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Characteristics of Vegan Corned Beef (Study of Soybean Paste Proportions: Gluten Flour and Lecithin Addition)

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A B S T R A C T

This study aims to determine the proportion of soybean paste and gluten flour with the addition of soy lecithin to the characteristics of vegan corned beef. This research used a Completely Randomized Design (CRD) with a factorial pattern and three replications. Factor I is the proportion of soybean paste: gluten flour (65:35, 60:40, 55:45). Factor II is the addition of lecithin (0.25%, 0.50%, 0.75%). The data obtained were analyzed using ANOVA and continued with the Duncan Multiple Range Test (DMRT) at the 5% level. The results of the research show that there is a real interaction with the values of water content, hardness, emulsion stability, protein content, and organoleptic tests. Vegan corned beef with soybean paste treatment: Gluten flour (55:45) with the addition of 0.75% lecithin is the best treatment which produces vegan corned beef with characteristics of 59.72% water content, 31.17% protein content, 17.85 N hardness, emulsion stability 1.90%, as well as a taste preference score of 3.28 (neutral), color 3.44 (neutral), and texture 4.04 (like).

1. INTRODUCTION

1.1. Research Background

Corned beef or what is known as corned beef, is a processed product made from beef which is processed by preserving it in brine, namely by mixing it with a saturated salt solution. Corned beef is often used as an additional ingredient in making fritters, omelets, and roulades [1]. In general, corned beef is made from animal ingredients, but this use can be modified using raw materials that have protein almost equivalent to meat [2].

Soybeans can be used as an alternative to beef because of their high protein content. Soybeans contain as much as 35% protein, even in some superior varieties it can reach 40-43%, this value is higher when compared to rice, corn, cassava flour, green beans, meat, fresh fish, chicken eggs, and almost close to the protein content in skim milk. [3]. Rahmandanti et al [4] also explain products containing soy are generally highly nutritious and contain easily digestible protein.

To produce an analog meat texture that has a chewy texture and meat-like fibers, it is necessary to add an emulsifier. Many studies show that emulsifiers can be used as fat substitutes in meat analogs and provide positive effects on texture and reduce fat content. One type of emulsifier that can be used in making meat analogs is lecithin. Lecithin can inhibit gel matrix formation through hydrophobic interactions, thereby increasing its ability to interact with water molecules.

Apart from lecithin, the addition of gluten in making meat analogs can help form structure and help absorb water in the product. In research conducted by Novita [5], gluten is used as a raw material in making meatballs besides vegetable flour because it can bind some water to form a lattice-like structure and is elastic. Apart from improving the texture, the use of gluten together with soybeans can produce better analog meat characteristics compared to using either ingredient alone [6].

Based on these things, vegan corned beef will be made using soybeans and gluten flour as a source of high protein and comparison of lecithin proportions. It is hoped that this research can produce a vegan corned beef product that has good

physicochemical and organoleptic characteristics so that it is suitable for consumption and can be accepted by the public.

1.2. Literature Review

Analog meat is a product made using vegetable protein that has functional similarities to real meat such as appearance, texture, taste, and color [7]. Meat analogs include texturized vegetable protein products which are made from pre-heating a mixture of soy protein isolate, vegetable oil, gluten, cereal binder, and others in the form of sheets and cut like meat or extruded to resemble sausage strands [8].

Many product variants have been made using analog meat, one of which is corned beef. Corned beef is a processed beef product using drying technology which is cooked by steaming at a temperature of 80°C [9].

In making analog corned beef, a stable emulsion is required. In this study, lecithin was used as an emulsifier. Lecithin can inhibit the formation of a gel matrix through hydrophobic interactions, thereby increasing the ability of interactions between water molecules and polar groups reducing the hardness of meat analogs. Lecithin is a type of emulsifier that can be obtained from palm, coconut, soybean, and corn vegetable oils. The mechanism of action of lecithin as an emulsifier is to reduce the interfacial tension of water and oil and form a film layer on the surface of the dispersed phase globules. Lecithin can also reduce meat toughness through its ability to inhibit disulfide binding from protein cross-links [10].

The addition of gluten is also needed to make the analog meat texture more like beef. Making vegan corned beef also requires a binder. The reason for using gluten in making meat analogs is based on its elasticity properties. The elasticity of gluten in the processing process will produce a soft texture in the final product thereby improving the physical characteristics of analog meat. This soft texture resembles the texture of animal protein or real meat. Gluten is a combination of two proteins gliadin and glutenin which is formed when wheat flour meets water [11]. A mixture of soy flour and gluten with the right formulation in making artificial meat will produce good flavor and protein content that almost matches the protein content of real meat [12].

1.3. Research Objective

This research aims to determine the effect of the proportion of soybean paste: gluten and additions of soy lecithin on physicochemical characteristics and organoleptic of the vegan corned beef produced.

2. MATERIALS AND METHODS

2.1. Material and Tools

The ingredients used in this research were soybeans, mushroom stock, garlic powder, sugar, and coconut oil purchased at Pabean Sidoarjo Market. Gluten flour was obtained at Indo Food Chem Jakarta, soy lecithin was obtained at Locavore Surabaya, Angkak was obtained at Batavia Herbal Shop Jakarta.

Materials used for analysis include Petroleum ether (Smart Lab), H_2SO_4 (Smart Lab), $Ca(OH)_2$ (Merck), NaOH 40% (Merck), Ethanol 95% (Merck) and Aquades.

The tools used in making vegan corned beef are a basin, pan, spoon, plastic container, knife, spatula, stove, analytical scale, and blender.

2.2. Design Experiment and Analysis

This research used a factorial Completely Randomized Design (CRD) and consisted of two factors where factor I was the proportion of soybean paste: gluten flour which consisted of 3 levels (65: 35, 60: 40, 55: 45) and factor II was the addition of lecithin. soybeans consisting of 3 levels (0.25%, 0.5%, 0.75%), each treatment was repeated 3 times.

Table 1. Combinations of treatments studied

Soy Bean Paste Proportions: Gluten Flour	Soy Lecithin		
	0.25% (B1)	0.5% (B2)	0.75% (B3)
65:35 (A1)	A1B1	A1B2	A1B3
60:40 (A2)	A2B1	A2B2	A2B3
55:45 (A3)	A3B1	A3B2	A3B3

2.3. Implementation of Research

2.3.1. Making soybean paste

The soybeans are washed thoroughly and then soaked for 12 hours. The soybeans have been soaked and then the soybean epidermis is peeled. Soybeans that have been cleaned from the epidermis are washed again. After that, the soybeans are boiled for 10 minutes and then ground using a blender with a water ratio of 1:1.

2.3.2. Making vegan corned beef

Soybean paste is mixed with gluten flour according to the proportions (65:35, 60:40, 55:45). Then it is mixed with other ingredients, namely 2% salt, 0.9% pickling, 5% mushroom stock, 0.5% nutmeg, 1.5% garlic powder and also lecithin (0.25%, 0.50%, 0.75%). Add 10% water to the dough. Then ground and shaped with the addition of 10% oil. Then stored for 1 hour in the chiller. After that, it is steamed for 30 minutes, the finished corned beef is cooled.

2.4. Observation

2.4.1. Physicochemical analysis

The parameters analyzed include water content (%), protein content (%), hardness (N), and emulsion stability (%).

2.4.2. Sensory analysis

Organoleptic tests were carried out on samples of vegan corned beef. In this organoleptic test, 25 panelists were asked to provide an assessment of the texture, color and taste of vegan corned beef. The analysis is continued with an effectiveness index test to determine the best treatment based on physical, chemical, and organoleptic properties.

3. RESULT AND DISCUSSION

3.1. Physicochemical Properties

Physicochemical Properties including water content, protein content, hardness, and stability of the emulsion can be seen in Table 2. The results of the analysis of the water content of vegan corned beef ranged from 42.25% to 59.72%, so it can be seen that the lower the proportion of soybean paste or the higher the proportion of gluten flour and the higher the addition of lecithin, the more water content in vegan corned beef will increase. This happens because gluten and lecithin contain relatively high levels of protein and can bind water, so they can bind water during

external treatment such as heating and grinding processes. The binding of water by proteins occurs through hydrogen bonds. Water molecules form hydrates with protein molecules through N and O atoms. The formation of hydrates causes the water to bind tightly which influences the determination of water content.

Table 2. Physicochemical properties results vegan corned beef

Physicochemical analysis	Treatment								
	A1B1	**A1B2**	**A1B3**	**A2B1**	**A2B2**	**A2B3**	**A3B1**	**A3B2**	**A3B3**
Water content (%)	42.45 ± 0.10^{a}	46.71 ± 0.09^{b}	47.44 ± 0.23^{c}	53.40 ± 0.08^{d}	53.63 ± 0.04^{d}	53.96 ± 0.05^{d}	58.04 ± 0.93^{e}	58.89 ± 0.20^{f}	59.72 ± 0.12^{g}
Protein (%)	23.27 ± 0.06^{a}	25.17 ± 0.64^{b}	26.03 ± 0.25^{c}	26.69 ± 0.13^{c}	27.92 ± 0.04^{d}	28.71 ± 0.07^{e}	29.70 ± 0.82^{f}	30.68 ± 0.06^{g}	31.17 ± 0.05^{h}
Hardness (N)	38.91 ± 0.03^{i}	35.43 ± 0.04^{h}	24.75 ± 0.12^{g}	23.19 ± 0.02^{f}	20.41 ± 0.03^{e}	20.18 ± 0.03^{d}	19.46 ± 0.04^{c}	18.36 ± 0.09^{b}	17.85 ± 0.03^{a}
Emulsion stability (%)	1.12 ± 0.03^{a}	1.19 ± 0.02^{a}	1.24 ± 0.02^{b}	1.31 ± 0.04^{b}	1.37 ± 0.04^{c}	1.55 ± 0.05^{d}	1.58 ± 0.3^{e}	1.74 ± 0.06^{f}	1.90 ± 0.02^{g}

Note: values accompanied by different letters indicate significant differences at $p \leq 0.05$

Based on Table 2, it can be seen that the results of the analysis of vegetable protein levels range from 23.27% to 31.17%. So the lower the proportion of soybean paste or the higher the proportion of gluten flour, the protein content of vegan corned beef will increase. This is because gluten flour has a higher protein content compared to soybean paste. This statement is supported by Sarofa et al [13], who states that if gluten is added to a product, the protein content of the product will increase. The value of vegan corned beef protein content will increase along with the addition of lecithin added. This occurs because of lecithin's ability to bind free water and retain water-soluble proteins so that the protein content of vegan corned beef will increase along with the increase in lecithin added.

Table 2 presents the results of the analysis of the hardness of vegan corned beef ranging from 17.85 N to 38.91 N. So the lower the proportion of soybean paste or the higher the proportion of gluten flour and the higher the addition of lecithin, the harder the vegan corned beef will decrease. This is because gluten can bind water from the environment, resulting in a product with a softer texture. The hardness of vegan corned beef decreased with increasing lecithin added. This is because lecithin is an emulsifier that plays a role in reducing surface tension or a surface active agent that functions to encourage formation and maintain stable conditions. This statement is supported by the addition of lecithin can reduce the hardness of a product due to its ability to inhibit disulfide bonds from protein cross-linking [14].

In **Table 2** it can be seen that the results of the emulsion stability analysis ranged from 1.12% to 1.90%. So the lower the proportion of soybean paste or the higher the proportion of gluten flour, the greater the stability of the emulsion in vegan corned beef. This is because gluten is a protein that can bind fat and water, as well as lecithin which functions as an emulsifier, thereby increasing the stability of the corned beef emulsion. The stability of the emulsion in a food product is influenced by the oil, water, and protein content in the emulsion system. Thus, the higher the protein content, the stronger the emulsifier's ability to envelop or bind with fat, which causes the stability of the emulsion to increase. The stability of the vegan corned beef emulsion will increase as lecithin is added, this is because lecithin can stabilize oil and water due to its structure. Hydrophobic groups have a strong affinity for fat, while hydrophilic groups have a strong affinity for water. So in a mixture of oil and water, lecithin will form an emulsion by reducing the surface tension between the oil and water phases. This is following Fitriyaningtyas' statement [15] that the addition of a lecithin emulsifier will cause the bond between fat and water to become stronger.

3.2. Sensory Properties

The organoleptic test for taste, color, and texture is carried out using a liking test or hedonic test, namely by taking samples randomly with 25 panelists who are presented with certain codes at random. The parameters observed were the scale of taste, color, and texture of vegan corned beef.

Table 3. Average hedonic test value of vegan corned beef

Treatment	Taste	Color	Texture
A1B1	3.08	3.76	3.12
A1B2	3.48	3.16	3.36
A1B3	3.20	3.44	3.40
A2B1	3.72	3.76	3.48
A2B2	3.88	3.28	3.56
A2B3	3.48	4.08	3.56
A3B1	2.92	3.52	3.64
A3B2	3.36	3.36	3.84
A3B3	3.28	3.44	4.04

Note: the higher the score, the more the panelists like it

Table 3 showed that the highest taste preference value was found in vegan corned beef treated with the addition of a proportion of 60% soybean paste and 40% gluten flour with the addition of 0.50% lecithin with an average value of 3.88 (neutral). This is because soy flour has the property of binding flavour. Research conducted by Eni [16] stated that research on the organoleptic quality of the taste of sea bass nuggets was influenced by soybean flour which has the properties of binding flavour, water, and fat.

Table 3 showed that the highest color preference value was found in vegan corned beef treated with the addition of a proportion of 60% soybean paste and 40% gluten flour with the addition of 0.75% lecithin with an average value of 4.08 (like). This is because the addition of soybean paste causes the color of the resulting vegan corned beef to be paler compared to the addition of gluten flour. According to Mentari [17], the effect of adding soybean flour affects the color of the product produced, the resulting color is gray with a pale appearance obtained from the natural color of soybeans, namely pale yellow.

From Table 3 it can be seen that the highest texture preference value was found in vegan corned beef treated with the addition of

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a proportion of 55% soybean paste and 45% gluten flour with the addition of lecithin. 0.75% with an average rating of 4.04 (likes). This is because gluten flour has a higher protein content compared to soybean paste, this condition causes the ability of gluten flour to bind water to increase so that the texture of the vegan corned beef produced will be more tender. This statement is supported by Avanza [18], stating that the chemical composition which is closely related to water absorption capacity is protein and carbohydrates, this is due to the hydrophilic nature and polar constituent compounds which have polar gaps such as polar carboxyl and amino groups which can bind polar ions.

4. CONCLUSION

There was a significant interaction between the treatment of the proportion of soybean paste with gluten flour and the addition of lecithin on water content, hardness, emulsion stability and protein content. The best treatment combination is soybean paste: gluten flour (55:45) and the addition of 0.75% lecithin which produces vegan corned beef with characteristics of 59.72% water content, 31.17% protein content, 17.85 N hardness, emulsion stability 1.90%, as well as a taste preference score of 3.28 (neutral), color 3.44 (neutral), and texture 4.04 (like).

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