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Original Paper

Physical, Chemical, and Sensory Characteristics of Frozen Salted Edamame During Storage at Room Temperature

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***Abstract* — Edamame soybeans are a superior product in Jember regency. Edamame has substantial amount of protein, calcium and iron content. In general, edamame soybeans are a perishable food commodity that must be processed immediately. One of the processed edamame products is frozen salted edamame which is a practical ready-to-eat snack. Frozen salted edamame has attracted the public interest in Jember and people outside the city. This product is popular among people outside the city, so they often buy it as a souvenir from Jember Regency. Uncontrolled environmental conditions during the trip with sudden temperature changes without cold storage cause the potential for physical damage or deterioration of quality in frozen salted edamame. Therefore, further observations are needed to determine changes in the quality of frozen salted edamame products during a trip without cold storage at room temperature. The purpose of this study was to determine the effect of room temperature storage duration on physical quality, chemical quality, and organoleptic quality of frozen salted edamame products. The study used a completely randomized design with a single factor, namely five treatments for different durations (0 hours, 12 hours, 24 hours, 36 hours, and 48 hours after the products were removed from freezer). The analyses carried out in this study were focused on the texture, color, pH, total dissolved solids, total acid, antioxidant activity, moisture content, and organoleptics. The results showed that the quality of frozen salted edamame product decreased during storage duration at room temperature. Based on the research results, the duration of storage for frozen salted edamame products at room temperature has an effect on their color, pH, total dissolved solids, total acid, and water content, but it does not affect the texture and antioxidant activity. The product quality also decreased in terms of color, taste, aroma, and texture attributes.**

Keywords*— *frozen salted edamame, thawing, color, texture, content, organoleptic

I. INTRODUCTION

Indonesia is a country which has natural potential and a good climate for farming so that it offers good opportunities in developing agricultural products, one of which is horticultural products. One of the most popular horticultural products is edamame. Edamame is a healthy food because it is rich of protein, calcium and iron. According to [20], edamame contains 100 mg /100 g vitamin A or carotene, 0.27 mg /100 g vitamin B1, 0.14 mg /100 g vitamin B2, 1 mg /100 g vitamin B3, and 27% vitamin C. In addition, edamame contains potassium, ascorbic acid, and vitamin E with a percentage of 40% protein, 20% fat (no cholesterol), 33% carbohydrates, 6% fiber, and 5% ash (dry weight). Edamame also contains antioxidants that can strengthen the body's immune system and reduce the risk of cancer, and contains isoflavones that reduce cancer risk, prevent heart disease, lower blood pressure, and reduce disorders during menopause [29]. Jember regency is one of the regencies in East Java province which produces edamame with diverse quality products. According to [24], Jember has a high average production of around 27,732 tons with plantation area of approximately 1,200 hectares for edamame cultivation which is owned by companies and farmers as partners. The abundant productivity of edamame has made a company in Jember regency produce frozen salted edamame products which are ready to eat.

Frozen salted edamame is produced to maintain the quality of edamame in terms of taste, color, aroma, texture and nutritional content during the shelf life of the freezer. In addition, the savory taste of frozen salted edamame products is used to add salty flavor and also inhibits the growth of microorganisms which can cause various diseases so that they have preservative benefits [17].

Frozen salted edamame products have become one of the icons or superior products for souvenirs typical of Jember regency. Consumers often bring frozen salted edamame products home as souvenirs from Jember without cold storage during their trip home. The absence of proper storage refers to uncontrolled environmental condition that causes the potential for physical damage and deterioration of edamame

quality. The quality of frozen salted edamame products has decreased or changed due to internal and external factors. Damage or deterioration of quality in frozen salted edamame products can affect physical conditions such as color changes, pH changes, protein denaturation, and enzyme damage in edamame. Therefore, this study was carried out to analyze the quality resistance of frozen salted edamame to temperature and time changes, which aims to produce recommendations for the feasibility of time and temperature in bringing frozen edamame products as souvenirs. The analysis was carried out with organoleptic test, physical test, and chemical test.

II. MATERIALS AND METHOD

A. *Materials*

Materials used in this study were Deluxe frozen salted edamame as the main ingredient obtained from outlets, and lso several chemicals such as 0.1 N NaOH (KGaA brand, Germany), H2SO4 (KGaA brand, Germany), starch 1 % (KGaA brand, Germany), phenolphthalein (KGaA brand, Germany), aquades, 96% ethanol (KGaA brand, Germany), and 0.01 N iodine (KGaA brand, Germany).

B. *Methods*

This study used the completely randomized design method with a single factor, namely five treatments for different duration in frozen salted edamame storage at room temperature as in Table 1.

Table I. Treatment Design

Code	Type of treatment
Control (P0)	*Frozen salted edamame freshly removed from the freezer*
P12	*Frozen salted edamame after being removed from freezer for 12 hours*
P24	*Frozen salted edamame after being removed from freezer for 24 hours*
P36	*Frozen salted edamame after being removed from freezer 36 hours*
P48	*Frozen salted edamame after being removed from freezer 48 hours*

This research was conducted in two steps. The first step, the physical test, assessed the product characteristics and it was followed with chemical test to measure the physical characteristics and chemical components of frozen salted edamame products during room-temperature storage, without cold storage. The second step was the organoleptic test of frozen salted edamame products using the hedonic test [27] which focused on such parameters as taste, aroma, color, texture, and overall preference with control treatment (0 hours) and last storage (48 hours). Meanwhile, the test of physical characteristics measured color using a color reader [31] and texture using a penetrometer [26]. The chemical components analyzed included the pH test measured using a pH meter [1], the total dissolved solids test using the hand refractometer [28], the total acid test using the titration method [1], the antioxidant activity test using the DPPH with a spectrophotometer [1], and water content testing using the gravimetric method [2]. The data obtained were analyzed using the analysis of variance, ANOVA. If there is a significant difference in the interaction of the two treatments, the DMRT (Duncan's Multiple Range Test) is carried out with the aid of SPSS software.

III. RESULTS AND DISCUSSION

A. *Texture Test*

Texture is a certain quality of a surface which arises as a result of the three-dimensional structure and is also a visual element that shows the feel of the surface of a material. Texture is also defined as a characteristic which supports the physical properties of an object. Based on the results of analysis of variance, a significant level was obtained (p> 0.05) which implied that the storage duration at room temperature did not significantly affect the texture of frozen salted edamame. Figure 1 shows a bar chart of the texture value of frozen salted edamame under the effect of varied storage durations at room temperature.

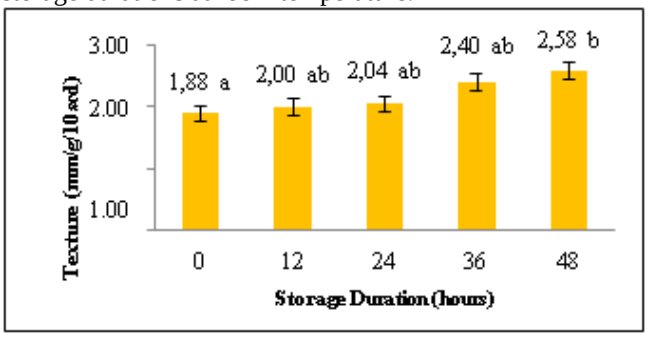

Figure 1. Texture result score

Figure 1 shows that the 0 hour storage duration did not significantly pose different effect from that of the other storage durations. However, significant different was marked between 0-hour treatment and 48-hour treatment. This is in accordance with [19] stating that freezing fruits and vegetables will cause these ingredients to be thawing after they are removed from the freezer, making the texture soft. Also, the removal can cause contamination by microbes. [5] states that the longer room temperature is stored, the lower the hardness will be. The decrease in the material hardness during storage occurs due to the alteration of the constituent components of cell walls so that the material becomes soft [30]. According to [18], water makes up more than 90% of the weight of most crops and is held within the cell walls to provide support, structure and texture of vegetables. In fact, vegetable freezing consists of freezing water contained in plant cells. When water freezes, it expands, and ice crystals cause broken cell walls.

B. *Color Degradation*

Color can be seen visually by the human eyes and is influenced by lighting effects which affects the perception of the color intensity. Color is a determining parameter of quality in a food product. The Konica Minolta CR-10 color reader was the tool for showing brightness values, frozen

salted edamame products during storage at room temperature with storage durations ranging from 0 hours (control), 12 hours, 24 hours, 36 hours, to 48 hours. Based on the results of the analysis of color variance L with storage duration at room temperature, there was no significant difference (p> 0.05). Figure 2 is a bar chart presents the brightness value of frozen salted edamame resulting from the effect of different storage durations at room temperature.

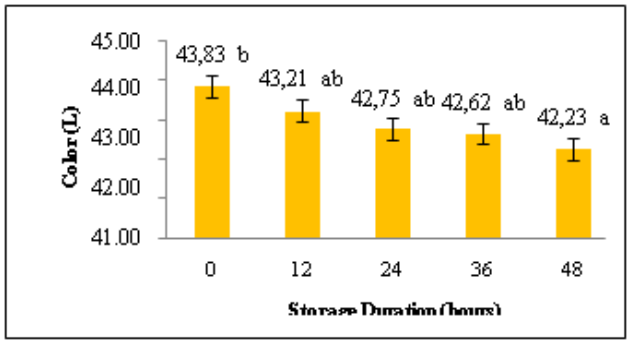

Figure 2. Brightness (L) score

Figure 2 shows the brightness score (L) of frozen salted edamame products, which has decreased directly in relation to the longer storage. This is in accordance with the theory that the decrease in color brightness is in line with the duration of storage duration [3]. The notation contained in Figure 2 shows that the storage duration of 0 hours is not significantly different from that of 12 hours, 24 hours, and 36 hours. To contrast, significant difference is marked between 0 hour and 48 hours. This decrease in brightness is caused by chemical oxidation reactions including the occurrence of carotenoid degradation and enzymatic browning reactions, resulting in a dull dark color of edamame [9].

In addition to the brightness score (L), the Konica Minolta CR-10 Color reader also shows the color value (a). Value (a) indicates the color of the sample which will lead from green-red [32]. Positive (a) value (+ a) indicates the sample has a degree of redness, while negative (a) value (-a) indicates that the sample has a greenish degree. The analysis of color variance a with storage duration showed a significant difference (p <0.05), so it was continued with the Duncan test which showed that the storage duration at room temperature of 0 hour was significantly different from all treatments. Figure 3 is a bar chart of the color value (a) of frozen salted edamame under the effect of different storage durations at room temperature.

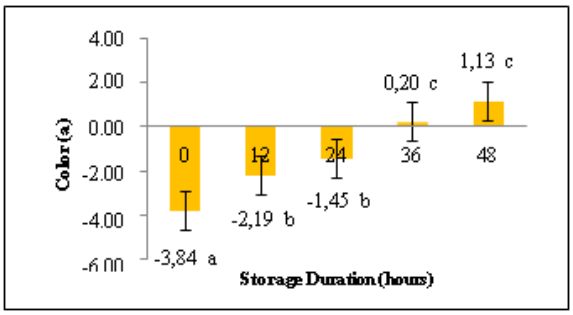

Figure 3. Color (a) result score

Figure 3 shows the color under 12-hour treatment was significantly different from that of the other treatments, but there was no difference between 12-hour treatment and 24-hour treatment. The 36-hour and 48-hour treatment were not significantly different. Significant different was evident between 0-hour, 12-hours, and 36-hour treatment. The color score in the 0 hour to 24 hour treatment, as shown by the sample, is still on a negative scale, which means that the sample color is green. The longer the storage duration results in an increase in the value (-a) or degree of greenness. The increase of degradation made the samples with 36 and 48 hours of treatment become positive because of carotenoids in edamame. Chlorophyll will further disappear during storage, so that the color fades as stated by [9], claiming that color will decrease due to oxidation reactions. Oxidation is the main change which causes destruction of karetonoid and chlorophyll during processing and storage, which is caused by storage temperature and the presence of oxygen due to extensive storage at room temperature [12].

The Konica Minolta CR-10 color reader also shows the color value (b). The value (b) indicates that the sample shows the degree of yellowish or bluish. The more positive the b (+ b) value indicates that the sample has a high degree of yellowness, while the more negative the b (-b) value indicates that the sample has a high degree of blueness. Analysis of color variance on b with room-temperature storage showed a significant difference (p <0.05), so it was continued with the Duncan test. Figure 4 shows that the edamame sample during storage at room temperature demonstrates decreased b score.

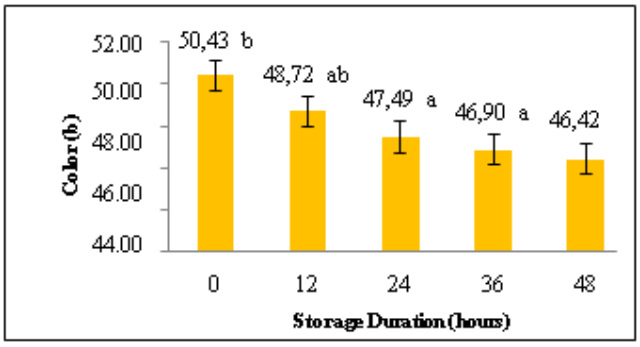

Figure 4. Color (b) score

Notation in Figure 4 shows that the storage duration at room temperature of 0 hour is not significantly different from the treatment for 12 hours, 24 hours, and 36 hours, but significant different is found between 0-hour and 48-hour treatment. The decrease in the score of b in Figure 4 is caused by carotenoids and xanthophylls, which are originally closed then opened during storage at cold temperatures. The opening of these two compounds can fade the chlorophyll pigment which causes the color to turn yellow and then brownish yellow due to the brown pigment of the two compounds that come out [8][4]. This is supported by the statement of [15] who explain that carotene can experience degradation during storage at room temperature and high temperature due to the oxidation process that converts carotene compounds into ionone compounds in the form of ketones. Storage at high room temperature causes carotene to experience isomerization and results in decreased color intensity and melting point [16].

The score of C (Chroma) shows the level of color intensity and color fading of the sample. The value of C is the value obtained from the coordinates of the score a and b. Correlation between the score of b and C gives a coefficient score that is close to 1 and positive. This shows that these two parameters have a very close relationship. Both of these parameters have a positive relationship where the value of b increases along with the increase of C will, and vice versa. Figure 5 shows a decrease in C score in frozen salted edamame products after 48 hours of storage at room temperature. Analysis of color variance C with room temperature storage duration showed a significant difference ($p<0.05$), so it was continued with the Duncan test.

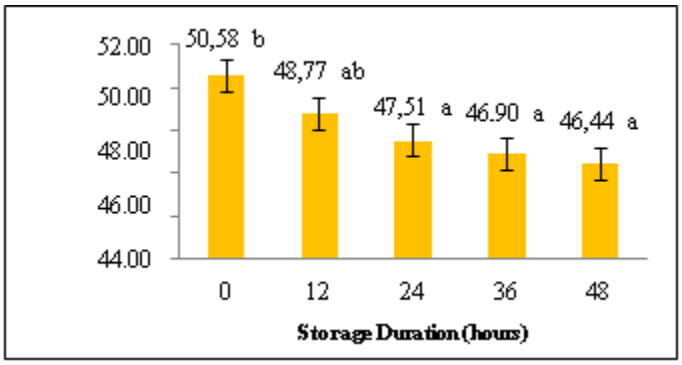

Figure 5. Color (C) score

Notation in Figure 5 shows that the storage duration at room temperature for 0 hour is similar to 12-hour treatment, but it is significantly different from the treatment for 24 hours, 36 hours, and 48 hours. This indicates a change in the color intensity of the sample, which was originally green, and then it began to change during storage at room temperature. Decrease in the score of C in Figure 5 results from the chlorophyll or green pigment of edamame subsequent to degradation affected by denaturation of protein replacement in the magnesium atom contained in chlorophyll molecule by hydrogen atoms to form feophytin. In other words, that process denotes the formation of chlorophyllide by the chlorophyllase enzyme and oxidation during storage [4]. This is also caused by carotenoids and xanthophylls which were originally closed, and then these were open during storage because of cold temperatures. The opening of these two compounds can fade the chlorophyll pigment which causes the color to turn brownish yellow due to the brown pigment of the two compounds [8][4].

C. pH

The pH test with the Martini Mi-151 pH meter is a test of the degree of acidity used to assess the acidity level or alkalinity of a material. Figure 6 shows that the pH value of frozen salted edamame products with storage duration treatment at room temperature has decreased. Based on the results of variance with a level of 5%, the score ($p <0.05$) was obtained, which means that the storage duration at room temperature had a significant effect on the pH score. The test results showed a significant effect, which was followed with the Duncan test.

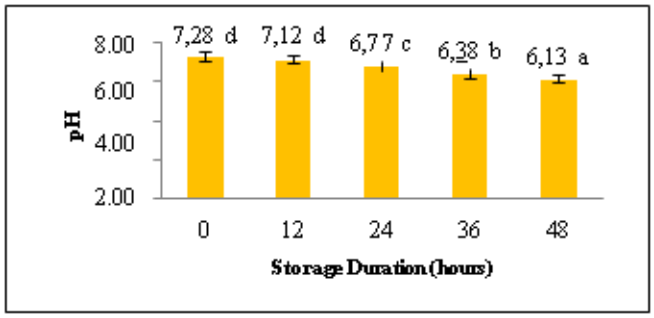

Figure 6. Results of pH Test

Figure 6 the shows results of Duncan's test, which evinces that the 0-hour treatment is similar to 12-hour treatment, while the treatments for 24 hours, 36 hours and 48 hours are significantly different from 0-hour treatment. Figure 6 shows that the 0-hour treatment at room temperature is not significantly different from the 12-hour treatment, but 0-hour treatment is found to be significantly different from the treatments for 24 hours, 36 hours, and 48 hours. The decrease in pH is caused by uncontrolled room temperature and the absence of proper product handling. This makes pH decrease generate acidic properties. According to [7] lactic acid bacteria produce a number of lactic acid as the end product of carbohydrate metabolism, thereby reducing the pH value of the growing environment and causing a sour taste. The activity of lactic acid bacteria increases as temperature rises, which affects organism growth. The high number of microbes at room temperature results in the degradation of carbohydrates into acids. The higher the acid is produced, the lower the pH will become

D. Total Dissolved Solids

Total dissolved solids or degree of brix (0 Brix) is a test carried out to determine the content of dissolved materials. Most of the changes in total solids in food are sugar. Based on Figure 7, the result of total dissolved solids shows that the

total dissolved solids will decrease along with the length of storage duration at room temperature.

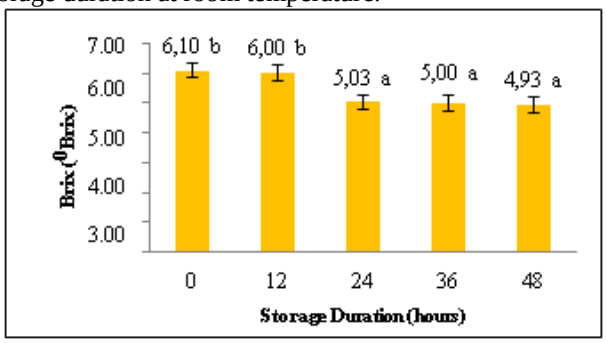

Figure 7. Total dissolved solid

Total dissolved solids can be used to estimate the amount of sugar contained in a material. Based on the results of the variance with α level of 5%, p score <0.05 was obtained, which means that the length of storage duration at room temperature has a significant effect on the total score of dissolved solids in frozen salted edamame products. The test results showed a significant effect, which was then continued with the Duncan test. The results of Duncan's test showed that the 0-hour treatment showed similarities to the 12-hour treatment, while the 24-hour, 36-hour and 48-hour treatments showed no significant difference between treatments. The decreased score of total dissolved solids was due to the microbial activity. Carbohydrates (in this case sucrose because it is the only disaccharide found in plants) become the main substrate which is broken down by microbes into simpler sugar units. The longer it is stored, the more carbohydrates are degraded by microbes into organic compounds [11][10].

E. Total Acid

The total acid test was carried out to determine the acidity level of frozen salted edamame products during storage at room temperature. Based on the research results, the total acid value obtained from 0 hour to 48 hours treatment ranges from 1.17% to 2.11%. The total acid value has increased. Based on the results of variance with α level of 5%, p value <0.05 was obtained, which means that the storage duration at room temperature has a significant effect on the total acid value of frozen salted edamame products. Figure 8 presents the total acid value of frozen salted edamame under the effect of different storage durations at room temperature.

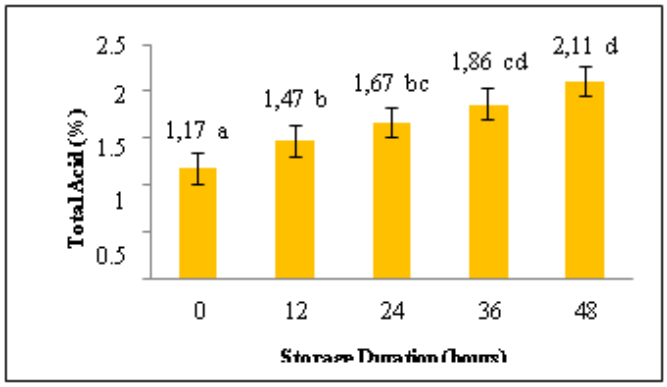

Figure 8. Total acid result

Figure 8 is the total acid result which has increased. The test results showed a significant effect, which was then continued with the Duncan test. The test showed that the 0 hour treatment was significantly different from all treatments. The treatments that were not significantly different were 24-hour treatment, compared to 12-hour and 36-hour treatment. The 48-hour treatment was not significantly different from 36-hour treatment, but was significantly different from all treatments. [21] also stated that the longer storage duration, the higher total acid will be. Increasing microbial activity breaks down carbohydrates into acids resulting in total acid at higher room temperatures. The higher carbohydrates that are broken down will lead to increased total acid. This is in accordance with [23] stating that apparently the acid produced comes from microorganisms which start to grow on edamame.

F. Antioxidant Activities

Antioxidants are compounds that are useful for overcoming oxidative damage due to free radicals in the body so that they play a role in preventing various diseases in the body. The results of analysis of variance using paired sample t test showed that there was a relationship between 0-hour treatment and 48-hour treatment at room temperature, which was then followed up with another test. The test results of the test sample obtained p value > 0.05, which means that there is no significant difference between the storage duration for frozen salted edamame products at room temperature. Figure 9 shows the value of frozen salted edamame antioxidant activity as the result of different storage durations at room temperature.

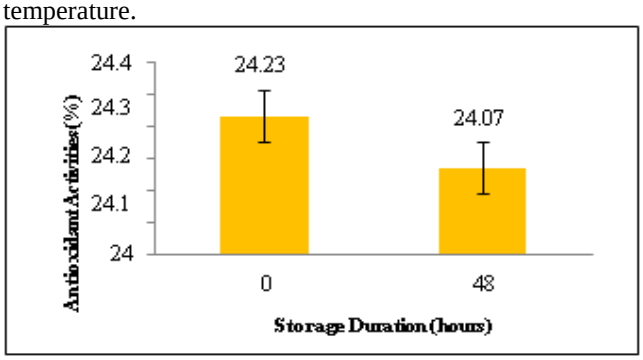

Figure 9. Result of Antioxidant activities

Based on Figure 9, the longer the frozen salted edamame product is stored at room temperature, the antioxidant activity decreases. The results of the antioxidant activity test for 0 hour and 48 hours obtained values of 24.23% and 24.07%, respectively. The decrease in antioxidant activity in frozen salted edamame products is caused by unstable temperature and external environmental factors. The decline occurred allegedly because edamame captured other radical compounds such as hydrogen peroxide which was produced from metabolic processes in its cells. This resonates [25] who state that hydrogen peroxide (H2O2) is a less reactive radical but in the certain conditions it can poison cells because it increases hydroxyl radicals.

G. Moisture Content

Water is an important component in food ingredients because of its properties which can affect the appearance, texture and taste of food. The water content in frozen salted edamame products that have experienced thawing process will decrease. This happens because the ice crystals formed during frozen storage will melt and evaporate into the air. Based on the research data, it is known that the moisture content recorded ranges from 67.48% to 69.25%. The results of analysis of variance with α level of 5% demonstrates p value <0.05), which means that the storage duration at room temperature has a significant effect on the value of water content. The test results showed a significant effect, which was then continued with the Duncan test. Figure 10 is a bar chart of the water content value of frozen salted edamame on the effect of storage duration at room temperature.

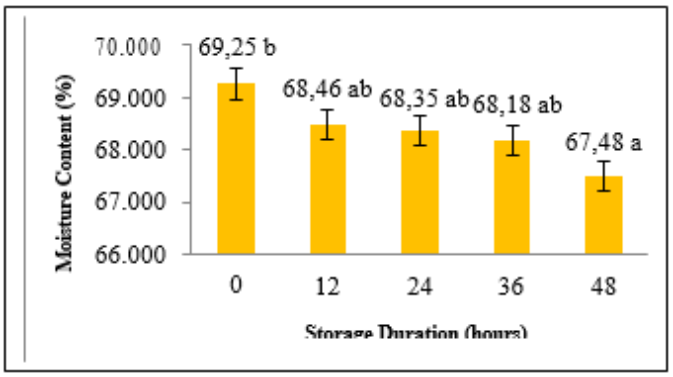

Figure 10. Moisture content

Notation in Figure 10 shows that the 0-hour storage was not significantly different from all treatments, except for the 48-hour treatment. Based on Figure 10, water content decreases due to uncontrolled temperature. This is because the temperature at that time exceeds the normal room temperature (hot), so that it can evaporate the water content in frozen salted edamame products. Besides, it is influenced by temperature. Foodstuffs will also lose water due to the humidity of the surrounding environment. According to [14], a factor that greatly influences the decrease in the quality of food products is the change of water content in the product. Changes of water content in frozen salted edamame products are influenced by room temperature and humidity during storage. According to [22], evaporation is caused by the difference in vapor pressure between the material and water vapor in the air. The water vapor pressure of the material which is greater than the air vapor pressure causes the mass transfer of water in the material to the air [6].

H. Organileptic

1) Color

Color can be seen visually by the human eyes and is influenced by lighting effects, giving rise to a separate perception of the color intensity. Figure 11 is a bar chart of the average organoleptic color of frozen salted edamame on the effect of storage duration at room temperature.

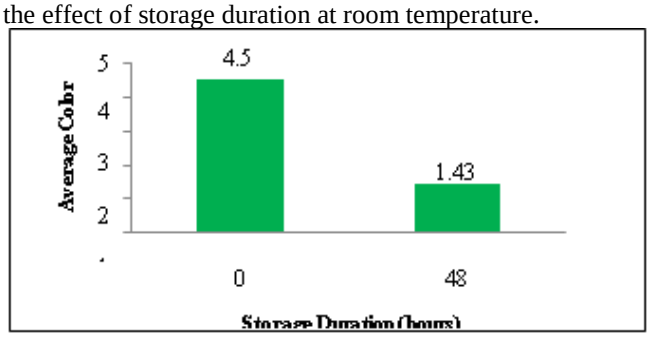

Figure 11. Average score of color organoleptic

Figure 11 shows the average color results, with the chi square test at α level of 5% and a calculated score greater than the table score, which means that storage duration at room temperature has a significant effect on the level of color preference by panelists. Figure 11 shows that the panelist's preference for the preferred color has decreased. It can be seen from the average score obtained in the 0-hour treatment as much as 4.5, and a decrease associated with the 48 hour treatment by 1.43. The color of frozen salted edamame products is different due to the influence of extensive storage duration at room temperature. The color change that occurs is caused by a chemical oxidation reaction, carotenoid degradation, and an enzymatic browning reaction, resulting in a yellowish color of edamame. This is harmonious with what [9] states, pointing out that color decreases due to oxidation reactions. Chlorophyll will further disappear during storage, so that the color becomes yellowish. Oxidation is the main change that causes destruction of carotenoid and chlorophyll during processing and storage, which is caused by storage temperature and the presence of oxygen resulting from extensive storage at room temperature [12].

2) Taste

Taste is a parameter that uses the sense of taste as a tool to analyze it. Taste is also one of the most important parameters because taste is the core of a product. Based on the research results, it is known that the organoleptic taste average score with the chi square test with α level of 5% shows the calculated score is greater than the table score. The finding indicates that storage duration at room temperature has a significant effect on the level of taste preference by panelists. Figure 12 is a bar chart of the average organoleptic

color score of frozen salted edamame as the effect of storage duration at room temperature.

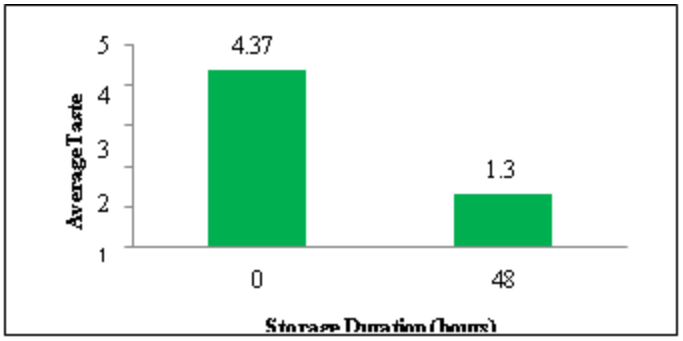

Figure 12. Average score of organoleptic taste

Figure 12 shows the average score of the panelists' preference for taste with the highest average score in the 0 hour treatment with a score of 4.37. The level of preference has decreased in the 48-hour treatment with an average score of 1.3. The decrease in Figure 12 occurs because the frozen salted edamame product is considered unsuitable for consumption because of an unattractive color and unpleasant aroma. Taste arises due to chemical stimuli that can be accepted by the taste buds. If the color, aroma and texture are good, but consumers do not like the taste, consumers will not accept the food product [13]. The change of taste occurs because frozen salted edamame products got the breakdown of carbohydrates or the degradation of carbohydrates so they become acidic. [21] state that the longer the storage period in the room, the higher the total acid will become. The higher amount of the carbohydrates broken down is, the total acid will also increase.

3) Aroma

Aroma is one of the sensory parameters inherent in a product that is identified with the sense of smell. A pleasant, fragrant, and delicious aroma will usually be more preferable than an unpleasant aroma. Based on the research results, the organoleptic taste average score with the chi square test and α level of 5% shows that the calculated score is greater than the table score, which means that storage duration at room temperature has a significant effect on the level of aroma preference by panelists. Figure 13 is a bar chart of the average score of the organoleptic aroma of frozen salted edamame on the effect of different storage durations at room temperature.

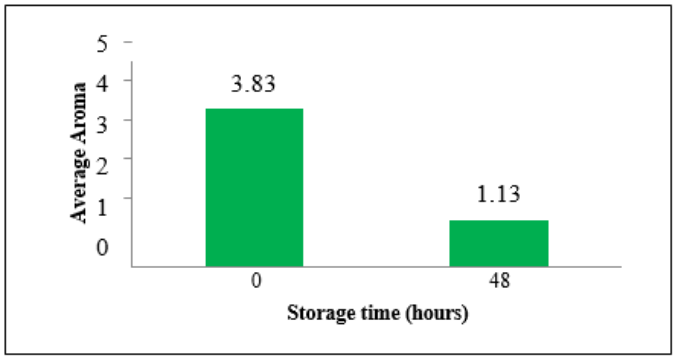

Figure 13. Average score of organoleptic aroma

frozen salted edamame products with 0 hours treatment which has an average score of 3.83 compared to products with 48-hour treatment at room temperature which have an average of 5% show that the count score is greater than the table score, which means that storage duration at room temperature has a significant effect on the level of aroma preference by panelists. Panelists prefer fresh frozen salted edamame products because they have a pleasant aroma than those that have been stored at room temperature for a long time. The unpleasant aroma makes panelists do not want to taste or consume the product. The aroma produced by frozen salted edamame products has a sour smell and has a very strong aroma. The sour smell is caused by the degradation of carbohydrates into acids. The higher the carbohydrates that are broken down, the higher acid will also increase. This is in accordance with [23] stating that it is likely that the acid produced comes from microorganisms that start to grow in edamame so that the sample emits an unpleasant aroma.

4) Texture

Texture is an important parameter in a product that can determine the characteristics of a material as a result of the combination of several physical characteristics. Based on the research results, the organoleptic color average score with the chi square test with α level of 5% shows the F value is greater than F table, which means that storage duration at room temperature has a significant effect on the level of texture preference by panelists. Figure 14 presents the average organoleptic texture score of frozen salted edamame under the effect of different storage durations at room temperature.

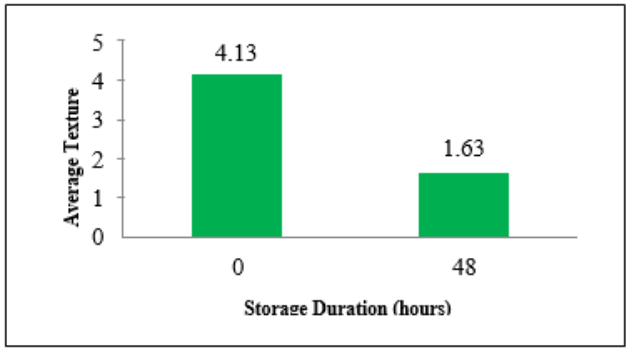

Figure 14. Average score of organoleptic texture

Figure 14 shows that the level of preference by the panelists to the texture of frozen salted edamame products demonstrates that the sample with 0-hour treatment with an average score of 4.13 more preferable than that with the 48-hour treatment with an average score of 1.63. The results of the chi square test with α level of 5% show that the F score is greater than F table score, which means that storage duration at room temperature has a significant effect on the level of texture preference by panelists. The crispness of frozen salted edamame products is influenced by proper storage duration which makes the product fresh.

The texture of the frozen salted edamame product in sample 648 which received storage treatment at room temperature for 48 hours received low scores from the panelists because the product began to generate an unpleasant aroma and mucus. In addition, it was also starting to become less crunchy. Decreased crunchiness of the edamame texture occurs due to the hydrolysis reaction. The uncontrolled room temperature triggers a hydrolysis reaction in edamame so that the edamame which is initially frozen and crunchy becomes soft because the frozen water starts to melt.

5) The Whole Preferences

The level of whole preference including color, taste, aroma, and overall texture is another set of key parameters the panelists scrutinize. Based on the research, it is known that the organoleptic color average score with the chi square test at α level of 5% shows the F score is greater than F table score, which means that storage duration at room temperature has a significant effect on the overall preference level by the panelists. Figure 15 is summarizes the average overall organoleptic preference score of frozen salted edamame due to the effect of different storage durations at room temperature.

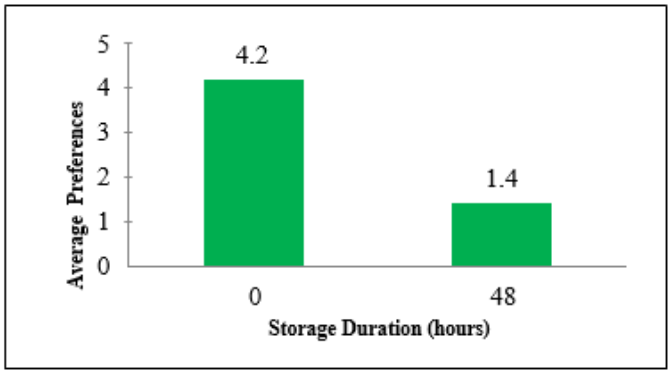

Figure 15. Average score of organoleptic preferences

Figure 15 shows that the panelists' preference for the sample with the 0-hour treatment receives a high average score of 4,2, compared to the sample with the 48-hour treatment with markedly lower average score of 1,4. The results of the chi square test at α level of 5% show that the F score is higher than F table score, which means that storage duration at room temperature has a significant effect on the overall preference level by the panelists. In other words, it can be concluded that frozen salted edamame products with 0-hour treatment are more preferred than samples with 48-hour treatment because panelists prefer fresh products as indicated by fine color, taste, aroma, and texture.

IV. CONCLUSION

This study has conducted physical, chemical, and sensory tests on the effect of different storage durations on store frozen salted edamame products at room temperature. The results of the texture observation indicates that the products still possess fine properties with a value of 1,88 mm/g/10s subsequent to 0-hour storage, and 2,58 mm/g/10s after 48-hour treatment, which implies no significant difference as indicated by the results of analysis of variance. The research results show that the edamame becomes softer in room-temperature storage. The color test employing the color indicator during the storage at room temperature makes the green edamame color gradually change into yellow, and the color indicator b shows that during storage at room temperature the edamame begins to lose its yellow color. The results also show that the chemical content decreased for 48 hours with a pH value from 7,28 to 6,13; total dissolved solids decreased from 6,10 0Brix to 4,93 0Brix; total acid increased from 1,17% to 2,11%; antioxidant activity decreased from 24,23% to 24,07%; and water content decreased from 69,25% to 67,48%.

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