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THE TEXTURAL CHARACTERISTICS OF JACKFRUIT PULPS TREATED WITH CALCIUM

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ABSTRACT

This study investigated the textural changes of jackfruit pulps treated with calcium through different infusion methods. Two infusion methods were evaluated; blanching in calcium solution and vacuum-treatment of the pulps immersed in calcium solution. The jackfruit pulps were blanched in calcium chloride at two different concentrations; 0.5% and 1.0% (w/v) and by immersing the pulps in a calcium solution prior to applying vacuum treatment to facilitate infusion of calcium. Jackfruit pulps treated with calcium showed firmer texture than control sample. The level of calcium chloride concentration and the infusion methods did not have a significant effect on the texture of the jackfruit pulps after 7 days of storage at 8 – 10 °C.

Keywords: Jackfruit; calcium; texture; blanching; vacuum

INTRODUCTION

Fruits are important for health as they provide vitamins, minerals, antioxidants and other bio- functional components. Various studies showed that jackfruit contains carotenoids, flavonoids, volatile acids, sterol and tannins [1, 2, 3]. However, flawed handling and lack of knowledge after harvest lead to a lost in quality and shelf life. Long term storage of whole fruits at 5 °C in modified atmosphere packaging has been shown to undergo nutritional changes similar to those found for the fresh-cut fruits [4].. The current trend of eating out and consuming ready-to-eat meals has resulted the increase in minimally processed fruits[1]. Fresh-cut produce industries has shown large growth rate due to increased consumer demand [2]. The International Fresh-cut Produce Association (IFPA) defines fresh-cut products as fruit or vegetables that have been trimmed and/or peeled and/or cut into 100% usable product that is bagged or pre-packaged to offer consumers high nutrition, convenience, and flavour while still maintaining its freshness [5].

Minimally processed fruits appealed to consumers for its convenience and fresh-like quality. This is especially important for bulk produce, such as jackfruit. The edible part of the jackfruit is only 30- 35% of the whole fruit [3]. Separation of the jackfruit pulps from the whole fruit wounded the fruits' tissues thus reducing the shelf life [6]. This is a major problem faced by this industry [4]. This paper aims to evaluate the effect of different methods of calcium infusion on the textural quality of minimally processed jackfruit pulps.

Minimally processed fruits.
Consumers demand for fresh-quality, convenience and ready-to-eat products has resulted new processing methods in the fresh produce industry [7, 8]. The fruits and vegetables processing companies aim to provide wholesome, safe, nutritious and acceptable products to fulfill this demand [9]. Minimally processed products are more susceptible to spoilage as it has gone thruough the process of peeling, slicing or cutting. These effects may be visible through browning, discolouration, foiled produce or signs of decay [10, 11, 12]. Previous preservation of fruits and vegetables involved introducing of heat (cooking) or removal of heat (chilled or frozen). Although these methods are successful in prolonging the shelf life of the products, thermal processes cause changes in the chemical and physiological properties of the products [13]. To retain the fresh-like characteristics of the minimally processed fruits and vegetables, various methods have been developed. Among others are immersion in chemical solution [14], blanching [15], high pressure processing [16], irradiation [17] and pulsed electric processing [18]. In heat processing, the texture of fresh products is greatly affected. This is because, the cell walls, which gives the fruits and vegetables their crisp and firm characteristics lose its integrity [19].

Effect of Calcium treatment on the texture of minimally processed fruit.
Texture is an important aspect of fresh fruits. During processing or storage, the firmness of fruits is lost through degradation of the cell walls. Calcium salt has been proven to be beneficial in maintaining the integrity of the cell walls and texture preservation. The fortification of calcium in food products has long been a practice in the industry to help boost calcium intake of the population [20]. İn fruit processing, the effect of calcium salts in maintaining the firmness of the fruit are widely studied [21, 22, 23]. Studies have shown that calcium forms bridges within the cell walls of the fruits, strenghtening its mechanical stucture, thus sustaining firmness [23, 24, 25].

EXPERIMENTAL

The Sample.
Mature jackfruits were obtained from a farm in Perak and transported to the laborotary. The jackfruits were packed in boxes and kept at room temperature for 3 days to ripen. The fruits were considered ripe when the fruit soften slightly when pressed and a typical jackfruit aroma was detected. The jackfruit was cut, the pulps separted from the rind and deseeded.

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Calcium Chloride Treatment.
Solution of calcium chloride in distilled water was prepared at concentrations of 0.5% and 1.0% (w/v).

Blanching treatment.
The calcium chloride solution was heated in a clean water bath to 50 ^{o} C – 55 ^{o} C. The deseeded jackfruit pulps were placed in a wired basket and immersed into the calcium chloride solution for 25 minutes. The ratio of pulps to calcium solution was approximately 1:2 (w/v). Thorough contact with blanching solution and even temperature distribution was ensured by manually shaking the wire basket every 5 minutes and moving the middle pulps to the outer layer with tongs. Samples were rinsed with distilled water (3 x 400 ml) to bring the fruits to room temperature and drained for 15 minutes. The blanched pulps were arranged onto polystyrene plates, wrapped with cling plastic wrap and kept at 8-10 ^{o} C until further analysis. Control samples were prepared by blanching in distilled water.

Vacuum-Infusion.
The seedless jackfruit pulps were placed in plastic trays, and calcium chloride solution was poured until all the pulps were covered. The ratio of pulps to calcium chloride solution was 1:2 (w/v). The tray was put into a desiccator and securely covered. A vacuum pump was attached to the desiccator and vacuum was applied until no gas bubbles was observed. The vacuum pump was switched off and the sample was left in vacuum for 15 minutes. When the vacuum was released, the sample was left in solution for another 5 minutes before the pulps were drained and rinsed with distilled water. The jackfruit pulps were arranged onto polystyrene trays, wrapped with cling film and stored at 8-10 ^{o} C until further analysis. Control samples were prepared by immersing in distilled water.

Texture Analysis.
The jackfruit pulps were cut into 1 cm strips with thickness of between 8 to 15 mm and analysed using the Texture Analyzer (Stable Micro System version 1.05, UK) equipped with 5 kg load cell and samples were cut with probe HDP/BSK blade set with knife. Test speed was set at 2 mm/s. The probe was programmed to cut through the samples at 17mm distance. The data acquisition rate was set at 200 pps. Force unit was in Newton (N). The maximum force required to cut through the samples was considered as the firmness data. Higher force required to cut through the samples correlate to firmer texture of the sample. A total of at least 10 strips per treatment were averaged for the texture data.

RESULT AND DISCUSSION

The firmness of the jackfruit pulps treated with calcium chloride by two different infusion methods was evaluated during storage at 8 – 10° C. The samples were control, jackfruit treated by blanching in 0.5% $CaCl_2$, sample treated by blanching in 1.0% $CaCl_2$, samples treated by vacuum in 0.5% $CaCl_2$ solution and samples treated with vacuum in 1.0% $CaCl_2$ solutions.

Figure 1 showed that after the treatments, all the treated samples showed a marked increase in firmness compared to the control sample, except for sample blanched in 0.5% $CaCl_2$ which recorded the same firmness as control sample. The sample treated by vacuuming in 1.0 % $CaCl_2$ was the firmest. Blanching and vacuum treatment expel gases from the intercellular spaces between the cells. This enabled calcium solution to enter these spaces and imparted turgor pressure, which exhibited in the higher pressure required to cut through these samples.

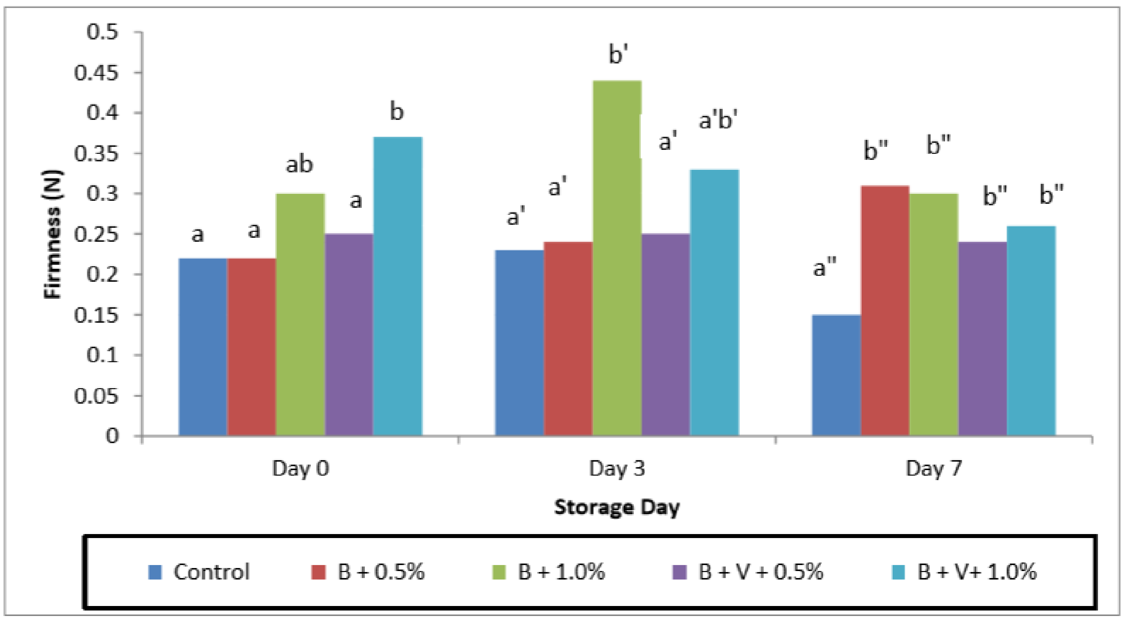

Figure 1: Firmness Analysis of Treated Jackfruit Pulps During Chilled Storage

Control: blanched in distilled water
B + 0.5% : Blanched in 0.5% $CaCl_2$
B + 1.0% : Blanched in 1.0% $CaCl_2$
B + V+ 0.5% : Blanched in 0.5% $CaCl_2$ and vacuumed treated
B + V+ 1.0% : Blanched in 1.0% $CaCl_2$ and vacuumed treated
Data are mean value ± standard deviation of 10 independent samples.

Note: Superscript with the same alphabet signifies no significant difference between treatment during storage ($p \leq 0.05$).

After 3 days of storage, the sample blanched in 1.0% $CaCl_2$ exhibited an increase in firmness. The texture of control and blanched and samples blanched and vacuumed in 0.5% $CaCl_2$ remained low while the sample blanched and vacuumed in 1.0% $CaCl_2$ lost its firmness.

Blanching of the samples was done to de-aerate the jackfruit pulps, which expelled the air from the intercellular spaces. As gases were expelled from the cells during blanching, the solution containing calcium replaced the empty spaces vacated by the gases. Blanching in calcium solution had been proven to increase the rigidity of Jalapeno pepper rings [27]. This heat treatment may have altered the permeability of cell wall, which caused calcium to diffuse through the cell walls [28]. A study showed that blanching, which include higher temperature facilitated the diffusion of calcium into the carrot tissue [29] and texture maintenance of pears [30]. The heat also activated the pectin esterase enzymes which caused a reduction of pectin methyl-esterification facilitating the formation of calcium-pectin bridges, resulting in a more intact texture as shown by pulps treated with calcium in this study. Heat treatment has also been shown to reduce the activity of lipase, which plays a role in membrane deterioration [22].

However, after 7 days of storage, the firmness of all samples decreased. The heat during blanching treatment of ripe jackfruit pulps caused the breakdown in the cell walls integrity. This was shown by the deterioration of control samples. Infusing the jackfruit pulps with 1.0% $CaCl_2$ solution increased the firmness of samples, while no change in texture measurement were recorded for samples treated with 0.5% CaCl2. The infusion of calcium managed to initially maintain the texture through the formation of calcium bridges brought about by the activation of pectin esterase by blanching. However, the cell walls degradation due to the heat treatment failed to sustain the firmness of the ripe jackfruit pulps, as shown by the decreased texture data.

Samples treated with blanching followed by vacuuming in $CaCl_2$ solution showed mixed data. The sample treated in 0.5% $CaCl_2$ showed stable firmness during storage; while those treated in 1.0% $CaCl_2$ exhibited an initial increase in texture, which were lost after 7 days of storage. The texture of the jackfruit pulps treated in 0.5% $CaCl_2$ was slightly higher than control and those treated by blanching in 0.5% $CaCl_2$ for day 0 and day 3. The sample treated with 1.0% $CaCl_2$ solution displayed the firmest texture immediately after treatment, compared to the other samples. Blanching expelled air from the jackfruit tissue while vacuum assisted the infiltration of the calcium solution into the cells [31, 32]. However, the texture integrity decreased during storage. The vacuum treatment may have caused the cell walls which were weakened by the blanching treatment to collapse and lost its integrity. The presence of calcium reduced the force needed for sample rupture [33]. These reasons may explain why the infusion of $CaCl_2$ into jackfruit pulps through blanching and; blanching and vacuum treatment failed to sustain the firmness of the samples.

CONCLUSION

The application of calcium into the jackfruit cells proved beneficial in increasing the firmness of chilled jackfruit pulps. However, the methods of application determined whether this firmness can be sustained. Blanching in $CaCl_2$ solution showed the firmest texture after 7 days of storage.. The use of vacuum infiltration had proved to be beneficial in other experiments. Nevertheles, blanching prior to vacuum treatment caused the loss of the jackfruit texture integrity during storage.

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