harvest loss at the wholesale level was minimal, system loss (farm to retail) occurred mainly during retail, and was reduced from 25 percent to 7 percent with the improved practices and technologies introduced in the

supply chain. The reduction in loss across the system was equivalent to 80 percent.

2. Shelf-life

Shelf-life is the length of time that a commodity may be stored or displayed for sale without becoming unfit for use or consumption. Marketable mangoes consisted of sound fruits and fruits with slight anthracnose infection. On the 5th day of retail when fruits were almost ripe, 93 percent of mangoes handled using improved practice were still marketable while only 74.9 percent handled using traditional practice were marketable.



Disease infection on the 5th day of retail: SER-improved practice (A); SER-traditional practice (B); anthracnose-improved practice (C); and anthracnose-traditional practice (D).
SER = Stem end rot.

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3. Produce safety

Applying good practice in handling mangoes from harvest to retail is critical in minimizing the risks of contamination posed by pathogenic microorganisms that may originate from the fruit itself and from workers who come in contact with produce during handling. As a result, all actors involved in the supply chain (farmers, collectors/ wholesalers, retailers) and other stakeholders also benefit.

Economic benefit realized

A partial budget analysis was used to estimate the profitability of applying HWT to control post-harvest diseases in mango fruit. Since the onset of decay occurs at the retail level when mangoes start to ripen, the partial budget analysis made use of data gathered on the 5th day of retail. Assuming 4 000 kg of mangoes are handled over a 5-day retail period, and using other relevant information gathered, the analysis showed the expected changes in cost and returns of operating the HWT facility.

Table 3: Partial budget analysis of improvements introduced at different levels of the supply chain

| Cost (Tk) | |
|---|-----------|
| (A) Added cost: | |
| Depreciation | 173.57 |
| Opportunity cost of capital | 289.28 |
| Electricity | 1 032.00 |
| Water | 8.00 |
| Labor for HWT operation | 1 000.00 |
| (B) Reduced returns | 0.00 |
| Total cost (A + B) = Tk 2 502.85 | |
| Returns (Tk) | |
| (C) Reduced cost: | |
| Savings in labor for sorting | 500.00 |
| (D) Added returns: | |
| Additional gross income | 73 400.00 |
| Total returns (C + D) = Tk 73 900.00 | |
| Additional income = (C + D) – (A + B) = Tk 71 397.15 | |

Results of the analysis showed that HWT of mangoes results in increased returns at the retail level.

In order to be effective, HWT must be applied within 24-36 hours after harvest. HWT must, therefore, be conducted at the field level possibly as a common service facility for a group of smallholder farmers or at the collector level where large volumes of mangoes are handled. Market support is, however, critical in providing a premium price for HWT-treated mangoes which are of better quality and which have a better shelf-life than untreated mangoes in order to ensure sustained utilization of the HWT facility.

This information sheet summarizes the results of the FAO Technical Cooperation Project: TCP/IRAS/3502 Reduction of post-harvest losses in Horticultural chains in SAARC Countries

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