

Effect of Ginger Extracts and Storage Temperature on Shelf Life of Kent Mango Fruits

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Abstract

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Postharvest loss is a major problem affecting fresh mango trade in most developed and developing nations. The ability of mango farmers, distributors, processors and consumers to use natural plants extracts and solutions to maintain fruits quality will significantly affect quality and return on investments. This research was conducted to discover the effects of immersion tomato fruits in dissolved ginger extracts on Total Soluble Solid, Weight loss, pH, Flesh firmness, Pulp cube texture and Consumer acceptance of Kent mango fruits stored at 5°C and 25°C for 12 days. One hundred and twenty eight (128) Kent mango fruits were used for the experiment. The entire sample was divided into four and each division was replicated two times. The research confirmed that the treatment that reduced weight loss better was shown by Twenty minutes solution for 5°C with 4.5%. Also, immersing of mango fruits in dissolved ginger extract for 30 minutes at 25°C was appropriate in TSS and pH which resulted in better taste. In respect of the flesh firmness a short immersing duration at 5°C was found with the best sweet taste keeping the flesh firmness better. In all the cases immersing of fruits sample in dissolved ginger extract resulted in better quality than non-treated samples. Therefore, based on the results produced it can safely be concluded that immersing of Kent mango fruits in dissolved ginger extract offered a promise for adoption for small scale postharvest management of Kent mango fruits.

Keywords

Kent mango
Postharvest quality
Storage life
Plant extract
Shelf life

INTRODUCTION

Postharvest technologies are required in recent times to prevent both chemical and biological deterioration of foods and also to extend the shelf life of fruits and vegetables. Alzamora et al.(2000) reported that about 30-50% of fruits harvested in developing countries including Ghana are never consumed due to spoilage during transportation, storage and processing. Mango fruits are primarily consumed in the fresh state usually as dessert and sometimes as a fruit drink or juice. Mango production in developing nations is usually at the small-scale level with few commercial farmers but the maturity of the fruits is seasonal with high volumes of production during the main season. Kent is among the common varieties usually cultivated by small scale farmers with the perception of its ability to store for reasonable length of time. The storage and handling of these fruits becomes a challenge resulting from the complex nature of supply chains of the fresh produce and retail sectors. Due to high postharvest losses of fruits, there is the need to preserve

perishable fruits during bumper harvest to make these fruits available throughout the year in a value added form (Godson, 2008). Temperature difference contributes to the loss of quality and physiological processes causing aging and senescence are reduced at low temperature (Tefera et al., 2008; Rabet al., 2012). It is therefore essential to optimize the storage temperature for quality retention (Badshah and Abdur, 2016). Higher enzymatic activities and ethylene production at higher temperature cause the hydrolysis of starch and pectic substances and increase the ripening process (Kader and Mitcham, 2008). Fruits immersion technology application as a postharvest treatment has been reported on several commodities in maintaining quality, and prolonging shelf life (Verdini et al., 2008). Several factors account for the effectiveness of an immersion process such as the concentration of the solution and the immersion duration. The rate of solution imbibition by treated samples through immersion varies among different food commodities. A research with an immersion technology of mango and pineapple during osmotic

dehydration showed gradual increase in weight loss during the initial immersion stages (Tiwari and Jalali, 2004). The effects of long duration immersion contributed to the water loss and sugar gain was also reported in banana and apple slices (Gaspartero et al., 2003; Mauro et al., 2004). Using immersion technology by Monica et al. (2013) for Litchi and Liu et al. (2009) in apricots also supported the suitability for postharvest management. However, the potential of application of ginger dissolved ginger extracts on mango fruits to extend shelf life has not been extensively investigated. Therefore, the current study looks into the effects of natural ginger extract solution on Kent mango fruits at different temperatures. The shelf life after treatment was assessed based on total soluble solids, Flesh firmness, weight loss, pH and marketability.

MATERIALS AND METHODS

Plant Materials

The plant materials used for the research were Ginger Rhizomes, and Kent mango fruits. One hundred and Twenty eight Kent mango fruits (128) were purchased from Matco Farms at Kaleo on the day of harvest and five (5) kilograms of Ginger was purchased from the Wa central market for the experiment.

Preparation and Fruits Immersion in Solution

The ginger rhizomes were soaked in water for five minutes to allow the soil particles dissolved from the ginger. After which water was poured away and the ginger rhizomes rewash before they were chopped into pieces and finally was blended using blender. Forty five (45) litres of water was added to the blended ginger and then sieved to take only the solution which was used for the experiment. The fruits were soaked in three different containers with the dissolved ginger extract. Each container had 15 litres of the dissolved ginger solution and the fruits were immersed at different durations. The durations were 10 minutes, 20 minutes, and 30 minutes and these immersions started at the same time.

Design of the Experiment

The experiment was set up with One hundred and Twenty eight (128) Kent mango fruits. The entire sample was divided into four to represent the treated and untreated samples where each division was replicated two times in a 2 x 4 factorial experiment. Each treatment combination then consisted of Sixteen (16) Kent fruits used for daily

readings and marketability assessment. In the experiment the quality parameters monitored were: firmness, weight loss, total soluble solids, pH and consumer acceptance.

Data used for the analysis were obtained from computing the weight loss, Total Soluble Solid (TSS), pH, firmness based on daily readings and taste test on the last day of the experiment. The analyses of the data was done using Mini Tab version 17. The data on taste values were converted into their log forms to allow for analysis using the Analysis of Variance to test for any significant difference among the treatment means at $P \leq 0.05$. A two-way Anova was used and significant difference claimed at $p \leq 0.05$. Means separation was done using the individual Fishers' error rate.

RESULTS

Total Soluble Solid of Kent Mango Fruits

The results obtained from the data on Total Soluble Solid (TSS) of Kent mango fruits indicated that, fruits immersed in dissolved ginger extract for Ten (TS), Twenty (TWS) and Thirty (TRS) minutes and stored at 5°C recorded TSS values of 10 °Brix, 12 °Brix, and 14 °Brix respectively on day two (2), while fruits sample immersed in dissolved ginger extract and stored at 25°C for Ten (TSA), Twenty (TWSA) and Thirty (TRSA) minutes recorded high TSS values of 18 °Brix, 13 °Brix and 14 °Brix (Figure 1). Fruits that were not immersed in dissolve ginger extract and stored at 5°C (NS) produced a TSS of 11 °Brix while fruits sample stored at 25°C recorded the TSS of 18 °Brix on day 2. All the treatments demonstrated a progressive TSS pattern as duration at storage reached day 12 when the experiment was terminated. It was clear that the highest TSS value was found with fruits samples TWSA and TRS producing the same TSS of 21 °Brix. Treated samples TS and TSA were the same with 20 °Brix while TWS, NS and NSA were 19 °Brix respectively (Figure 1). The least TSS was found with TRSA with 18 °Brix.

Flesh Firmness of Kent Mango Fruits

The results produced from the data on firmness of Kent mango fruits showed that, fruits immersed in dissolved ginger extract for Ten (TS), Twenty (TWS) and Thirty (TRS) minutes, and stored at 5°C were 9.1kgf, 6.4kgf and 5.5kgf respectively for the first two days. Fruits sample immersed in dissolved ginger extract for Ten (TSA), Twenty (TWSA) and Thirty (TRSA) minutes at 25 °C, produced fruit firmness of 4.5kgf, 8.6kgf and 3.6kgf respectively. For the first two days the least fruit firmness was found with un-immersed fruits stored at 25 °C (NSA) with fruit firmness of 3.2kgf compared with un-immersed sample at 5 °C

(NS), with firmness value of 5.0kgf (Figure 2). On day 12 when the experiment on flesh firmness was terminated, the highest firmness was found with treated sample TS with 4.5kgf. Treated samples TWS and control sample NS were the same with

2.3kgf. TWSA firmness was 1.8kgf while the treated samples TRS and TSA were also the same with 1.4kgf. The least fruits firmness was found with Treated sample TRSA and control sample NSA with same firmness of 0.9kgf (Figure 2).

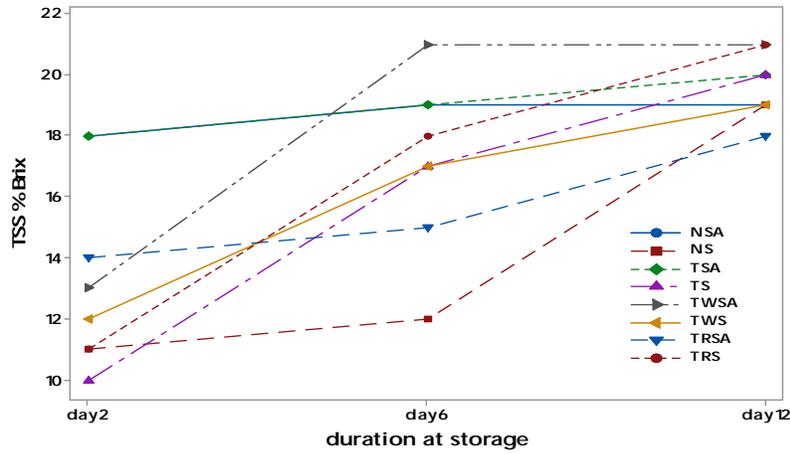


Fig 1. Changes in total soluble solid content in treated kent mango fruits stored at 5°C and 25°C for 12 days

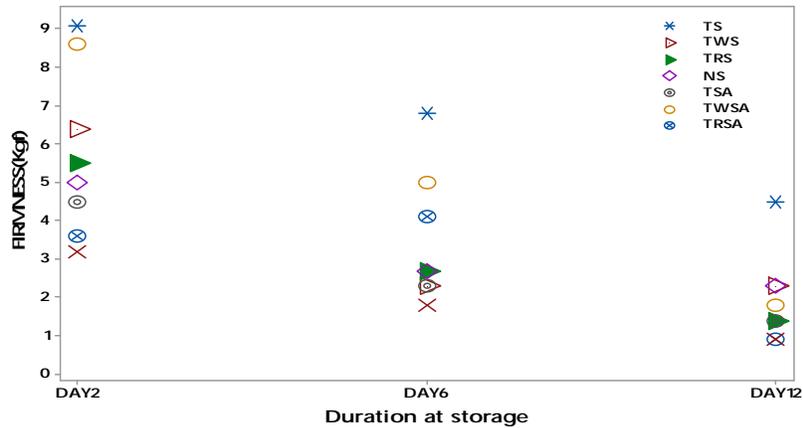


Fig 2. Changes in firmness in treated kent mango fruits stored at 5°C and 25°C for 12 days

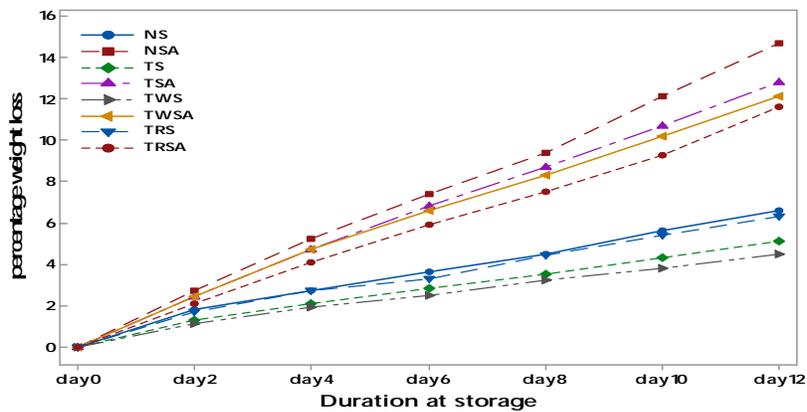


Fig 3. Percentage weight loss in kent mango fruits of treated with dissolved ginger extract for Ten (TS), Twenty(TWS), Thirty(TWS), minutes and not treated (NS) at 5°C and ten(TSA), Twenty(TWSA) Thirty(TRSA) and not treated (NSA) at 25°C for 12 days.

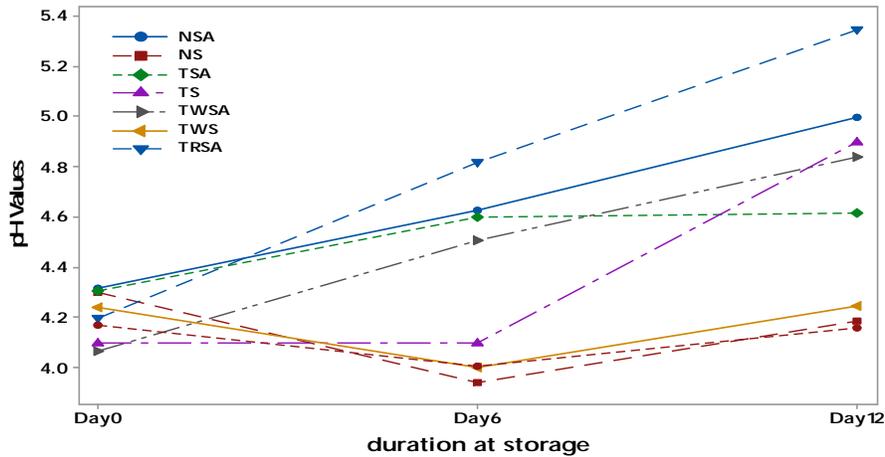


Fig 4. Changes in pH in treated Kent mango fruits stored at 5°C and 25°C for 12 days.

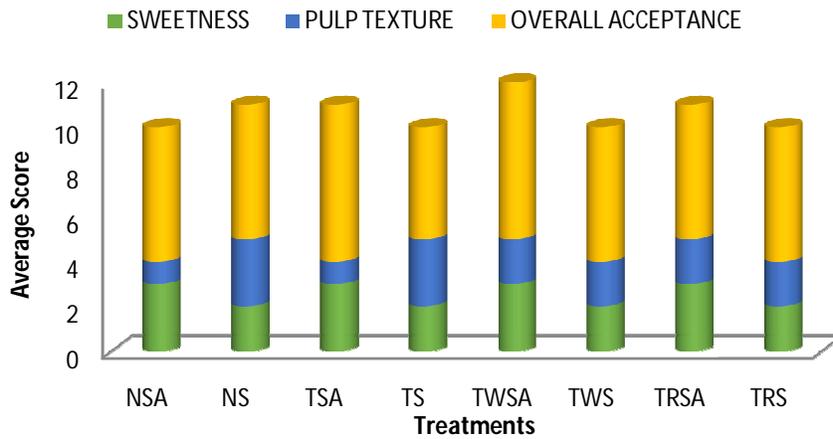


Fig 5. Sensory Evaluation of sweetness, pulp cube texture and consumer acceptance of treated Kent mango stored at 5°C and 25°C

Percentage Weight Loss of Kent Mango Fruits

The results obtained from the data revealed that weight loss of fruits immersed in dissolved ginger extract for Ten minutes (TS) was 1.3% whiles Twenty (TWS) and Thirty (TRS) minutes were 1.1%, and 1.7% respectively at 5°C on day 2. Fruits sample immersed in dissolved ginger extract for Thirty (TRSA) minutes loss weight by 2.1% but 2.4%, was shown respectively by both Ten (TSA) and Twenty (TWSA) minutes at 25 °C. The control samples (NS and NSA) for day 2 recorded weight loss of 1.8% at 5°C compared with 2.7% at 25°C (Figure 3). At the end of the experimental period, it was clear that the highest weight loss was found with NSA fruits sample with 14.7% whiles the treatment that reduced the least weight loss was shown by TWS with 4.5%. Significant difference

was found due to dissolved ginger treatment but temperature has no significant effect.

pH of Kent Mango Fruits

The pH results obtained from experiment on Kent mango fruits revealed that, on day 2 fruits immersed in ginger extract for Ten (TS), Twenty (TWS) and Thirty (TRS) minutes, and stored at 5oC produced pH values of 4.1, 4.24, and 4.17 respectively, whiles fruits sample immersed in dissolved ginger extract and stored at 25oC for Ten (TSA), Twenty (TWSA) and Thirty (TRSA) minutes produced pH values of 4.31, 4.07 and 4.20. Fruits sample that were not immersed in dissolve ginger extract stored at 50 °C (NS) recorded a pH value of 4.30 whiles fruits sample stored at 250C (NSA) recorded pH value of 4.32 (Figure 4). The inconsistent pattern of pH continued as storage

proceeds to day 12 when the experiment was terminated. All the treatments demonstrated that there were higher pH values than the set of readings for day 6. The least pH value was produced by TRS with 4.16 and the highest was 5.35 from TRSA (Figure 4). Temperature produced significant effect on pH but dissolved ginger could not produce any difference.

Consumer Acceptance

The results produced by 14 panellists for sweetness of Kent mango fruits immersed in dissolved ginger extract stored at 5°C showed that sweetness values of 2 were scored for all the fruits immersed which described fruits with average sweetness. However, Kent mango fruits immersed and stored at 25°C were scored 3 which described fruits as sweet. Fruits that were not immersed (NS) but stored at 5°C were scored 2 to mean average sweetness compared with fruits sample not immersed (NSA) but stored at 25°C with 3 which was described as sweet fruits (Figure 5)

The results produced by the panellists on consumer acceptance of Kent mango fruits immersed in dissolved ginger extract for Ten (TS), Twenty (TWS) and Thirty (TRS) minutes stored at 5°C showed that an average acceptable value of 5 was scored which meant good fruits (limit of marketability) for produce immersed in dissolved ginger extract for Ten minutes (TS) compared with a consumer acceptable value of 6 scored for TWS and TRS. However, for fruits stored at 25°C a consumer acceptable value of 7 was scored which described fruits as very good for Ten (TSA) and Twenty (TWSA) minutes treated sample. The scores for Thirty minutes treated stored at 25°C and the two control samples (NSA and NS) were all described as good fruits beyond the limit of marketability.

DISCUSSION

TSS

Statistical analysis of the data revealed that, no significant difference at $P \leq 0.05$ was found with fruit samples immersed in dissolved ginger extract and sample stored at different temperatures. There was also no interaction effect with storage temperature and dissolved ginger extract on TSS. Although no significant difference in TSS was shown by this research, all the treatments demonstrated higher TSS at later time in storage than the initial stages. This confirmed the assertion that total soluble solids of fruits increased with the advancement of storage period in treatments (Jawandha et al., 2012; Khan et al., 2013).

Flesh Firmness

The results produced from the statistical analysis on Kent mango fruit firmness demonstrated that, no significant difference at $P \leq 0.05$ was found with fruit due to immersion time of dissolved ginger extract and storage temperature. There was no interaction effect with storage temperature and dissolved ginger extract on firmness. There was a continues decrease in firmness of fruits of all samples as storage proceeds and Treated sample immersed for Ten minutes at 5°C could maintain firmness better than the rest of the treatments. A similar observation was made by Badshah and AbdurRab (2016) that increases in storage duration resulted in gradual decrease in fruit firmness. However, Sadiq et al., (2016) found that short immersion duration resulted in significant difference in firmness which was confirmed by lumetal.2011)

Weight Loss

The results demonstrated that immersion of dissolved ginger extract had significant effect at $P \leq 0.05$. However, no significant difference was found at $P \leq 0.05$ with fruits sample in weight loss due to temperature. There was also no interaction effect with storage temperature and dissolved ginger extract on weight loss. The differences among the dissolved ginger extract could be due to the immersion time, mango variety used and duration at storage. The current findings partially supported Doreyappa-Gowda and Huddar (2001) who observed that weight loss in mango fruits were influenced by size of fruit and variety used. The results further agreed with Abdul-Rahaman et al. (2014) that immersion of mango fruits in hot water for 11 minutes produced significant difference in weight loss. The current results demonstrated that weight loss was higher as storage proceeds which were in line with research by Islam et al. (2016) who found highly significant variation in moisture content of fruits at different days after storage.

pH

The results demonstrated that no significant difference at $P \leq 0.05$ was found in pH of Kent Mango fruit due the immersion interval. However, significant differences were found at $P \leq 0.05$ with fruits sample stored at different storage temperatures. There was no interaction effect with storage temperature and dissolved ginger extract on pH. The significant differences that were produced on pH due to storage temperature coincided with those by Doreyappa-Gowda and Huddar (2001) who reported that mango fruit stored at different temperatures resulted significant difference in treatments due to increase in pH. A similar result was found by Sadiq et al. (2016) who reported that

fruits pH was significantly increased by immersion technology during the storage for all tested treatments.

Sweetness

The results obtained from the sensory assessment of taste test on sweetness level by the score of 14 panellists of Kent Mango fruits demonstrated that there was significant difference at $P \leq 0.05$ on sweetness due to the immersion of fruits in dissolved ginger extracts. Temperature could not produce any significant difference on sweetness and there was no interaction effects. The difference that was found in the sweetness level could be attributed to the secondary compounds generated in the mouths of panellist as earlier suggested by Buttery and ling, 1993; Crouze et al., 1990; Maarse, 1990 Beulieu and lea, 2006). In this research few cases of poor taste were recorded for treated samples which support the position of Diane et al., 2010 that fungal and bacterial presence results in musty and foul odour in fruits.

Pulp Cube Texture

The results on pulp cube texture demonstrated that dissolved ginger treatment produced significant difference at $P \leq 0.05$ but temperature could not produce any significant difference in the fruits after storage on pulp cube texture and there was no interaction effect. The results of the current research disagree with earlier work by Habib et al. (2007) who reported that fast reduction in texture scored for fruit sample might be due to accelerated ripening process in free atmospheric conditions of storage temperature. Further research by Opara et al. (2000) also demonstrated that firmness of mango fruits was highly dependent on storage temperature and reduced firmness resulted in fruit quality been unacceptable which contradicted the current results.

Consumer Acceptance

The assessment of the panellist on acceptability indicated that both temperature and dissolved ginger extract treatments could not produce any significant effects at $P \leq 0.05$. It further showed that there was no interaction effect of the treatments. The non-significant difference demonstrated by the current research could be due to the consumer preference scale that was used for the assessment of acceptability. Although the nine point hedonic scale was suggested by (Meilgaard et al., 1999; Lawless and Heymann, 1998), it was noted with many flaws due to unequal interval (Diane et al., 2010). Also, appropriate scales

suggested for measuring willingness to purchase (Moskowitz et al., 2006) and acceptability (Dubost et al., 2003) could produce significant difference but that was not applied in the current research.

CONCLUSION

Based on the analysis of the results it was clear that, immersing of Kent mango fruits in dissolved ginger extract could maintain it quality for 12 days. With regard to weight loss immersing of Kent mango fruits for a duration of 20 minutes at 5°C was more appropriate which resulted in a more acceptable score rate for the treated sample. Also, immersing of mango fruits in dissolved ginger extract for 30 minutes at 25°C was appropriate in TSS and pH which resulted in better taste. In respect of the flesh firmness a short immersing duration at 5°C was found suitable in keeping the flesh firmness better. In all the cases immersing of fruits sample in dissolved ginger extract resulted in better quality than non-treated samples. Therefore, based on the results produced it can safely be concluded that immersing of Kent mango fruits in dissolved ginger extract offered a promise for adoption for small scale postharvest management of Kent mango fruits.

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