

Application Of Hot Water And Temperature Treatments To Improve Quality Of Keitt And Nam Doc Mai Mango Fruits.

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ABSTRACT: Hot water dipping (HWD) at a range of treated temperatures at 50°C /11ms and stored at temperatures of 7°C and 25°C were applied to keitt mango and Nam doc mai mango fruits after harvest and some were also left on control without hot water dipping. During the storage both treated and untreated fruits were stored at 7°C and 25 °C. The quality characteristics such as surface colour changes, weight loss, firmness and sensory evaluation were investigated for a storage period of Ten (10) days. Regarding the effect of storage temperatures on the changes in fruit weight loss, the data of both varieties indicated less weight loss in 7°C and high weight loss in room temperature of 25°C, leading to significance difference in fruits weight loss between the two temperatures. Loss in fruit firmness was also high in temperatures of 25°C compared to 7°C in both varieties but Nam doc mai variety retained fruits firmness better than the Keitt fruits. Panelist after the organoleptic test scored high for sweetness (sugars content) for 25°C , and low for 7°C but in both conditions panelist rated Keitt mango fruits higher than the Nam doc mai mango fruits. Overall acceptance was high in fruits treated and stored at 25°C for both varieties. Generally in overall acceptance Keitt mango did better in both 25°C and 7°C in both treated and untreated fruits.

Key words: Hot water treatment, Temperature, Keitt, Nam do mai, Weight loss, Colour, Firmness, Overall quality.

Introduction

Mango (*Mangifera indica*) fruit is one of the most important food crops for the people living in the tropics. Based on the uses and economic value of the fruit the importance cannot be estimated. Over the years efforts have been made to maintain the quality and add value to freshly harvested food commodities, with chemical treatments which later pose health problems to consumers. It is among the widely consumed crops [4] and there are 150 cultivars of mangoes produced across the world [9]. But the majority of producers and players of the supply chain involved in handling usually encounter difficulties due to the perishable nature of the crop. Mango fruit which when harvested in the Upper West Region of Ghana are difficult to store, their rate of postharvest disease increases during storage as a result of physiological changes and senescence which induces other diseases. The poor quality of fruit affects the quality of juice produce from the fruit, as the production of these fruits increases in the Upper West Region of Ghana, there is the need to adopt appropriate preservation methods to improve the shelf life and ensure availability of the crop. Heat treatment on mango fruits has been widely applied as an appropriate disease control method since it is environmentally safe and non-chemical.

It was also found that dipping Mango fruits in hot water up to 55°C delayed ripening and controlled decay [3]. Hot water has earned firm and adoption at a large scale because of the high efficacy in reducing the postharvest disease as well as the low cost [5, 14]. [15] reported that the quality of 'Tommy Atkins' and Keitt Mangoes were not affected when fruits were treated with hot water at 46°C for 90 minutes and then stored for 3 days at 13°C and subsequently ripened at 24°C.

Materials and Methods

Mature fresh fruits of keitt and Nam doc mai Mango fruits were purchased from the farmer at Hamile in the Upper West Region of Ghana. Eighty (80) uniformly sized of mango fruits without any blemishes were randomly selected for this experiment. The entire sample were divided into four to represent the different treatments for the trial. Fruits were washed to remove dirt and allowed to naturally air dry. The experiment was carried out at the Wa Polytechnic Postharvest Laboratory, department of Agricultural Engineering. A Randomized Complete Block Design (RCBD) was applied. Using 2*2 factorial experiments, each treatment was replicated five (5) times. After washing, forty fruits were randomly selected to represent each variety. Treated fruits were dipped at a determined temperature of 50°C/ 11 minutes and then placed in cold water bath for 3 minutes. The pulp temperatures were taken for initial and last days of the trial. Each treatment was assessed on Firmness, Weight, and colour before storage. These fruits were stored at temperatures of 7°C/90 ± RH and 25°C/80± RH for the period of ten days before sensory evaluation were assessed. The readings were taken every 2 days up to 10 days, that is at 0, 2,4,6,8, and 10 days. The sensory assessment was done by a panel of 14 untrained judges using a 3 hedonic scale for sweetness and 9 hedonic scale for the overall acceptance designed purposely for this research. Data obtained were processed in relation to weight loss and averages for colour changes. However data obtained on firmness and sensory evaluation were transformed into their log forms to allow for the use of ANOVA. Data was analyzed using Minitab version 16. All

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data for quality evaluation were analyzed statistically by analysis of variance (ANOVA); using two factors ANOVA with replications and the means were compared at a significance level of $p \leq 0.05$.

Results

Colour changes of Keitt and Nam doc mai mangoes

The results obtained on mango fruits colour changes indicated that Keitt mango treated (KT) with hot water at 50°C /11ms and stored at 7°C produced same average colour value of 2 as Nam doc mai mango treated (NT) on day two of the storage period. However, the colour scored increased for Keitt mango fruits to 3 compared with 4 for Nam doc mai mango fruits on day Ten when the experiment was terminated (Fig.1). The results showed that for Keitt mango treated (KTA) with hot water at 50°C /11ms stored at ambient temperature at 25°C the lowest value of 4.5 was produced and Nam doc mai mango treated (NT) produced the highest with 5 on day Ten. Also, for control samples of the two varieties stored at 7°C , the highest colour of 4.8 was found with Keitt compared with an average value of 4 for Nam doc mai. The results indicated that for the two varieties stored at 25°C as control, an average of 6 was produced on day Ten when the experiment was terminated.

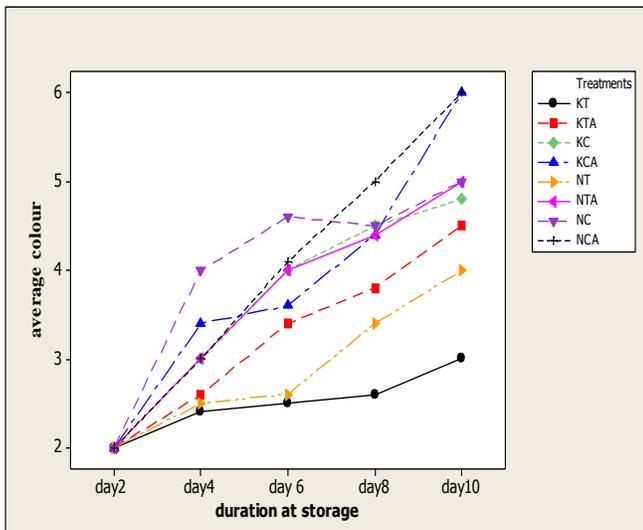


Fig 1: Colour changes of Keitt mango and Nam doc mai mango stored at 7°C and 25°C

Firmness

The results obtained were based on the destructive method with the use of analog penetrometer which was effective for individual variety test. The results obtained on mango fruits firmness of Keitt mango stored at 7°C showed that Keitt mango fruits treated with hot water at 50°C /11ms, produced an interesting pattern of firmness. An initial fruit firmness value of 5.5N , and 4.5N was recorded for Keitt mango fruits and 3.5N when the experiment was terminated. Nam doc mai mango fruits treated produced an initial firmness value of 5N , and 4.5N thereafter 2.8N at the end of experiment (Fig 2). Keitt mango treated and stored at 25°C produced a firmness value of 1.5N compared with Nam doc mai with 1.0 for the trial period.(Fig. 2). The results for the Keitt mango fruits untreated (KCF) produced a firmness value of

0.8N compared with Nam doc mai mango fruits (NCF) of 0.5N

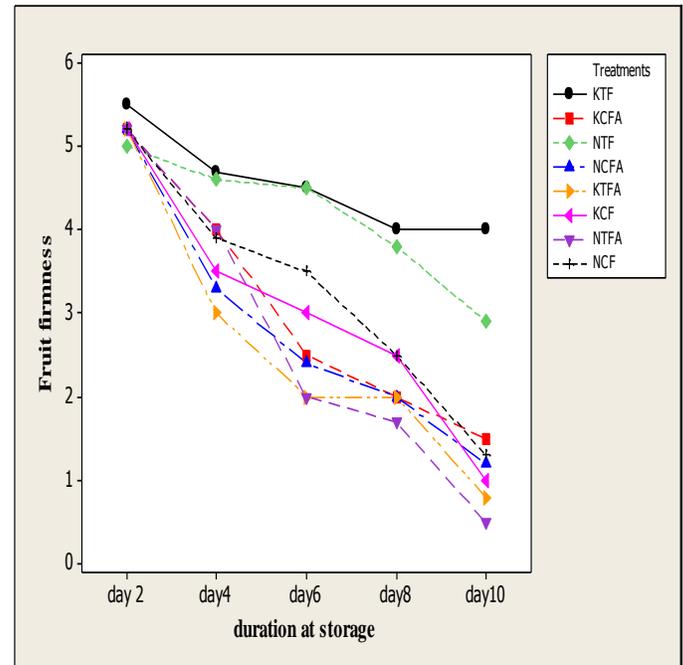


Fig 2: Firmness level of Keitt mango and Nam doc mai mango stored at 7°C and 25°C

Sensory evaluation

The results produced by the data on sensory evaluation blind taste test on mango fruits scored by the 14 panelists indicated that Keitt mango fruits treated with hot water at 50°C /11ms (KTA) and stored at 25°C recorded the least consumer acceptance on sweetness with a value of 3, compared with Nam doc mai mango treated (NTA) with 5. Treatments at the 7°C for the two varieties showed that an average of 2.5 sweetness was produced for Keitt compared with 1.5 by Nam doc mai. For overall acceptance the results produced indicated that Keitt mango treated with hot water at 50°C /11ms stored at ambient temperature 25°C recorded the highest acceptable value of 5.5. The least preferred consumer acceptance was produced by Nam doc mai mango on control stored at 25°C with an acceptable value of 4 (Fig. 3).

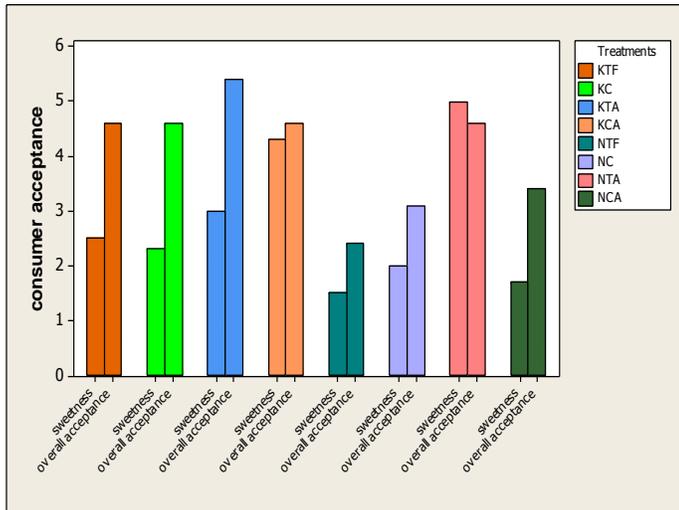


Fig. 3: Sensory assessments of Keitt mango and Nam doc mai mango on overall acceptance and sweetness.

Percentage Weight Loss

The results produced on mango fruits weight loss indicated that Keitt mango treated with hot water at 50°C/ms stored at 7°C (KT) produced 3% compared with Nam doc mai mango fruits treated which recorded weight loss of 2% on day Ten (Fig. 4). Keitt mango fruits treated, stored at 25°C (KTA), recorded a weight loss of 4%, compared with Nam doc mai mango fruits treated, (NTA) which produced an average weight loss 3% on day Ten (Fig. 4.). The results produced on Keitt mango untreated stored at 7°C (KC) showed an average weight loss 3% compared with 3.5% for Nam doc mai on day ten. Also the Keitt mango control stored at 25°C (KCA) recorded a weight loss of 16.1% compared with Nam doc mai mango with 15.5% on day ten. (Fig. 4)

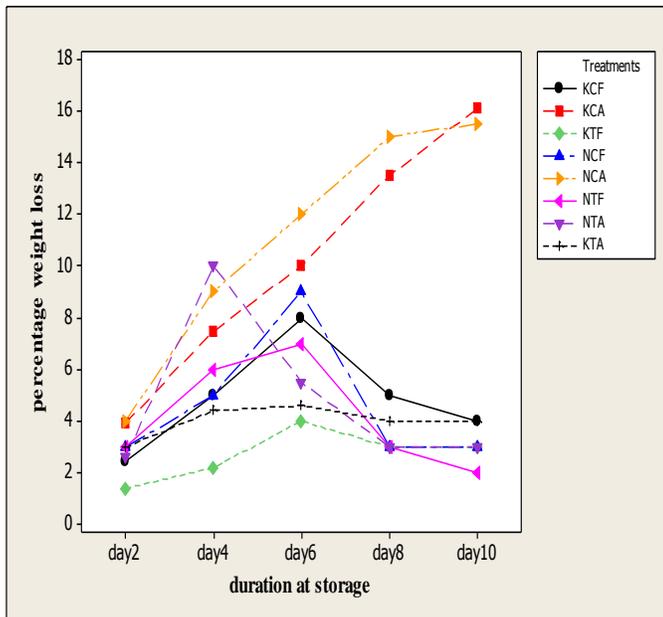


Fig 4. Weight loss of Keitt mango and Nam doc mai stored at 7°C and 25°C

Discussion

Analysis of the results demonstrated that for day four, day six, day eight and day ten, there were significant difference at $p \leq 0.05$ on temperature treatment between 7°C and 25°C and no significance at $p \leq 0.05$ treatment on the variety. The results produced on the statistical analysis on colour changes of Keitt mango and Nam doc mai mango treated could be as a result of ripening and heat. This research conducted partially agrees with findings by [4] that treatments of mango fruits subjected to higher temperature during hot water developed more yellow and uniform colour during storage. Also this research agrees with the findings by [2]. [17] that a wide range of fruits ripening processes are affected by heat, such as colour. In this research an internal pulp temperatures of Keitt at 10 °C and 12 °C for Nam doc mai was found which further suggested that ripening could be more pronounced with the latter variety. Also, the results could not produced any interaction effects on temperature and variety which contradicts with the research by [6] which produced Interaction between mango fruits during the study of fruit colour development at a specified temperature.

Firmness

The results obtained from the data on firmness level of Keitt mango and Nam doc mai mango treated with hot water at 50°C/11ms and non treated, stored at temperatures of 7°C and 25°C, indicated that there was significant difference at $p \leq 0.05$ on firmness of treated Keitt and Nam doc mai mango fruits. Also there was significant difference at $p \leq 0.05$ on the varieties of Keitt mango and Nam doc mai mango treated throughout the period of the experiment. The results produced from the data demonstrated that, no interaction effect was observed at $p \leq 0.05$ on variety and temperature on firmness level of Keitt mango and Nam doc mai mango stored at 7°C and 25°C. The differences in firmness of the mango fruits could be as a result of respiration which enhances ripening, water temperature and dipping time. This was found to be in agreement with earlier research by [16] which revealed that increasing storage temperatures from 8 to 13°C significantly decreased the firmness of mango fruits. Also in this research fruits subjected to hot water at 50°C/11ms and non treated, stored at temperatures of 7°C and 25°C, indicated that there was significant difference at $p \leq 0.05$ on firmness level of fruits which contradicts research by [6] that fruits subjected to hot water treatment at 48°C for 60 min remained more firm during storage.

Sensory Assessment

The results obtained from the sensory evaluation of blind test on sweetness level by the score of the 14 panelist of Keitt mango fruits and Nam doc mai mango treated with hot water at 50°C/11ms and non treated, stored at temperatures of 7°C and 25°C, showed that there was significant difference at $p \leq 0.05$ on sweetness. Also there was a significant difference at $p \leq 0.05$ for the two varieties.. The results obtained from the sensory evaluation of blind test on overall acceptance by the score of the 14 panelist of Keitt mango and Nam doc mai mango treated, demonstrated that there was significant difference at $p \leq 0.05$ on overall acceptance of Keitt mango and Nam doc mai mango treated stored at 7°C and 25°C. Also significant

difference at $p \leq 0.05$ was found for the varieties of Keitt mango and Nam doc mai mango treated. This research agrees with findings by [7] that temperature has effect on the rate of metabolism of produce, when temperature of products increased; the rate of metabolism is increased and mature green fruits can be kept at room temperature for about 4 to 10 days depending upon the variety. However this research contradicts with the findings by [1] which stated that, the organoleptic qualities of different treatments were scored to be non-significantly different by panelists. Also this finding contradicts with earlier findings by [13] which concluded that hot water induced ripening without impairing taste and flavour of fruits. However this research is in agreement with findings by [8] which in demonstrated that Interaction of treatments and storage period also produced statistically non-significant result. It was clear that hot water does not negatively affect end-consumer preferences. Also results produced by [6] that results for the effect of hot water treatment and its interaction with storage temperature on organoleptic characteristics were non-significant was found to be in line with this research.

Weight loss

The results obtained from the statistical analysis on the percentage weight loss of Keitt mango and Nam doc mai mango treated with hot water at $50^{\circ}\text{C}/11\text{ms}$ and non treated, stored at temperatures of 7°C and 25°C , stated that there was significant difference at $p \leq 0.05$ on percentage weight loss of Keitt mango and Nam doc mai mango stored at 7°C and 25°C on day two and day four. There was also significant difference at $p \leq 0.05$ on the varieties of keitt mango and Nam doc mai mango fruits treated. The sharp rise in average weight loss could be as a result of maturity index, high temperature and low relative humidity. This agrees with the findings by [10] that green fruit should be stored at 10 or 15°C , while ripe fruit can tolerate lower temperatures. This is also in agreement with earlier research by [11] that some mango cultivars can safely be stored at $7-8^{\circ}\text{C}$, and others require temperatures above 10°C or even 13°C .

Conclusion

The effectiveness of hot water treatment as a medium for maintaining the quality of Keitt mango and Nam doc mai mango fruits was carried out in this research. Regarding the effect of storage temperatures and varieties on the changes in fruit colour changes, fruit firmness, sensory attributes, weight loss, and overall quality, hot water treatment was found beneficial for Keitt mangoes. The treatment of fruits stored at 7°C with $90 \pm 5\%$ RH and 25°C at $80 \pm 5\%$ RH reduced fruit weight loss, maintained firmness, and enhanced entire quality for the trial period of ten days. The use of hot water water treatment of for Keitt mango fruits can be of enormous benefit to farmers, market women and consumers.

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