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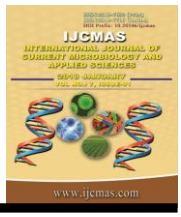

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Efficacy of BiOWiSH™ Washing Treatment for Extending Shelf-Life of Mango

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A B S T R A C T

Mango is widely sprayed fruit crop in tropical region of the world. Mango fruit production is seasonal in nature, it results surplus fruit production in the harvesting season. Accordingly, high post-harvest losses have been occurred during season. Therefore, about 25% - 40% of post-production losses of mango can be observed specially in developing countries. These losses are mainly occurred during post-harvest operations such as harvesting, packing, storage and transportation. As well as product hygiene is very important in order to extend its shelf-life and prevent post-harvest disease spreading. Washing of fruit after harvesting is one of the main important post-harvest practices which directly affected to improve hygienic condition and shelf-life of product. However, generally most farmers are not washing their fruits after harvesting. Hence, this study was conducted to evaluate the efficacy of washing treatment consist of BiOWiSH™ (BW) washing powder for mango fruits in order to extend their shelf life and hygienic condition. Washing treated mangoes were compared with existing non-washed mangoes by weight loss percentage, visual quality rating (VQR), firmness, total soluble solids (TSS), pH change and colour change to evaluate efficacy of BW washing treatment. BW washing treatment has been shown significant effect to improve visual quality rating (VQR) of mango. However, BW washing treatment was not significant for altering weight loss percentage, firmness, total soluble solids (TSS), pH and colour of mango fruits.

Introduction

Mango is widely sprayed fruit crop in tropical region of the world. The world largest mango producer is an India. The top 5 largest tomato producing countries are India, China, Thailand, Indonesia and Mexico. They account for 69% of global mango production (www.worldatlas.com). Total mango production in India in year 2013 was 18 million tons. Mango is also one of major fruit crop in Sri Lanka. Many type of indigenous and improved mango varieties can be observed in local market in Sri Lanka. About 30% - 40% of post-production losses of these fruits and vegetables are observed specially in developing countries. These losses occur mainly during harvesting and post-harvest operations such as handling, packing, storage, transportation, and marketing (Ryall and Lipton, 1972). After harvesting mango fruit starts deterioration mainly due to high

respiration because of high water content and perishable in nature. In addition, stored environment condition caused to increase postharvest diseases and reduce shelf life. Shelf life of the mango fruit can be increased providing suitable low temperature (15^{o}C) and increasing product hygiene (Anon, 1986). Generally, mango latex can be easily spread on fruits skin during harvesting, that act as media for microbial growth such as fungus. Cleaning and washing are very important practices to remove latex from mango fruits in order to improve the hygienic condition of product. That has greatly affected to improve post-harvest life of mango. Local mango farmers sell their product without any washing practices. Soaking and rinsing or spray washing are generally followed washing methods of fruits and vegetables. Proper sanitation of the washing water is essential to maintain to prevent spread of diseases and inoculums build up in the wash water. The most commonly used sanitizer to wash fruits and vegetable is chlorine (100-150 ppm) solution. BiOWiSH™ (BW) is a powdered product introduced for washing fruits and vegetables as a sanitizer. BW producer has shown BW is a powerful composite biocatalyst that breaks down complex organic molecules, eliminating waste and odours, increases storage life by maintaining the freshness, and reduces harmful chemicals used for washing. Hence, this research study was conducted to identify the efficacy of BW solution to extend the shelf–life of mango in comparison to non-washing mango

Materials and Methods

Experiment was conducted at Institute of Post-Harvest Technology, Sri Lanka. Mango variety call "Karathakolomban" harvested at correct stage of maturity were used for this experiment. Washing solution was prepared by 5g of BW powder in one litre of water. Experimental mango sample (1000g) was dipped 10min in this solution washed and remove excess solution viper out by assonant tissue paper. As a control, same amount of mango samples were kept without any washing. These samples were placed at laboratory in room temperature with proper ventilation. Weight loss percentage, visual quality rating (VQR), firmness change, total soluble solids (TSS) change, pH change and colour change were analysed by adopting following procedures and instruments. These parameters were used for determination of extension in shelf-life of mango. All experiments were replicated three times.

Analysis of weight loss percentage

The physiological weight loss of mango was determined using formula 2.1. Weight of the mango samples (treated and untreated) was measured at regular 2 days intervals for 7 days (experimental duration).

$$\text{Weight loss \%} = \frac{\text{Final weight of the sample}}{\text{Initial weight of the sample}} \times 100 \quad \text{- Formula 2.1}$$

Visual Quality Rating (Visual quality changers) (VQR)

Visual Quality Rating (VQR) was determined by observations of mango samples at regular 2 days interval for nine days. Individual mango fruits in sample were evaluated and rated using table 1.

Firmness change

The firmness of mango was measured by 2 days intervals for 7 days. Digital fruit firmness tester with a 4 mm cylindrical shape (flat end) probe (TR Model 53205) was used.

Total soluble solids (TSS) change

The total soluble solids (TSS) in fruit juice was recorded using a hand held refractometer

(ATAGO, model: HR-5) and reading was reported as percentage of brix. Procedure explain by Sultani *et al.,* (2010) was adopted to analysis TSS i.e. 10g piece was taken from samples and blended for one minute in 50 ml of distilled water and measured for TSS.

pH change

pH of experimental mango samples were measured in two days interval for 7 days using a digital pH meter.

Colour change

Outer peel colour of mango samples were measured 2 day regular intervals for 7 days using mini-scan XE plus Hunter Lab Colorimeter. L*, a*, b* values were determined. L*, a*, b* values were determined. *L** stood for lightness (back=0, white=100), *a** represented for greenness and redness (+*a**, redness; -*a**; greenness), *b** indicated blueness and yellowness (-*b**, blueness; +*b**, yellowness)

Statistical analysis

Experimental data was analysed by SAS® computer statistical package. Each treatment was replicated three times.

Analysis of Variance (ANOVA) on Complete Randomized Design (CRD) by General Liner Model (GLM) procedure was performed. Treatment mean were separated by Duncan Multiple Range Test.

Results and Discussion

Change of weight loss percentage of mango

Figure 1 shows the change of weight loss percentage of mango. Weight loss of tomato occurs mainly due to continuous evapotranspiration of moisture from fruits. Results clearly indicated that BW treatment was not significantly effected to change weight loss of mango in comparison to control. It indicates that BW treatment was unable to control water evaporation from mango.

Change of VQR of mango fruits

The visual quality of fresh mango is one of the most important factors for determination market value. VQR of mango samples were determined by trained panel. BW treated mangoes were not changed for until 5 days however, control sample start deteriorate from its first day.

After the 5thday BW treated samples start deteriorate as shown in figure 2. It was clear from the results that BW treatment has significant effect to improve visual quality of mango

Change of firmness of mango fruits

Figure 3 shows the firmness change of experimental mango samples. Results revealed that BW treatment were not significantly effected to alter its firmness.

Wills *et al.,* (1980) showed that firmness of fruits and vegetables was reduced with starting of repining process. The BW treated mango was not reported significantly effect in comparison to control (Table 2).

Change of TSS of mango fruits

Figure 4 shows change of Total Soluble Solids (TSS) of experimental samples. Ryall and Lipton (1972) indicate TSS is increased with ripening, if the ripening process was slow, TSS change was also slow. BW treated mango samples were not shown significant different in comparison to control samples for TSS change.

Table.1 Rating scale for overall Visual Quality of Produce (VQR)

Score	Degree of severity	Description
9	Excellent	Essentially no symptoms of deterioration
7	Good	Minor symptoms of deterioration, not objectionable
5	Fair	Deterioration evident, but not serious, limit of saleability
3	Poor	Serious deterioration, limit of usability
1	Extremely poor	Not usable

Table.2 Mean comparison between BW treatment and control

Treatment	Weight Loss%	VQR	Firmness	TSS	pH	Colour change		
						L	*a*	*b*
BW	17.125[a]	6.01[a]	5.16[a]	15.18[a]	6.81[a]	43.32[a]	-8.71[a]	39.81[a]
Control	17.013[a]	2.51[b]	4.81[a]	14.51[a]	6.19[a]	42.80[a]	-8.63[a]	39.69[a]

* Columns having same letter are not significantly difference at $\alpha = 0.05$ by DMRT

Fig.1 Change of weight loss percentage of mango during experiment

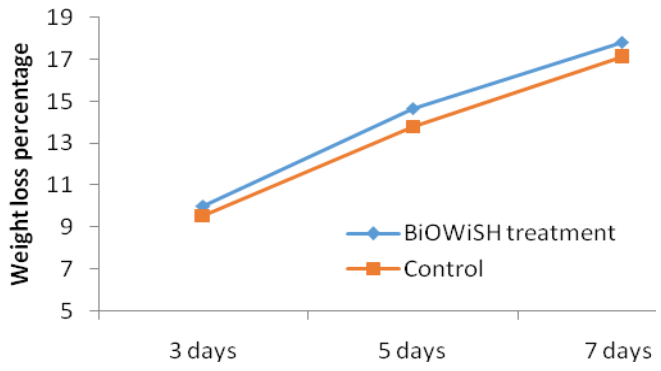


Fig.2 Change of VQR of mango in experimental samples

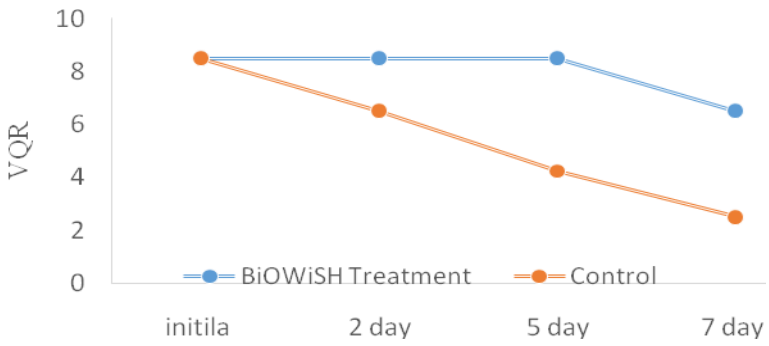


Fig.3 Change of firmness of mango in experimental samples

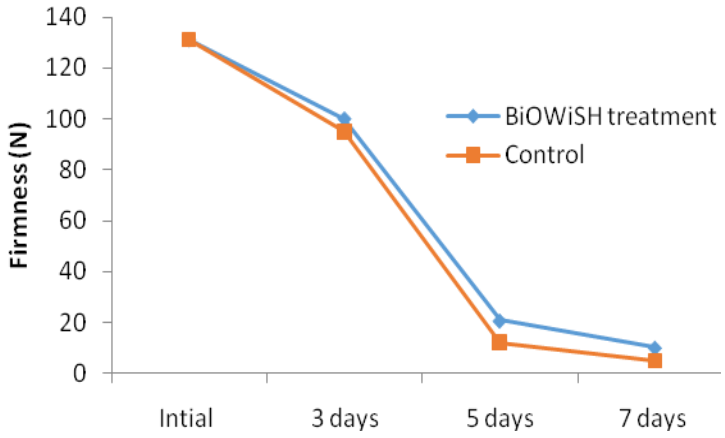


Fig.4 Change of TSS of mango in experimental samples

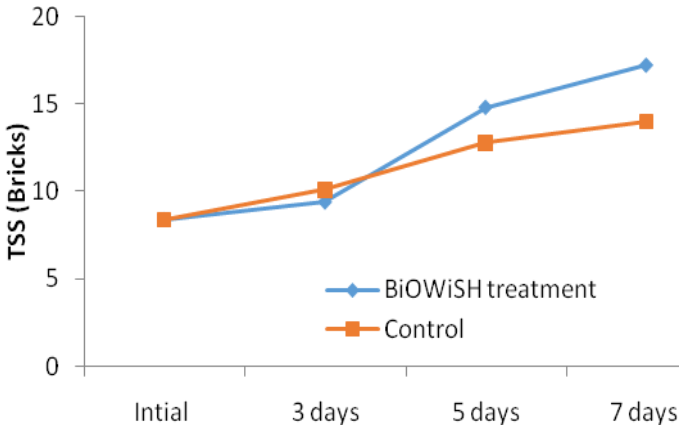
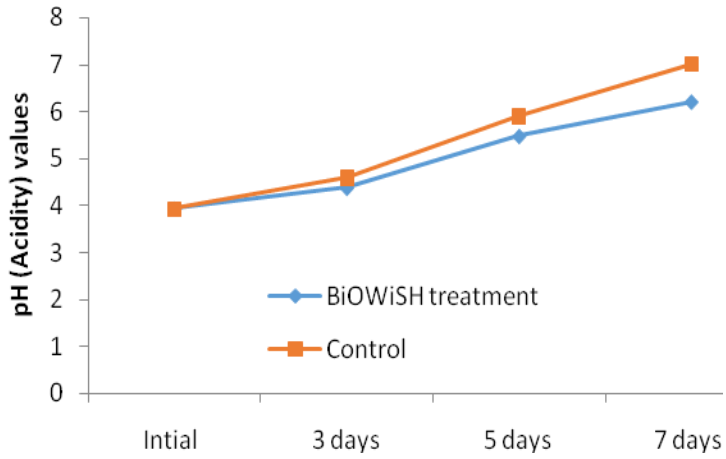


Fig.5 Change of pH of mango in experimental samples



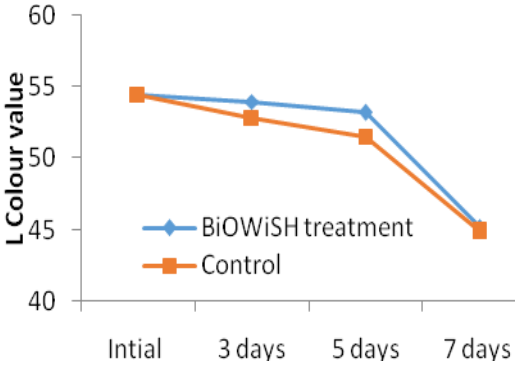


Fig.6 Change of L colour value

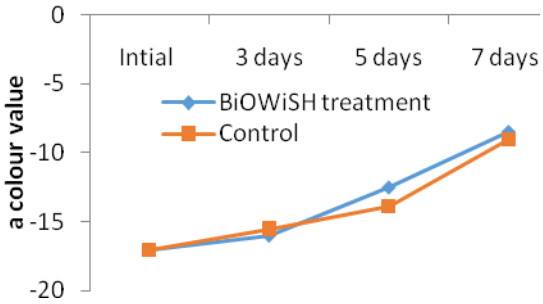


Fig.7 Change of a colour value

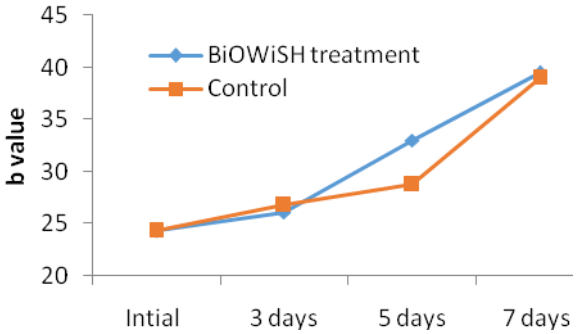


Fig.8 Change of b colour value

Change of acidity (pH) of mango fruits

Figure 5 shows change of acidity (pH) experimental samples. pH of fruits changes with maturity (Wills *et al.*, 1980). Mangos were slight low pH in initially however slight increase in acidic range can be observed with time of storage. Although BW treated samples were shown slight decrease in first two days, after that it was increased high rate than control sample. Hence, results revealed that BW treatment had not shown special effect to control pH level of the fruits.

Change of colour (L* a* b* values) of mango sample

Figures 6, 7 and 8 show colour change of the experimental samples with time. It was clear that colour change of BW treated mango were not shown significant difference comparison to control treatment. Hence it can be concluded that BW treatment was not affected to colour change of mango fruits

Table 1 is shown the results of the mean comparison by Duncan Multiple Range Test (DMRT) for weight loss percentage, VQR, firmness, total soluble solids (TSS), pH and colour values obtain in 7^{th} day.

It was clear from the results that BW treatment had shown significant affect only for improving VQR (visual quality) of mango. Other parameters were not showed any significant affect. BW treatment were not effective to alter the parameters negotiated mango shelf-life i.e. weight loss percentage, firmness change, total soluble solids (TSS)change, pH change and colour change in comparison to control treatment (existing method). However, visual quality and hygienic condition of mango can be improved by washing treatment. Based on the overall

discussion made over, it can be concluded that BW treatment was significantly improve visual quality due to its ability to control microbiological contamination and spreading. However BW washing treatment were not effective to alter weight loss percentage, firmness, total soluble solids (TSS), pH and colour of mango fruits.Finally it can be determined that BW treatment had not showed any significant affect for improving shelf-life of mango fruit.

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