Acceptability Test and Potassium Levels of Edamame Ice Cream *(Vetsoice)* as an Alternative Snack to Prevent The Risk of Hypertension

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ABSTRACT

Hypertension is a public health problem in Indonesia whose prevalence continues to increase every year. One of the factors that cause hypertension is a high sodium consumption pattern. Potassium can overcome excess sodium in patients with hypertension. Edamame is rich of potassium. Therefore, edamame soybeans can be used as ice cream with the hope that it can be another alternative in obtaining potassium intake. The objective of this study was to determine the acceptability of panelists and potassium levels of edamame ice cream. This research is an laboratory experimental research type. The data were obtained from 2 tests: one is the acceptance test, and two for potassium content of ice cream formulations with different edamame soybeans. Data analysis used the *Kruskal Wallis* statistical test and continued with the *Mann – Whitney* test to determine the significant difference in acceptability between treatments. Furthermore, the potassium content of the product that is most preferred is tested using the spectrophotometer method. The results of this study showed that the ice cream with the highest value was the formulation with the addition of 20% edamame soybeans. The results of the *Kruskal Wallis* test and continued with the *Mann – Whitney* test showed that there were significant differences in the color and taste indicators (P<0,05), while not on the aroma and texture indicators (P>0,05). Selected ice cream with the addition of 20% edamame soybeans has a potassium content of 3214,80 mg in 100 grams of the product. By consuming 30g of edamame ice cream, it could fulfill the potassium needed which prevent the risk of hypertension. Therefore, this edamame ice cream could be as a healthy snack for those who has hypertension risk.

Keywords : *Acceptability, Potassium Content, Edamame Ice Cream*

INTRODUCTION

The shift in epidemiology in Indonesia is currently in line with changes in demographics and technology that cause changes in disease patterns from infectious diseases to non-communicable diseases. This epidemiological shift occurs because people adopt unhealthy lifestyles, such as smoking, lack of exercise, intake of high-fat foods and high-calorie drinks) which are considered risk factors for non-communicable diseases. It is estimated that in the 21st century, the incidence and prevalence of non-communicable diseases will increase rapidly, this is a major challenge for future health problems. Hypertension is one of the most serious health problems and is often referred to as the silent killer[1].

According to WHO data, the number of people with hypertension in the world has increased by 26.4%. It is estimated that in 2025, the number of people with hypertension in the world will increase to 29.2% or around 1.6 billion[2]. The World Health Organization (WHO) states that hypertension affects 22% of the world's population, and the incidence in Southeast Asia has reached 36%. In 2016 hypertension was also the cause of death in Indonesia with 23.7% of the 1.7 million population[3]. The results of the Basic Health Research (Riskesdas) conducted by the Ministry of Health in 2018 resulted in an increase in the incidence of hypertension compared to 2013. Based on the results of Riskesdas 2018, the prevalence of hypertension was 34.1% with a prevalence in women of (36.85%) while in men – men by 31.34%. This figure is higher than in 2013, and the prevalence rate in 2013 was 25.8%. These results are based on the incidence of hypertension based on blood pressure measurements of Indonesian people aged 18 years[4]. East Java Province was ranked sixth in the prevalence of hypertension in 2018[4]. The number of hypertension cases in East Java in 2018 was 2,360,592 people (22.71%), of which 808,009 people (18.99%) were male and 1,146,412 people (18.76%) were female[5].

Risk factors that influence the incidence of hypertension are classified into two, namely risk factors that cannot be controlled and those that can be controlled. Risk factors for hypertension that cannot be controlled are age, gender, genetic or family history, and ethnicity, while risk factors for hypertension that can be controlled are obesity, stress, smoking, physical activity, alcohol and caffeine consumption, excessive salt consumption, and hyperlipidemia/ hypercholesterolemia[6].

One of the risk factors for hypertension is excessive salt consumption. Excessive sodium consumption causes the body to retain fluids which can increase blood volume. Micronutrients that play an important role in the occurrence of hypertension are the result of excessive sodium (Na) intake over a certain period of time and an imbalance in potassium (K) intake[7]. Lack of potassium intake is also a risk factor for hypertension. The effect of potassium on hypertension is to increase the excretion of water and sodium in the body, thereby reducing the occurrence of fluid retention. This is inversely proportional to the nature of sodium which retains fluid[8]. Consumption of sodium needs a balance with potassium consumption. A diet high in potassium found in vegetables and fruits can also reduce the risk of cardiovascular disease.

The body's need for potassium can be obtained through food, medicine, and other natural ingredients. Food sources that are good and rich in potassium include vegetables, fruits, and nuts. Examples of nuts that contain potassium, one of which is edamame, in 80 grams or the equivalent of cup cooked there are 485 mg of potassium, while ordinary soybeans are 442 mg. So that the potassium content of edamame is greater than that of ordinary soybeans[9]. Based on data on the nutritional adequacy rate in 2019, the potassium requirement for adults is 4,700 mg[10].

Edamame *(Glycine max L. Merill)* is a type of legume that is classified as a vegetable plant, with high nutritional value. Compared to other plants, edamame contains the highest quality complete protein, and the nutritional content of edamame is equivalent to milk and higher than beef. In addition, Edamame is a source of protein, carbohydrates, fiber, amino acids, bioactive peptides, omega-3 fatty acids and other micronutrients such as iron, folic acid, magnesium and potassium[11].

The use of edamame into processed food products is currently still relatively small. In general, edamame is consumed directly after the blanching process or processed in frozen form. Therefore, it is necessary to innovate processed edamame products, one of which is to process them into edamame ice cream. Ice cream is one of the processed food products that is very popular in the world and favored by various age groups. Ice cream is also very good for health because it is rich in nutrients and includes foods with high nutrition[12]. At this time in the manufacture of ice cream has been developed by replacing the basic ingredients of milk or the addition of other food ingredients such as nuts, seeds, and fruits[13]. Making edamame ice cream with high potassium levels is expected to be another alternative in obtaining potassium intake to prevent the risk of hypertension.

METHODS

Place and Time of Research

Production and Acceptability by Organoleptic Testing of Edamame Ice Cream held at the Department of Nutrition, Health Polytechnic of Surabaya, potassium content testing was carried out at the Laboratory of Research and Industrial Standardization of Surabaya. The research was conducted in the period November 2020 - June 2021.

Types of Research

In research, research design is made as a plan of activities carried out. In this study using an experimental research design because this study provides treatment to the sample under study and aims to determine the symptoms or effects that arise as a result of certain treatments or certain experiments. This type of research is *True Experimental* because the subject group is chosen randomly, and there is a comparison group when laboratory tests are carried out to determine potassium levels. The independent variables in this study were edamame ice cream formulations 100%:0%, 80%:20%, and 70%:30%. The dependent variable in this study was the Acceptance Test and Potassium Levels in ice cream with the addition of edamame soybeans.

Experiment Design

The design of this study was a completely randomized design (CRD) with 1 control and 2 treatments, namely the addition of 0%, 20%, and 30% of the total UHT skim milk added.

Milk-based ice cream which is modified in processing with the addition of edamame soybeans. The first stage of making edamame ice cream is weighing all the ice cream raw materials according to their respective treatments that have been determined. Next, the steamed edamame soybeans are ground together with UHT skim milk first. Then mix the edamame soy porridge, skim milk powder, whipped cream, granulated sugar, and cornstarch, then cook and stir until the mixture explodes. The purpose of mixing is to prevent the dough from clumping. If the dough has exploded - popping indicates that the dough is cooked.

After that, cool the dough first until it reaches room temperature. After that, put it in the freezer for 12 hours. Once the dough is frozen, remove it from the freezer, then use a blender to smooth again and freeze it back into the freezer. Once frozen, remove the dough from the freezer. The process of whisking many times is intended so that the resulting ice cream will have a soft texture.

The final stage in the process of making ice cream is mixing the dough with SP for 30 minutes or until the dough expands. The next step in making ice cream is to put the dough into a small cup. The dough is weighed 10 grams each so that it has the same weight.

After the ice cream has been made, it can be tested for acceptability and potassium levels. Acceptance test was carried out by 25 moderately trained panelists who were given a hedonic test form. The panelists were students of the Department of Nutrition, Health Polytechnic of Surabaya. There are 3 samples that were tested for acceptability, the test aims to determine the level of preference for each sample, each panelist gets 10 grams of sample for tasting. While the potassium level test aims to determine the potassium levels in 2 samples of ice cream with different compositions of the use of edamame soybeans in their manufacture, the samples are control ice cream (without edamame soybeans) and ice cream with the best formulation.

Data Collection Technique

Tests on Edamame Ice Cream were carried out through 2 types of tests, namely, subjective tests and objective tests. The subjective test was carried out by knowing the results of the organoleptic test which included color, taste, aroma and texture, while the objective test was carried out using the spectrophotometer method by looking at the potassium content in Ice Cream with Edamame Soybean formulation.

1. Organoleptic Test

   The hedonic scale test is the level of acceptance with several indicators in the form of liking or disliking the color, taste, aroma and texture of the ice cream. The assessment criteria are using a hedonic scale from 1 – 5, with information (1 = very dislike, 2 = dislike, 3 = neutral, 4 = like, and 5 = very like). The three ice cream formulations were randomly presented to 25 moderately trained panelists, in providing assessment the panelists did not repeat the assessment or compare one sample (Edamame Ice Cream) with other samples. The three formulations of Edamame Ice Cream are served in one plate directly.
2. Potassium Level Test

   The potassium level test uses the atomic absorption spectrophotometer (AAS) method, this tool is used to measure the content of a metal in samples, both solids and liquids. The working principle of this tool is that the free atoms of these elements will absorb radiation energy with a certain wavelength from the cathode lamp.

Data Analysis

The data analysis of the acceptability test results which included color, aroma, taste, and texture was tested using the hedonic test then analyzed using the *Kruskal Wallis* test and continued with the *Mann – Whitney* test to determine the most preferred product by the panelists with an error rate of 0.05 ($\alpha = 0.05$), and the potassium content of the sample was carried out by using the Atomic Absorption Spectrophotometer test using the sample from the acceptability test with the most preferred product formulation by the panelists.

RESULTS

Characteristics of Edamame Ice Cream Formulation

The formula design was carried out 3 times with different comparisons. The difference between these three formulations aims to determine the differences in the organoleptic characteristics of each edamame ice cream, which can be seen in Table 1 as follows :

Table 1 Characteristics of Edamame Ice Cream Formulation

Indicator	Edamame Ice Cream Formulation		
	Formulation 045 UHT Skim Milk : Edamame Soybean (100% : 0%)	**Formulation 154 UHT Skim Milk : Edamame Soybean (80% : 20%)**	**Formulation 285 UHT Skim Milk : Edamame Soybean (70% : 30%)**
Color	White	Light green a bit faded	Light green color
Flavor	Sweet, the taste of milk is more pronounced	Sweet, milky taste, typical of edamame, slightly unpleasant	Sweet, the distinctive taste of edamame is more dominant, a little unpleasant
Smell	The smell of milk is more dominant	There is a milky smell, a little bit of edamame	There is a smell of milk, the distinctive aroma of edamame is more dominant
Texture	Solid, fine ice crystals	Solid and slightly coarse ice crystals	Solid, slightly coarse ice crystals

Organoleptic Test

In this study, the results of the organoleptic test with a hedonic test scale were obtained to determine the level of preference for the 25 moderately trained panelists, the results are presented as follows :

Table 2 Distribution of Mean Ratings for Edamame Ice Cream Formulations

No	Indicator	Formulasi Es Krim Edamame		
		Formulation 045 UHT Skim Milk : Edamame Soybean (100% : 0%)	Formulation 154 UHT Skim Milk : Edamame Soybean (80% : 20%)	Formulation 285 UHT Skim Milk : Edamame Soybean (70% : 30%)
1.	Color	3,88	4,12	4,36
2.	Flavor	4,56	4,16	3,72
3.	Smell	3,88	3,92	3,88
4.	Texture	3,92	4,16	3,96
	Mean	**4,06**	**4,09**	**3,98**

Based on the table above with the three formulations of edamame ice cream with a total of organoleptic test research using a hedonic scale, it can be seen that the general preference results based on color, taste, aroma and texture on ice cream with the formulation (code 154) most favored by the panelists with an average score of 4,09 which falls into the likes category.

Kruskal Wallis Non Parametric Test aims to see whether there are differences in the indicators of color, taste, aroma and texture in Edamame Ice Cream. *Kruskal Wallis* test results can be seen in Table 3

Table 3 *Kruskal Wallis* Test Result of Edamame Ice Cream

Indicator	*Kruskal Wallis* Test Value
Color	0,056
Flavor	0,005
Smell	0,974
Texture	0,566

Based on table 3, the results of the *Kruskal Wallis* test on the color and taste indicators have a value ($p < 0,05$), which means that there are differences in color and taste in the 3 formulations of edamame ice cream. While the results of the *Kruskal Wallis* test on the aroma and texture indicators have a value ($p > 0,05$), which

means that there is no difference in aroma and texture in the 3 formulations of edamame ice cream.

Furthermore, to find out the difference between each formulation of edamame ice cream on color and taste, further tests were carried out, namely the *Mann – Whitney* test, which can be seen in Table 4 as follows:

Table 4 Mann – Whitney Test Results on Color and Taste of Edamame Ice Cream

Indicator	*Mann – Whitney* Test Value		
	045 : 154	045 : 285	154 : 285
Color	0,251	0,015	0,229
Flavor	0,049	0,002	0,139

Based on the *Mann – Whitney* follow – up test, it can be seen that there is a significant difference in the color indicator in the formulation (code 045) and (code 285) ($p < 0,05$), while in the formulation (code 045) with (code 154) and formulation (code 154) with (code 285) there is no significant difference ($p > 0,05$).

However, based on the taste indicator, it can be seen that there is a significant difference in the formulation (code 045) with (code 154) and formulation (code 045) with (code 285) ($p < 0,05$), while in the formulation (code 154) with (code 285) there was no significant difference ($p > 0,05$).

Potassium Level Test

The results of the analysis of potassium levels in edamame ice cream with the most preferred formulation with code 154 compared to control ice cream or without the addition of edamame soybeans can be seen in table 5 as follows:

Table 5 Potassium Levels in 100 grams of Edamame Ice Cream

Formulation Code	Potassium Content in 100 g
Formulation 045 (UHT Skim Milk : Edamame Soybean) (100% : 0%)	1670,73 mg/100g
Formulation 154 (UHT Skim Milk : Edamame Soybean) (80% : 20%)	3214,80 mg/100g

The results of the analysis of potassium levels showed that the most preferred edamame ice cream contained 3214.80 mg/100g of potassium. Can be compared with the results of potassium levels of ice cream without the addition of edamame soybeans, which contain potassium levels of 1670,73 mg/100g. This high level of potassium is due to the comparison of the composition of UHT skim milk and soy edamame in ice cream.

Table 6 Calculation of 1 Portion of Edamame Ice Cream

Product	Weight (1 Recipe)	Portion	Potassium Level
Edamame Ice Cream (code 154)	580 grams	12 servings (per 50g serving)	3214,80 mg/100g

Potassium Content in 1 Serving of Ice Cream	1607,4 mg/50g
Potassium Needs for Hypertension Patients	4500 mg/day
Potassium Needs 2x Snack	900 mg
Suggested Consumption of Ice Cream 2/3 cup (30g)	964,44 mg

The calculation results in 1 edamame ice cream recipe (code 154) yields 12 servings (50g per serving). Analysis of potassium levels showed that edamame ice cream contained 3214.80 mg/100g potassium levels. The need for potassium for patients with hypertension is 4500 mg/day. Meanwhile, a person's potassium requirement that can be obtained from 2x snacks is 20% x 450 mg = 900 mg. So, if converted to edamame ice cream in 1 serving containing potassium levels of 1607.4 mg/cup, then 2/3 of 1 cup of edamame ice cream can be fulfilled.

 ISBN 978-623-97447-4-8

DISCUSSION

Organoleptic Properties

a. Color

Edamame Ice Cream color assessment is a subjective assessment based on the sense of sight. Based on the organoleptic test, the highest average value on the color indicator shows the results that have a significant difference in formulation (code 285) with a value of 4.36 which means like, has a light green color, followed by formulation (code 154) with a value of 4.12 which means like , has a slightly faded light green color, while the lowest value is formulation (code 045) with a value of 3.88 which is still in the like category, has a white color. This is because, of the three formulations of edamame ice cream tested, the color is not much different.

Ice cream products which were dominated by light green color in the study were influenced by the addition of edamame soybeans. The green color of edamame soybeans is the color produced by chlorophyll. Chlorophyll is the green pigment in plants, algae, and photosynthetic bacteria. These compounds play a role in plant photosynthesis by absorbing and converting sunlight energy into chemical energy. In higher plants there are two kinds of chlorophyll, namely chlorophyll - a which is dark green and chlorophyll - b which is light green[14].

b. Flavor

The evaluation of the taste of edamame ice cream is an assessment based on the subjective perceived by the sense of taste. Panelists' acceptance of the taste of ice cream also varies due to stimulation of different flavors, so the results of the assessment given are also very relative. Based on the organoleptic test, the highest average value on the taste indicator showed the highest result in the formulation (code 045) with a formulation of 100%:0% edamame soybean and UHT skim milk with a value of 4.56 which means very like, has a sweet taste and milk is more pronounced, while the lowest value is the formulation (code 285) with a formulation of 70%: 30% soy edamame and UHT skim milk with a value of 3.72 which means liking, has a sweet taste, the characteristic of edamame is more dominant and slightly unpleasant, making the ice cream taste slightly less favorable .

This is because the more edamame soybeans are added, the more beany flavour. This unpleasant taste is thought to be caused by compounds that cause off flavor. The unpleasant taste (beany flavor) is caused by the lipoxygenase enzyme that hydrolyzes or decomposes edamame soybean fat, causing a bad taste[15].

c. Smell

Observation of sensory smell based on the sensation of smell or aroma when smelled with the sense of smell. Based on the organoleptic test, the average value of the aroma indicator showed the highest results in the formulation (code 154) with a value of 3.92 having a liking category, having a milky aroma and slightly edamame, while the formulation (codes 045 and 285) had a value of 3.88 entered. in the likes category. The formulation (code 045) has a more dominant milk aroma, while the formulation (code 285) has a more dominant milk and edamame aroma. The distinctive aroma of edamame gets stronger at the highest ratio of edamame soybeans.

d. Texture

Texture is a sensation of pressure that can be observed with the mouth (when bitten, chewed and swallowed) or touched with the fingers. Based on the organoleptic test, the average value on the texture indicator showed the highest result, namely the formulation (code 154) had a value of 4.16 which was included in the like category, had a dense texture and slightly coarse ice crystals. while the lowest result is the formulation (code 045) which has a value of 3.92 which is included in the like category.

This is because the panelists' acceptance of the texture of ice cream is caused by the fact that edamame soybeans have a relatively difficult to separate epidermis so that the addition of edamame soybeans, both pure and chopped, is carried out along with the epidermis[16]. This causes the ice crystal texture in the formulation (codes 154 and 285) to be somewhat coarse, the more edamame soybeans added to the formulation, the coarser the texture of the resulting ice crystals.

In addition, the texture of ice cream is also strongly influenced by fat as a raw material for ice cream. The fat in ice cream serves to give a smooth texture[17]. The addition of edamame soybeans to ice cream can make the texture rougher. The decrease in the softness of the ice cream is due to the fact that edamame soy puree has a very low fat content, so there is no increase in the fat content that is too high in the ice cream.

The addition of whipped cream in the manufacture of edamame ice cream in each treatment can increase the fat content so that the texture of the ice cream becomes soft. This is in accordance with Nissa's (2013) statement that the addition of whipped cream makes the fat content higher. The fat is needed in the formation of the ice cream structure where the size of the fat globular that forms the granules determines the

size of the air cavity in the cell. This fat also produces a soft texture in ice cream, where the fat is evenly distributed with a homogeneous and small size can help produce the desired melting point.

Potassium Levels in Edamame Ice Cream

Potassium belongs to the mineral group. Potassium is a mineral that can be found in most foods. Sources of potassium can be obtained from vegetables (long beans, cucumbers) and fruits (bananas, star fruit), nuts and seeds, milk, fish, shellfish, beef, chicken, turkey and bread[18].

The benefits of potassium for human health are quite a lot, including playing an important role in maintaining the body's fluid and electrolyte balance, ensuring normal functioning of the brain, nerves, muscles, and heart. In addition, potassium also helps stabilize blood pressure and prevent stroke, heart disease, kidney damage, and bone loss. Potassium deficiency can cause various health problems such as fatigue, muscle weakness, tingling, nausea, constipation, and arrhythmias[19].

Edamame ice cream is a food product that is rich in potassium content, with the diversification of adding edamame soybeans as a potassium-rich food, it is expected to produce a formulation that can increase the nutritional value of ice cream, namely potassium levels. Edamame ice cream with a high potassium content can be said as a superior alternative product that has the potential to become a functional food.

Testing potassium levels using the Atomic Absorption Spectrophotometry method, with the results of the analysis of potassium levels in ice cream with the most desirable acceptability test, namely the formulation of UHT skim milk and edamame soybeans as much as 80% : 20%, with an average potassium content of 3214,80 mg/100g , while the potassium content of ice cream without the addition of edamame soybeans has an average potassium level of 1670,73 mg/100g. Different amounts will also produce different levels of potassium.

According to Grober (2012) the need for potassium for people with hypertension is 4500 mg/day. In this study, the potassium content of edamame ice cream formulation (code 154) per 100 grams was 3214.80 mg. The standard serving of ice cream in general is 50g/cup. So from the above value, one serving of edamame ice cream is 50g/cup. A person's potassium requirement that can be obtained from 2x snacks is 20% x 450 mg = 900 mg. So, if converted to edamame ice cream in 1 serving containing potassium levels of 1607.4 mg/cup, then 2/3 of 1 cup of edamame ice cream can be fulfilled. Then it can be assessed the amount of potassium contribution is 20%. The potassium contribution is calculated based on the recommended potassium consumption for hypertensive people of 4500 mg/day. Increasing potassium intake (4,5 g or 120 – 175 mEq/day) can lower blood pressure. In addition, potassium administration also helps to replace potassium losses due to low sodium consumption[19].

The difference in the amount of potassium mineral content is thought to be caused by several factors. First, the characteristics of the potassium mineral itself which is very reactive and easily oxidized so that it is possible to bind with other compounds to form new compounds. Second, the decrease in potassium levels in edamame ice cream is related to the fiber and phytic acid content of edamame soybeans. Phytic acid in pea fiber can bind certain minerals[20].

The presence of phytic acid will reduce the utilization of metal ions, because 1 mole of phytic acid can bind 6 protons (6p)[21]. Third, several studies reported that the potassium content in beans is influenced by variety, harvest time and planting location, planting time and climatic conditions. So that the growing conditions, varieties, locations and planting times distinguish the amount of potassium minerals[22]. .

CONCLUSION

Based on research and experiments that have been carried out, it is concluded that ice cream with addition 20% of edamame formulation has the highest rating in terms of color, taste, aroma and texture with an average of 4.09 which falls into the like category. The most preferred potassium level in the formulation was 3214,80 mg/100g compare to he potassium level in the control formulation was 1670,73 mg/100g. The addition of soy edamame greatly affects the potassium levels in ice cream.. By consuming 30g of edamame ice cream, it could fulfill the potassium needed which prevent the risk of hypertension. Therefore, this edamame ice cream could be as a healthy snack for those who has hypertension risk. Suggestions for further research may could examine the formulation of ice cream with the addition of edamame soybeans on folic acid levels because folic acid is one of the important nutrients for pregnant women.

ACKNOWLEDGEMENTS

To all panelists of nutrition students from the Health Polytechnic of Surabaya who have participated in organoleptic testing, the manager of the nutrition laboratory of the Health Polytechnic of Health of Surabaya who has facilitated this research, and the testing and calibration laboratory (Surabaya Industrial Research and Standardization Center) who has contributed to the testing of research products. This research has obtained a research ethics permit from the Health Polytechnic Ethics Committee of the Surabaya.

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