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Shelf-Life of Mango (Mangifera indica L.) as Infulenced by Different Rates of Hot Water and Dipping Duration at Wolaita Sodo, Southern Ethiopia

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Abstract
A laboratory experiment was conducted at wolaita Sodo University, horticulture laboratory during the 2013/2014 season, to evaluate the effects of hot water treatment on shelf life of mango. Treatments consists a combination of hot water at 50°c for five minutes, hot water at 50°c for ten minutes, hot water at 52°c for five minutes, hot water at 52°c for ten minutes and a control (washing with tap water only) laid out in Completely Randomized Design replicated three times. The mango variety known as Kent was used as a test crop. Results revealed that significant differences in peel color intensity when mango is treated at different hot water. It should be noted that mango treated at 52^{0}c for 10 minutes remained on the way break green color during the 3 days of storage. The longest shelf life extended up to 13 days under treatment hot water at 52^{0}c for 10 minutes. Weight loss of mango during a period of 12 days, showed that significant difference. The control showed the maximum weight loss but treatments (Hot water at 52^{0}c for 10 minute, hot water at 52^{0}c for 5 minutes and hot water at 52^{0}c for 10 minute) does not showed as such significant variations

INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the family *Anacardiaceae*. It is one of the oldest tropical fruits and has been cultivated over 4000 years, originated in the Indo-Burma region (Mendoza and Wills, 1984). Growing and marketing of fresh produce in Ethiopia are complicated by post-harvest losses in quantity and quality between harvest and consumption. In Ethiopia, postharvest losses of same horticultural commodities in state farm and peasant sectors are estimated to be 25-35% caused by a combination of several factors (Fekadu, 1991). This high loss was attributed party to lack of packaging, storage facilities, poor means of transportation and handing. Several mango postharvest techniques have been developed for controlling disease and insets and for protection against injury during packaging and storage (pinto *et al*., 2004). Many physical and chemical treatments have been used for control of postharvest losses in mango (Johnson *et al*., 1997). Therefore it is necessary to make prepackaging disinfection treatments. Particularly the use of hot water treatments have number of advantages which include short treatment time, reliable and accurate monitoring of fruit temperature with the benefits of killing surface decay organism and cleaning the fruit of plant exudates (Sharp,1994). Another important advance of hot water treatment system approximately 10% that of a commercial vapor heat temperature (VHT) system (Jordan, 1993). A few chemicals such as chlorine and sulphurdioxide are considered to be true fungicide (Johnson *et al*., 1997). For several reasons such as the availability of chlorinated solution and cost, chlorine disinfections seem to be more suitable to developing countries (Tilahun, 2002). Besides to chlorinated solution hot water treatments has also a tremendous impact for the increment of the shelf life of fruits due to fruit surface pathogens and insect avoidance. In spite of the importance of mango in diet and economy subsistent farmers and country level less attention has been given to the management of its postharvest losses in Ethiopia. There is a need to develop afordable postharvest treatments that minimize the postharvest losses of the commodity. Therefore evaluating the effect of hot water treatment on shelf life of mango was the objective of this paper

MATERIALS AND METHODS

Description of the Experimental site

Laboratory experiments were conducted at wolaita zone, southern Ethiopia. It is located at 6^{0}49'N and 37^{0}45' E and lies on an altitude of 1483 meters above sea level. The annual average temperature of the zone is 20°c and the mean annual rainfall ranges from 1200 to 1300mm. the rainfall has a bi-modal distribution pattern with small rains from March to May and long and heavy rains from June to September. The zone covers an area of 44,721km^2 and found in the altitude range of 1500-2100 masl. (Hailu *et al*., 2011).

Treatments and Experimental Design

A five prepackaging disinfection treatments with three replications were used in the study. The treatments were arranged in a complete randomized design (CRD). The disinfection treatments consisted of: hot water at 50°c for five minutes, hot water at 50°c for ten minutes, hot water at 52°c for five minutes, hot water at 52°c for ten minutes and a control (washing with tap water only). The temperature of the water in each experimental unit is monitored and adjusted during the treatment using thermometer. An experiment was laid out in completely randomized design (CRD) with three replications and five treatment (3*5=15) 15 treatment combinations, five

fruits in each container, 15 containers (Plastic bugs) were used for the three replications, 25 fruits in each Block and totally 75 local mango fruits were required for the study. The fruits were uniform shape, size, and free of any visible defects, disease symptoms and insect infestations.

Experimental Procedures

On the way to break the green color of Kent mango fruits were obtained from Sodo town, Sodo Zuria woreda of southern region. Maturity of fruits were determined with the aid of uniform unblemished fruits having similar size and color are then selected and by using glove and hand washed with tap water to remove field heat, soil particles, and to reduce microbial populations on the surfaces. After washing, the fruits were subdivided in to 3 groups for dipping treatments. Plastic containers were washed and rinsed with distilled water prior to use for the dipping treatments. After surface drying of the washed fruits, prepackaging disinfecting treatments were performed on the same day. All treatments were carried out in Horticulture laboratory.

Data collected

- Shelf Life (day)

Shelf life is one of the important quality parameters of mango. Shelf life of mango fruit was a period of time which started from harvesting and extends up to the start of rotting of fruits (Bevery, R. B. *et al*., 1992). Shelf life of mango fruits were calculated by counting optimum marketing and eating qualities.

- Peel Color Change

Days required to reach different stages of color during storage and ripening were determined objectively using numerical rating scale of 1-3 where 1= represents on the way to break green color, 2=50% yellow and 50% on the way to break green color, and 3=100% yellow (Miller and McDonald, 1991).

- Weight loss (WL)

Weight loss (WL) was determined by periodical weighing of fruits an interval of three days for a period of 13 days storage. The weight loss percentage was calculated by using the methods described by Amayogi and Alloli, 2007. The percentage weight loss was calculated for each sampling interval using the formula given bellow and the cumulative WL is expressed as percentage for the respective treatments.

$$WL\ (\%) = \frac{IW-FW}{IW} * 100,$$

Where: IW = Initial Weight
FW = Final Weight

Data Analysis

The data collected were subjected to Analysis of variance (ANOVA) for Completely Randomized Design (CRD) with three replications and five treatments. The Significance differences between and among treatments were determined by using LSD (Least significant difference) at 5% probability level of significance.

RESULT AND DISCUSSTION

Shelf life (day)

The shelf life of mango were significantly ($P < 0.05$) influenced by hot water treatments. Form the treatments hot water at 52^0 for 10 minutes showed the maximum shelf life (10days). Whereas the control (tap water) treatment showed the lowest shelf life (6 days). This was may be due to the reason that when perishable fruits were treated with hot water at 54^0c +/- 1^0c for five minutes can be used to regulate kipping and control postharvest microbial spoilage (Lakshiminaryana *et al*, 1974). This idea in the present work is in agreement with previous reports. The only difference was dipping duration.In this manner, the shelf life of mango fruits was extended. This is attributed to delay ripening in the keeping of fruits due to the retardation of various physic-chemical changes accompanying keeping and maintenance of quality over the storage period. The fruits treated at 52^0c for 10 minutes displayed shelf lives of 10 days, but the controls were started to die after day 6.

Peel color change (scale) on day

Peel color change was significantly ($P< 0.05$) affected by treatments. When Mango is treated by hot water at 50^0c for 5 minutes, 50^0c for 10 minutes, 52^0c for 5 minutes, $52^0$for 10 minutes and tape water (control) it was noted that mangoes treated at 52^0 for 10 minutes remained on the way break green color up to 3 days. By the end of 9 days, except mangoes treated at 52^0 for 10 minutes all other groups showed a bright yellow color. Influence of postharvest treatments on the color development indicated significant differences ($P<0.05$) between the treatments at 3, 6 and 9 days (table 2). Among the treatments, hot water at 52^0c for 10 minutes has significantly delayed the color development. However, among groups of this treatment, there was fast rate of color development observed after 6 days. Finally, at the end of 11 days almost all fruits were changed to complete yellow color.

Weight loss (gm)

Significant difference at (P< 0.05) in weight loss of mango fruits was observed between the treatments up to 9 days only; after that, there was no significant difference among treatments (table 3). This may be the perishability of the produce due to high water content lead to water loss (transpiration). On day 12, nearly all mango fruits were unmarketable while those groups treated act 52^0c for 10 minutes were left. But this difference is not as much significant as hot water at 52^oc for 10 minutes.

Table 1 Effects of different hot water treatments on shelf life of mango.

Treatments	Shelf life (day)
Hot water at 52^0 c for ten minutes	10.13a
Hot water at 52^0c for five minutes	8.6 b
Hot water at 50^0c for ten minutes	8.2 b
Hot water at 50^0c for five minutes	7.9 b
Tap water (control)	6.0c
F test	*
LSD	0.98838
CV (%)	9.6

Means followed by the same letter within a column are not significantly different at 5% level of significance; Ns = non significant; *, ** = significant at 5% and 1% levels of significance, respectively; LSD = least significant difference at 5% level of significance; CV = Coefficient of variation

Table 2. Effect of different hot water treatments on peel color change of mango during period of 12 days.

Treatments	Peel dolor (scales) on day
Tap water (control)	2.9478 a
Hot water at 50^0c five minutes	2.682 b
Hot water at 50^0c for 10 minutes	2.5185 c
Hot water at 52^0c for 5 minutes	2.3185cd
Hot water at 52^0c for 10 minutes	2.0815 d
F- test	*
LSD	0.2235
CV (%)	6.9

Means followed by the same letter within a column are not significantly different at 5% level of significance; Ns = non significant; *, ** = significant at 5% and 1% levels of significance, respectively; LSD = least significant difference at 5% level of significance; CV = Coefficient of variation

Table 3. Effect of different hot water treatments on weight loss of mango during period of 12 days.

Treatments	Weight loss (WL) (gm) on days
Tap water (control)	2.20251 a
Hot water at 50^0c for 5 minute	1.69706 b
Hot water at 50^0c for 10 minute	1.38168 c
Hot water at 52^0c for 5 minute	1.37718c
Hot water at 52^0c for 10 minute	1.2980 c
F-test	*
LSD	0.27703
CV %	13.5

Means followed by the same letter within a column are not significantly different at 5% level of significance; Ns = non significant; *, ** = significant at 5% and 1% levels of significance, respectively; LSD = least significant difference at 5% level of significance; CV = Coefficient of variation

Conclusion

The hot water at 52^0c for 10 minute is better to extend the shelf life, to delay the peel color change and to reduce the weight loss of Kent mango fruits. But this is not the end result; therefore further testing with different mango varieties and different dipping duration is required to get the best understanding on the effects of hot water treatment on the shelf life of mango.

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