Enhanced Knowledge in Sciences and Technology Vol. 2 No. 2 (2022) 121-128

EKST

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/ekst
e-ISSN: 2773-6385

Dipping treatment: Effectiveness of Ascorbic Acid and Calcium Chloride on physicochemical properties of Fresh Cut Jackfruit

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DOI: https://doi.org/10.30880/ekst.2022.02.02.013
Received 02 January 2022; Accepted 08 June 2022; Available online 23 November 2022

Abstract: Jackfruit with the scientific name, *Artocarpus heterophyllus* L. was believed to have originates in rainforests of India. It is known as one of the most nutritious fruits. In this study, the jackfruit was deseeded and cut into the desired size which is 2 cm x 2 cm. The untreated sample or also known as control sample was left for storage after sanitized with chlorinated water (30 ppm) for 5 minutes. The other sample was treated with 1% of calcium chloride and 0.25% of ascorbic acid. All of the samples were stored in zip lock bag according to day of analysis and was left in a chilled condition for 17 days. A total of 7 analyses was done which are pH, total soluble solid, titratable acidity, ascorbic acid content, color, texture and moisture content. The sample was analyzed for day 0, 3, 6, 10, 13, 17 and was done in triplicate for each analysis. The texture of the fresh cut jackfruit bulb dipped with calcium chloride was firmer than ascorbic acid dipped samples. Both chemicals were proven to be effective on the physicochemical properties of the fresh cut jackfruit, as it shows a decrease trend in analysis of pH, corresponding to increase of titratable acidity. The analysis of total soluble solid and ascorbic acid content decreases by time. Analysis of color which is the value of a* that indicates redness was the highest in ascorbic acid dipped samples. The calcium chloride helps maintained the value of L* that indicates lightness and b* due to its role to inhibit the color changes of the sample. To conclude, calcium chloride and ascorbic acid able to maintain the physicochemical properties of fresh cut jackfruit bulb while act as firming and anti-browning agent throughout the 17 days of storage.

Keywords: Fresh Cut Jackfruit, Dipping Treatment, Ascorbic Acid, Calcium Chloride, Physicochemical Properties

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1. Introduction

Jackfruit is one of the well-known fruits that is beneficial for health benefits. It has 18.9 g carbohydrate, 1.9 g protein, 0.1 g fat, 77% moisture, 1.1 g fiber, 0.8 g total mineral matter, 20 mg calcium, 30 mg phosphorus, 500 mg iron and 84 calories [8] which can conclude that jackfruit is chosen due to its high nutritional value content of protein, starch, calcium and thiamine [8]. One of the methods to certify the freshness of the fruit is by minimally processed. The minimal processed fruit is usually affecting the quality of the fresh-cut fruit whereby it degraded through contamination of microbes, exhaustion of phytochemicals, tissue softening and browning [5].

Cut fruit causes severe physiological stress and accumulation of the phenolic metabolite on the surface of the cut fruit. Any physical damage that occurs to the fresh-cut fruit will result in rapid deterioration. It can increase the percentage of microbial growth, exhaustion of phytochemicals, tissue softening and browning effect. Hence, appropriate method is required to preserve the quality of freshcut fruit and lowering the possibility of deterioration. The post-harvest dipping treatment with chemical preservatives such as ascorbic acid and calcium chloride is known to reduce the stress-induced metabolism. Dipping treatment is known to maintain firmness of the fresh-cut fruit, lowering browning reaction along with extension of its shelf life [4].

According to research from Sadili Bico, (2010) texture and color analysis are the most noticeable quality parameters that might change during storage, influencing the marketability of the product. Therefore, this study aims to apply ascorbic acid and calcium chloride as chemical treatment on minimally processed jackfruit bulb and to evaluate the effectiveness of dipping treatment on the retention of overall quality in terms of physicochemical properties such as pH, total soluble solid, titratable acidity, ascorbic acid content, color, texture and moisture content during storage.

2. Materials and Methods

2.1 Materials

Jackfruit was purchased from local market at Muar, Johor. It was in brownish yellow skin color at optimum ripening stage, fresh, matured, healthy, in a uniform-sized and good quality. As for chemical solution, the calcium hypochlorite, calcium chloride and ascorbic acid was purchased from Merck, German

2.2 Preparation of fresh cut jackfruit

The jackfruit was washed using tap water and cut into halves using sharp stainless-steel knife that has been smeared with cooking oil to avoid sticking between them [4]. The bulbs were separated from the rind and core of the fruit. The bulbs were deseeded and cut into uniform slices, approximately at size of 2 cm x 2 cm.

2.3 Preparation of chemical solution

A chlorinated water was prepared by diluting 14.2 g of dry powder (35% calcium hypochlorite) to 1 liter of distilled water. 147.02 g of anhydrous calcium chloride was dissolved into 1 liter of distilled water to make 1% of calcium chloride. As for the ascorbic acid solution, 44 g of ascorbic acid powder is stirred into 1 liter of deionized water to produce 0.25% of ascorbic acid.

The fresh cut jackfruit bulb was dipped into the chlorinated water for 5 minutes. After sanitizing, the samples were divided into three which were used as control sample and the other two group were dipped into the solution of ascorbic acid and calcium chloride respectively. The dipping treatment was left for 5 minutes before packed into zip lock bag. Excess liquid after the dipping process was drained off and the samples were stored in a chilled condition for 17 days.

2.4 Physicochemical properties

2.4.1 pH

The pH of fresh-cut jackfruit reveals acidity by measuring H^+ ion activity. A pH meter (Radiometer PHM 210, Metro Lab, France) was used to determine the pH of all of the samples in triplicate reading.

2.4.2 Total Soluble Solid

5 g of ground fresh cut jackfruit was diluted with 100 ml of distilled water to measure the total soluble solids. Before using the refractometer (Hand-Held Refractometer; Atago Co. Ltd., Japan), calibration was done by placing several drops of distilled water onto the prism surface and wait until it gave a reading of zero. A few drops of diluted samples were placed onto the prism of the refractometer. Wait for few minutes for the reading to come out. The percentage of the sugar was recorded in terms of ◦Brix. The refractometer was then immediately cleaned and dry thoroughly before proceed with other samples. After every reading of the homogenized sample, the refractometer was calibrated by putting distilled water onto the prim surface until reading of zero obtained

2.4.3 Titratable Acidity

1 N NaOH was used to determine the total titratable acidity of the fresh-cut jackfruit bulb. It was expressed in g of citric acid/100 g of jackfruit. 10 g of fresh cut jackfruit bulb were homogenized with 100 ml of distilled water using homogenizer. 10 ml of the homogenized sample was put into Erlenmeyer flask. 5 drops of phenolphthalein were used as indicator which it becomes clear if the solution was acidic but change to purple when it becomes neutral to basic. 0.1 N of sodium hydroxide was titrated while stirring the solution until a pinkish color appeared.

2.4.4 Ascorbic Acid

0.005 mol L^{-1} of iodine solution was used to titrate the sample along with 0.5% of starch indicator to determine the ascorbic acid content in the sample. 20 ml of the aliquot sample solution was pipetted into 250 ml conical flask and 150 ml of distilled water was added along with 1 ml of starch indicator solution. The endpoint of titration was identified as the first permanent trace of a dark blueblack color due to the starch-iodine complex. The titration was repeated using all samples and was done in triplicate for each sample.

2.4.5 Color

The color changes in fresh-cut jackfruit were assessed using a hand-held colorimeter (Mini Scan XE Plus, Hunter Associates Laboratory, Inc., Virginia, United States). The colorimeter was first calibrated with black and white tile before use to read the color of the sample that was put into a clean and dry petri dish with a lid. Three reading was obtained for each sample.

2.4.6 Texture

The texture of the fresh-cut jackfruit was measured using CT3 texture analyzer [5]. The texture analyzer was set as follows: pre-test speed:1.50 mm/sec; test speed:1.50 mm/sec; post-test speed:10.00 mm/sec. Before using, the texture analyzer was set for height and force calibration. The penetration was done at three different point on each sample and a total of nine samples were used for control, ascorbic acid and calcium chloride dipped samples.

2.4.7 Moisture content

The determination of moisture content was done by using thermogravimetric approach. An oven drying of range of temperature of 55◦C to 60◦C was used to dry the sample for 24 hours. Three pieces of fresh cut jackfruit bulb was used for each sample and the initial and final weight was obtained.

3. Results and Discussion

3.1 pH

The pH decreases by time corresponds to the increases in titratable acidity since both are not directly correlated. Control sample is more alkali after it has been dipped in chlorinated water only compared with other samples. Both samples dipped in ascorbic acid and calcium chloride show a similar trend where it becomes more acidic that is indicated by lower value of pH.

Table 1: pH of fresh cut jackfruit bulb

Day	Control Sample	Ascorbic Acid	Calcium Chloride
0	6.81 ± 0	4.87 ± 0.0058	5.41 ± 0.0058

3	5.49 ± 0.0058	4.77 ± 0	4.69 ± 0.0058
6	5.38 ± 0	4.74 ± 0.0058	4.52 ± 0.0058
10	5.40 ± 0.0153	4.75 ± 0.01	4.54 ± 0.0058
13	5.28 ± 0.0100	4.74 ± 0.0252	4.63 ± 0.0058
17	5.32 ± 0.0351	4.78 ± 0.0208	4.51 ± 0.0306

3.2 Total Soluble Solid

An increase trend of soluble solid content in ascorbic acid samples was influenced by the presence of the chemical itself. The soluble solid content in the dipped sample with chemicals is supposed to be increased by time as it influences the process of ripening with solubilization of carbohydrates content [2]. Since the trend shown by dipped samples are decreasing by time after day 3, it might be due to the increasing respiration which is caused by some wounding during the process of preparing the sample.

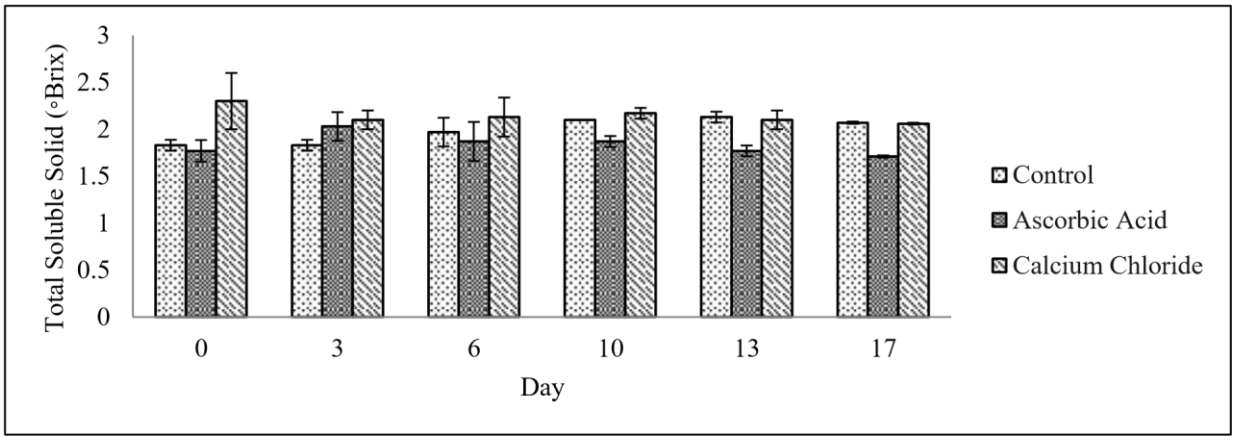

Figure 1: Graph of total soluble solid of fresh cut jackfruit bulb

3.3 Total titratable acidity

The increase trend of titratable acidity was recorded on ascorbic acid sample until day 10 with the highest value of 0.77. The increase trend is because of the fixation of carbon dioxide that has been formed during respiration into organic acids. On the other hand, samples treated with calcium chloride also showed an increased trend from day 0 until day 17 due to the role in reducing the respiration rate and maintaining the structure of the cell wall. Calcium chloride manages to inhibit senescence and the ripening process itself and thus reducing the possibility of the fresh cut fruit rot by time.

Table 2: Value of titratable acidity of fresh cut jackfruit bulb

Day	Control Sample	Ascorbic Acid	Calcium Chloride
0	0.13 ± 0.0577	0.50 ± 0	0.20 ± 3.399x10-17
3	0.43 ± 0.1528	0.53 ± 0.0577	0.37 ± 0.0577
6	0.43 ± 0.1528	0.73 ± 0.4163	0.40 ± 6.7987x10-17
10	0.27 ± 0.0577	0.77 ± 0.2887	0.33 ± 0.0577
13	0.33 ± 0.0577	0.60 ± 0	0.40 ± 6.7987x10-17
17	0.30 ± 0.1000	0.63 ± 0.0577	0.43 ± 0.0577

3.4 Ascorbic Acid

Throughout the 17 days of storage in chilled condition, the determination of ascorbic acid content all of the samples show a significantly decrease trend. The lowest decrease trend is shown on sample control and calcium chloride. Vitamin C content is reducing by time as it was altered due to the action of oxidized [7]. However, dipping with ascorbic acid has been proved by research from Saxena, (2013) is to reduce antioxidant loss and therefore the higher amount of vitamin C obtained. There is a contradict result from research by Saxena (2013) where samples of ascorbic acid resulted in an increase trend.

Table 3: Value of titration of ascorbic acid of fresh cut jackfruit bulb

Day	Control Sample	Ascorbic Acid	Calcium Chloride
0	5.17 ± 3.4990	16.67 ± 4.1477	5.57 ± 0.9713
3	5.27 ± 4.6058	9.43 ± 5.7501	1.67 ± 1.7673
6	6.33 ± 5.7047	12.43 ± 1.6073	3.60 ± 3.1480
10	4.57 ± 2.8290	13.89 ± 2.5580	3.83 ± 3.1974
13	3.93 ± 2.7502	15.13 ± 17.3039	5.67 ± 4.7596
17	3.37 ± 2.6312	6.20 ± 2.6514	3.13 ± 2.4111

3.5 Color

The decrease trend of L* in control samples on day 0 with value of 54.06 to day 17 which is 48.52 was due to absence of anti-browning agent and therefore more browning was observed in the sample. The highest value of L* on day 17 with the presence of calcium chloride is because of the function of calcium chloride itself to maintain the lightness of the fresh cut jackfruit bulb.

Table 4: Value of L* of fresh cut jackfruit bulb

Day	Control Sample	Ascorbic Acid	Calcium Chloride
0	54.06 ± 0.5805	51.58 ± 0.0306	54.02 ± 0.0493
3	50.05 ± 0.0058	52.00 ± 0.6953	54.03 ± 0.0794
6	49.48 ± 0.0493	52.80 ± 0.1021	54.05 ± 0.0173
10	49.63 ± 0.0551	52.72 ± 0.2312	53.25 ± 0.1442
13	50.24 ± 0.0153	51.65 ± 0.1500	53.91 ± 0.2301
17	48.52 ± 0.2701	51.54 ± 0.6954	55.16 ± 0.0643

Decreasing value of a* from day 0 with value of 13.38 to day 17 with value of 10.72 specify that there are fewer browning processes that have occurred on the sample to be compared with the control and dipped with calcium chloride samples. The obvious difference shown from ascorbic acid samples is because it is known as a reducing agent that functions in inhibiting the brown pigment from being developed by time.

The higher value of a* in control sample is due to the wounding during processing of deseeded that increases rate of water loss and leads to more browning. On the other hand, the higher value of a* shown in calcium chloride samples is because of the presence of chemical that is not specifically to prevent browning during storage, similar with result obtained from Danyen, 2019. A journal from Navindra, 2009 mentioned that changes value of a* and L* can be interpreted in monitoring enzymatic browning which relates to polyphenol oxidase enzyme, PPO.

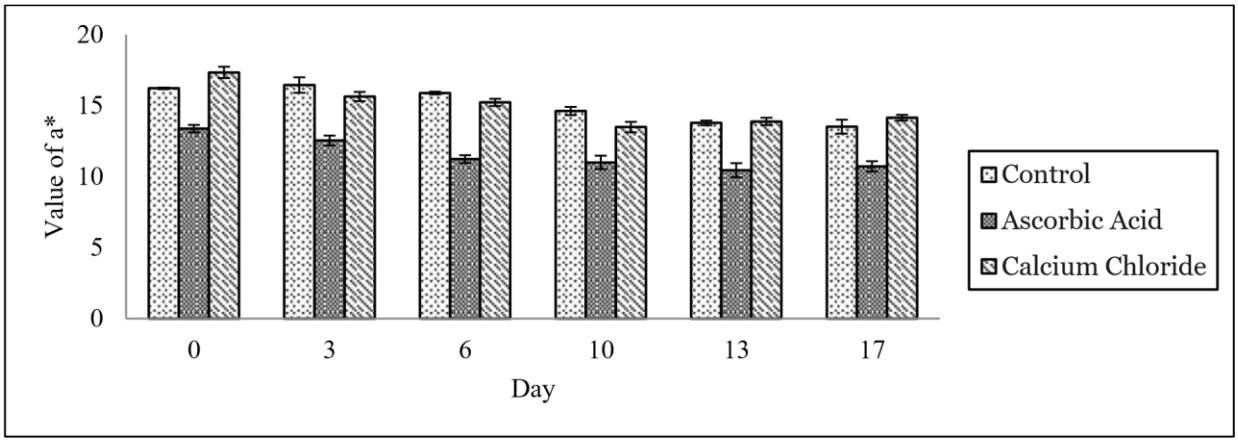

Figure 2: Graph of value of a* of fresh cut jackfruit bulb

Value of b* indicates yellowness of the sample but there is a lower increase trend of b* shown in figure 3 of control samples, due to deseeded processes that cause deterioration of the tissue leading to

the browning of the pulps in early stages. This explained how calcium chloride affected the processes handled which function to inhibit any color changes of the sample during storage.

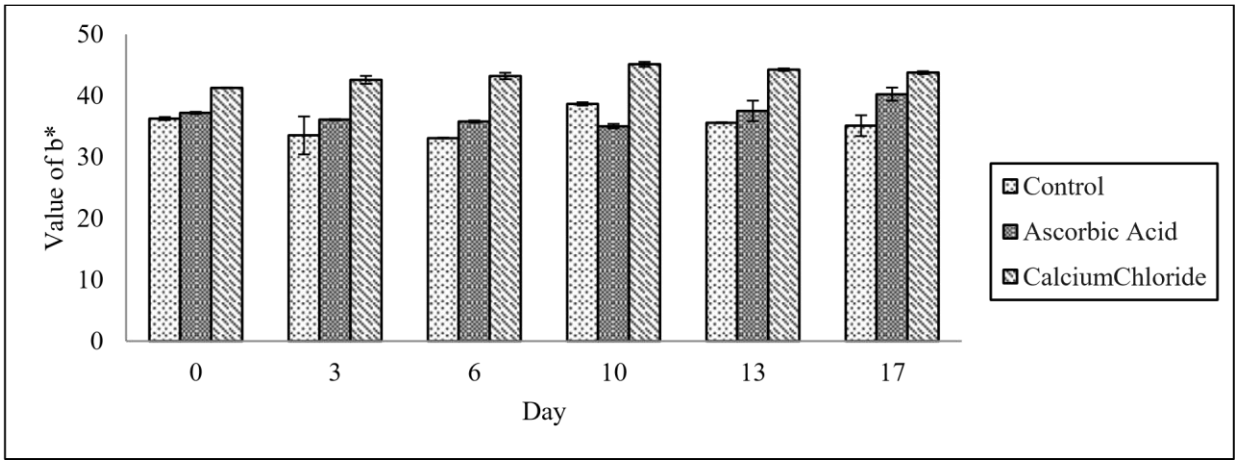

Figure 3: Graph of value of b* of fresh cut jackfruit bulb

3.6 Texture

After 3 days of treatment, the value of firmness for all of the sample continue to increase with 1% of calcium chloride dipped samples as the firmest of all the samples with value of 0.151 N. Dipped samples with 0.25% of ascorbic acid is firmer than control samples because of present of calcium ion that helps in strengthening cell wall and turgor pressure within tissue [1]. Research from Rana (2018) said that the range of firmness should be around 0.686 N to 4.595 N. The highest firmness value of dipped samples with calcium chloride is 0.483 N which less than the expected range of firmness. This might be due to the concentration of chemicals used and the time for dipping treatment.

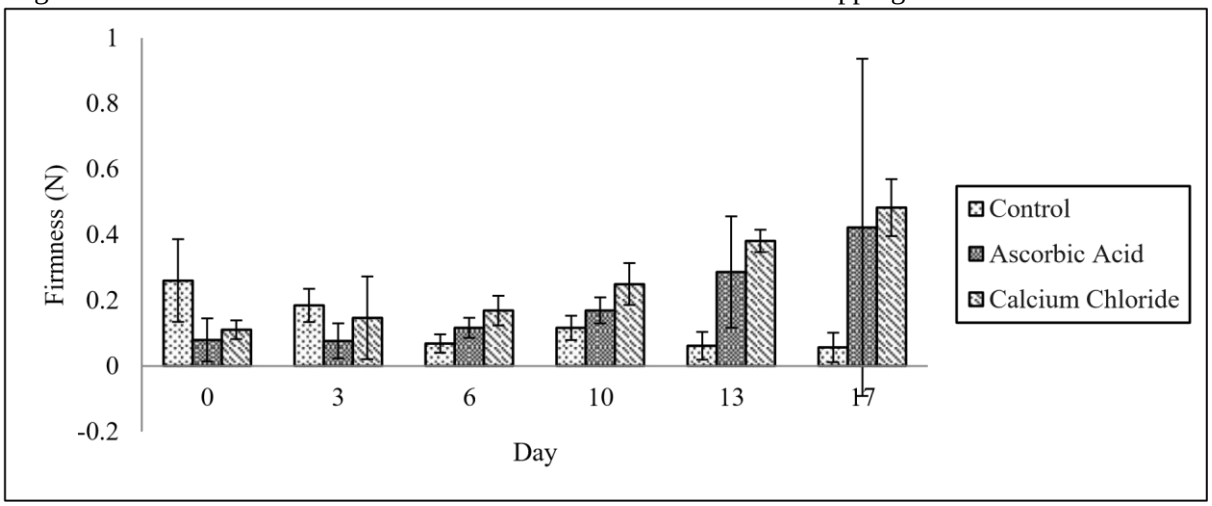

Figure 4: Graph of firmness of fresh cut jackfruit bulb

3.7 Moisture Content

All of the samples showed a decrease trend from day 0 to day 3 of storage. Sample treated with calcium chloride show to have the lowest moisture content until the end of the storage. This is because calcium chloride has a higher absorption rate compared with ascorbic acid. Control sample has the highest moisture content as it does not contain any drying agents that help to absorb moisture during the storage. The percentage of the moisture content regarding the loss of drying was calculated using the following equation:

$$\text{Percentage moisture content (\%)}: (W_f - W_i)/W_i \times 100\% \qquad \textit{Eq. 1}$$

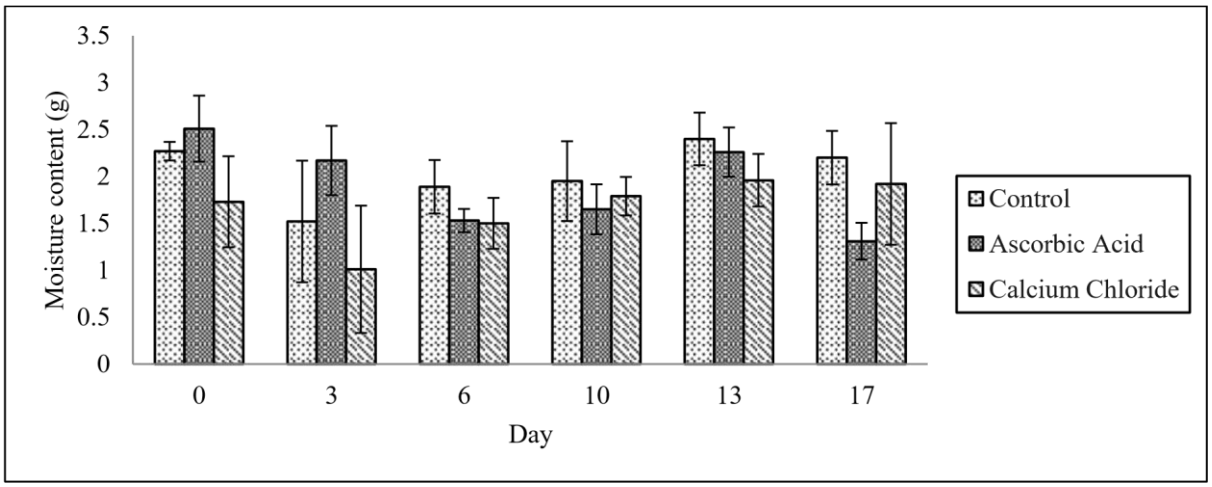

Figure 5: Graph of moisture content of fresh cut jackfruit bulb 3. Conclusion

Ascorbic acid and calcium chloride was proven to be effective on the physicochemical properties of the fresh cut jackfruit, as it shows a decrease trend in analysis of pH, corresponding to increase of titratable acidity. The analysis of both total soluble solid and ascorbic acid content was supposed to be increased by time but from this study it showed a different trend on dipped treatment.

However, the analysis of color that consists of the observation of L*, a*, b* showed better result whereby the value of L* and a* that indicated in enzymatic activity. The calcium chloride was functioning in determining the value of b* which it inhibit the color changes of the sample. It also gave better result on the firmness of the jackfruit bulb to be compared with ascorbic acid dipped samples, same goes with moisture content which it has a higher absorption rate. To be conclude, calcium chloride has better retention in maintaining the firmness of the texture and color meanwhile ascorbic acid helps in preventing browning on the jackfruit bulb.

Acknowledgement

The authors would also like to thank the Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia for its support.

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