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Qualitative Post-harvest Losses in Mango (*Mangifera indica* L.)

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ABSTRACT. *A post-harvest loss of 20-30% of mango is observed in Sri Lanka. As there is a limited production of fruits, methods to reduce post-harvest losses are imperative. An experiment was done with the objectives of reducing the qualitative post-harvest losses and increasing the storability of mango. Fruits treated with 1000 ppm Benomyl (50% w/w) at 52-55 C for 5 minutes and subsequently packed in 150 gauge sealed polythene bags maintained quality up to a period of 11-14 days.*

Under these storage conditions comparatively lower incidence of Diploidia end rot disease was observed. The losses due to anthracnose were minimal. Higher acceptability based on satisfactory qualitative characteristics were maintained. Higher Brix value and titratable acidity were also observed under the above conditions.

INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae and is known to be one of the most popular fruits in the tropics. It is a good source of vitamin A (Beta carotene) and rich in vitamin C as well. However, the market prices of fruits are not affordable to most consumers. High prices are the consequence of inadequate availability of fruits resulting from low production and high post-harvest losses.

Furthermore, tropical climatic conditions of Sri Lanka are more conducive for growth and survival of disease causing micro-organisms. Twenty to thirty percent of the harvest losses are reported to be due to infections caused by pathogenic fungi (Singh, 1960).

Therefore, it is important to avoid or reduce such losses for growers to increase their profits and consumers to be able to buy fruits at affordable

prices. Moreover, the reduction of post-harvest losses will enable export of fresh fruit.

A study was carried out on mango to investigate the post-harvest physiology of mango, with the objectives of,

1. evaluating the major post-harvest qualitative changes of mango fruit; and

2. increasing the storability of mango fruits.

MATERIALS AND METHODS

Treatments

The experiment was carried out at the Peradeniya University Experimental Station at Dodangolla. The fruits (mature, healthy, unripe fruits-cv. Veleicolomban-at colour break stage and hand harvested) were randomly assigned to the following 4 treatments.

a) Dipping in hot water at 52-55 C for 10 minutes, (packed)

b) Dipping in benomyl (1000 ppm wettable powder at 52-55 C for 5 minutes, (packed)

c) Untreated, (packed)

d) Control (untreated, unpacked)

Following the dip treatment, the fruits were allowed to air dry in shade for 25-30 minutes. Nine fruits per sub-sample were randomly selected and each sub-sample was packed in a 150 gauge sealed polythene bag (35 x 45 cm) containing 6 bags (sub-samples) per treatment per block. These were stored immediately under the following conditions.

i) 20 C temperature and 50-55% relative humidity, (in an air conditioned chamber).

ii) Ambient temperature (26 C) and relative humidity of 63-75%.

The eight treatments were arranged in a factorial arrangement in a randomized complete block design, consisting of three blocks.

Sensory observations

Each sub-sample of 9 fruits per treatment was periodically assessed for the following qualitative parameters for 22 days at 5 sampling intervals ranging from 3-6 days.

Qualitative parameters

The assessments comprised of separate subjective ratings of acceptability, flavour of flesh, incidence of anthracnose and stem end rot. Assessment scale of qualitative parameters for mango fruits is given below.

Assessment scale

Parameter	Rating			
	0	1	2	3
Acceptability	-	poor	moderate	high
Eating quality	-	poor	moderate	high
Disease severity	nil	slight	moderate	high

Quantitative parameters

Juice from a sub-sample of 9 fruits was obtained by squashing the whole fruit mesocarp after removal from the fruit and filtering through a nylon cloth (0.5 x 0.5 mm). The percentage total soluble solids (brix value) and the titratable acidity of juice samples were measured. The brix value was directly measured using a hand refractometer. For determination of titratable acidity, 1 ml of juice extract was diluted in 10 ml distilled water, titrated with 0.1 N NaOH (using phenolpthaline as the indicator) to an end

point colour change from orange to salmon pink. Percentage titratable acidity was calculated using AOAC (1984) method.

Statistical analysis

Quantitative variables

The variables brix value and percentage acidity were subjected to ANOVA. As some treatments had to be discarded in ambient temperature storage on extending the storage period, PROC GLM in the Statistical Analysis System (SAS) was performed.

Qualitative variables

A score was calculated using the following equation, for each of the qualitative variable.

$$\text{Score} = nr^1 + nr_2 + nr_3$$

where,

n = number of fruits per each respective rating

$r1$, r_2 and r_3 = respective ratings

RESULTS AND DISCUSSION

Severity of fruit rot

Fruit rot appeared initially as small, dark brown circular spots that later enlarged and coalesced to form bigger and sunken lesions, black in colour. On isolation, the pathogen was identified as *Colletotrichum* spp. by the colony characteristics and conidia shapes (Barnett and Hunter, 1972). On re-isolation of the organism from these rotted portions, the identity was confirmed.

The interaction effects of dip treatments x storage temperature were found to be non-significant ($p=0.05$) at 5,11 and 14 days of storage, but significant at 19 and 222 days of storage. After 14 days fruits became

inedible due to rotting. The main effects of dip treatments and storage temperature were shown significance (p=0.05) in all 5 days of storage.

Out of two dip treatments benomyl (1000 mg/l) at 52-55 C for 5 min. and storage at 20 C recorded the minimum occurrence of the disease. Whereas fruits dipped in water at 52-55 C for 10 min. and hot benlate had more or less similar incidence of disease, showing the incapability of control in the disease at ambient temperature (Figure 1).

Passam (1982) reported that hot water treatment alone reduced fruit rot of mango *cv* Alponso. In highly susceptible cultivars such as Dooth and Rose, a fungicide such as benomyl was also incorporated to control fruit rot. The results of this experiment are consistent with the findings of Passam (1982). The *Colletotrichum* disease incidence of variety *Veleicolomban* cannot be controlled by hot water treatment alone. However, incorporation of 1000 ppm benomyl into hot water could control fruit rot caused by the *Colletotrichum* fungi successfully.

Severity of Stem-end-rot of fruits

Disease is first observed at the stem end of fruit as irregular brown lesions. Later, these lesions turned black and had a water soaked appearance. When the stem end rot organism was isolated, the conidia was identified as *Diploida* spp. according to colony and spore characteristics given by Barnett and Hunter (1972).

On re-isolation the identify was confirmed. Either dipping or combination of dipping and high temperature treatment did not cause any significant difference in the severity of stem end rot incidence. The main effects of two storage temperatures were found to be significant (p=0.05) at all storage intervals.

There was a clear difference between the dip treated fruits stored at 20 C and those stored at ambient temperature. Dip treatment did not control the disease but fruits stored at low temperature showed reduced disease incidence (Figure 2).

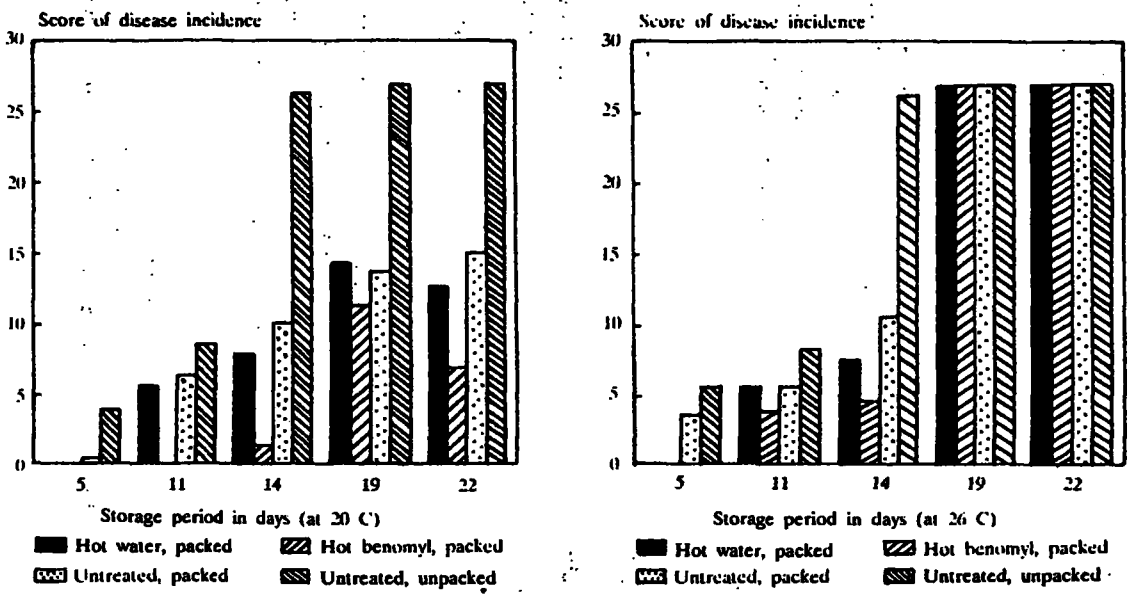

Figure 1. Effect of different treatments on severity of *Oolletotrionum* disease incidence of mango fruit stored at 20 C and 26 C.

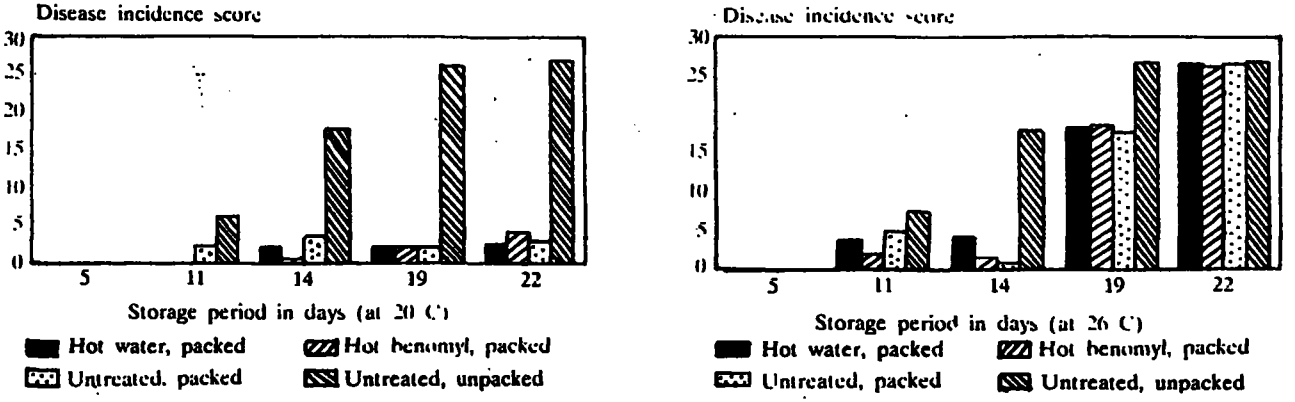

Figure 2. Effect of different treatments on severity of stem end rot disease incidence of mango fruits stored at 20 C and 26 C.

Percentage total soluble solids (brix value) and titratable acidity of fruit juice.

The interaction effects of dipping and storage temperature did not show significant difference ($p=0.05$) in Total Soluble Solids (TSS) on sampling day 5-14. Dip treatment and storage interval have shown significant effect ($p=0.05$) at 5 C and 11 days of storage.

With increased storage time, an increase in TSS and a decrease in titratable acidity (TA) of extractable juice were observed in fruits treated by dipping in heated fungicide and packing in sealed polythene. However, fruits dipped in hot benomyl (packed) had shown a significantly higher increase of TSS value than those of untreated, packed stored at low temperature at 11th and 14th days ($p=0.05$).

It indicates that heated benomyl increased the ripening, resulting in a higher value of TSS at cool storage, due to the metabolization of carbohydrates into soluble sugars. Rappel *et al.*, (1986) revealed that benomyl accelerates ripening of mango fruits treated with 1g/l than that of fruits treated 2g/l at a temperature of 52-55 C. The results of the current experiment are consistent with their findings.

The change in the percentage of total soluble solids and the titratable acidity showed similar patterns (Figures 3 and 4). The total acidity decreased with ripening. The decrease in acidity was highest in untreated (control) fruits at both temperatures. However, the interaction between dip treatment and storage temperature was found to be significant ($p=0.05$) throughout storage.

Generally, destruction of acids occurs due to metabolization of organic acids, while at the same time di-and tri-carboxylic acids are utilized in operation of the Kreb's cycle in the process of respiration (Biale *et al.*, 1954). Yuniarti (1980) has also shown the increase in total solids and decrease in titratable acidity during fruit ripening.

Degree of flavour of flesh

No significant difference ($p=0.05$) was observed in flavour score of fruits stored at the two temperatures. Similarly the interaction did not show significant difference on any sampling day.

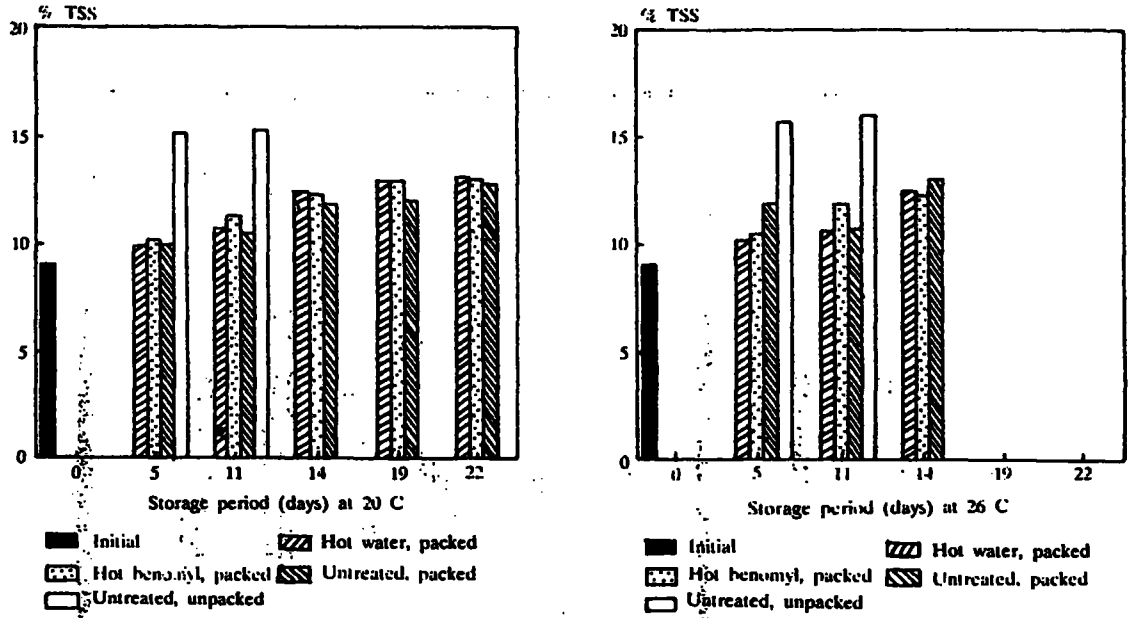

Figure 3. Effect of different treatments on total soluble solids of juice extracted from mango fruits stored at 20 C and 26 C.

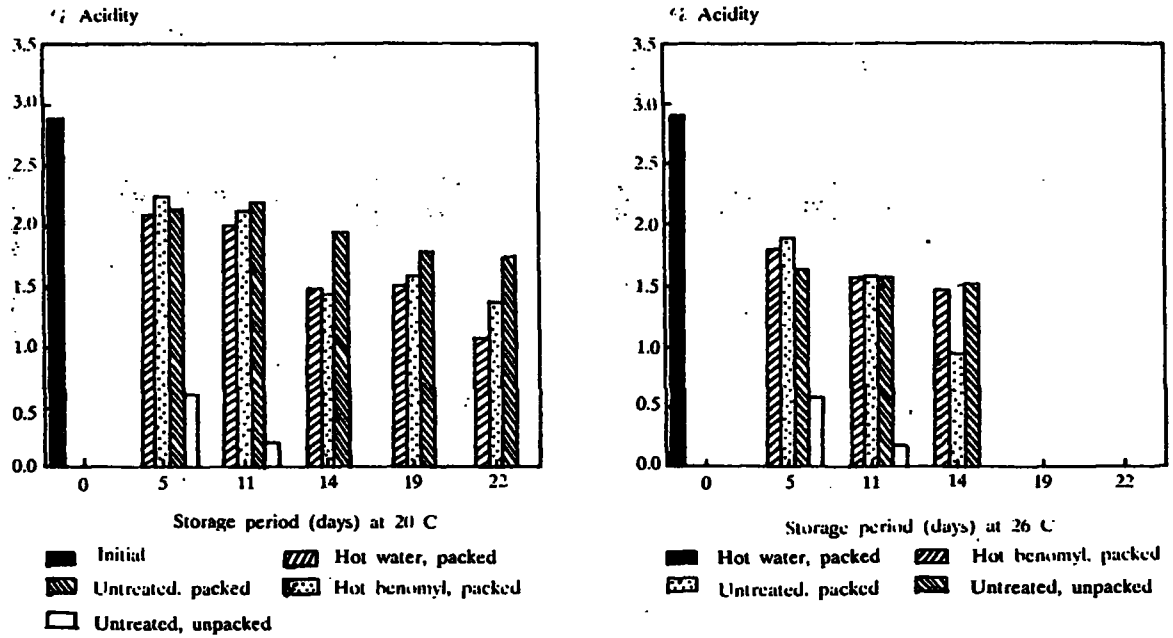

Figure 4. Effect of different treatments on titratable acidity of juice extracted from mango fruits stored at 20 C and 26 C.

Untreated (uncovered) fruits have scored a significantly (p=0.05) high degree of flavouring than that of treated fruits on 11th day. However, no significant difference (p=0.05) in flavour score between the untreated (uncovered) and hot benomyl dipped fruits was observed on the 14th day at cool temperature (Figure 5). It indicates that flavour was not dependent on benomyl dip treatment.

Rappel *et al.*, (1986) also reported that flavour is not affected by benomyl treatment (1-2g/l at 30-55 C).

Acceptability of fruits

Fruits treated with hot benomyl, sealed in polythene and stored at 20 C were the most acceptable (p=0.05). This treatment has recorded the minimum susceptibility to *Colletotrichum*, stem end rot and no shrinkage of fruit rind over the other treatments, hence it possessed the highest acceptability (Figure 6).

This was followed by the hot water treatment which maintained a fairly high acceptability at 20 C storage temperature, but lesser degree of flavour than in hot benomyl treatment. Vulnerability to disease was only less than that of the hot benomyl treatment (Figure 1) and it was not susceptible to shirinkage.

Either benlate or sealed packing and storing at low temperature alone has not contributed to advanced storability. A combination of all factors was essential in order to maintain the storability.

CONCLUSION

Fruits treated with heated benomyl, packed in sealed polythene containers and stored at low temperature (20 C) were showed minimum infection, no shrinkage of rind and better maintenance of brix, titratable acidity. They also fetched a higher score for acceptability.

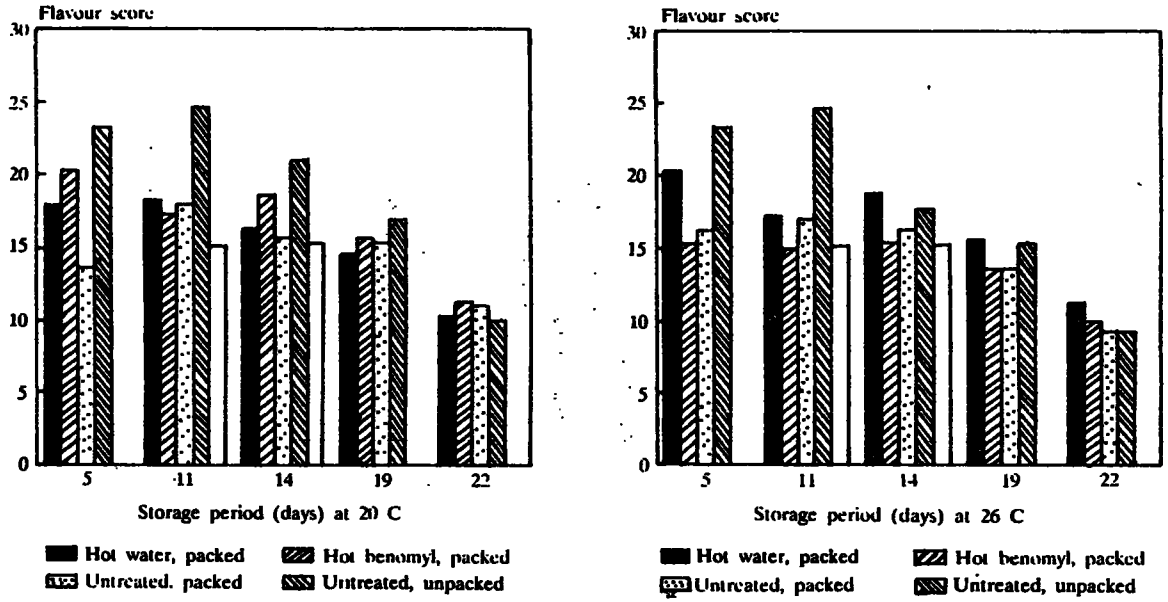

Figure 5. Effect of different treatments on degree of flavour of flesh of mango fruits stored at 20 C and 26 C.

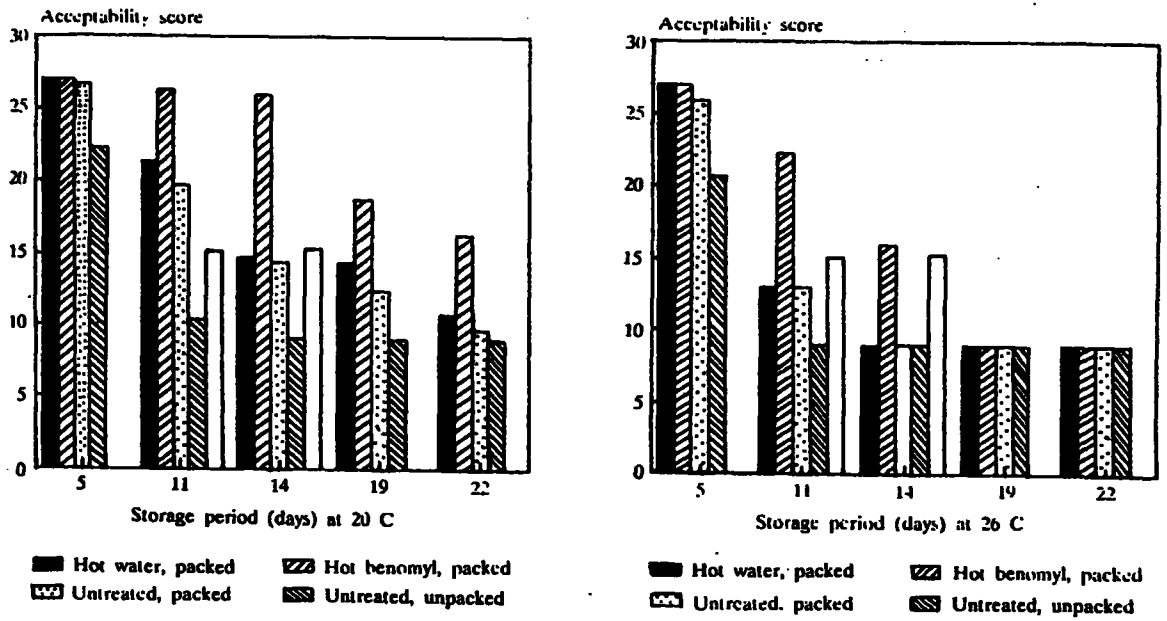

Figure 6. Effect of different treatments on degree of acceptability of mango fruits stored at 20 C and 26 C.

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