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Influence of evaporative cooling and near infrared reflection storage on the chemical properties of mangoes

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Abstract : *Mango (Mangifera indica L.) is a valuable fruit crop in Kenya due to its nutritive and economic value. However, at least 40 to 45% of the fruit is lost during postharvest handling attributed to inadequate availability of affordable storage systems by the peasant farmers. An applicable technology (S_{NR} -) is the use of combination of evaporative cooling and near infrared reflection to lower the temperature of the storage environment. Therefore, this study was aimed at investigating the effect of storage environment of the S_{NR} store on the chemical properties of mangoes against those stored in the identical evapoaratively cooled non-near infrared reflecting store (S_{NNR}) and room conditions (R_C) as a control experiment. The fresh and mature Apple and Kent were stored under the three storage conditions and the chemical properties such as total soluble solids (TTS), total titratable acids (TTA) and pH were determined and recorded on daily basis. The analysis of variance results did not show significant difference ($P>0.05$) in the TTA and pH of the fruits stored in the three conditions except TTS however, the rate of ripening was lower for the fruits stored in the S_{NR} compared to those in the S_{NNR} and R_C. Therefore, the S_{NR} store can be considered as an alternative storage system for preserving the quality mangoes.*

Keywords: *Chemical properties, evaporative cooling, mango fruit, near infrared reflection, storage*

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I. Introduction

Mango (Mangifera indica L.) is an adaptable fruit which thrives well under different agro-ecological zones ranging from sub-humid to semi-arid [1]. The main mango producing areas in Kenya are Coast and the semi-arid parts of Eastern region. In Kenya, 280,884 metric tonnes of mango fruit are produced at an estimated production area of 14,387 Ha [2]. Due to expansion of mango production area and increasing productivity, mango production has increased to about 450,000 metric tonnes. However, only 1,800 metric tonnes of the mango produced are exported [3]. The remaining mangoes in the year are mainly utilized as supplies to the local market and the processing industry. Mango juice, chutney, prickles, jam, jelly, canned and dried fruits include some of the products from the processed mangoes [1]. Despite increased production at least 40 to 45% of the fruit is lost along the postharvest handling attributed to mechanical damage (bruises), pests and diseases and immature harvesting are the causes of losses [4]. In addition, postharvest losses are also due to inadequate storage facilities for mangoes particularly during the peak harvesting seasons. It is possible to develop improved storage systems and use to reduce the losses leading to increased net returns for the resource poor farmers [5]. The existing modern storage systems are unaffordable and rely heavily on electricity hence inappropriate for use by peasant farmers and in areas without electric power supply, respectively. An applicable technology is the use of combination of evaporative cooling and near infrared reflection to low the temperature of the storage environment as described by [6]. However, the effect of its storage conditions on the chemical properties of mangoes has not been investigated. Therefore this study was aimed at evaluating the effect the technology on the chemical properties of mangoes and using it as an alternative method for mango storage.

II. Methodology

Two mango varieties namely Apple and Kent were selected based on the results of the baseline survey. The fruits were sourced directly from the local farmers. Harvesting was done in the morning and the fruits transported on the same day and kept in a cool dry place overnight. The fruits were then kept in the evaporatively cooled near infrared reflection store (S_{NR}) and the chemical properties such as total soluble solids (TSS), total titrable acid (TTA) and pH were evaluated daily against the fruits stored in an identical evaporative cooled non-near infrared reflecting store (S_{NNR}) and room conditions (R_C) was used as a control experiment. The TSS was determined as percentage Brix using a digital hand held pocket refractometer (PAL-1, ATAGO Company, Tokyo, Japan), TTA by titrating homogenized mango juice extract with 0.1N NaOH in the presence of phenolphthalein indicator according to AOAC method and expressed as percentage citric acid and the pH by using digital pH meter (HI 98130, Hanna instruments, Mauritius).

III. Indentations and EQUATIONS

The TSS for Apple mangoes at the start of experiment was 6.80±0.13% Brix and 19.10±0.04, 19.08±0.09, and 19.08±0.06% Brix at the end of the experiment for the fruit stored in the S_{NR}, S_{NNR} and R_C, respectively. Similarly, the initial TSS for Kent mangoes was 5.40±0.13% Brix and 14.75±0.54% Brix at the end of the experiment for the fruit stored in the S_{NR} and 14.75±0.57% for those stored in the S_{NNR} and R_C. These results are comparable to that reported in [7] in which TSS for different mango varieties during storage was investigated. Further, TSS of 18.9% was presented for Dodo mango variety which ripen under room conditions [8]. Fig. 1 and 2 present variations in TSS for Apple and Kent mangoes stored under the three storage conditions, respectively.

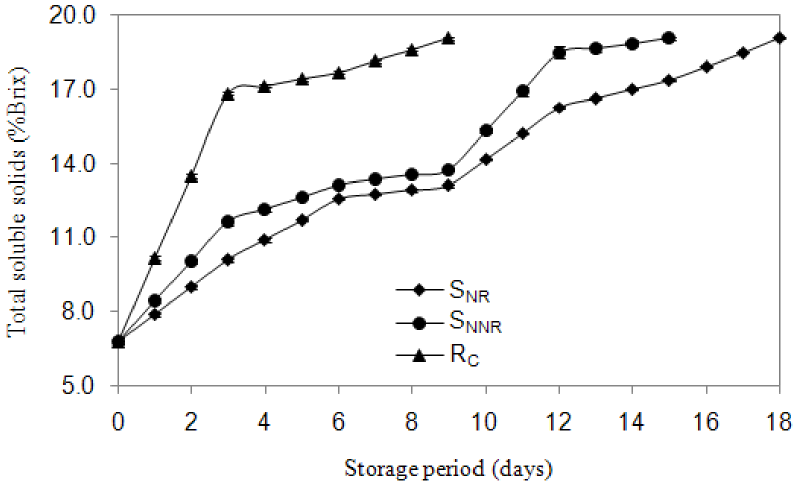

Figure 1 Variations in TSS with storage period for Apple mangoes stored in the S_{NR}, S_{NNR} and R_C.

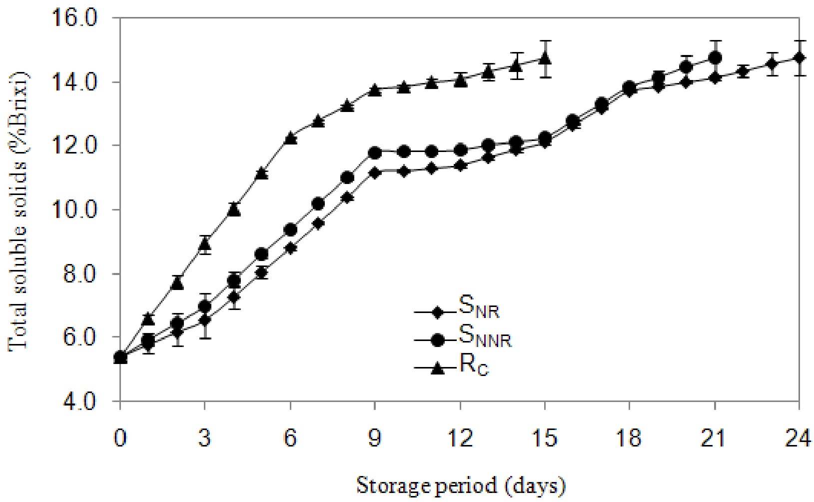

Figure 2 Variations in TSS with storage period for Kent mangoes stored in the S_{NR}, S_{NNR} and R_C.

The figures showed increased trend in the TSS for the fruits stored in the S_{NR} having lowest increased in TSS compared to those stored in S_{NNR} and R_C. This implied the rate of ripening was lower for the fruit stored in the S_{NR} than those stored in the S_{NNR} and R_C. A rapid increase in TSS was observed at the initial period of storage and gradually until the end of the experiment due to decline in the amount of substrate and conversion of non-reducing sugars to reducing sugars. Similar trend was observed in which the TSS increased gradually at the later stage of ripening due to less substrate remaining attributed to rapid and partial breakdown of non-reducing sugars and other polysaccharides and their subsequent inversion to reducing sugars as the fruit ripens [9]. The increase in TSS observed is attributed to changes in cell wall structure and breakdown of complex carbohydrates into simple sugars during storage. The increase and decrease in TSS is linked to hydrolytic changes in starch and conversion of starch to sugar being an important index of ripening process in mango and other climacteric fruit and further hydrolysis decreased the TSS during storage [10]. The analysis of variance results did show the existence of significant difference ($P<0.05$) in TSS for the fruits in the SNR, SNNR, and RC.

The initial TTA of Apple mangoes was 1.66±0.07% and 0.17±0.04% at the end of the experiment for the fruit stored under the three storage conditions. Similarly, the TTA for Kent mangoes at start of the experiment was 1.28±0.01% and 0.17±0.04% at the end of the experiment. This indicated that the TTA decreases as the fruit ripens due to reduction in citric acid content [11]. This was in agreement with the observation made for Thai mangoes in which TTA decreased during storage [12]. Further, a similar trend was observed in which the TTA for Neelum mango variety decreased during storage [13]. In addition, the decrease in TTA for different varieties of mangoes during storage was presented as in [7]. The reduction in TTA of Aphonoso mango variety during storage at ambient conditions was revealed as in [14]. Further, a decreased in TTA during ripening of mangoes was observed as in [8]. Similarly, a decreasing trend in TTA for Dosehari mangoes as the fruit ripen was reported as in [15].

The variations in TTA with storage time for the Apple and Kent mangoes stored under the three conditions as in Fig. 3 and 4, respectively. The figures showed that the decrease in TTA was lower for the fruit stored in the S_{NR} compared to that stored in the S_{NNR} and R_C. This implied the fruit stored in S_{NR} were characterized by lower rate of loss of citric acid than those stored in the S_{NNR} and R_C. The analysis of variance results did show significant difference ($P<0.05$) in TTA for Apple mangoes stored under the three conditions. However, the difference in TTA for Kent mangoes stored under the conditions was not significant ($P>0.05$).

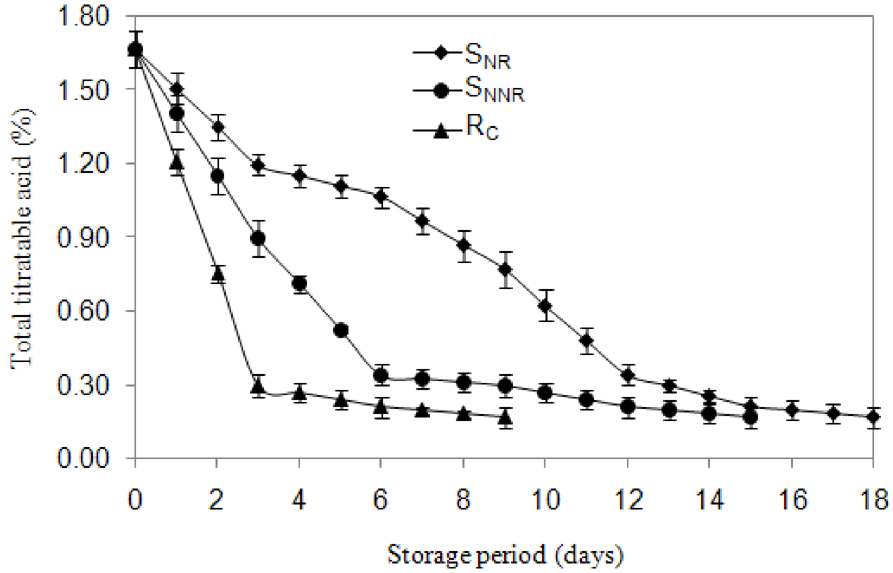

Figure 3 Variations in TTA with storage period for Apple mangoes stored in the S_{NR}, S_{NNR} and R_C.

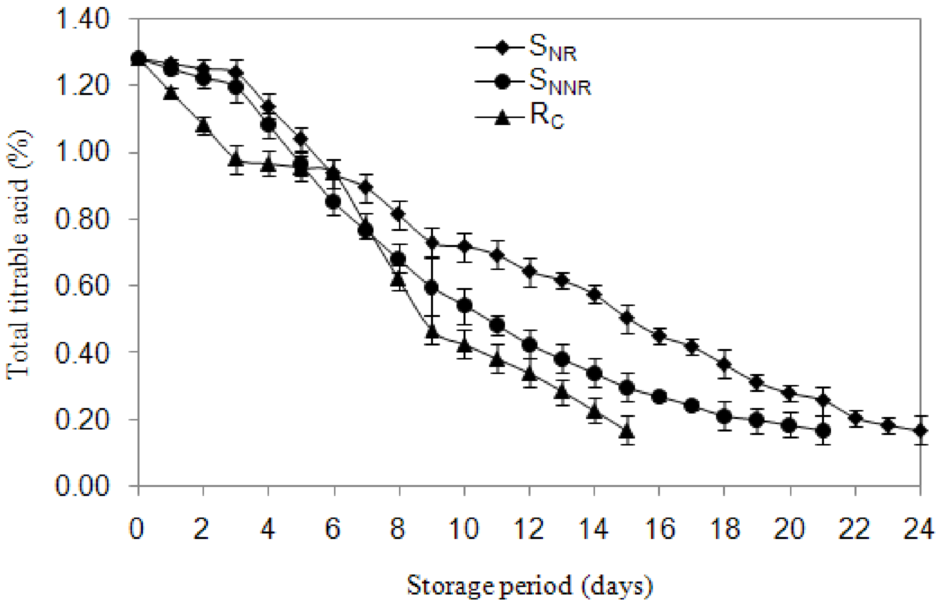

Figure 4 Variations in TTA with storage period for Kent mangoes stored in the S_{NR}, S_{NNR} and R_C.

The pH of the Apple mangoes was 3.60±0.06 at the start of the experiment and 5.18±0.06 at the end of the experiment for the fruit stored in the S_{NR} and 5.27±0.01 for those stored in the S_{NNR} and R_C. The initial pH value of the Kent mangoes was of 3.22±0.01 and 5.22±0.01 at the end of the experiment for the fruits stored in the three conditions. The increased in pH with storage time indicated a decrease in acid content due to oxidation. The increase in pH is due to oxidation of the acid during storage and also genetical differences between varieties [16]. Fig. 5 and 6 present variations in pH with storage time for Apple and Kent mangoes kept in the three storage conditions, respectively.

An increasing trend in pH values was observed for both varieties during storage. A similar trend was observed for different varieties of mangoes during storage [7]. The analysis of variance results did not indicate significant difference (P>0.05) in pH for both varieties stored under the three conditions.

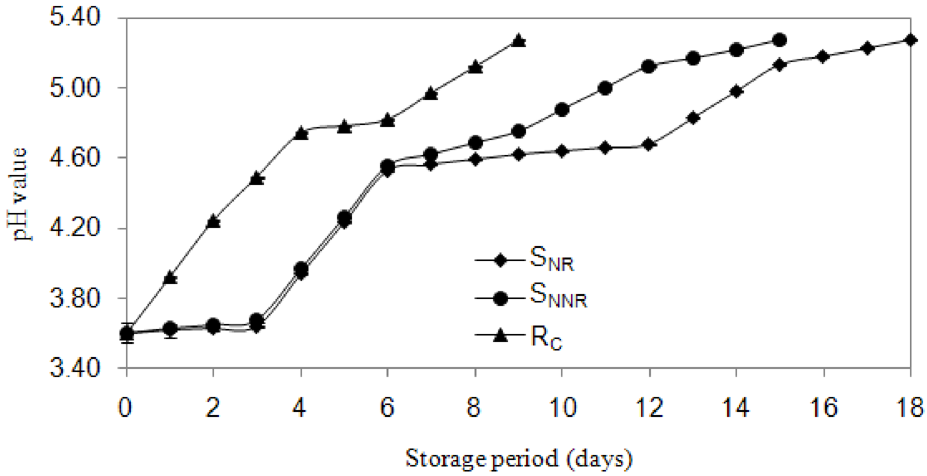

Figure 5 Variations in pH with storage period for Apple mangoes stored in the S_{NR}, S_{NNR} and R_C.

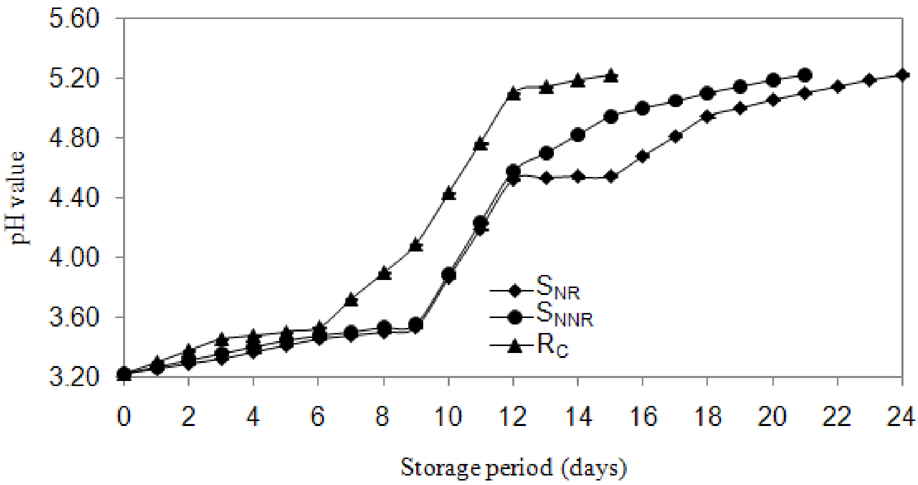

Figure 6 Variations in pH with storage period for Kent mangoes stored in the S_{NR}, S_{NNR}, and R_C.

The variations in TSS to TTA ratio with storage time for Apple and Kent mangoes stored under the three conditions as in Fig. 7 and 8, respectively. The initial TSS to TTA ratio for both varieties was 4.0 and 112.0 and 86.0 at the end of the experiment for the Apple and Kent mangoes, respectively. The increase in the ratio is attributed to increase in TSS with decrease in TTA during storage. The increase in the TSS is as result of modification of the cell wall structure and conversion of carbohydrates into simple sugars while the decrease in TTA is due to degradation of citric acid as well as the conversion of the acid to sugars and use of the acid in the metabolic activities. This observation is in agreement with the research work in which TSS increased as TTA decreased in during storage [17].

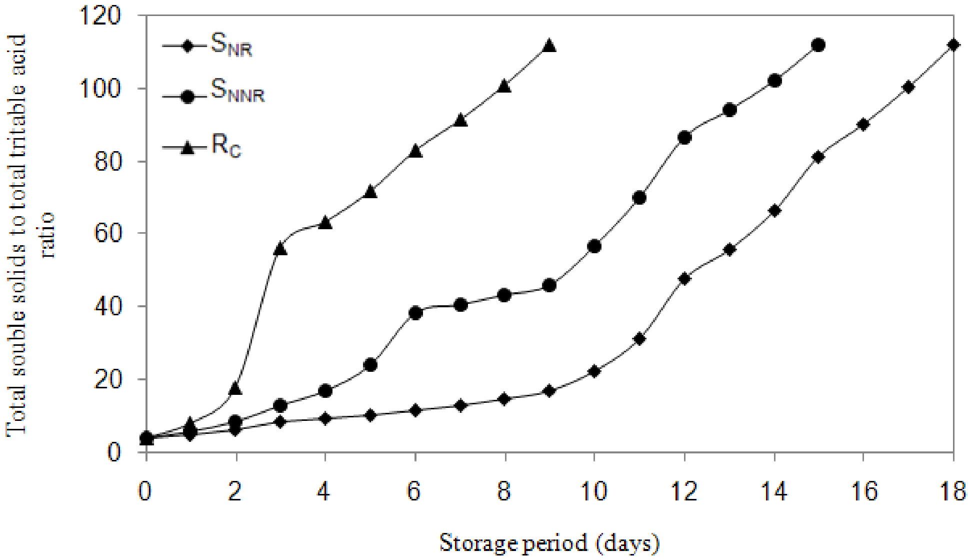

Figure 7 Variations in TSS to TTA ratio with storage period for Apple mangoes stored in the S_{NR}, S_{NNR} and R_C.

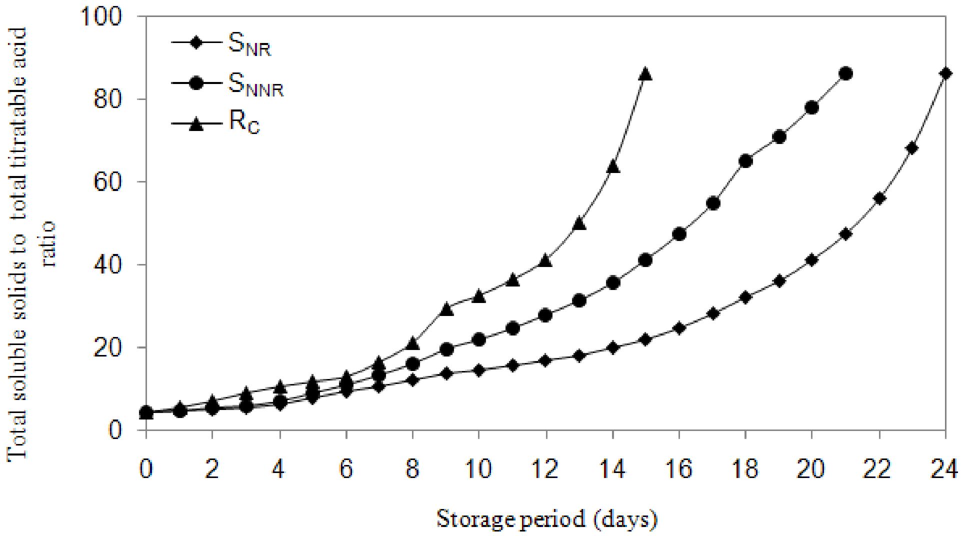

Figure 8 Variations in TSS to TTA ratio with storage period for Kent mangoes stored in the S_{NR}, S_{NNR} and R_C.

IV. Conclusion

This study concluded that the combination of evaporative cooling and near infrared reflection technology preserved the quality and did not show significant effect on the total titratable acid and pH except total soluble solids and hence can be used as an alternative storage system for mangoes.

Acknowledgements

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References

[1] J. Griesbach, Mango Growing in Kenya, *World Agroforestry Centre*, 2003.
[2] HCDA, Horticultural Data 2005-2007, *Validation report*, Nairobi, Kenya, 2008.
[3] HCDA, Export Statistics *Report*, 2010.
[4] KARI, Kenya Agriculture Research Institute, *Annual report*, 1994.
[5] S. Jha, Development of a pilot scale evaporative cooled storage structure for fruits and vegetables for hot and dry region, *Journal of Food Science and Technology*, Mysore, 45(*2*), 2008, 148-151.
[6] M.K. Korir, U.N. Mutwiwa, G.M. Kituu, and D. N. Sila, Effect of near infrared reflection and evaporative cooling on quality of mangoes, *Agricultural Engineering International: CIGR* Journal, 19(*1*), 2017,162-168.
[7] I. Doreyappa Gowda and A. Huddar, Studies on ripening changes in mango (*Mangifera indica l.*) fruits, *Journal of Food Science and Technology*, 38(*2*), 2001, 135-137.

[8] P. Mamiro, L. Fweja, B. Chove, J. Kinabo, V. George, and K. Mtebe, Physical and chemical characteristics of vine ripened mango (*Mangifera indica* l.) fruit dodo, *African Journal of Biotechnology*, 6(*21*), 2007.

[9] V. Sagar and D. Khurdiya, Effect of ripening stages on quality of dehydrated ripe mango slices, *Journal of Food Science and Technology*, 33(*6*), 1996, 527-529.

[10] S.J. Kays, Postharvest physiology and handling of perishable plant products, *Van Nostrand Reinhold Inc*, 1991.

[11] A.P. Medlicott and A.K. Thompson, Analysis of sugars and organic acids in ripening mango fruits (*Mangifera indica l*. Var keitt) by high performance liquid chromatography, *Journal of the Science of Food and Agriculture*, 36(*7*), 1985, 561-566.

[12] I.P, Upadhyay, A. Noomhorm, and S. Ilangantileke, Effects of gamma irradiation and hot-water treatment on the shelf life and quality of Thai mango cv. rad, *Proc. ACIAR*, 1994.

[13] V. Kudachikar, S. Kulkarni, M. Keshava Prakash, M. Vasantha, B. Aravinda Prasad, and K. Ramana, Physico-chemical changes during maturity of mango (mangifera indica l.) variety Neelum. *Journal of Food Science and Technology*, 38(*5*), 2001, 540-542.

[14] P. Srinivasa, R. Baskaran, M. Ramesh, K.H. Prashanth, and R. Tharanathan, Storage studies of mango packed using biodegradable chitosan film, *European Food Research and Technology*, 215(6), 2002, 504-508.

[15] H.A. Rathore, T. Masud, S. Sammi, and A.H. Soomro, Effect of storage on physico-chemical composition and sensory properties of mango (*Mangifera indica l*.) variety dosehari, *Pakistan Journal of Nutrition*, 6(*2*), 2007, 143-148.

[16] M. Shahjahan, M. Sheel, M. Zaman, and M. Sakur, Optimization of harvesting maturities for major mango cultivars in Bangladesh, *Bangladesh Journal of Scientific and Industrial Research*, 12, 1994, 209-215.

[17] M.Y. Hosakote, T.N. Prabha, and R.N. Tharanathan, Mango ripening: changes in cell wall constituents in relation to textural softening, *Journal of the Science of Food and Agriculture*, 86(*5*), 2006, 713-721.

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