FE010

Effect of Selected Freezing Methods on Quality of Durian Flesh with Seed

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Abstract

Durian (*Durio zibethinus* Murray) is considered the king of fruit throughout southeast asia. The fruits are seasonal and perishable and there is a need for extending shelf life. This study evaluated effect of freezing methods on physical and sensory qualities of durian flesh with seed. The method of freezing included still air (at -20°C), air blast (at -40 and -50°C) and cryogenic freezing (with nitrogen convection chamber). The frozen flesh were thawed and evaluated for drip loss, color value, textural properties (hardness and firmness) and sensory qualities (appearance, taste, color, texture, and overall acceptance) for every months during six months storage. The results showed that freezing adversely affected durian flesh in all tested aspects. Cryogenic freezing is noted to be a promising method for preserving the quality of durian flesh with seed. Cryogenic freezing should be considered as the promising method for better preserve qualities of during flesh.

Keywords: Durian, Freezing, Drip loss, Color, Texture.

1. Introduction

Durian (Durio zibethinus Murr.) is king of tropical fruit and highly priced fruit in Southeast Asia due to its seasonality, unique smell, taste and texture.(Jackie et al.,2016; Subhadrabandhu and Ketsa.,2001) But durian also has problem related to transportation and shorted shelf life. (Subhadrabandhu and Ketsa ,2002). Low temperature unable decelerated the physical attribute leading to the deterioration of the product. Recently, various techniques had developed to increase the shelf life of durian contain with modified atmosphere for reduce respiration and produce ethylene in fruits, but this technology can be maintained for 20 days. (Jingta et al.,2003).

The freezing was preserve freshness and preserve food quality better than other methods of preservation. It was food processing to lower food temperatures by reduced temperatures to -18 °C (Arpassorn et all., 2015). Moreover, it was decreases the water activity, inhibits microorganism growth and reduces enzymatic activity (Abdullah et al., 2015).

However, the major problem of freezing fruits and vegetables found that change physical quality during storage, such as texture and color change (Abdullah et al., 2015; Arpassorn et all., 2015). In addition, during storage was formed ice crystals which was known to damage fruits cell, liquid loss occurs after dissolution, which is associated with decreased cellular integrity (Arpassorn et al., 2015). It was found that the freezing rate was the main factor correlated with the completeness of the microstructure and tissue of the cell if it has a higher freezing rate Integrity the microstructure and tissue of the cell is higher (Dongwu et al., 2015).

Ago in the frozen food industry uses still air freezing which was slow freezing. The slow freezing, as the temperature decreases, the water vapor contained in the intercellular spaces condensed and was then transformed into ice. As the extracellular ice crystals produced has a vapors pressure lower than that of water in the intercellular, the pressure difference lead to the loss of liquid from the cells which aggregate to form extracellular ice crystals. Slow freezing rates provide the time for water to leave the cells by permeation through the membranes. Frozen fruits and vegetables are generally large-volume, it was difficult to achieve a high freezing rate in the whole sample, resulting in a low freezing the freezing rate at the center of product was low (Laura et al.,1998). To improve the freezing rate, many studies have been conducted using air blast freezing of fruits such as mango, cantaloupe, pineapple, lychee, etc. (Arpassorn and Sanguansri., 2012; Dongwu et al. 2015; Laura et al., 1998). However, it was

also found that when stored for a long time, it also caused damage to the microstructure and tissue of the cell. This affects the quality, such as color and texture change, and the resulting higher drip loss (Dongwu et al.,2015).

Cryogenic freezing was lead to improved issue freezing rate and quality of frozen food during storage for long-term, cryogenic media must be employed, but a higher freezing rate does not always mean that the quality of the final product is better. Exposure to cryogenic media may lead to cracking or shattering of frozen food; this damage, due to the expansion associated with the transition from the water to the ice phase, and internal stresses, is critical and irreversible. (Laura et al.,1998).

Therefore, this research aims to study the freezing process of durian pulp with different freezing techniques. And study physical quality during storage for 6 months, changes occurring during storage, and acceptable to the consumer. To use in business and can be sold commercially.

2. Materials and Methods

2.1 Raw materials.

Durian (cv. Monthong) were purchased from the Thai market in Pathumtani, Thailand, the fruits were selected for uniformity in maturity by expert person.

2.2 Sample preparation.

The sample were washed in chlorine solution for 2 minutes. Then aired at room temperature approximate 20-25°C. durian husk were peeled by knife for bring out the durian pod. Selected the pod on the basis of similar size, and weighed 300-350 g put in the plastic box, then stored at ambient temperature (0-4°C) for one day before testing for freezing process.

2.3 Freezing and thawing process.

Four Freezing process were used thermocouples (K type, Omega engineering, USA.) insert into the center of the fruit pulp. The fruit pulp were segmented frozen at -40°C in a Still air freezer (Asia cooling fresh Co., Ltd. Thailand), at -40°C and -50°C in Air blast freezer (ITC Co., Ltd. Thailand), at -40°C in a Still air freezer (Asia cooling fresh, Pathumtani Co., Ltd. Thailand), and at -65°C in a cryogenic freezer which liquid nitrogen, until the central temperature of the samples reached -20°C. The frozen samples were then stored at -20°C in a freezer (Sanyo refrigerator, model SF-C1497, Japan) for 6 months place the fruits thawed at 25°C in a low temperature and low relative humidity prior to the analysis of the frozen-thawed samples. The freezing rate of the samples the freezing rate was calculated by modifying the equation of (Pan and Yeh, 1993).

2.4 Drip loss.

The drip loss of the frozen fruits was measured using the method outlined by Arpassorn and Sanguansri (2012). Four frozen sample were absorbent paper and placed into a plastic grid during thawing. Until the samples were thawed at 0-4°C. Weighing the absorbent paper until a constant value was reached. The measurements were done in triplicate for each treatment and the results were calculated following equation (1).

$$\text{Drip loss } (\%) = (W_t - W_0) \times 100 / W_s \quad (1)$$

where W_0 is the weight of the paper prior to thawing, W_t is the weight of the paper after thawing and W_s is the weight of the sample.

2.5 Texture analysis

Preparation for texture analysis were measured using the dissolved durian in a temperature and relative humidity control room, keep in a polypropylene (PP) plastic box and place it in ice foamed container at all times. Control durian samples before measuring quality. Set the center of the sample not larger than 5 x 5 cm. Place the durian on the base parallel to the horizontal plane. The texture of thawed samples was determined using a Texture Analyzer (TA.XT2i Stable Micro Systems, Surrey, UK) with a 2 mm cylinder probe (P/2). The firmness and hardness was measured using a compression of 50% strain and a compression rate of Pre-test speed: 2.0 mm/s. ; Test speed: 1 mm/s.; Post-test speed: 5.0 mm/s., measured according to the variables to be measured: Hardness (N) is the maximum force produced during the first injection. Firmness(N/mm): is the slope of graph. Three pieces of fruit were tested for each treatment.

2.6 Color.

The surface color of the durian pulp was measured through a Hunter Lab (ColorFlex EZ, UK) was used for the CIE Lab system to compare fresh and frozen durian. In this system, L* is presented to ligthness (0-100 scale, black to

white); a* relate to red color and to green color, if it is positive and nagative respectively); and b* corresponds to yellow color and blue color, if it value is positive and nagative respectively). Frozen durian color was determined by calculating the relationship between L * and b * Hunter scale, calculated as the yellow index of durian plup calculated from equation (2) (Neelima, 2014).

$$YI = 142.86b^{*} / L^{*} \quad (2)$$

Compare color difference (ΔE^{*}) of durian frozen month 0 and Frozen fruits each month during storage by equation (3).

$$\Delta E^{*} = \left[(\Delta L^{*})^{2} + (\Delta a^{*})^{2} + (\Delta b^{*})^{2}\right] \quad (3)$$

Where L0*, a0* and b0* are the color of durian frozen month 0

2.7 Sensory evaluation.

The sensory test of durian frozen were determined in terms color, flavor, taste, texture and overall acceptability by a panel consisting of ten semi-trained panelists using a 9 point hedonic scale (9: excellent; 1: extremely poor). The sample were randomly number and serven while cold (at 0-4°C).

2.8 Statistical analysis.

The collected data were analyzed using a one-way analysis of variance with SPSS for Windows. Duncan's multiple range test was used to compare the means ($p<0.05$).

3. Results and Discussion

3.1 Freezing time and Freezing rate.

The freezing rate and freezing times of fruits were showed in the Table 1. These result show that cryogenic freezing method provide highest freezing rate and had shorter freezing times ($p<0.05$).

The statistical analysis to compare freezing rates. It was found that different freezing conditions and freezing temperature had a significant effect on the freezing rate.

Table 1 Freezing Rate And the freezing time of durian.

Freezing method	Parameter		
	Average radius (cm)	Freezing time (hr.)	Freezing Rate (cm/hr.)
Still air	3.27	2.46	1.33±1.14[c]
AF(-40°C)	3.50	1.05	3.33±1.36[b]
AF(-50°C)	3.50	0.57	6.14±1.58[a]
Cryogenic	3.14	0.24	13.08±0.86[a]

Data are recorded as the mean ± standard deviation as measured from 3 replications. In each column, values followed by different letters are significantly different ($p<0.05$).

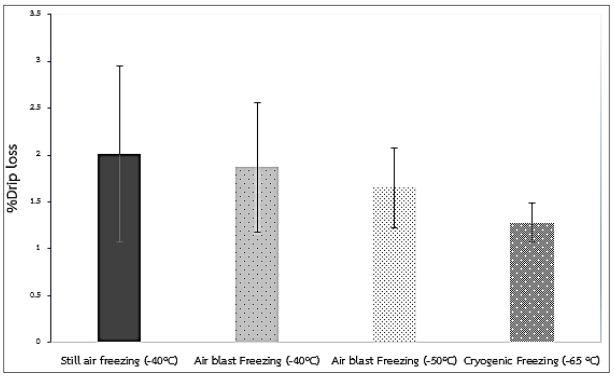


Figure 1 Drip loss of durian samples after storage for six month. Mean values ± standard devition of nine replicate meansurement are shown.

3.2 Driploss.

The effect of thawing on drip loss of durian pulp after storage for 6 months was presented in Fig. 1. The drip loss value of durian samples that freezing by cryogenic freezing had the lowest drip loss values, follow by Air blast freezing -50°C, -40°C and the highest drip loss value was found for still air freezing. During freezing, the water in the sample partially formed ice crystals which negatively damaged the cellular. Then during the thawing process, liquid can leak from the interior to the exterior of the cells. Different conditions of freezing have different levels of drip loss (Arpassorn and Sanguansri, 2012). For that reason, the lower drip loss of fruits were most likely what caused the higher freezing rate.

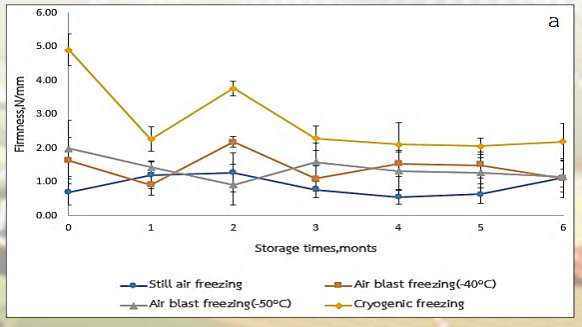
3.3 Texture characteristics.

The texture characteristics of frozen durian during six months of frozen storage were showed in Figure 2. The hardness and the firmness was measured using a compression test for compared to fruit, frozen through a

freezing method was different between frozen durian storage zero month and frozen durians at various shelf life months. High quality frozen durian products should represent a high degree of hardness and firmness of the pulp (Dongwu et al.2015; Kausshik,Kaur and Rao,2013). The results when they compressed to 50% strain of sample. it was found in frozen durian with cryogenic freezing in the zero month of storage showed the highest 1.43 N. of hardness and 4.92 N/mm. of firmness, when stored for longer periods of time, the both values are significantly reduced with the initial month. Were different frozen samples with still air freezing, air blast freezing (-40) and air blast freezing (-50), the initial hardness value and firmness value did not have the highest of values of increased storage times. When compared the hardness and the firmness of the samples frozen in different freezing methods in each month for 6 months they were occurred the highest hardness and firmness value from cryogenic freezing method throughout the shelf life of six months. Due to the textural characteristics of frozen food, this is mainly influenced by freezing rate. (Dongwu et al.,2015; Kraues et al.,2007). The results presented that freezing rate was the key role of the maintaining the texture of frozen foods, if it was had high freezing rate it can been reduce damage effects of crystallization and recrystallization on the tissues of durian during freezing and frozen storage by cryogenic freezing process. (Dongwu et al.,2015)

3.4 Color and color difference.

Changes of color, presentive of important yellowing and lighting of fruit tissue after freezing and thawing. The color diference (ΔE) as shown in Figure 3. The experiment claer that cryogenic freezing method provides the smallest color difference when compared to fresh sample prior freezing process. Although stored for long to 6 months.



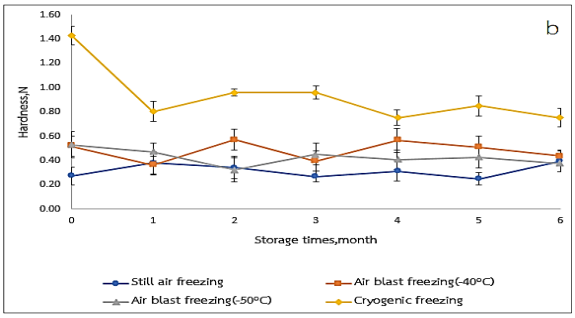


Figure 2 Changes of hardness (a) and firmness (b). Mean values ± standard devition of nine replicate meansurement are shown.

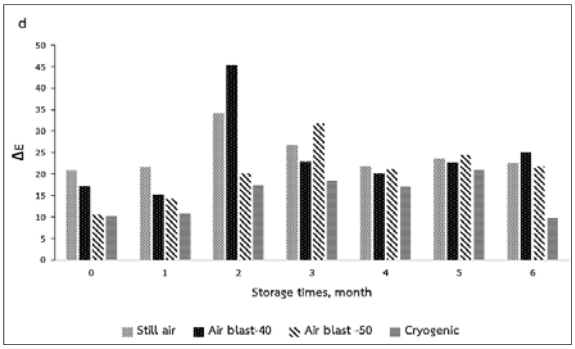


Figure 3 Changes in color deference parameters of durian frozen. Mean values ± standard devition of three replicate meansurement are shown.

3.5 Sensory evaluation of durian.

Sensory quality has important to reference for producers to determine shelf-life and to establish consumption guidance for marketing. The sensory attributes of the frozen durian after storage for 6 months that freezing by still air freezing, air blast freezing(-40°C), air blast freezing(-50°C) and cryogenic freezing from Table 2 it is clear that cryogenic freezing had given better results than other freezing in terms of Flavor, Taste, Texture and Overall.

Table 2 Sensory evaluation of frozen durian by still air freezing, air blast freezing(-40°C), air blast freezing(-50°C) and cryogenic freezing.

Freezing method	Parameter				
	Color	Flavor	Taste	Texture	Overall
Still air	6.40±1.51	5.30±1.77	4.70±1.97	4.70±1.64	5.60±1.65
Air blast(-40°C)	6.50±1.51	6.10±2.23	6.10±1.62	6.10±2.18	6.20±1.23
Air blast (-50°C)	6.50±1.65	6.20±2.49	5.70±1.84	5.70±1.64	6.10±1.60
Cryogenic	6.60±1.43	6.60±1.78	6.40±2.35	6.40±1.43	6.30±1.25

Data are recorded as the mean ± standard deviation as measured from 10 replications

4. Conclusions

Obviously, the freezing methods and freezing rates influenced on quality of frozen durian when preserve for a long time. Cryogenic freezing has the highest freezing rate, this resulted in the least drip loss, highest of the hardness and firmness value. In addition, the color difference compared to fresh durian has few difference. and highest average score of sensory quality of durian. Especially the sensory quality, flavor, texture and taste. After 6 months of storage, it is also acceptable for consumers.

5. Acknowledgements

The authors would like to thank Asia Inter Fresh Co., Ltd for financially supporting this project and also would like to thank Prof. Pimpen Pornchaloempong and Wasan Inta for important suggestions to make the project successful

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