HOT WATER TREATMENT OF MANGO: A STUDY OF FOUR EXPORT CORPORATIONS IN THE PHILIPPINES

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ABSTRACT

This study involved four mango export corporations in Manila. Hot water treatment (HWT) entails dipping of freshly harvested fruits in 52-55°C heated water for approximately 10 minutes. The companies have been practicing HWT since the start of their mango operation, in response to the fruit quality requirement of importing countries. They have similar marketing terms and conditions. During peak season, around 70-75 percent of mangoes come from Luzon, while the rest (25-30%), are from Visayas and Mindanao. Japan and Hong Kong are the most common export destinations, although exports were also negotiated with China, US, Singapore, Australia, New Zealand and Europe.

While HWT is accepted as an effective disease control technology, particularly anthracnose and stem-end rot, its use however, is confined mainly to mango processors and exporters. This is because these diseases only show-up when fruits are already harvested and in the hands of exporters/processors. The findings from the four cases revealed that they all practice the recommended HWT technology, but with some modifications. With HWT, the companies were assured of lower anthracnose incidence of only 10 percent, compared to those not subjected which have an occurrence of as much as 30 percent. This in turn resulted in higher volume of fruits procured and sold and consequently increased income and profit.

The key informants perceived HWT as technically feasible when examined in terms of its relative advantage, compatibility, ease of application, health and environmental soundness.

Keywords: hot water treatment, HWT technology, mango, quarantine procedure

1. INTRODUCTION

Mango is the third most important fruit product next to pineapple and banana in terms of value and volume of production. At present, there is an increasing demand for this fruit from both local and foreign markets. To meet this demand however, the Philippines mango industry should gear up for competition with other mango producing countries in order to maintain and increase its share in the world market.

Scientists in various research and development agencies in the country are developing programs to boost mango production and ensure the quality of mango. In fact, the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)

[1] have launched three complementary programs to address the wide range of problems facing the mango industry. For example, the Mango Comprehensive Technology Transfer Program (MCTTP) implemented from 1993-1998 was designed to solve production and post-production technological problems of mango.

Despite all these efforts, the mango industry have not significantly improved. Much remains to be done considering the enormity of the variety and complex problems that face the industry. In fact, actual and potential yield gap remains wide, exhibiting a difference of around 200 percent (average yield of 100 to 200 kg per mature tree/fruiting season compared to potential yield of 300 to 600 kg/mature tree/fruiting season [2]; good quality fruits barely reach 50 percent of the total harvest; postharvest losses are high, and production cost, still a major concern.

Post harvest losses are often caused by anthracnose and stem-end rot. Nonetheless, researchers have found that disease incidence could be minimized if not altogether avoided if mangoes are subjected to Hot Water Treatment (HWT). Bagged mangoes and 10-minute hot water dip reduced anthracnose infestation by 83 percent and stem-end rot by 100 percent [3]. Although, HWT has proved to be effective in disease control, its use however is limited to exporters/fruit processors who are required to perform post harvest treatment to enhance fruit quality before export particularly to Japan.

This study was conducted to determine the extent of HWT technology adoption and to assess its impact in the mango industry.

2. METHODOLOGY

Mango export/processing corporations were selected based on their willingness to grant an interview and open their offices and plants/stations for inspection. Formal and informal interviews were conducted among key informants (KI) using an interview guide. Inspection of the plant was likewise made to observe the on-going mango operation, see the facilities, tools and equipment used for HWT and vapor heat treatment (VHT). Data were analyzed and presented descriptively with particular focus on the description of HWT practices and cost requirement.

3. RESULTS AND DISCUSSION

Mango Operation and Marketing

The four corporations under study have been in the mango operation for an average of 15 years (Table 1). The pattern and terms by which they procure mango for export and processing were similar. Mango operation usually commences in December and January, when canvassing for possible sources of mango for export is done. This is because, export of fresh mangoes starts as early as the second week of January. The peak months for exporting however are from March to May, while the off-peak season or lean months are from December to January. Processing of mango also coincides with the peak months as unexportable fruits or "rejects" are processed into purees and concentrates.

Table 1. The mango exporters and processors

Company	Year Mango Operation Started	Product Lines
Valley of Hope	1989	Fresh mango
Premium Fruits, Inc	1984	Fresh mango, puree, halves, jam and juices
Everlasting Food Corp	1983	Fresh mango, puree
Mabuhay	1993	Mango puree, concentrates

Sources of Mango and Quality Requirements

As cited earlier, the peak months in mango exporting is from March to May. This coincides with the peak production months called the *Luzon season* which runs from February to May. During these months, mango supply is from Luzon particularly Pangasinan, Zambales, Bulacan, Pampanga, Nueva Ecija, Batangas, Nueva Vizcaya and La Union.

The average volume procured by these four corporations during peak season was around 2467 tons. They buy mangoes during lean months at an average of 667 tons. Volume and frequency of buying mangoes varied greatly by season as buying during peak months was almost daily compared to only about 2-3 days a week during off-peak season.

All four corporations have roving agents in each of the source provinces mentioned above. Marketing transactions, that is, buying mango can also be done directly from the growers/cooperatives, through telephone, word of mouth and walk-in sellers.

Most specifically for the Luzon season, canvass/buying/delivery cycle is from Saturday to Wednesday, with Friday as the cut-off period. This marketing scheme is adhered to in order to catch up with the shipping schedule for Japan. With this schedule, buyers canvass mango on Tuesday, and mangoes are harvested the next day. The harvested fruits are delivered to the company's station by Thursday for quarantine, and then packed and shipped by Friday. The shipping period from the Philippines to Japan and Korea takes about 5 and 6 days respectively.

Mangoes are bought either "straight" or "classified". Straight buying means all harvests regardless of size are taken, while classified refers to sorting the fruits into export grade/sizes. Export grade mangoes weigh from around 160 to > 370 g per fruit. There are five grades (Table 2), super small (SS) weighs 160 to 200 g; small (S) weighs 201 to 240 g; medium (M), 241 to 280 g; large (L), 281 to 350 g; and extra large (XL), 351 and up. Mangoes bought on straight basis are paid at a price range of P 25-27 per kg (February to April) down P10 per kg in May. Export grade mangoes are bought at P40-42 kg during February and March, down P3 for other sizes, and drops to P24-25 in May, down P5 for S to SS. The price of mango however is influenced by the Hong Kong market, hence other corporations have lower price ranges. Nevertheless, the key informants said that Japan importers offer a better price than Hong Kong.

The company imposed quality requirements on their buying agents as they themselves were prescribed with the same by their importers. The fruit should be at right maturity (Fig. 1), free from scab and sooty mold, latex burns, windbreak marks and scratches. Other companies like Valley of Hope additionally require that fruits be sorted by size right in the farm before delivery to their plant station at the FTI Complex in Metro Manila. This was their preventive measure for incurring higher rates (30% of total volume purchased) of rejects they call RSP or reject *sa puno*. RSP is equivalent to local grade.

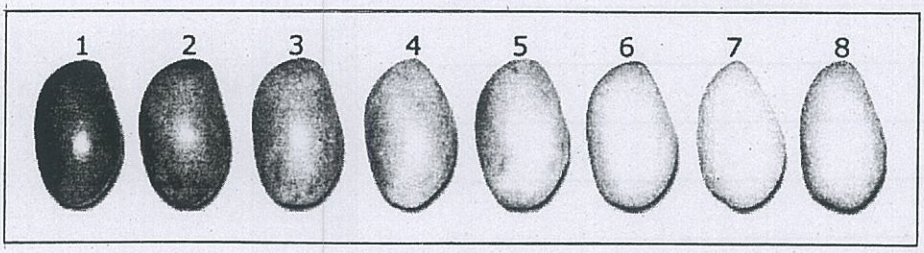

Figure 1. Color index of mango, best eaten at 7th stage (photo From http://www.dsapi.com.ph) [3]

Quality control and recovery rates however are sometimes threatened especially when buying agents have to fulfill their quota. As a result, the agents' priority is focused more on the volume they can acquire rather than quality of the fruit. As a result, fruit rejects can be as high as 50%.

Based on research and key informants testimonies, mangoes that are subjected to HWT only had 10% anthracnose incidence as compared to 30% disease incidence without HWT. Suffice it to say, the lower the anthracnose infestation, the higher their recovery rate and income would be.

Export Destinations

Fresh mangoes from the Philippines are usually exported in Japan and Hong Kong. Other importing countries include Singapore, Korea, China, US, Australia, Europe and New Zealand. The bulk (60-70%) of mangoes, however, goes to Japan. Each country however had its own size preference. For instance, Japan and Hong Kong request SS and XL sizes, while Korea together with US, Switzerland and London order M to XL sizes only. These are packed in corrugated carton with partitions and from pudding. A box weighs approximately 5 kgs. Taking Japan as an example, a 5 kg box of mangos costs approximates US$10. Valley of Hope manages for instance, yielded a gross income of US$10,000. Based on experience, the use of HWT and VHT (Fig. 2) had reduced anthracnose incidence to 10 percent as compared to 30 percent infestation to non-HWT/VHT treated fruits. A reduction of 20 percent incidence could result to an added income of as much as US$2,000 per delivery.

Table 2. Standard measures for exportable mango

Size	Net Weight	Pieces/carton
XL	371gms and up/pc	12 pcs
L	281-370	16
M	241-280	20
S	191-240	24
SS	151-190	30

Adoption of HWT

The four companies have used hot water treatment (HWT) from the very beginning of their export business on mango.

The actual practice of the companies studied did not differ significantly from the standard recommended practice. As in the recommended practice, mangoes are treated immediately within 24 hours after harvest/delivery. The fruits are dipped in hot water for about 10 minutes. This time limit may however be shortened to 2-7 minutes depending on weather condition and mango source. Most particularly from the experience of Premium Fruits, Inc., mangoes from Pangasinan have minimal anthracnose incidence, hence dipping time is shortened to 2 minutes. If mangoes came from Batangas or Bulacan, a 5-minute dip is required. They also practice mango floatation in 10% salt solution. If the fruit floats, it means delayed HWT.

Water temperature is however followed strictly by all companies. Water temperature is kept between 53-55°C through an installed automatic thermostat.

Temperatures beyond this range can result in fruit damage such as scalding and discoloration. After HWT, mangoes are hydro-cooled for 10 minutes then air-dried. HWT and hydro-cooling lengthen the shelf life of mango for a month under cold storage (PCARRD, 2002). Exporters to Japan likewise subject mango fruits to VHT after HWT as this is required by Japan consignees. The duration of VHT is about 3-4 hours.

Perception toward HWT Technology

On the whole, the key informants representing the four companies agree that HWT increased profit as a result of lower damage and higher market value for fruits. The technology was thus perceived as advantageous, could be tried on small scale basis, compatible with current practices, easy to follow, and health and environment friendly. Most specifically, one KI strongly agreed that HWT enhanced fruit quality and therefore commanded higher price. He also agreed with the statement that HWT requires minimal labor, investment and other cost requirements. He further explained that if the company used mechanized procedures/facilities, then the investment cost would be relatively higher.

As to the trialability of the technology, the key informant agreed that the technology could be adopted on a small scale basis because it does not require complicated machines and facilities that would necessitate higher capital outlay.

HWT is likewise perceived as highly compatible with existing practices to control post harvest losses caused by anthracnose and stem-end rot. Moreover, the KI strongly agreed that inputs needed are readily available, facilities and equipment needed can be locally manufactured and fabricated and, there is available labor supply. The respondent also agreed that HWT creates additional employment opportunities.

The KI further agreed that the technology is easy to follow, although factors such as farm conditions, etc. have to be considered when applying the technology. No special equipment or facilities are likewise needed. Interestingly, the respondent did not agree to the statement that HWT activities were not time consuming. While a batch of mangoes requires no more than ten minutes of dipping, to finish the total amount of mangoes for export takes a lot of time and effort considering the big volume and the capacity of existing tanks. Similarly, the usefulness or effectiveness of the HWT is affected by temperature and changing weather conditions. For instance, if it is raining when fruits are harvested, the temperature is reduced, but the duration for attaining the required temperature is prolonged which could affect fruit quality.

With regard to health issues, the KI had a mixed perception. Although he considered that HWT does not pose any health risks, he qualified that if the HWT facilities and equipment were not mechanized, risks were inevitable. He however, perceived HWT as environment friendly because water could be disposed easily, practices involved would not degrade the surrounding environment, and the facilities and equipment will not cause air or water pollution.

Labor and Cost Requirement

Water tanks powered by either electricity, liquefied petroleum gas (LPG), or kerosene are the only major facility needed for HWT. These are fabricated based on specifications required by the company. Two companies have two boiler-type tanks with a capacity of about 2 tons per dip, while the two others have capacity. Other materials needed are water, plastic crates and pallets for dipping and stacking.

Labor activities for HWT was the same for all companies that is, loading, unloading, layering, dipping and stacking. So far, the companies did not experience any labor difficulty problem. A HWT worker is paid an average of P282.50 per day. Taking the case of Premium Fruits, they pay a total of P10,080.00 a day equivalent to P604,800.00 for 36 laborers working 3 shifts of 8 hours during peak months. One key informant on the other hand, said that on a per kilogram basis, they pay a labor cost of P0.10-0.20 per kg of mango for both peak and off-peak season.

The operational costs on electricity and water cannot be ascertained as all of the KI professed that such were lumped with the total consumption of the whole company. Two companies provided an estimate of electricity and water consumption on a per day basis, while the other two had computed power and water consumption on a per kilogram basis. The estimated details are presented in Table 3.

Table 3. HWT operational cost of four corporations in Manila (Philippines)

Particular	Valley of Hope[a]	Premium Fruits[b]	Everlasting Foods[c]	Mabuhay [d]
HWT Tank	P 48,000	P 195,000	P 100,000	P 30,000
Crate	4,000	720,000	1,600,000	625,000
Electricity/fuel	62,400	202,107	1,368,000	1,024,000
Water	4,000	8,712	750,000	768,000

Basis of computation
a : tank = 1unit; crate = 10pcs @ P400/ea; LPG/fuel = P1300/tank/3days; water = P100/operation, H_2O change after 3days
b : tank = 3units; crate = 4000pcs @ P180/ea; electricity =P1403.52/dayx24daysx5mo; water =P72.60/dayx24daysx5mo
c : tank = 1unit; crate = 7000pcs @ P200/ea; electricity =P0.20/kg of mangox50t/dayx24daysx5mo
d : tank = 1unit; crate = 2500pcs @ P250/ea; electricity = P0.20/kg of mango @ 50000kg/mo; water = P0.15/kg of mango

4. CONCLUSION

Gleaning from the above findings, the following conclusions can be drawn:

1. The HWT technology has been used by export and processing corporations since the beginning of their mango operation. This was in response to export requirement imposed specifically by Japanese importers.

2. HWT is so far, the most effective quarantine procedure in preventing anthracnose and stem-end rot on harvested mangoes
3. As a technology, HWT is technically feasible owing to its attributes of being relatively advantageous, trialability, compatibility, ease of application and health and environmental friendliness
4. HWT reduced anthracnose and stem-end rot incidence by 10 percent resulting in almost a hundred percent recovery rate which leads to increased sales volume and income
5. Although proven effective against anthracnose and stem-end rot, the applicability of the technology is limited mainly to exporters and processors. This is because such diseases do not normally show up while in the farmer's field until the fruits are harvested and in the hands of mango exporters and processors. Although it can also be used by farmers' cooperative, it is only in terms of providing HWT as a service facility in the field level.

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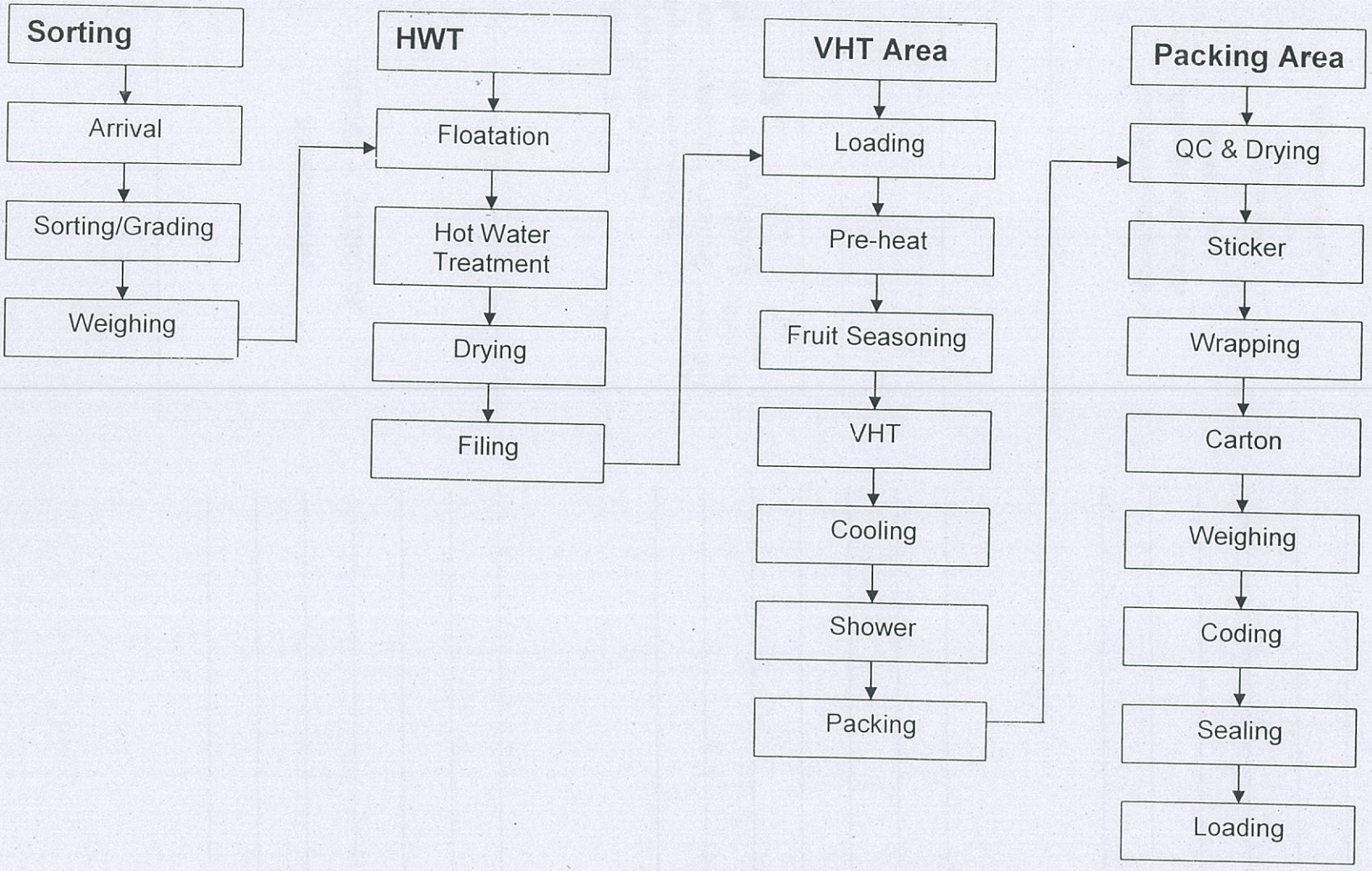

Figure 2. HWT and VHT Process Flow Chart (adopted from Everlasting Foods Corporation)