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B Naveena
Ph. D Scholar, Department of Post-Harvest Process & Food Engineering, JNKVV, Jabalpur, Madhya Pradesh, India

Genitha Immanuel
Associate Professor, Department of Food Process Engineering, SHUATS, Allahabad, Uttar Pradesh, India

Corresponding Author:
B Naveena
Ph. D Scholar, Department of Post-Harvest Process & Food Engineering, JNKVV, Jabalpur, Madhya Pradesh, India

Effect of dipping treatments on storage life of fruits and vegetables

B Naveena and Genitha Immanuel

Abstract
Minimizing post-harvest losses of horticultural perishables is a very effective way of reducing the area needed for production and/or increasing food availability. This research investigated the effectiveness of dipping treatments on storage life of fruits and vegetables. Bananas, Tomatoes and Cucumbers were dipped in Calcium Chloride, Sodium Chloride and Lime juice solutions with different steeping time. The effects of these agents on pre-treated fruits and vegetables were evaluated by analyzing the pH, TSS, Weight loss and Shelf life. The results indicated that due to pre-treatment increase in pH, TSS and Weight loss was low in fruits and vegetables dipped in Calcium Chloride and Sodium Chloride as compared to Control, there was no significant difference between fruits and vegetables dipped in Lime juice and control. Shelf life of Bananas dipped in Calcium Chloride with a steeping time of 10 min was increased from 7 days to 9 days, Shelf life of Tomatoes was increased from 10 days to 13 days and Shelf life of Cucumbers was increased from 16 days to 22 days. Overall, Calcium Chloride was observed to be effective in increasing the shelf life of fruits and vegetables.

Keywords: Post-harvest losses, perishables, dipping treatments, calcium chloride, sodium chloride, lime juice

1. Introduction
Fruits and vegetables are a major source of essential dietary nutrients such as vitamins and minerals (Sagar and Suresh Kumar, 2010) [8]. Moreover, polyphenols, such as anthocyanins, flavonols and phenolic acids, constitute one of the most numerous and ubiquitous groups of plant metabolites. They are an integral part of both human and animal diets and are also assumed to be beneficial for human health due to their biological activities, including antioxidant, anti-inflammatory, antibacterial, and antiviral functions. Fruits and vegetables contain important plant chemicals, calcium and magnesium. They contain phytochemicals, these biologically active substances can help to protect from some diseases. They have health benefits for consumers, due to their content of fibre, carbohydrates, vitamins and antioxidant compounds. Fruits and vegetables are low in fat, salt and sugar. The World Health Organization (WHO) recommends a daily intake of five to eight portions (400–600 g) of fruits and vegetables to reduce the risk of micronutrient deficiencies, cardiovascular disease, cancer, cognitive impairment, and other diet-related health conditions (Rodriguez-Casado, 2016) [7].

Post harvest losses of fruits and vegetables are serious problem because of rapid deterioration during handling, transport and storage in tropical regions (Yahia, 1998) [10]. These loses are due to changes in texture, flavour, odour and nutritional value after harvest. Post-harvest losses of fresh fruits and vegetables minimize rate of deterioration. Length of storage, respiration, transpiration, chemical composition, external appearance, anatomical structures, delay harvesting, taste qualities and other post harvest behaviours have significant impact on fruit quality. These controllable and uncontrollable factors affect the attainment of maximum quality of fruits (Babalola *et al*., 2010) [1].

The banana is an edible fruit – botanically a berry which is produced by several kinds of large herbaceous flowering plants in the genus *Musa.* In banana, post harvest compositional changes following are important since banana is a climacteric fruit. Cucumber (*Cucumis sativus* L.) is one of the most important vegetables around the world. It is a widely cultivated plant in the gourd family, Cucurbitaceae. It is a creeping vine that bears cucumiform fruits that are used as vegetables. Tomato is one of the most produced and extensively consumed vegetable crops in the world which belongs to *Solanaceae family*.

Tomato is one of the most important "protective foods" because of its special nutritive value. Despite benefits that can be derived from the crop, postharvest losses make its production in most parts of the world unprofitable. Postharvest losses in tomatoes can be as high as 25-42% globally and are due to physiological disorders, physical injury and fungal infections. As ripening progressed in tomatoes, bound calcium content of control fruit decreased, in contrast fruits treated with 8% $CaCl_2$ had increase in the bound calcium content. It is also noted that increase in the concentration of Calcium Chloride increases the firmness of the fruit (Hong and Lee 1999) [5].

Dipping treatments favour the dispersion of the solution on the surface of the vegetable (Soliva-Fortuny *et al*., 2003) [9]. Pre and post-harvest Calcium applications have been used to delay aging or ripening, to reduce post-harvest decay and to control the development of many physiological disorders in fruits and vegetables (Conway *et al.*, 1994) [3]. From the study of the effects of Calcium Chloride dip on the weight loss and texture of the carrot shreds, it is noted that the treatment substantially maintained their quality during the storage period. (Izumi and Watada 1994) [6]. Post-harvest treatment of pineapples with Calcium Chloride retards their decay rate (Goncalves *et al*., 2000) [4]. To prolong the shelf-life of fruits and vegetables different Physical and Chemical methods have been so far used. Calcium Chloride, Sodium Chloride and Lime juice were selected in this study to treat Banana, Tomato and Cucumber. The aim of present work was to evaluate the effects of these agents on physico-chemical properties and to increase the shelf life of treated fruits and vegetables.

2. Methods and Materials

2.1 Selection of raw material

Fresh Bananas, Tomatoes and Cucumbers were procured from a local wholesaler in Allahabad. All the fruits were cleaned and sorted to remove the undesirable fruits and vegetables. The good ones were washed thoroughly with water.

2.2 Preparation of dipping solution

Calcium chloride 3% solution was prepared by dissolving 3 g of $CaCl_2$ in 100 ml of distilled water and Sodium chloride 3% solution was prepared by dissolving 3 g of $CaCl_2$ in 100 ml of distilled water and Lime juice 3% solution was prepared by dissolving 3 ml of lime juice in 100 ml of distilled water.

2.3 Dipping fruits and vegetables in solutions

Selected Fruits and vegetables were dipped in all the solutions for 5 minutes and 10 minutes. After that they were air dried under fan and kept in baskets at room temperature.

2.4 Determination of pH

To determine the pH, distilled water was taken in a beaker and an electrode of the pH meter was dipped in the distilled water and reading of pH meter was set manually by knob to 7 i.e. the neutral value. Then film samples were taken in beaker and pH was measured by dipping electrodes of digital pH meter.

2.5 Determination of TSS

The Percent juice content was measured to determine the quality of fruits and vegetables. TSS was measured using Hand Refractometer. A drop of juice sample was dropped on the face of the Refractometer. TSS was noted through the eye piece and is expressed as °Bx.

2.6 Determination of Weight Loss

For determination of weight, before storage three fruits in each replication were separately marked and weighed on digital balance at the start of the experiment and thereafter the same fruits were consistently weighed during the storage period. Weight was calculated by using the following formula:

Weight Loss % = (fruit initial weight-fruit weight at each sampling date/fruit initial weight)×100

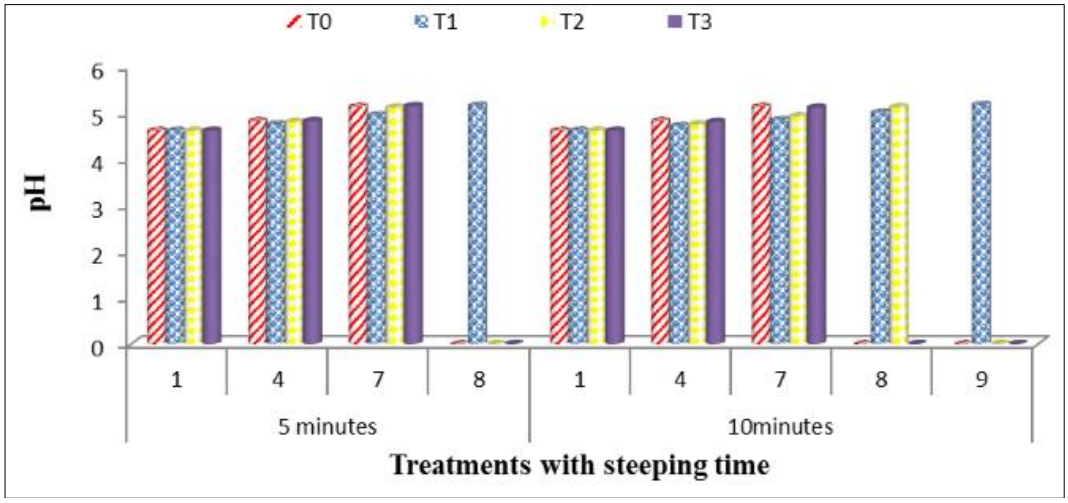
2.7 Determination of Shelf life

After pre-treatment, the fruits and vegetables were drained. The treated and control fruits and vegetables were stored at room temperature. Quality Evaluation was done for every 2 days by measuring pH, TSS and Weight loss. Shelf life was calculated by counting number of days.

3. Results and discussion

3.1 Effect of dipping treatments on pH of fruits and vegetables

3.1.1 pH of Banana: The results regarding to the pH of Bananas is shown in Fig 1. The measured pH of Bananas before treatment was 4.6. On 7^{th} day, pH of Calcium Chloride treated Bananas with steeping time of 5 min (4.93) and 10 min (4.83) was less followed by Sodium Chloride treated Bananas with steeping time of 5 min (5.1) and 10 min (4.91), compared to Control (5.12) and Lime juice treated Bananas with steeping time of 5 min (5.13) and 10 min (5.1). On 8^{th} day, control, Sodium Chloride treated fruits with a steeping time of 5min and Lime juice treated Bananas were spoiled. On 8^{th} day, Sodium Chloride treated Bananas with a steeping time of 10 min were spoiled, Calcium Chloride treated Bananas with a steeping time of 10 min were recorded with a pH of 5.14, after 9^{th} day they were spoiled.

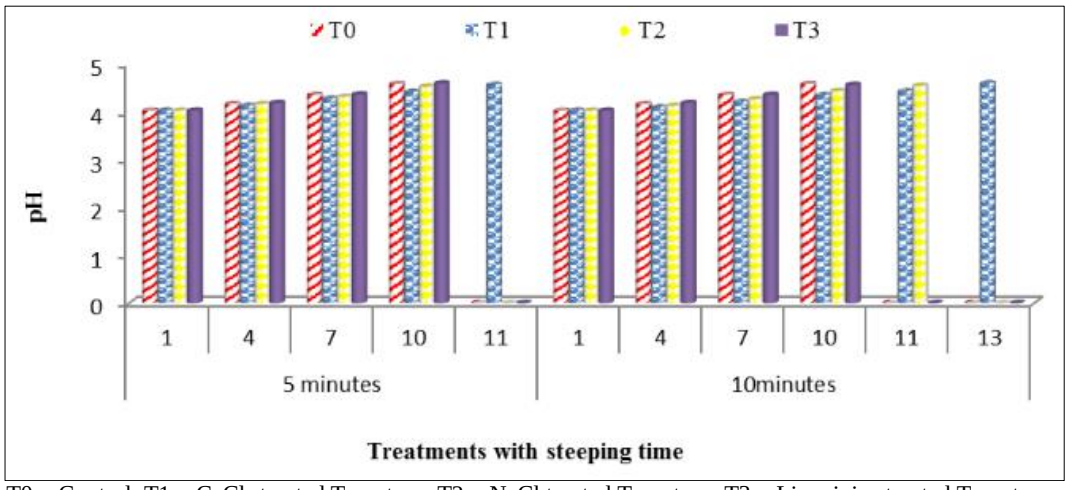


T0 = Control, T1 = $CaCl_2$ treated bananas, T2 = NaCl treated bananas, T3 = Lime juice treated bananas

Fig 1: Effect of dipping treatments on pH of Banana

3.1.2 pH of Tomato

The results regarding to the pH of Tomatoes is shown in Fig 2. The measured pH of Tomatoes before treatment was 4.02. On 10th day, the pH of Calcium Chloride treated Tomatoes with steeping time of 5 min (4.41) and 10 min (4.34) was less followed by Sodium Chloride treated Tomatoes with steeping time of 5 min (4.52) and 10 min (4.46) compared to Control (4.58) and Lime juice treated Tomatoes with steeping time of 5 min (4.58) and 10 min (4.56). On 11th day Control, Sodium Chloride treated Tomatoes with steeping time of 5 min and Lime juice treated Tomatoes with steeping time of 5 min 10 min were spoiled. On 13th day, Sodium Chloride treated Tomatoes with steeping time of 10 min were spoiled, Calcium Chloride treated Tomatoes with steeping time of 10 min were recorded with a pH of 4.59, after 13th day these tomatoes were spoiled.

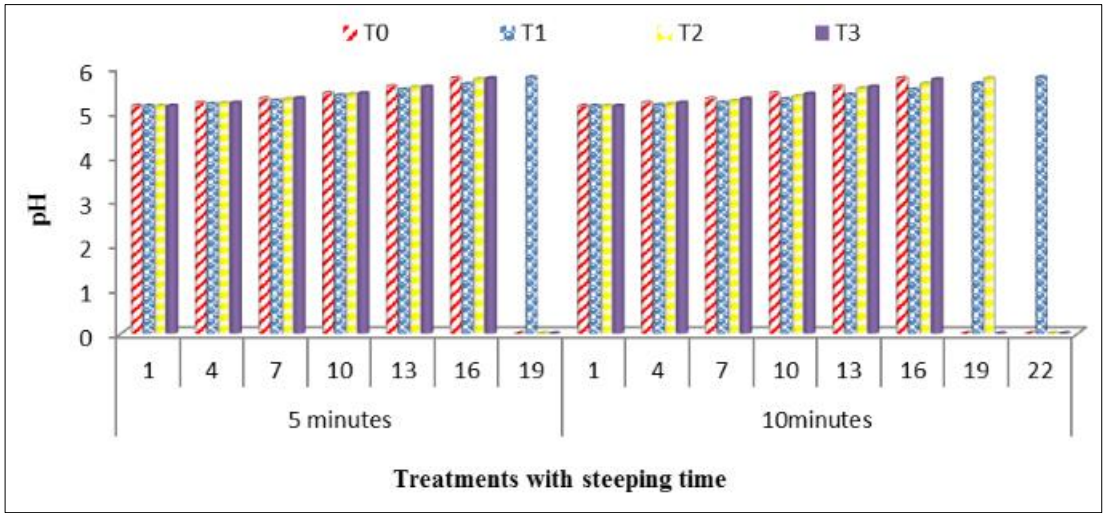


T0 = Control, T1 = $CaCl_2$ treated Tomatoes, T2 = NaCl treated Tomatoes, T3 = Lime juice treated Tomatoes

Fig 2: Effect of dipping treatments on pH of Tomato

3.1.3 pH of Cucumber

The results regarding to the pH of Cucumber is shown in Fig 3. As the storage period is increasing, the increase in pH of Control and Sodium Chloride and Lime juice treated Cucumbers was more but the increase in pH of Calcium Chloride treated Cucumbers was less. On 16th day, the pH of Calcium Chloride treated fruits with steeping time of 5 min (5.61), 10 min (5.49) was less followed by Sodium Chloride treated fruits with steeping time of 5 min (5.72), 10 min (5.62) compared to Control (5.74) and Lime juice treated fruits with steeping time of 5 min (5.74), 10 min (5.72). On 19th day, Control, Sodium Chloride treated Cucumbers with steeping time of 5 min and Lime juice treated Cucumbers were degraded. On 22nd day, Sodium Chloride treated Cucumbers with steeping time of 10 min were spoiled, Calcium Chloride treated fruits with steeping time of 10 min were recorded with a pH of 5.76, after 22nd day they were spoiled.



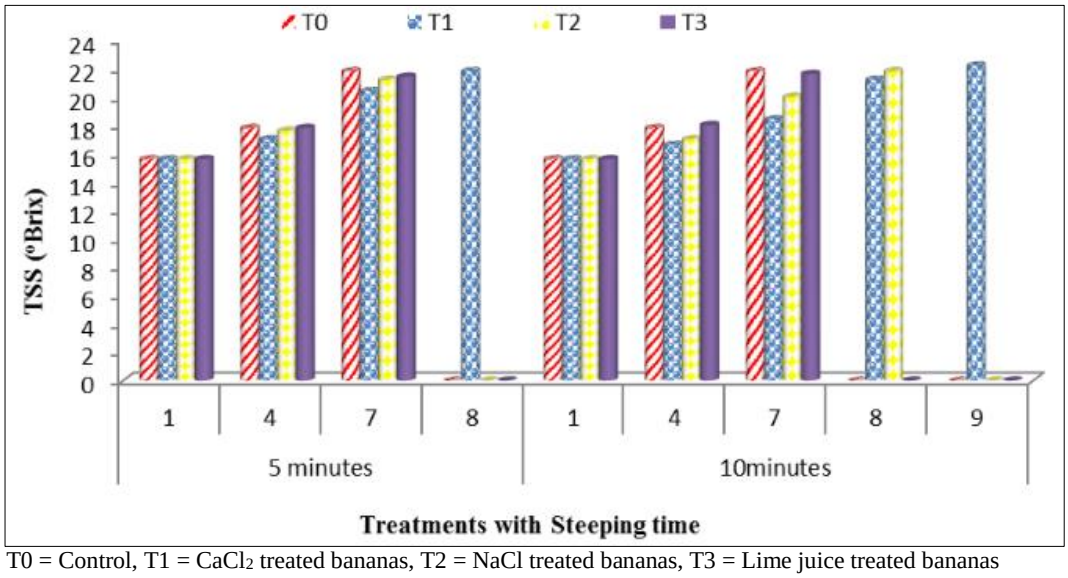
T0 = Control, T1 = $CaCl_2$ treated Cucumbers, T2 = NaCl treated Cucumbers, T3 = Lime juice treated Cucumbers

Fig 3: Effect of dipping treatments on pH of Cucumber

3.2 Effect of dipping treatments on TSS of fruits and vegetables

3.2.1 TSS of Banana

The results regarding to the TSS of Bananas is plotted in Fig 4.The measured TSS of Bananas before treatment was 15.6 ^{o}Brix. On 7th day, TSS of Calcium Chloride treated Bananas with steeping time of 5 min (20.4 ^{o}Brix) and 10 min (18.4^{o}Brix) was less followed by Sodium Chloride treated Bananas with steeping time of 5 min (21.2 ^{o}Brix) and 10 min (20 ^{o}Brix) compared to Control (21.8^{o}Brix) and Lime juice treated Bananas with steeping time of 5 min (21.4 ^{o}Brix) and 10 min (21.6 ^{o}Brix). On 8th day, Control, Sodium Chloride treated Bananas with steeping time of 5min and Lime juice treated Bananas were spoiled. On 9th day, Sodium Chloride treated Bananas with steeping time of 10 min were spoiled, Calcium Chloride treated Bananas with steeping time of 10 min were recorded with a TSS of 22.2 ^{0}Brix, after 9th day they were spoiled. Starch content decreased gradually as the bananas ripened, which was due to the breakdown of starch into sugars.

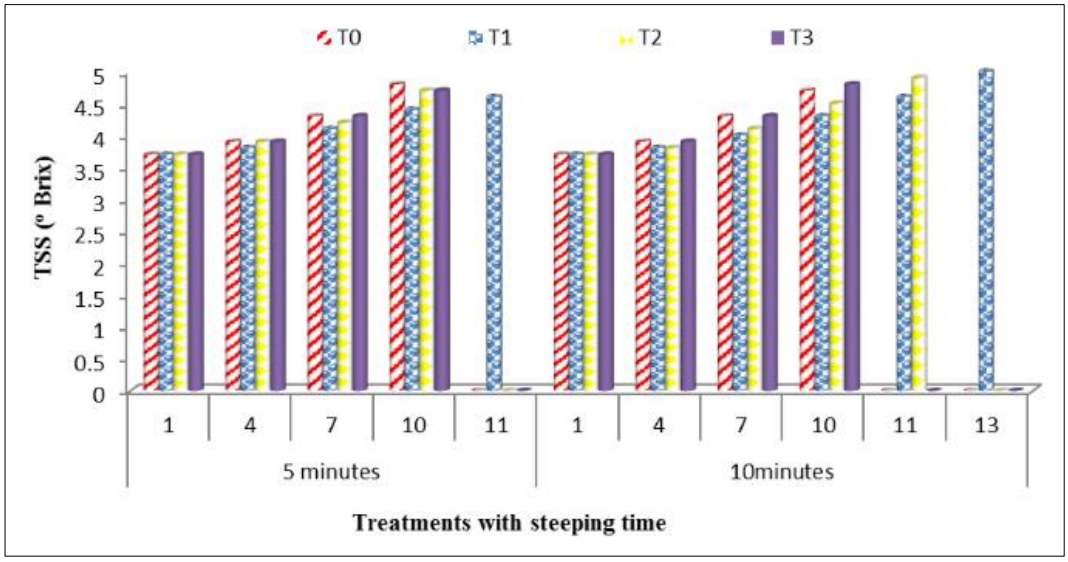


T0 = Control, T1 = $CaCl_2$ treated bananas, T2 = NaCl treated bananas, T3 = Lime juice treated bananas

Fig 4: Effect of dipping treatments on TSS of Banana

3.2.2 TSS of Tomato

The results regarding to the TSS of Tomatoes is shown in Fig 5. The measured TSS of Tomatoes before treatment was 3.7 (^{0}Brix). On 10th day the TSS of Tomatoes dipped in Calcium Chloride with steeping time of 5 min (4.4 ^{0}Brix) and 10 min (4.3 ^{0}Brix) was less followed by Sodium Chloride treated Tomatoes with steeping time of 5 min (4.7 ^{0}Brix) and 10 min (4.5 ^{0}Brix) compared to Control (4.8 ^{0}Brix) and Lime juice treated Tomatoes with steeping time of 5 min (4.7 ^{0}Brix) and 10 min (4.8 ^{0}Brix). On 11th day Control, Sodium Chloride treated Tomatoes with steeping time of 5 min and Lime juice treated Tomatoes with steeping time of 5 min and 10 min were observed to be degraded. On 13th day Sodium Chloride treated Tomatoes with steeping time of 10 min were degraded, Calcium Chloride treated Tomatoes with steeping time of 10 min were recorded with a TSS of 5.0 (^{0}Brix), after 13th day they were observed to be degraded.

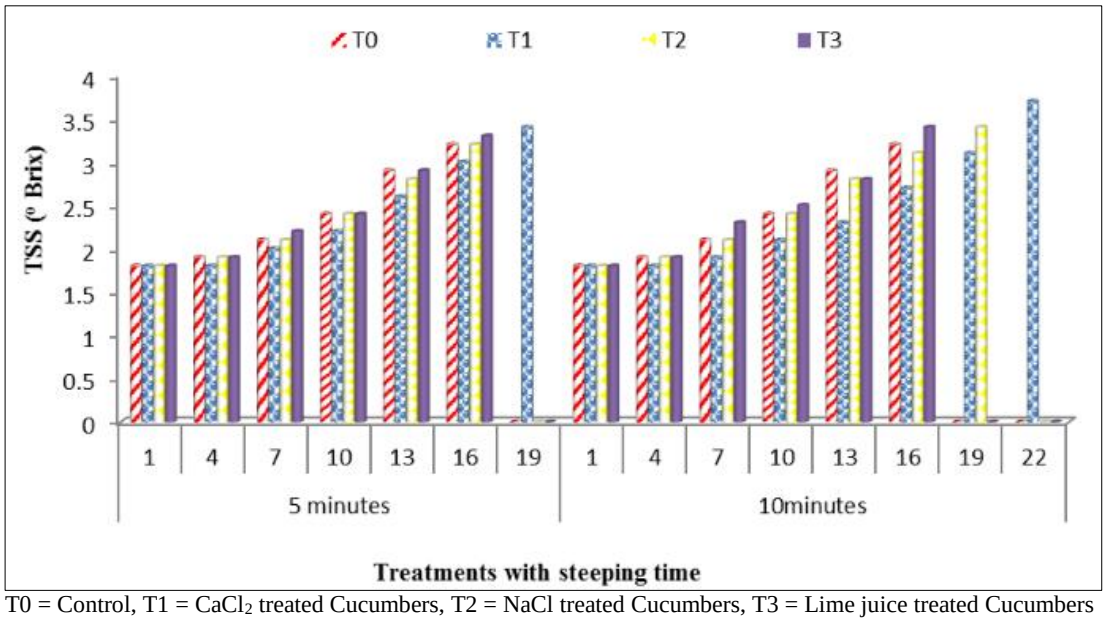


T0 = Control, T1 = $CaCl_2$ treated Tomatoes, T2 = NaCl treated Tomatoes, T3 = Lime juice treated Tomatoes

Fig 5: Effect of dipping treatments on TSS of Tomato

3.2.3 TSS of Cucumber

The results regarding to the TSS of Cucumber is shown in Fig 6. On 16th day, the increase in TSS of Calcium Chloride treated Cucumbers with steeping time of 5 min (3°Brix), 10 min (2.7 °Brix), was less followed by Sodium Chloride treated Cucumbers with steeping time of 5 min (3.2 °Brix), 10 min (3.1 °Brix) compared to Control (3.2 °Brix) and Lime juice treated Cucumbers with steeping time of 5 min (3.3 °Brix), 10 min (3.4 °Brix). On 19th day, Control, Sodium Chloride treated Cucumbers with steeping time of 5 min and Lime juice treated Cucumbers were spoiled, Calcium Chloride treated Cucumbers with steeping time of 5 min and 10 min were recorded with a TSS of 3.4 (^{0}Brix), 3.1 (^{0}Brix). On 22nd day, Sodium Chloride treated Cucumbers with steeping time of 10 min were spoiled, Calcium Chloride treated Cucumbers with steeping time of 10 min was recorded with a TSS of 3.7 (^{0}Brix), after 22nd day they were spoiled.



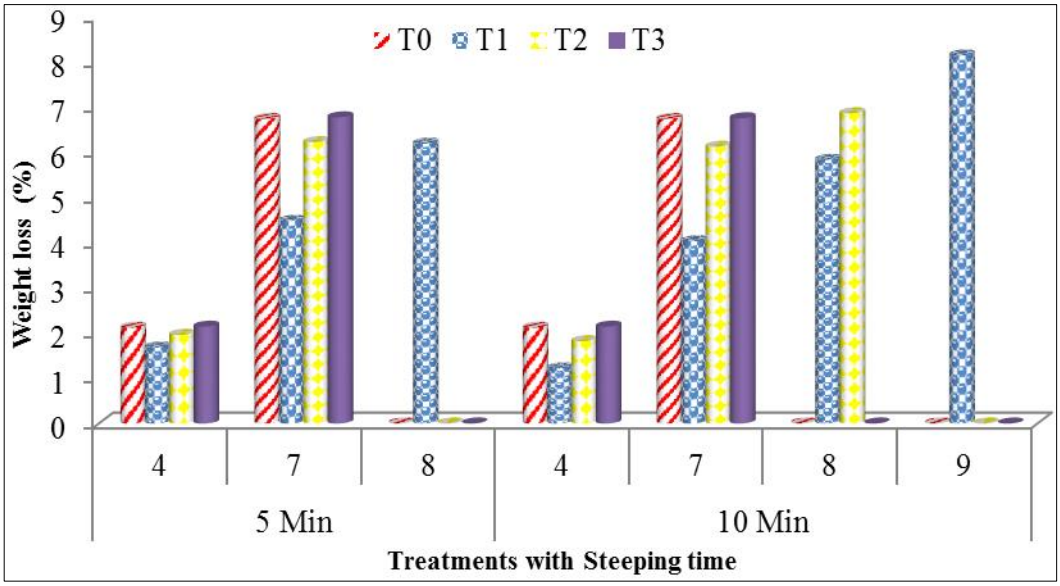
T0 = Control, T1 = $CaCl_2$ treated Cucumbers, T2 = NaCl treated Cucumbers, T3 = Lime juice treated Cucumbers

Fig 6: Effect of dipping treatments on TSS of Cucumber

3.3 Effect of dipping treatments on weight loss of fruits and vegetables

3.3.1 Weight loss of Banana

The results regarding to the Weight loss of Bananas is shown in Fig 7. On 7th day, the weight loss of Bananas dipped in Calcium Chloride with steeping time of 5 min (4.48%) and 10 min (4.03%) was less, followed by Sodium Chloride treated Bananas with steeping time of 5 min (6.22%) and 10 min (6.12%) compared to Control (6.74%) and Lime juice treated Bananas with steeping time of 5 min (6.77%) and 10 min (6.75%). On 8th day, Control, Sodium Chloride treated fruits with steeping time of 5 min and Lime juice treated Bananas with steeping time of 5 min and 10 min were spoiled. On 9th day, Sodium Chloride treated Bananas with steeping time of 10 min were degraded, Calcium Chloride treated Bananas with steeping time of 10 min were recorded with a weight loss of 8.14%, after 9th day they were spoiled. The reduction in weight of fruits treated with Calcium chloride was less, there was no significant difference between Control and Lime juice treated Bananas.

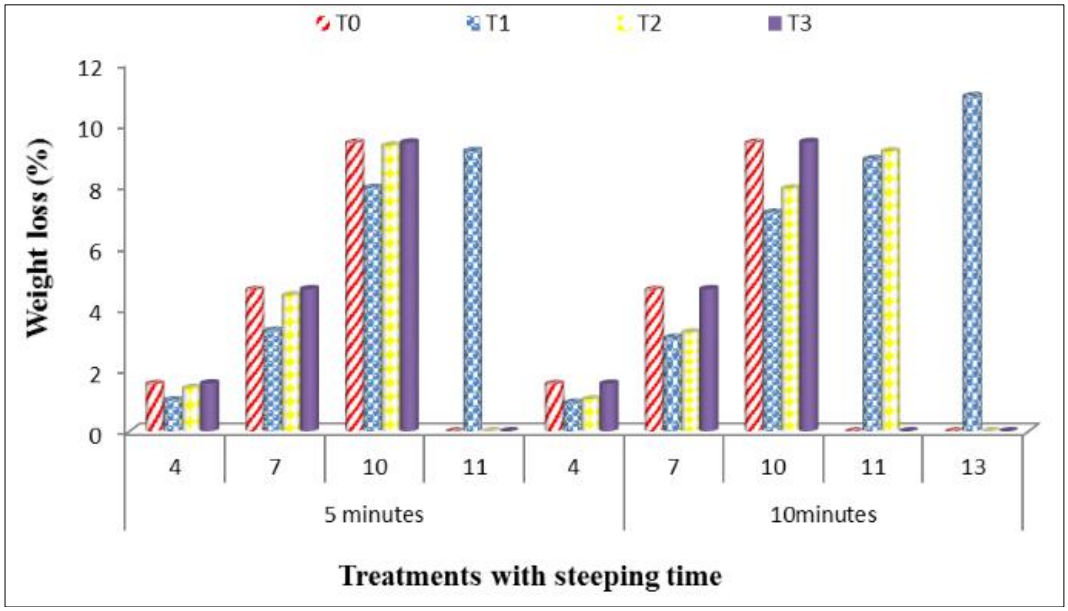


T0 = Control, T1 = $CaCl_2$ treated bananas, T2 = NaCl treated bananas, T3 = Lime juice treated bananas

Fig 7: Effect of dipping treatments on Weight loss of Banana

3.3.2 Weight loss of Tomato

The results regarding to the Weight loss of Tomatoes is shown in Fig 8. On 10th day, the weight loss of Calcium Chloride treated Tomatoes with steeping time of 5 min (7.93%) and 10 min (7.12%) was less followed by Sodium Chloride treated Tomatoes with steeping time of 5 min (9.31%) and 10 min (7.91%) compared to Control (9.39%) and Lime juice treated Tomatoes with steeping time of 5 min (9.4%) and 10 min (9.42%). On 11th day, Control, Sodium Chloride treated Tomatoes with steeping time of 5 min and Lime juice treated Tomatoes with steeping time of 5 min and 10 min were degraded. On 13th day, Sodium Chloride treated Tomatoes with steeping time of 10 min were degraded, Calcium Chloride treated Tomatoes with steeping time of 10 min were recorded with a weight loss of 10.92%, after 13th day they were spoiled. There is no significant difference between Control and Lime juice treated Tomatoes.



T0 = Control, T1 = $CaCl_2$ treated Tomatoes, T2 = NaCl treated Tomatoes, T3 = Lime juice treated Tomatoes

Fig 8: Effect of dipping treatments on Weight loss of Tomato

3.3.3 Weight loss of Cucumber

The results regarding to the weight loss of Cucumber is shown in Fig 9. As the storage period is increasing the decrease in weight of Control and Sodium Chloride and Lime juice treated Cucumbers was increased but the decrease in weight of Calcium Chloride treated Cucumbers was less. On 16thday, the weight loss of Calcium Chloride treated Cucumbers with steeping time of 5 min (10.37%) and 10 min (10.01%) was less followed by Sodium Chloride treated Cucumbers with steeping time of 5 min (10.77%) and 10 min (10.64%), compared to Control (10.85%) and lime juice treated Cucumbers with steeping time of 5 min (10.84%) and 10 min (10.85%). On 19th day, Control, Sodium Chloride treated Cucumbers with steeping time of 5 min and Lime juice treated Cucumbers with steeping time of 5 min and 10 min were degraded. On 22nd day, Sodium Chloride treated Cucumbers with steeping time of 10 min were spoiled, Calcium Chloride treated Cucumbers with steeping time of 10 min were recorded with a weight loss of 16.82%, after 22nd day they were spoiled.

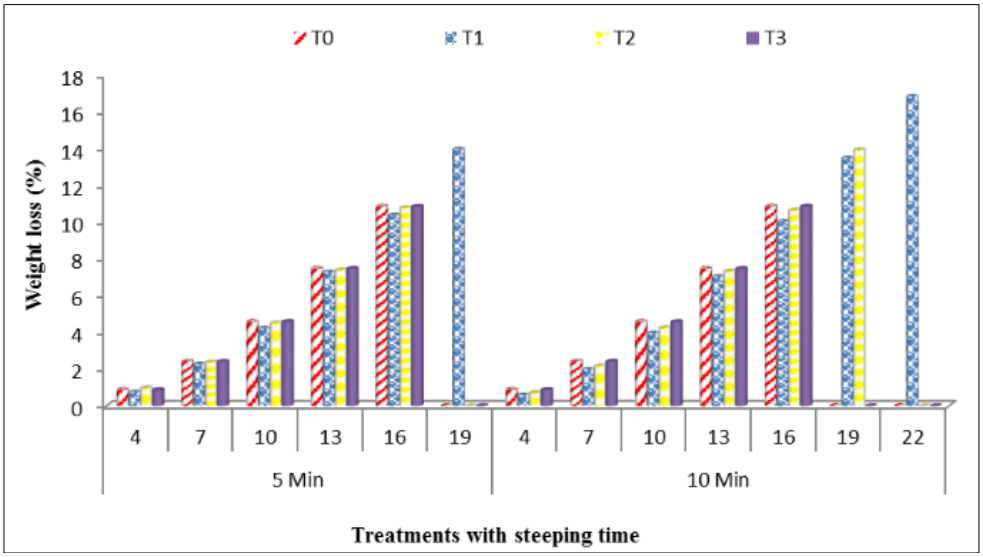


Fig 9: Effect of dipping treatments on Weight loss of Cucumber

3.4 Effect of dipping treatments on shelf life of fruits and vegetables

3.4.1 Shelf life of Banana

The results regarding to the shelf life of Bananas is shown in Fig 10. The shelf life of Control, Lime juice treated Bananas and Sodium Chloride treated Bananas with steeping time of 5 min was 7 days which is less compared to Calcium Chloride treated Bananas with steeping time of 5 min (8 days) and with steeping time of 10 min (9 days), Sodium Chloride treated Bananas with steeping time of 10 min (8 days).

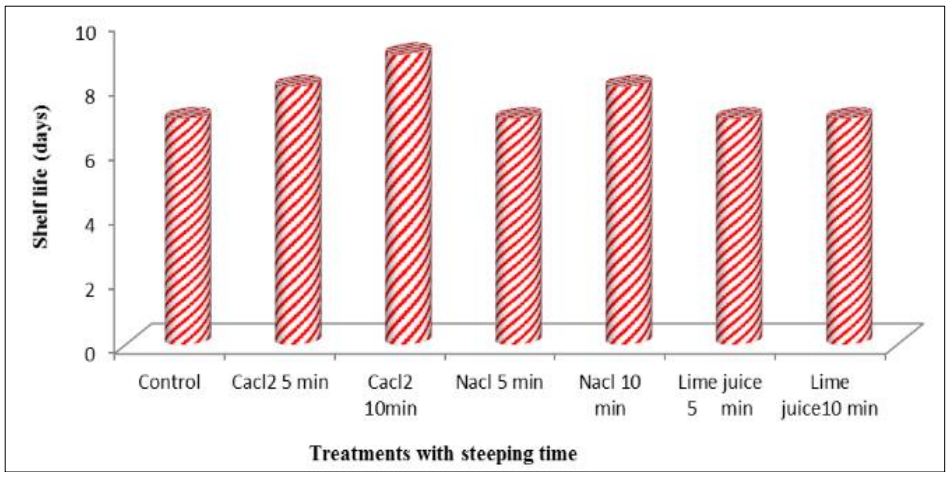


Fig 10: Effect of dipping treatments on Shelf life of Banana

3.4.2 Shelf life of Tomato

The results regarding to the shelf life of Tomatoes is shown in Fig 11. The Shelf life of Calcium Chloride treated Tomatoes with steeping time of 5 min (11 days) and 10 min (13 days) was more followed by Sodium Chloride treated Tomatoes with steeping time of 5 min (10 days) and 10 min (11 days). The shelf life of Control (10 days) and Lime juice treated Tomatoes with steeping time of 5 min (10 days) and 10 min (10 days) was less compared to Calcium Chloride and Sodium Chloride treated Tomatoes.

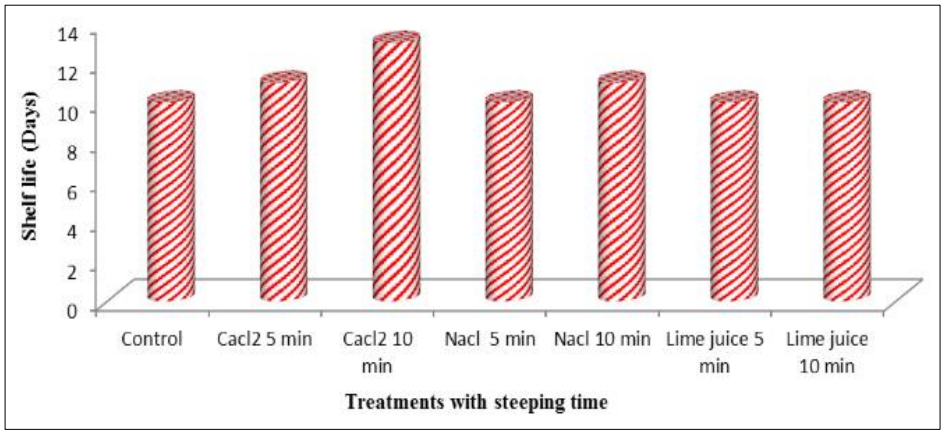


Fig 11: Effect of dipping treatments on Shelf life of Tomato

3.4.3 Shelf life of Cucumber

The results regarding to the shelf life of Cucumbers is shown in Fig 12. The shelf life of Calcium Chloride treated Cucumbers with steeping time of 5 min (19 days) and 10 min (22 days) was more followed by Sodium Chloride treated Cucumbers with steeping time of 5 min (16 days) and 10 min (16 days) compared to Control (16 days) and Lime juice treated Cucumbers with steeping time of 5 min (16 days) and 10 min (16 days). There was increase in shelf life of fruits dipped in Calcium chloride, as calcium in the cell wall serves as a binding agent which helps to maintain the quality and extend the storage life particularly by delaying ripening and senescence as well as reducing respiration rate and physiological disorder. The above results were comparative with Bhattara *et al*., (2006) [2]. There was no significant difference between Control and Lime juice treated Cucumbers.

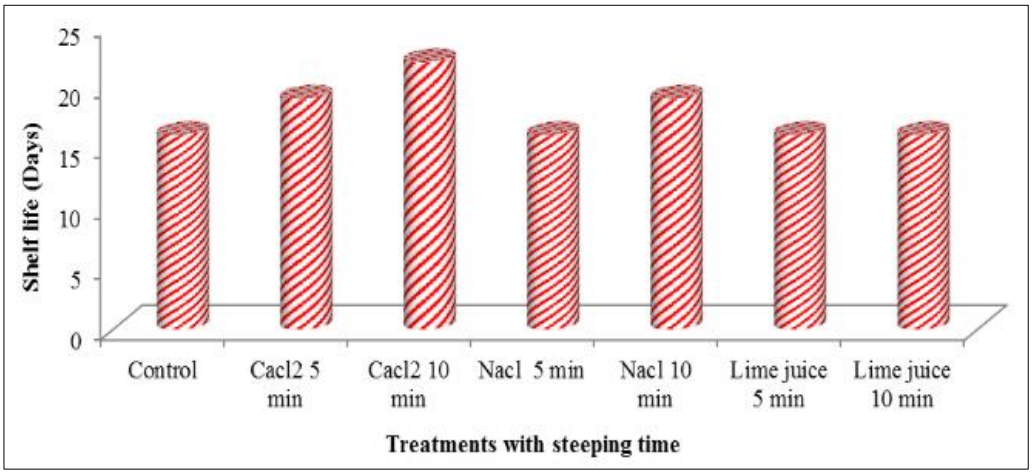


Fig 12: Effect of dipping treatments on Shelf life of Cucumber

4. Conclusion

This research reveals the effect of dipping treatments on physico-chemical properties of Bananas, Tomatoes and Cucumbers during storage. This work shows that the effect of dipping treatments on pre-treated fruits and vegetables is quite beneficial in terms of pH, TSS and Shelf life. The decrease in weight was observed to be less in fruits and vegetables dipped in Calcium Chloride and Sodium Chloride solutions. Overall, the results presented in this study show that Calcium Chloride with steeping time of 5 min, 10 min and Sodium Chloride with steeping time of 10 min was effective in increasing shelf life of fruits and vegetables.

5. References

1. Babalola DA, Makinde YO, Omonona BT, Oyekanmi MO. Determinants of post harvest losses in tomato production: A case study of Imeko - Afon local government area of Ogun state. Journal of Life and Physical Sciences, Acta SATECH 2010;3(2):14-18.
2. Bhattarai DR, Gautam DM. Effect of harvesting method and calcium on postharvest physiology of tomato. Nepal Agricultural Resource Journal 2006;7:23-26.
3. Conway WS, Sams CE, Wang CY, Abbott JA. Additive of effects of postharvest calcium and heat treatments on reducing decay and maintaining quality in apples, J Am. Soc. Hortic. Sci 1994;119:49-53.
4. Goncalves NB, de Carvalho VD, de A JR. Goncalves. Effect of calcium chloride and hot water treatment on enzyme activity and content oh phenolic compounds in pineapples, Pesquisa Agropecuaria Brasileira 2000;35(10):2075-2081. (Portuguese/ English Abstract).
5. Hong JH, Lee SK. Effect of calcium treatment on tomato fruit ripening, J Korean Society of Horticultural Sciences 1999;40(6):638-642.
6. Izumi H, Watada AE. Calcium treatments affect storage quality of shredded carrots. Journal of Food Science 1994;59(1):106-109.
7. Rodriguez-Casado A. The health potential of fruits and vegetables phytochemicals: notable examples. Crit. Rev. Food Sci. Nutr 2016;56(2016):1097-110.
8. Sagar VR, Suresh Kumar P. Recent advances in drying and dehydration of fruits and vegetables: A review. Journal of Food Science and Technology 2010;47:15-26.
9. Soliva-Fortuny RC, Martin-Belloso O. New advance in extending the shelf life of fresh-cut fruits: A review. Trends in Food Science and Technology 2003;14:341-353.
10. Yahia A, Kevers C, Gaspar T, Che Ânieux JC, Rideau M, Cre Áche J. Cytokinins and ethylene stimulate indole alkaloid accumulation in cell suspension cultures of Catharanthus roseus by two distinct mechanisms. Plant Science 1998;133:9±15.