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Improvement of Sensory and Chemistry Quality of Fried Edamame by Freezing

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Abstract. Fried edamame is an edamame soybean product which is processed by vacuum frying with the peculiarities of crispy products which are crispy, savory, flavorful and green. Some research studies the freezing before vacuum frying fruit or vegetable can improve crispness and taste quality of the product. The duration of freezing before the vacuum frying process is expected to improve sensory qualities such as crispness, color, flavor and chemical characteristics of fried edamame products. The study was carried out using fresh edamame samples with 3 freezing time variations (temperature - 20 °C) which is 1 day; 2 days and 3 days, each with 4 replications, using a Completely Randomized Design. Observation on the quality of edamame samples in the form of Sensory Quality includes hedonic testing of Color, Texture, Aroma and Taste, and Chemical testing includes Water Content, Carbohydrates, Proteins, Fats, and Ash Content. The results showed that the longer the freezing time sequentially from 1, 2 and 3 days the hedonic color values were higher and the carbohydrate content was also higher, but for other quality attributes such as texture, aroma and taste and other chemical components didn't show difference significantly.

1. Introduction

Edamame is green soybean or also known as (*Glycine max* (L.) Merr.) harvested as a vegetable when the pods are immature, Such as a local soybean, the varieties of edamame has rich in protein and highly nutritious. Edamame is consumed especially as snack, but also as vegetable, an additive in soups, or processed into Edamame milks, As snack, the pods are soaked in boiling water with sort time, or cooked directly with boiling water and then the seeds are separated with peel [1].

Edamame is produce a sweet flavor when cooked. At the peak of maturity, aromatic concentrates have much higher levels of (Z)-3-hexenyl acetate, linalool, acetophenone, and cis-jasmone [1]. Several components of beany odor were also identified: hexanal, 1- hexanol, (E)-2-hexenal, 1-octen-3-ol, and 2- pentylfuran. Cis-jasmone is found in edamame only at the peak of ripeness and may be the key component of aroma.

For edamame, the two most important components of flavor are sweet and savory. Its sweet taste is determined by sucrose content and its savory taste probably by amino acids like glutamic acid [1] Beany flavor increases with maturity and can be divided into two components--beany and bitter. The beany taste may come from linolenic acid oxidized by lipoxygenase and the bitter taste my be the lipoxygenase itself.

One of the methods to increase the shelf life of fruits and vegetable are processing technology. Processing technology is improved the food diversity and reduced of the losses in post-harvest. One of the product developments of fruits processing and a lot of markets are chips. Fruit chips are more



resistant into storage than fresh condition due to the lower water content of fruit chips and the physiological processes are terminated, on the contrast, where are still occurring in a fresh fruit. Fruit Processing methods into chips need to design with a novel methodology to produce the chips be accepted for the consumers. Several methods to produce healthy food without change the native structure used by vacuum frying. Edamame Processing into Edamame Chips or fried Edamame are used vacuum frying which provides the products crispy and persistent the color and taste of a edamame [2]. Vacuum frying is a frying process to vapor or drying of Edamame also other ingredients use boiling oil at low pressure. Nevertheless, is also be required alternative strategy to improve the quality attributes of Fried Edamame.

The freezing is an alternative strategy of pretreatment to make the fruit matrix are crispy on vacuum frying process. Shyu and Hwang [3] are reported freezing process at temperature -30 C during overnight will be formed the fruit matrix as like sponge or porous matrix of vacuum-fried apple. These conditions due to rapidly of the heat transfer on a matrix. Water crystals in cells are sublimated under vacuum conditions when released from a pore of the food matrix, this situation is also a decrease of the humidity and water contents. Albertos et al [4] are reported that vacuum-fried carrot has lower water contents with under freezing conditions during overnight than without freezing. Furthermore, Rate of freezing has also affected the fruits. Slightly freezing is produce a large size of the crystals, where can be damage of cells. Then, it can increase the penetration of oil into the cell during frying process. Thus, rapid freezing is preferred to reduce oil absorption. Freezing is also preserving raw materials before fried. During the lightly freezing process, the large water crystals can be damage cell membrane, then it caused the water were melted. However, fruits have different sensitivity about a frozen injury. The difference was caused by the performance of cell membrane to adapt or counter for changed of phased during different freezing of each fruit. Apricots, bananas, and peaches are sensitive, Such as apples, grapes and pears are quite vulnerable and dates are most resistant with freezing damage.

The principle of a freezing is a heat of material was taken and decreased to reach under freezing point of the material. So all mechanisms of change in materials were inhibited and the shelf life was extended. Generally, the freezing mechanism was divided in 3 stages. The first stage of sensible heat of food was taken that decreasing temperature to freezing. The second stage in a freezing process was transferred a number heat energy, where food and water are contained it was a freeze. And the last stage is a freezing process, where heat energy remains released so that decreases temperature to certainly a temperature.

One of the biggest edamame producers in Indonesia is Jember district. The objective study in this research is to improvement sensory and chemistry of fried edamame. Previously fresh edamame treated by freezing process to get a good condition for fried edamame.

2. Working Methodology

2.1. Research Area

The research area was carried out in the Jember State Polytechnic campus, starting from the treatment process in the processing of all parts that were done at UPT Food and Beverages, then the Sensory Analysis and Test study was conducted at the Food Analysis Laboratory.

2.2. Data Collection Method

The research data was obtained from primary data which was the result of direct observation from experiments at the Laboratory, including chemical analysis data and sensory test data on samples observed. Previously the edamame samples treated and observed were prepared as follows: Fresh Edamame were collected, after that were washed and then freezing at -20 oC with duration of Freezing variations as 1,2, and 3 days. Each treatment is used for three replications. The equipment used includes Airblast Freezers, Cold storage, Analysis Tools including Kjeldahl Analysis, Soxhlet Analysis, Furnaces, Ovens, and various glass tools for analysis.

2.3. Analysis Method

Analysis methods for research include:

2.3.1. *The observation method for obtaining primary data includes chemical analysis and sensory testing, namely: water content, Ash, Fat, Protein, Carbohydrate*

1. Determination water content

Initially, Crucible was dried at 100°C -105°C until 30 mnt, than it was transfered into desikator, this step were duplicate. Then 2 g vacuum-fried edamame transfered into crucible, furthermore sample was oven-dried at 105°C until 2 hours or weight stabilized, water content was calculated as follows :

$$(\%) \text{ water content (wb)} = \frac{(\text{weight sample} - \text{dry weight})}{\text{Weight sample}} \times 100\% \quad (1)$$

2. Determination of Ash content

Initially, a crucible dried at 85 °C during overnight, and then transfered into desikator until a dish temperature equal with ambient temperature or weight stabilized (G). 2000 g sample (W) transfered into placed into ashing crucibles were calcinated in a furnace at 600 °C until 3 hours. Sample was burned, than placed into desikator until there weight is stable (C). As content are calculate with followed by :

$$\text{Ash content} = \frac{C-G}{W} \times 100\% \quad (2)$$

3. Fat content [5]

7-10 g sample placed into paper were mounted and covered with a cotton. Than, sample transfered into soxhlet instrument, a fat sample are extracted until 6 hours, then the flash was dried into oven at temperature 105°C. a fat content calculate as follows :

$$\text{Fat content} = \frac{W_2-W_1}{W} \times 100\% \quad (3)$$

Where : W1 = weight flash soxhlet before extraction, W2 = weight flash soxhlet after extraction

4. Determination of Protein [6]

Determination of protein content was carried out using Kjeldahl steam distillation, where Kjeldahl steam distillation consist with 3 step : frist step is destruction, second step is distillation, and last step is titration.

Destruction step, 1 g placed into a 100 mL Kjedahl flask, then added 10 mL of sulfuric acid. Add a catalyst (selenium). Then Kjedahl flask is heated with a small flame, after that changed the level of flame with maximum level. Finally, collected the green solution. Distillation step, green solution diluted with distilled water up to 100 mL, pipetted as 5 mL, transfered into a distillation flask. Add 10 mL of 30% sodium hydroxide solution through the wall in the distillation flask,. Distillation flask is installed and connected to the condenser, then the condenser front is soaked in a liquid reservoir. Steam from boiling liquid will flow through the condenser to the erlenmeyer reservoir. Erlenmeyer added 10 mL of 0.1 N hydrochloric acid solution which has been dripped with methyl red indicator. Check with lakmus paper, if the propeties of the mixture no alkaline, then the distilation step is stopped. After the distillation process, the next step is titration. The result of distillation which is collected into erlemeyer was contained 0.1 N hydrochloric acid with dripped 5 drops of methyl red indicator, then titrated with 0.1 N. sodium hydroxide solution. The end point of the titration is marked with pink to yellow. Each sample is carried out 3 times.

5. Determination of carbohydrate

Carbohydrate calculate with different methods as follow :

$$\text{Carbohidrat} = 100 \% - (\text{water content} + \text{ash content} + \text{Fat content} + \text{Protein content}) \quad (4)$$

6. Sensoric Evaluation [7]

Sensory Evaluation include a preference test (hedonic) of edamame samples. In this Sensoric Evaluation, the criteria are using a hedonic test with a scale 1 to 7, 1 = Most dislike, 2 = very dislike, 3 = dislike, 4 = ordinary/soft, 5= likes, 6 = very like, and 7 = Most like. are Consumer preference was carried out 20 panelists and the test included color, taste, aroma, and texture.

2.3.2 Statistical Analysis Methods

The experiment was conducted as a completely randomized design, the tree experimental conditions were carried out with three replicates. Data were analyzed by analysis of variance (ANOVA) and means comparisons were performed according to the Tukey test. Where, a dependent variable or a response this experiments are Consumer preference and sensory evaluation, color, texture analysis, water content, carbohydrate content, Protein total, Fat conten, Ash content. Mathematic model for anlysis this experiment followed by this equation [8]:

$$Y_{ij} = \mu + \sigma_i \varepsilon_{ij} \quad (5)$$

Y_{ij} = response influence Freezing level at replication i to j

μ = Means value

σ_i = Long-term effect of freezing level

ε_{ij} = error value from i to j

3. Results and Discussion

The result of research as following a preference test (hedonic) components:

3.1. Colour

The results of analysis of variance in the freezing factor had a very significant effect on the colour of edamame, in Figure 1 presented the effect of freezing on the colour value of edamame with a range of 3, 65 to 4.8.

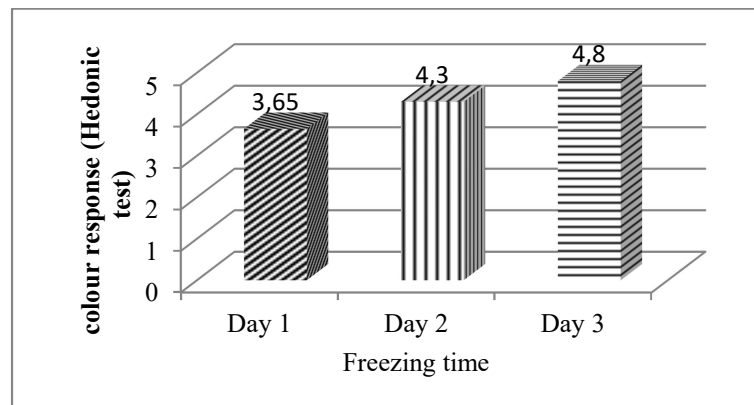


Figure 1. The influence of freezing time with the colour vacuum-fried edamame.

Based on Figure 1, the influence duration of Freezing on the hedonic level with a colour response is shown tend to be favoured. The result shows the longer duration of freezing produce the colour of fried edamame products have been brightly. Probably of freezing times variation are still influenced with an activity of enzymatic browning reaction, where the length duration of freezing up to 3 days showed that suppression process occurs for enzymatic browning reaction. Thus, fried edamame like as brighter.

3.2 Aroma

Range of hedonic aroma values are 3.7 to 4.15 is like medium criteria. The results of the analysis of variance showed no significant difference, which means that the duration of freezing does not affect an aroma of edamame.

3.3 Taste

The hedonic result of taste values have ranged from 3.8 to 4.6 is like medium criteria. The results of an analysis of variance showed no significant difference which means that the freezing treatment does not significantly affect the taste of edamame.

3.4 Texture

The preference test has shown the range of texture is 4.5 to 5.1 with criteria is Favored. The results of the analysis of variance showed no significant difference, which means that the duration of freezing did not significantly affect the edamame texture.

3.5 Water content

A moisture content of vacuum-fried edamame showed a range of 3.11% to 3.49%. The results of variance analysis showed that the duration of freezing did not significantly affect the water content.

3.6 Carbohydrate content

The result of Analysis of variance for the duration of freezing had a very significant effect to carbohydrates content are shown on Figure 2 with a range of 32.44% to 32.63.

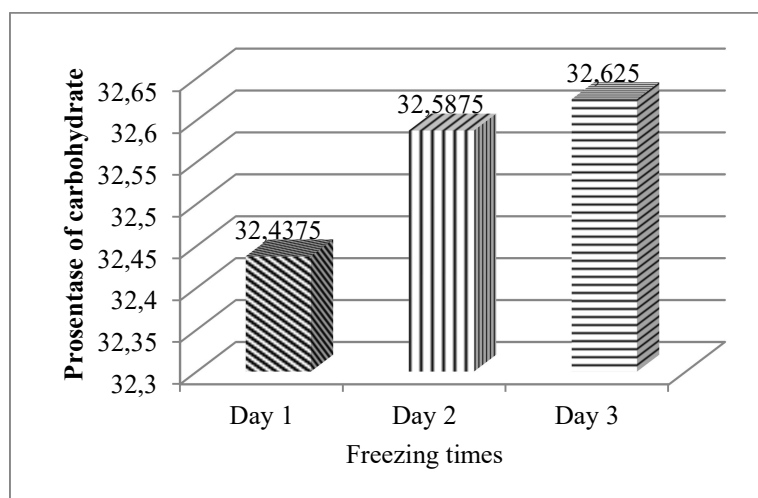


Figure 2. The influence of freezing time with persentase of carbohydrate on vacuum-fried Edamame.

In Figure 2 shows that the longest freezing is correlated with a highest of carbohydrate content, then hydrolysis process of starch is inhibited with a freezing process. Where is also known of a the hydrolysis process was initiated with enzymatic activity. Freezing process depressing effect of hydrolysed lactose and carbohydrates content increased.

3.7 Protein Content

The results of protein levels showed a range of 39.09% to 39.16%. The results of variance analysis show that the the duration of freezing did not significantly affect edamame protein levels.

3.8 Ash Content

The results of Ash content showed a range of 3,66 % to 3,75 %. The results of variance analysis show that the duration of freezing did not significantly affect edamame ash content.

3.9 Fat Content

The results of Fat content showed a range of 3,66 % to 3,75 %. The results of variance analysis show that the duration of freezing did not significantly affect edamame Fat content.

4. Conclusion

The results are shown that the influence of duration of freezing at day 1,2, and 3, to hedonic tests such as colour values and carbohydrate content was a highest, on contrast, freezing time showed no significant effect on other quality attributes such as texture, aroma and taste and chemical components are moisture, protein, fat and ash content of fried edamame.

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