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Effect of Lecithin on the Physical and Organoleptic Properties of Steamed Sponge

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Abstract

Lecithin is a group of fatty compounds that can be found in soybeans. Lecithin can function as a natural emulsifier and antioxidant. This research aims to improve the performance of steamed sponge on its physical, organoleptic characteristics and cost of production. The method used was a factorial Complete Random Design with two factors of comparing eggs and soy milk (100:0, 75:25, 50:50) and the addition of soy lecithin (2%, 4%). The data was analyzed using two-way ANOVA at a real level of 5%, followed by DMRT if there was a real influence. The results showed that soy milk had a real effect on Lightness, Hue Angle, Chroma while the addition of lecithin affected Chroma and Lightness. The interaction of the two had a significant effect on Lightness, Hue Angle and organoleptic tests showed that there was a significant difference in organoleptic color, aroma, texture, taste and overall. The cost of production from making steamed sponge using soy milk and lecithin is the highest preference level for T2L1 treatment of Rp. 24,512.63/baking sheet.

Keywords: Fat Substitute, Soy Lecithin, Soy Milk, Steamed Cake

Introduction

Eggs have high nutritional value in protein and fat content derived from animal foods. The content contained in egg whites, namely globulin and ovalbumin, is a protein to form and stabilize foam. The content in egg yolks is phospholipids, lipovitellenim, lipoproteins in the form of emulsifiers (Handayani, 2022). In the food industry, eggs are a food ingredient that is often used, especially as a skeleton former, binding agent, stabilizer and emulsifier, but eggs contain cholesterol (Ashwini et al., 2009). The cholesterol content in chicken eggs is 17.08 mg/100 mg egg yolk (Nizajuha et al., 2018). The development to replace the role of fat in eggs requires food as a fat substitute to produce healthier products that are low in cholesterol without sacrificing quality.

Soybean flour is a processed product of soybean seeds, contains a source of vegetable fat, protein that has an important role for the health of the body. Soybean flour is divided into three based on its fat content, namely full-fat soy flour (FFSF) of 21.86%, low-fat soy flour (LFSF) of 8.8% and de-fatted soy flour (DSF) of 1.2% (Handayani, 2022). This full-fat soybean flour contains high protein, healthy fats in the form of unsaturated fatty acids, fiber, and isoflavones that have health benefits. The protein content in roasted full fat soy flour also has functional properties such as emulsifiers and water binders, which are important in shaping the structure and texture of baked products. Soybean flour has a lecithin content of 1.48-3.08% and in eggs of 2.94% (Min et al., 2012).

Lecithin is a group of fatty compounds that can be found in sunflowers, milk, eggs and soybeans. Lecithin is a product of soybean processing that is widely used due

to its availability, good emulsifier and having binding properties. It has also been shown to provide health benefits and increase protein content in food (Hedayati & Tehrani, 2018). Lecithin is obtained from soybean oil which can function as a natural emulsifier of various foods (Sihmawati & Rosidaonggol, 2019). Soy lecithin has an unsaturated fat content that functions as a suppressant of cholesterol formation as well as antioxidants. The composition of soy lecithin consists of 3 types, phospholipids, phosphotidylinositol (PI) and phosphatidylethanolamine (PE) (Sihmawati & Rosidaonggol, 2019). Lecithin is often used to partially replace the function of eggs in the food industry, especially as an emulsifier and binder, which is especially important in baking and bakery products such as steamed sponges.

Steamed sponge is a type of traditional Indonesian sweet cake that is often found in various places. In Handayani (2022), research, in the manufacture of sponge cakes, the ratio of 25%: 75%, namely soybean flour and eggs with a concentration of 2% soy lecithin, produces the best formulation that is close to the control of the specific color, texture, volume, and volume of the cake. In the research of Hedayati & Tehrani (2018), that, by adding soy milk with a level of 4% soy lecithin can improve the physical and organoleptic properties of the cake and the quality finally approaches the control sample of height, volume, density, texture, color and taste in the cake.

In addition to the analysis of physical and organoleptic properties, this study also examines economic aspects simply, by calculating and analyzing the cost of production. According to (Wulandari et al., 2021). The cost of production is an important factor in determining the cost of a product, the determination of the right cost of production can affect and determine the selling price. This research aims to improve the performance of steamed sponge on its physical, organoleptic characteristics and cost of production.

Research Method

This research was carried out in December 2024 – January 2025, at the Agricultural Technology Laboratory, Faculty of Agriculture, University of Bengkulu. The tools and materials used in this study are digital scales, steamed sponge mold pans, mixers, stoves, boilers, blenders and 80 mesh sieves, colorimeters. The ingredients used in this study include: eggs, soybeans, soy lecithin, wheat flour, baking powder, vanilla powder, emulsifier (SP), cooking oil and sugar.

This study was conducted using the Factorial Complete Random Design method. Factor I is the comparison of eggs and soy milk (T) which consists of 3 levels of treatment, namely T1 (100%: 0%), T2 (75%: 25%), T3 (50%: 50%). Factor II is the addition of soy lecithin L1 (2%), L2 (4%). Each treatment was carried out 3 times so that there were 18 experimental units.

The data obtained from physical catharsis was analyzed by Analysis of Variance (ANOVA) using the SPSS 26.0 application to determine the effect between treatments. The treatment that had a real effect was then continued using DMRT (Duncan's Multiple Range Test) at a significant level of 5% (α=0.05) to find out the real difference between the treatments given. Organoleptic test data analysis was carried out using a non-parametric statistical method using the Friedman Test.

Results and Discussion

The results of ANOVA physical characteristics, chemistry of steamed sponge with a comparison of eggs: soy milk and the addition of lecithin can be seen in Table 1.

Table 1. ANOVA Results of Steamed Sponge

Parameters Observation		Eggs : Soy Milk	Lecithin	Eggs : Soy Milk*Lecithin
Physical Characteristics	Color :			
	L	*	*	*
	Hue	*	ns	*
	Chroma	*	*	ns

ket: notation (*) indicates a real effect treatment and ns (not significance) indicates an intangible effect treatment.

Physical Characteristics

Color

Color is one of the quality factors used to attract consumer interest that makes the impression of the product liked or not. According to Pathare & Al-Dairi (2022), the values of a* and b* have a positive and negative range. The value of a* represents the color spectrum from green (a*-) to red (a*+), while the value of b* describes the color spectrum from yellow (b*+) to blue (b*-). The results of color measurement on steamed sponges added with soy milk and lecithin can be seen in Table 2.

Table 2. Results of Observation of the Color of Steamed Sponge with Comparison of Soy Milk and Lecithin

Comparison Eggs : soy milk	**Addition Lecithin**	***L****	**a***	**b***	***Hue Angle***	***Chroma***	**Picture**
100:0	2%	67,53^{d}	3,57	96,83	87,88^{d}	96,89	
100:0	4%	57,58^{c}	2,58	90,12	88,38^{c}	90,16	
75:25	2%	44,67^{b}	4,01	80,91	87,16^{b}	81,02	
75:25	4%	42,43^{b}	4,11	77,99	86,98^{b}	78,10	
50:50	2%	41,04^{ab}	5,71	76,17	85,71^{a}	76,37	
50:50	4%	37,63^{a}	5,57	70,74	85,48^{a}	70,96	

Description: Superscript diffs show treatment differences that have a noticeable difference to other treatments on each line

The Lightness, Hue Angle, Chroma value shows that the brightness of the color of the steamed sponge decreases along with the increase in the addition of soy milk and lecithin. The Hue Angle value is a type of color on the measurement object with a value range of 0 – 360 degrees. The decrease in Lightness, Hue Angle value in steamed sponges is because soy milk made from soybean flour has a brown color which causes the resulting steamed sponge to be brown. The decrease in Lightness, Hue Angle, Chroma value in steamed sponges is also caused by the addition of lecithin, the higher

the percentage of lecithin, the darker the color in steamed sponges. The results of this study are in line with the research of Hedayati & Tehrani (2018) in the making of cakes, the more lecithin is added, the color of the cake will be darker.

Chroma is the concentration of color. According to Pathare & Al-Dairi (2022), the higher the Chroma value, the more color density an object is. According to Handayani (2022) research, in making cakes with the addition of soybean flour, the higher the addition of soybean flour, the resulting cake has a brown color. The decrease in the value of Chroma in steamed sponges is caused by the addition of lecithin, the more lecithin is used, the darker the color in the steamed sponge. This is due to the dark (slightly brownish) base color of soy lecithin. This is in line with the physical test on the color of lecithin using a colorimeter, which obtained a Chroma value on lecitin, which is 42.09. The results of this study are in line with the research of Hedayati & Tehrani (2018), in making cakes, the more lecithin is added, the darker the color of the cake.

Organoleptics

Color

Food products that have attractive colors will be preferred. The results of the Friedman test showed that the ratio of eggs: soy milk and the addition of lecithin had a real effect on the level of color preference, which was 0.002<0.05. The effect of the addition of soy milk and lecithin on the organoleptic color of steamed sponge can be seen in Figure 1.

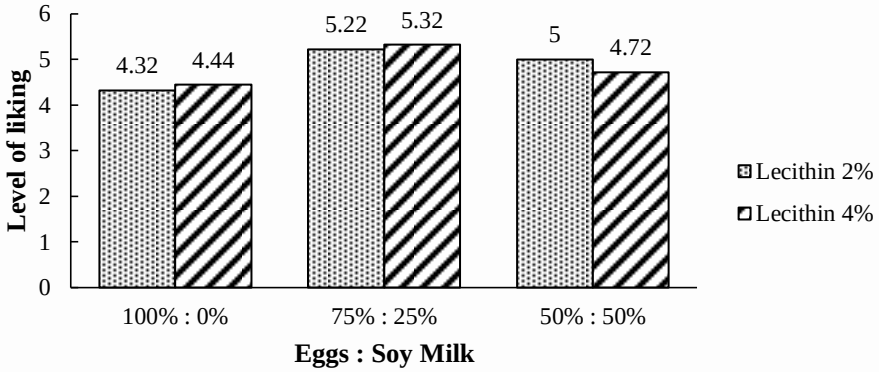

Figure 1. Egg Comparison of Steamed Sponge Color Preferences : Soy Milk and Lecithin

Based on the results of the physical color test on steamed sponges using colorimeters, it was obtained that the Lightness value of steamed sponge was in the range of 37.63 – 67.53, the value of a* of steamed sponge was in the range of 2.58 – 5.71, the value of b* on steamed sponge was in the range of 70.74 – 96.83, the Hue Angle value of steamed sponge was in the range of 85.48 – 88.38 and the Chroma value of steamed sponge was in the range of 70.96 – 96.89. Products that have a darker color will give a higher rating compared to products with no color, in this study there was an increase in the level of panelists' preference for color with the addition of soy milk and lecithin. This is in line with Nidia (2020) research, showing that the color sensory qualities of brownie cakes are increasingly added to soybean flour and brownish lecithin giving a more attractive color impression to brownies that are more attractive and liked by panelists.

Aroma

Aroma is one of the important components in consumer assessment of a product. Aroma is a reaction from food that will affect the consumer before the consumer enjoys the food, the consumer can smell the food. Aroma is also one of the components of food taste and can be a determinant of food delicacy (Naibaho et al., 2019). The effect of the addition of soy milk and lecithin on the organoleptic aroma of steamed sponge can be seen in Figure 2.

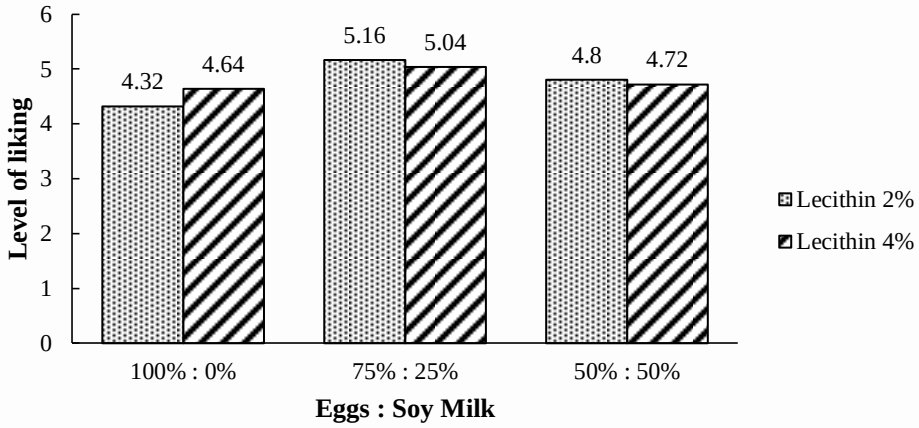

Figure 2. Favorite Level of Steamed Sponge Aroma Comparison of Eggs: Soy Milk and Lecithin

The results of the Friedman test showed that the ratio of eggs: soy milk with the addition of lecithin had a real effect on the level of aroma preference, which was 0.035<0.05. The aroma of this steamed sponge comes from the combination of a distinctive soy aroma, so the combination of the two makes the aroma of steamed sponge more preferred by the panelists. Soy milk made from roasted and roasted soybean flour. According to Gulkirpik et al. (2021), it shows that roasting soybeans decreases the activity of the enzyme lyxigenease, which is the formation of langu flavor in soybeans. Lecithin comes from soybeans, it has a typical smell of soybeans, making steamed sponges will have a more preferred aroma.

Texture

The texture of food ingredients is one of the important quality attributes, because it plays a role in influencing consumer perception of the quality of the product. The results of the Friedman test showed that the ratio of eggs: soy milk and the addition of lecithin had a real effect on the level of texture preference, which was 0.034<0.05. The results of the organoleptic test of the texture of steamed sponge can be seen in Figure 3.

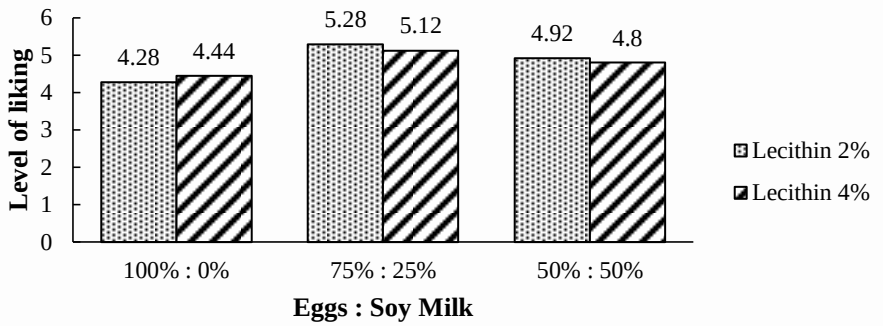

Figure 3. Preferred Level of Steamed Sponge Texture Comparison of Eggs: Soy Milk and Lecithin

The level of preference of the panelists for the texture was consistent with the physical texture test using the TX-700 texture analyzer with a hardness value of 111.39 N, a cohesiveness value of 0.97, a springiness value of 0.15, a chewiness value of 18.01, a gumminess of 109.03 and a resilience value of 1.88 because the panelists preferred a texture that was quite dense with a comparison treatment of eggs: soy milk and the addition of lecithin treatment of T2L1 (50: 50 : (2%)). Lecithin can reduce the crystallization of fats which can improve the appearance and texture of cakes (Alfarizi et al., 2024).

Flavor

Taste is a response to stimuli received by the taste buds of the tongue. Taste is one of the important factors for consumers to determine the decision to accept a product or not. Some of the components that play a role in determining the taste of food are the level of maturity, chewiness and tenderness (Sihmawati & Rosidaonggol, 2019). The results of the taste organoleptic test on steamed sponges can be seen in Figure 4.

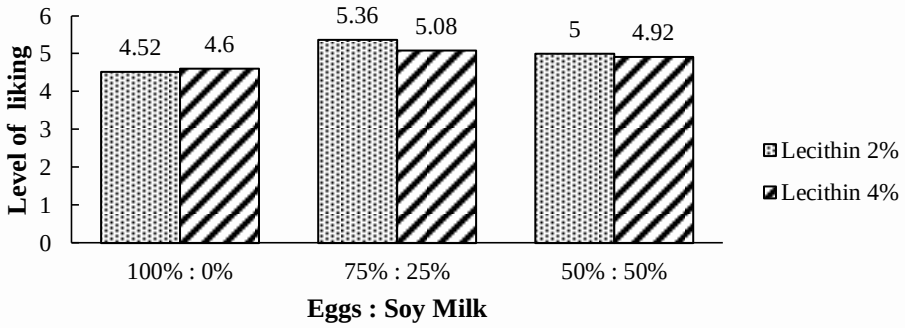

Figure 4. Flavor Preferences for Steamed Sponge with Egg Comparison: Soy Milk and Lecithin

The results of the Friedman test showed that the ratio of eggs: soy milk and the addition of lecithin had a real effect on the level of taste preference, which was 0.041<0.05. The flavor in food can come from added ingredients, key raw materials, or formed through processing. Soybeans can give a sweet and savory taste to steamed sponges. The savory taste can be caused by the content of fat and protein in one

product. The sweetness is caused by the 7% sugar content in soybeans (Amorta & Nurhidajah, 2020).

Overall

Overall organoleptic testing is to determine the degree of preference of panelists for a product as a whole of its existing attributes (color, aroma, texture and taste). The results of the overall organoleptic test of steamed sponge can be seen in Figure 5.

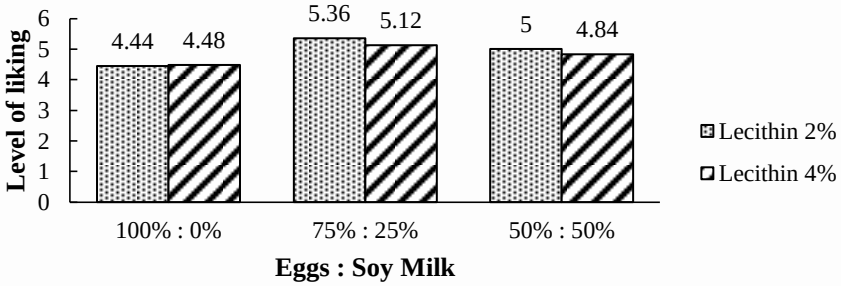

Figure 5. Overall Egg Comparison Steamed Sponge Rating: Soy Milk and Lecithin Addition

The results of the Friedman test showed that the ratio of eggs: soy milk and the addition of lecithin had a real effect on the overall preference level, which was 0.035<0.05. The highest level of taste preference was in the ratio of eggs: soy milk and the addition of lecithin T2L1 treatment (75 : 25 : (2%)) and the lowest level of preference for the taste of steamed sponge was found in the T1L1 treatment (100 : 0 : (2%)). This is due to the organoleptic properties of soybeans that are likely to be preferred by panelists. The food ingredients added to the steamed sponge add flavor to the steamed sponge that the panelists liked.

Cost of Production

The cost of production includes economic resources spent on the process of processing raw materials into products on a laboratory scale, namely irregular costs including the depreciation value of tools and irregular costs, namely the need for raw materials. The calculation of the cost of steamed sponge production using soy milk and lecithin with the best formulation, namely in the T2L1 treatment (75 : 25 : (2%)) can be seen in Tables 3 and 4.

Table 3. Overall Details of the Fixed Cost of Making Steamed Sponges

No	Description	Price (Rp)	Total Fixed Costs
1	Oven	Rp. 1,500,000	Rp. 3,122,398
2	Stoves	Rp. 200,000	
3	Pots	Rp. 70,000	
4	Sieves 80 mesh	Rp. 100,000	
5	Frying pans	Rp. 50,000	
6	Mixer	Rp. 500,000	
7	Gas	Rp. 75,000	
8	Sponge prints	Rp. 20,000	
9	Grinder	Rp. 600,000	
10	Electricity /month 8,22 kWh	Rp. 7,398	

Table 4. Overall Details of Variable Costs and Productivity of Steamed Sponges

No	Cost components	Quantity (1 Month)	Price (Rp)	Total Cost
1	Egg	16 kg	Rp. 30,000/kg	Rp. 480,000
2	Soybeans	4 kg	Rp. 24,000/kg	Rp. 96,000
3	Soybeans lecithin	896 g	Rp. 140,000/kg	Rp. 125,440
4	Wheat flour	16 kg	Rp. 14,000/kg	Rp. 224,000
5	Cooking oil	3.5 L	Rp. 20,000/L	Rp. 70,000
6	Sugar	11 kg	Rp. 20,000/kg	Rp. 220,000
7	Vanila	224 g	Rp. 170,000/kg	Rp. 38,080
8	Baking powder	112 g	Rp. 70,000/kg	Rp. 7,840
9	SP	336 g	Rp. 60,000/kg	Rp. 20,160
10	Mika sponge	9 pack	Rp. 12,000/pack	Rp. 108,000
11	Gas	2 unit	Rp. 25,000/unit	Rp. 50,000
12	Labor (1 person/month)	20 day/1 month	Rp. 100,000/day	Rp. 2,000,000
	Total Variable Cost			Rp. 3,439,520
	Productivity (C)			
1	7 baking sheet/7 business hour = 1 hour/ baking sheet			

Based on Tables 5 and 6, the cost of production can be calculated by the formula:

Value A $\frac{P-NA}{Tool\ life\ rating}$ = $\frac{Rp.\ 3{,}122{,}398 - 312{,}239.8}{60\ month}$
= Rp. 46,835.97/month
Value B = Rp. 3,439,520
Business hours = 140 hours/month

Cost of Production = $\frac{(A+B)}{working\ hours}$xC
= $\frac{(Rp.\ 46{,}835.97+Rp.\ 3{,}439{,}520)}{140\ hours}$x1 hour/ baking sheet
= Rp. 24,902.54/baking sheet

The fixed cost value for making steamed sponge is Rp. 3,122,398 with a variable cost of Rp. 3,439,520, the C value is 1 hour/pan. The total cost of production from making steamed sponges using soy milk and lecithin is Rp. 24,902.54/baking sheet. The determination of the cost of production has benefits that are obtained, among others: ensuring the selling price of a product and controlling production costs.

Conclusion

1). Comparison of eggs: soy milk and the addition of lecithin have a real effect on physical characteristics, lightness, hue angle. 2). Comparison of eggs: soy milk and the addition of lecithin to organoleptics based on the results of Friedman test analysis showed that there was a real difference in organoleptic color, aroma, texture, taste and overall steamed sponge. 3). Based on the calculation of the cost of production, the total cost of production from the manufacture of steamed sponge using soy milk and lecithin is Rp. 24,902.54/baking sheet.

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