Quality Characteristics of Natural Edamame Jam Without Preservative Ingredient as Supplementary of Emergency Food

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Jam is a intermediate moisture food made from nuts or fruits. Edamame is a soybean variety which contains high protein, but it is low fat and pectin. To improve the quality of edamame jam can used gelling agent such as carboxymethil cellulose (CMC) or modified cassava flour (MOCAF). The research aimed to formulate the edamame jam and evaluate the microbiology, sensory and chemical quality of jam. Formulation of jam were based on MOCAF and CMC composition i.e MOCAF composition 5% (A1), 7.5% (A2), 10% (A3) and CMC composition 0.5% (B1), 1% (B2), 1.5% (B3). The jam was made from main composition i.e 100g of edamamegreenbean, 300ml of drinking water, 150g of sugar. The jam no contain preservative ingredient. The edamame was blended with water on ratio of 1:1 (100g of edamame: 100ml of drinking water). The slurry was added 150g of sugar and 200ml of drinking water, then was heated for 30 minutes until formed the gel texture like jam. Microbiology analysis resulted the jam contained total microbe range from 3.80-4.61 $\log_{10}$ CFU/ml, *Salmonella*sp up to 1.74 $\log_{10}$ CFU/ml and *Escherichia coli* up to 1.56 $\log_{10}$ CFU/ml. The sensory evaluation showed that the preferred jam was A1B3 (5% of MOCAF and 1.5% of CMC). Sensory properties of the preferred jam (A1B3) were like for taste, edamame flavor, texture and spreadability, and no beany flavor. The chemical composition of the preferred jam were 33.3% of moisture content, 0.42% of ash, 7.42% of fat, 12.24% of protein and 46.42% of carbohydrate content. It can be concluded that the processing of no preservative (natural) jam should be pasteurized to reduce the bacteria. The edamame jam can be developed as supplementary of emergency food like for cake or bread topping.

Keywords: Edamame, Jam, Sensory, Soybean, Microbiology

1. INTRODUCTION

Jam is a intermediet moisture food that is a gel or semi-solid, so it has a short shelf life. Jam more resistance to the microorganisms growth cause contain high sugar content ± 40%. The soluble solids in jam was 65 -73%, pH 3.1 to 3.5, and a_w 0.75 to 0.83, and high temperatures during cooking(105-106°C). Good quality jam has characteristicscorresponding color evenly and basic materials, thick, creamy texture, natural flavor and strong, not overgrown mould, do not undergo syneresis and crystallization during storage[1].

Jam can be developed as functional food. Based on the basic materials, jam made from soybean contain high isoflavon. Edamame (*Glycine Max* (L.) Merrill.) is vegetable soybean and harvested at approximately 80% maturity. Edamame is widely cultivated at Jember East Java Provincy Indonesia. Hu *et al.*[2] reported that Edamame is rich in protein, fat, phospholipids, calcium, iron, vitamins and diet fibre, and popularly consumed after blanching in Korea, Japan, China, and other countries. It also have potentials for cancer prevention and suppression due to its high content of genistein. In recent years, with the increase of the human being's awareness of health and knowledge about the health function of natural products, edamame produces have gradually attracted extensive attention worldwide.

According to Masuda *et al.*[3], edamame quality was determined by the taste (sweetness), aroma, texture, smell of rotten (beany flavor), and a bitter taste. The sweet taste is caused by the sucrose content, taste delicious or tasty or savory (savory) is caused by the content of amino acids such as glutamic acid. Unpleasant odor (beany flavor) is derived from linolenic acid oxidation by lipoxygenase enzyme, while the bitter taste by the content of indegenouslipoxygenase enzyme. Edamame is rich in protein, calcium, iron, vitamin A, B1 and C. In addition to the nutritional value, edamame soybeans are also rich in potassium, ascorbic acid, and vitamin E to the percentage of the nutrient content of 40% protein, 20% fat (without cholesterol), 33% carbohydrate, 6% fiber and 5% ash (in dry weight)[4].

Coolong[5] stated that, edamame had a higher nutritional content and better, and was easier to digest than soy has matured. Additionally, edamame had a fat content which was much lower and carbohydrate levels were much higher than

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yellow soybeans[6]. The edamame jam was formulated by application of gelling agent. Zhang *et al.*[7]reported modified cassava starch is widely used as gelling, thickening, stabilizing and filling agents in prepared foods. The research aimed to formulate the edamame jam, and evaluate the microbiology and sensory quality of the jam and chemical characteristic of the preferred jam.

2. METHODOLOGY

Materials

Edamamegreenbean was collected from tradisional market at Jember Regency "PasarTanjung". Modified cassava flour (MOCAF) was provided by PT. Bangkit Jaya Indonesia. Formulation of jam were based on MOCAF and CMC composition i.e MOCAF composition: 5% (A1), 7.5% (A2), 10% (A3) and CMC composition: 0.5% (B1), 1% (B2), 1.5% (B3). There were six formulation of edamame jam. The main composition of edamame jam were 100g of edamamegreenbean, 300ml of drinking water, 150g of sugar.

Jam Processing

100 g of shelled edamame was milled using a blender by adding water ratio of 1: 1 until tender. Furthermore, the mixing between the edamame, mocaf and CMC with appropriate comparative research design that had been determined. Then cooked and added 150 g of sugar and 200 ml water, stirred until thickened formed a gel.

3. RESULT AND DISCUSSION

Microbiological Quality of Edamame Jam

Microbiology evaluation showed that the edamame jam contain total microbial up to 4.61 Log_{10} CFU/ml. It was affected by no pasteurization process in the edamame jam making. Supported date (Table 1) showed that the edamame jam contain coliform bacteria i.e*Salmonella*sp up to 1.74 Log_{10} CFU/ml and *Escherichia coli*sp up to 1.56 Log_{10} CFU/ml. That was indicated that thermal process during jam cooking can not destructed the bacteria. Beside that, the edamame jam no contain food preservative i.e sodium bicarbonate, natriumbisorbate, natrium lactate, etc.

Table 1. Microbial population of natural edamame jam made from MOCAF and CMC

Edamame jam	Population (Log_{10} CFU/ml)		
	Microbial Total	*Salmonella*	*Escherichia coli*
A1B1	4,03	1,74	0
A1B2	3,84	0,96	0
A1B3	4,61	0	0
A2B1	4,22	1,56	0
A2B2	3,80	0	0
A2B3	3,90	1,26	1,56
A3B1	3,97	0,96	0
A3B2	4,08	0	0
A3B3	4,61	0	0

According to Ray[8], *Escherichia coli* can be destructed by pasteurization process at temperature 64.3°C for 9.6 second, while *Salmonella* can be destructed by pasteurization process at temperature 71.7°C for 15 seconds. Oktaviant*oet al.*[9]reported that pasteurization at temperature 70°C for 1 minute can destructed *Salmonella*sp up to 4.86 Log_{10} CFU/ml and *Escherichia coli* up to 6.76 Log_{10} CFU/ml. Coefficient of destruction (k value) of heating treatment at high temperatures (90°C) for 2 minutes were 0.69 for *Salmonella* sp and 0.89 for *E. coli*[10]. The genus *Salmonella* belongs to the family of *Enterobacteriaceae*, is a gram-negative, rod-shaped, facultative anaerobic, negative oxidase, positive catalase and no spore[11]. *Salmonella* grow at temperatures between 5-47°C, with the optimum temperature of 35-37°C[8].

Based on the population of coliform bacteria in the natural edamame jam, it can be concluded that temperature process of edamame jam making was not adequacy of heat to destruct the coliform bacteria so the jam should be pasteurized after packing or canning process. The pasteurization process is very important to do the edamame jam after packaging. That aims to prevent the jam from contamination of microorganisms during storage. According Hastuti[12], microbes can grow and multiply on food and drinks after the manufacturing process or during storage. In addition, the growth of microbes on edamame was encouraged by no preservatives adding. Preservatives are food additives and beverages was added into foodstuffs to prevent or inhibite microbial growth[13].

Sensory Quality of Edamame Jam

Sensory quality of edamame jam was done by scoring test. The sensory attributes were color, unpleasant aroma (beany flavor), flavor, viscosity (thickness), spreadability and preference of edamame jam. Sensory characteristics of edamame jam can be seen in Figure 1.

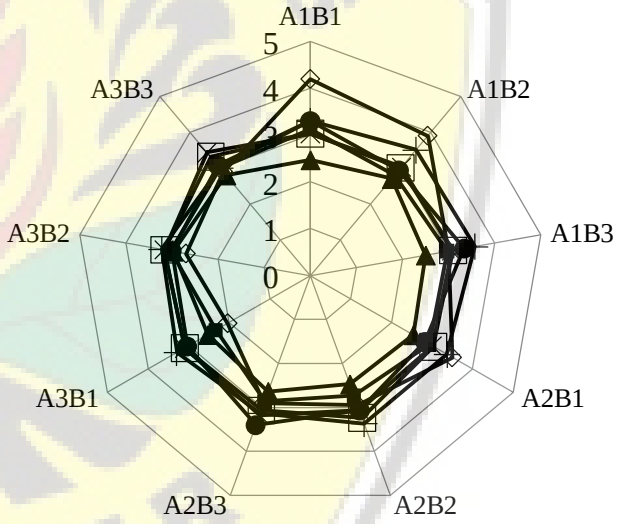

Figure 1. Quality sensory of edamame jam: color (◊), edamame aroma (■), beany flavor (▲), taste (□), texture (×), spreadability (●), preference (+)

Figure 1 showed that the highest score of jam color was 4.2 i.e the A1B1 formulation made from 5% MOCAF with 0.5% CMC. The lowest score of jam color was 2.04 i.e the A3B1 formulation made from mocaf 10% MOCAF and 0.5% CMC. Panelists favored jam with more colors typical of edamame. Colour of edamame jam was influenced by the percentage of mocaf and CMC. Increasing of MOCAF addition caused the color more brown color. It was caused by increasing of MOCAF percentage that was the color of MOCAF. In addition, the color was also influenced by the protein content of the material. According Indriyani[14], a high protein content can cause browning enzymatis during blending process or browning non enzymatis during the heating process. MOCAF had a low protein content about 1%[15]. Increasing of CMC percentage no

significantly affect the color of jam. CMC is a linear polymers, cellulose ethers and anion form compounds that are colorless. However, the addition of CMC was able to improve lighness of food products color. CMC can improve the flavor and consistency[16].

The sensory quality of jam flavor showed the highest score was 3.13 i.e the A1B3 formulation made from 5% MOCAF with 1.5% CMC, while the lowest score was 2.33 i.e the A3B1 formulation made from 10% MOCAF with 0.5% CMC. Specification and standardization of aroma sensory is the distinctive aroma of the basic material used[17]. Panelists preferred the distinctive flavor of edamame jam i.e A1B3 formulation, due to the formulation with the high percentage of CMC additional (1.5%). CMC has properties that can resist the aroma of the ingredients used. CMC is a hydrocolloid which serves as a binding agent, so that the distinctive aroma of the ingredients can be bound by the CMC. Increasing of MOCAF additional no significantly affect the distinctive aroma[18]. According to Salim[15], MOCAF is fermented cassava flour has the spesific properties finely textured, more whiteness and more acid flavor (cassava aroma is also missing).

The sensory quality of unpleasant flavor (beany flavor) of jam edamame showed the highest score was 2.97 i.e the A3B2 formulation made from 10% MOCAF with 1.0% CMC, while the lowest score was 2.47 i.e the A1B1 formulation made from 5% MOCAF with 0.5% CMC. Unpleasant flavor caused by lipoxygenase enzyme activity derived from edamame. The enzyme activity was removed by blanching process which is intended to inactivate enzymes, soften tissue and reduces contamination of harmful microorganisms[19].

The sensory quality of edamame jam taste showed the highest score was 3.31 i.e the A3B3 formulation made from 10% MOCAF with 1.5% CMC, while the lowest score was 3.0 i.e the A1B2 formulation made from 5% MOCAF with 1.0% CMC. According Prasetyan[20], mocaf has a fairly high starch content. The starch was degraded into glucose will produce a sweet taste. Tamaroh[18] stated that the higher percentage of stabilizer resulted the increasing of viscosity and influenced the taste of food. According to Zeleny[21], CMC is a cellulose derivative which has a sweetness level about 69%.

The sensory evaluation showed that the highest score of viscosity (thickness) of edamame jam was 3.43 i.e the A3B3 formulation made from 10% MOCAF and 1.5% CMC, while the lowest score was 3.0 i.e the A2B1 formulation made from 7.5% MOCAF and 0.5% CMC. The viscosity (thickness) was influenced by the percentage of mocaf and CMC were used.

Increasing of MOCAF percentage increased the jam viscosity which was caused by the MOCAF starch. The higher of starch content on food resulted the more viscous products[22]. MOCAF contain 87.3% starch content[15]. The modified starch played an obviously positive role in the color, baking resistance, WHC, appearance and spreadability of the blueberry jam[7].

The viscosity of edamame jam also increased with increasing of CMC percentage. CMC is a hydrocolloid that has the ability to bind and trap water molecules so as to form a gel. According to Rini*et al.*[23], giving rise CMC concentration in solution can lead to the amount of water bound. Increase water bound the higher level of viscosity. CMC is widely used in various food industry as thickeners, stabilizers of emulsions or suspensions and binders[24].

The spreadability of edamame jam reported that the highest score of sensory evaluation was 3.4 i.e the A2B3 formulation made from 7.5% MOCAF and 1.5% CMC, and the lowest score was 2.83 i.e the A2B1 formulation made from 7.5% MOCAF and 0.5% CMC. Panelists favored the spreadability of edamame jam on the higher CMC percentage which be more viscous. Spreadable nature is closely related to the level of consistency of jam. According Edinarwati[25], the ability of jam spreadability closely related to the formation of gel system and was influenced by several factors such as the concentration of the thickener and the concentration of sugar.

Sensory characteristics for preference showed that A1B3 made from 5% MOCAF and 1.5% CMC was more preferred than the others based on color, edamame aroma, sweet taste and more viscous. The distinctive color and aroma was A1 formulation made from 5% MOCAF, while the good taste and viscosity (thickness)was B3 formulation made from 1.5% CMC.

Chemical Quality of Edamame Jam

Based on sensory quality was concluded that the preferred formulation was A1B3 made from 5% MOCAF and 1.5% CMC. The chemical quality was evaluated the proximate composition i.e moisture content, ash, fat, protein and carbohydrate content. The characteristics of chemical quality of edamame jam were compared with the general quality of jam by Nio[26]. Chemical quality of preferred jam elected can be seen in Table 2.

Table 2. Chemical composition of preferred edamame jam and reference jam

Chemical composition	Preferred edamame jam (%)	Reference jam (Nio[27])
Moisture content	33,3	34,0
Ash	0,42	0,4
Fat	7,42	0,6
Protein	12,24	0,5
Carbohydrate	46,42	64,5

The moisture content of preferred edamame jam was 33.3%. According Nio[27], the jam contain moisture content about 34%. The moisture content of edamame jam influenced by the basic material used (edamame), ingredients added, sugar, mocaf and CMC. The moisture content of MOCAF was about 6.9%[15].

CMC are capable of trapping the water. The mechanism of CMC as emulsion stabilizers are closely related to a very high ability to bind water[27]. Guarda and Rooney[28] suggested that the increased absorption of water by the addition of hydrocolloid (CMC) has been associated with the presence of hydroxyl groups in the structure of hydrocolloid (CMC), which allows more interactions with water through hydrogen bonding.

The ash content of preferred edamame jam was 0.42% db, while Nio[26]reported the ash content of was about 0.4% db. The ash content of edamame jams was affected MOCAF percentage. Edamame had 1.0%wb[29], while MOCAF contain 0.4%db[15] and CMC contain 0.6% dbof mineralcontent[30].

The fat content levels of preferred edamame jam was 7,42% db. Edamame has a fat content of 6.6% wb[29], whereas 0.4% fat content was on MOCAF[15]. According Palupi*et al.*[31], the fat serves to add calories and improve the texture and taste of food. The protein content of edamame elected jam is 12.24%. According Nio[26], the protein content of peanut jam was 0.5%. It indicated that the protein content was more high in the edamame jam. Edamame has a protein content of 37.1%wb[32] and 1% in the MOCAF[15]. The protein due to the Maillard

reaction that occurs during the process of edamame jam making. Carbohydrate content of edamame jam was 42.75%. Edamame contain carbohydrate 38.6% wb[32], while mocaf contain carbohydrate about 87.3%[15]. Sugar is added to the jam-making can increase the jam carbohydrates content.

4. CONCLUSIONS

The edamame jam making were no pasterurization process and no preservative additive contain total microbial up to 4.61 $\log_{10}$ CFU/ml, *Salmonella* about 1.74 $\log_{10}$ CFU/ml and *Escherichia coli* about 1.56 $\log_{10}$ CFU/ml. The preferred edamame jam was based on sensory evaluation i.e A1B3 formulation made from 5% MOCAF (modified cassava flour) and 1.5% CMC (Carboxymethil Cellulose). The chemical composition of preferred jam were 33.3% moisture content, 0.42%db ash content, 7.42%db fat content, 12.24% db protein content and 46.42% db carbohydrate content.

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