Original Research Article

The Characteristics of Sponge Cake with Liquid Egg Yolk to Improve Texture and Physicochemistry

ABSTRACT

Aims: This research aims was determine the quality of sponge cake with the use of liquid egg based on expandability, texture, protein content, fat content, moisture content and color values.

Study design: This research are an laboratory experimental with a completely randomized design.

Place and Duration of Study: This research are located in Laboratory of Animal Product Technology, Faculty of Animal Science, Universitas Brawijaya. This research was conducted from July - August 2024.

Methodology: This research are using a 5 treatments and 5 replication. The main focus are a different substitutions. The 5 treatments are SPC1 (without using liquid egg yolk), SPC2 (25%), SPC3 (50%), SPC4 (75%), SPC5 (100%) of the total egg content.

Results: The use of different liquid eggs in making sponge cake gave a very significant effect ($P<0.01$) on the expandability, texture, protein content, fat content, moisture content and color values. Each variable increased as the use of liquid eggs added increased.

Conclusion: Besides being useful for improving texture, liquid egg yolk can also extend the shelf life of sponge cake. Additional research is required to evaluate the safety of sponge cake made with liquid eggs.

Keywords: Fresh egg; liquid egg; sponge cake; texture.

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1. INTRODUCTION

Liquid egg yolk is an egg product that has been separated from the shell and made of egg yolk, and has gone through processes such as homogenization and pasteurization which are useful for ensuring food safety [1]. There are several advantages of liquid eggs in terms of the food industry, namely ease of use, reducing the time and effort required to prepare eggs such as breaking and beating eggs. Liquid egg also has the advantage of having a stable consistency that allows it to produce a more consistent end result in bakery products, with the advantages possessed by this liquid egg which makes liquid egg an alternative to fresh eggs used in food products such as sponge and sponge cake [2].

Sponge cake is one of the foods made from simple ingredients such as eggs, flour and sugar. Sponge cake is known as a cake that has a soft texture like a sponge and tastes sweet [3]. There is an advantage that sponge cake has, which is not using baking powder as a developer. Instead, sponge cake is made from eggs beaten together with sugar, until it expands perfectly. Eggs are the main ingredient used in the process of making sponge cake, and eggs are very influential in determining the sensory characteristics of sponge cake. There is previous research on making angel cake with the use of pasteurized egg white which results in maximum cake volume

increase [4]. The making of angel cake with the use of fermented eggs produces a more attractive texture and aroma compared to the use of fresh eggs [5]. Therefore, the use of liquid egg in making sponge cake is useful to maximize the texture produced by sponge cake. The use of liquid egg in the preparation of sponge cake can provide a soft texture and high enough chewiness due to the presence of albumin in eggs which functions as a binding agent to form a smooth and soft texture. In addition, liquid egg is also useful for increasing the volume of sponge cake due to its effective emulsification properties, which maximizes the entry of air into the dough [6].

2. MATERIAL AND METHODS

2.1 Materials

This research focused on sponge cakes made with liquid egg yolk. The ingredients used to make sponge cake are fresh chicken eggs obtained from Batu chicken farm, liquid egg yolk, flour, sugar, and butter obtained from Supermarket. The tools used in the research are mixer, container, baking pan and oven.

2.2 Methods

The research was conducted using a laboratory experimental method with a completely randomized design (CRD), involving 5 treatments and 5 repetitions. The five treatments are SPC1 (without using liquid egg), SPC2 (25%), SPC3 (50%), SPC4 (75%), SPC5 (100%) of the total egg content.

2.3 Data Analysis

The experimental data collected was analyzed using Microsoft Excel. A series of statistical analyses such as determining the mean, standard deviation, and performing an analysis of variance test were performed on the numerical results. ANOVA indicated the presence of significant differences among the treatments. Therefore, Duncan's Multiple Range Test (DMRT) was conducted for pairwise comparisons to strictly distinguish means that were significantly different from each other.

2.4 Production of Sponge Cake using Liquid Egg

Put the fresh egg or liquid egg along with sugar into the mixer and mixer on high speed for 3 minutes until the egg is fluffy and white like foam, then add the flour slowly on low speed and make sure the dough is homogeneous. Then melt the butter and put it into the cake batter by stirring slowly until smooth. Put the dough on a baking sheet lined with parchment paper and bake in the oven at 145°C for 45 minutes. Sponge cake using liquid egg is ready for further analysis.

2.5 Quality of Sponge Cake

2.5.1 Expandabillity

Expandability is one of the quality indicators of sponge cake to show the ability of the dough to expand optimally during the baking process. The procedure for measuring the height of the dough before and after baking is then determined using the formula:

Expandabillity = B – A x 100%

A : Height of sample before oven
B : Height of sample after oven

2.5.2 Texture

Texture is a parameter that includes softness, elasticity, and density of the pore structure. Texture test measurements use a texture analyzer with units of N.

2.5.3 Protein Content

Protein content can affect the structure and quality of sponge cakes. Proteins in flour such as glutenin and gliadin are important in the elasticity and the ability of the dough to resist pressure during the dough's expansion. The procedure for testing protein content is by measuring the weight of the sample and then putting it in a kjeldahl flask, then adding distilled water and titrating it and then calculating it with the formula:

$$Protein = \frac{(VA - VB)\ Hcl\ x\ N\ Hcl\ x\ 14{,}007}{W\ x\ 1000}\ x\ 100\%$$

Notes:

VA: mL HCl for sample titration
VB: mL HCl for blank titration
N: normality of standard HCl used
14.007: atomic weight of nitrogen
W: sample weight in grams

2.5.4 Fat Content

Fat content acts as a tenderizer, which is to soften the texture of the cake by inhibiting the formation of excessive gluten, resulting in a more elastic texture. The procedure for measuring fat content is by putting the sample into a woolen cloth and placing it into a soxhlet and heating it to 105°C and cooling it in a desiccator for 30 minutes and then calculated by the formula:

$$Fat\ Content = \frac{Fat\ Weight}{Sample\ Weight}\ x\ 100\%$$

2.5.5 Moisture Content

Moisture content was measured using the gravimetric method. The petri dish was first weighed without the sample (A). Then, 2 g of sausage sample was placed on the petri dish, which had been preheated in a 105°C oven for 12 hours, and weighed again (B). Dry the sample for 12 hours, then placed it on desiccator for 10 minutes before weighed it (C). The final weight can be calculated using the content formulation =

$$Moisture\ Content = \frac{(B - C)}{(B - A)}\ x\ 100\%$$

2.5.6 Color Values

Color is determined using a color reader. Before analyzing the sample with a color reader, the color reader must be calibrated using black and white plates. Cut the sample about 2 cm x 2 cm x 2 cm and place it on the tray. Place the color reader lens over the sample and click the power button. The color value can be seen on the screen with 3 types of colors: redness, yellowness, and brightness.

3. RESULTS AND DISCUSSION

3.1 Expandability

The use of liquid egg yolk in making sponge cake give a very significant effect (P<0.01). This can happen because liquid egg has a high enough water content, so it can increase the moisture of the dough. In addition, liquid egg is easy to beat into a stable foam, so it can maintain the dough structure during the baking process. The proteins in eggs also coagulate when exposed to heat, helping to form a firm yet light cake structure. This is comparable to previous research which states that a good rise in sponge cake is in the range of 6.91-7.47% [7].

3.2 Texture

The use of liquid egg in making sponge cake gives a very significant effect (P<0.01). This can occur because the use of liquid egg in sponge cake has the ability to bind water and emulsification power that is more optimal and also with the presence of water content in liquid egg helps increase the viscosity of the dough, which affects the stability of the foam and increases the volume at the time of baking. The terdahuolu research states that the texture of sponge cake ranging from 5.9 - 10.5 N is a good texture on sponge cake [8].

3.3 Protein Content

The use of liquid egg yolk in making sponge cake gives a very significant effect (P<0.01) on the protein content of sponge cake. This can occur because liquid egg is one of the ingredients that has a high enough protein content and serves to form the dough with the interaction between water and fat in the dough. In addition, the proteins in liquid eggs denature and coagulate when heated, which forms a firm and voluminous sponge structure. This is comparable to previous research which states that protein levels in sponge cake with the addition of moringa flour increased, which ranged from 8.56-10.80% [9].

3.4 Fat Content

The use of liquid egg in making sponge cake gives a very significant effect (P<0.01). This can occur because liquid egg contains egg yolk which is rich in fat

and phospholipids, especially lecithin, which functions as an emulsifier [10]. The fat not only increases the softness of the cake, but also helps stabilize the air bubbles formed during whisking, maintaining the volume of the batter and resulting in a smoother texture. The emulsification process supported by lecithin also allows the fat to be well integrated, giving the sponge cake a moist and fluffy effect.

3.5 Moisture Content

The use of liquid egg in making sponge cake gives a very significant effect ($P<0.01$). This can occur because liquid egg that has gone through the pasteurization process has a higher water content, but with a high enough water content in liquid egg that can function as an emulsifier, resulting in a dough that is resistant to air and the texture of the sponge cake becomes light and soft. In making low fat sponge cake with the addition of pumpkin has a water content of 27.49-31.75% [11].

3.6 Color Values

The use of liquid egg in making sponge cake gives a very significant effect ($P<0.01$). This can occur because egg yolk contains natural pigments such as carotenoids (lutein and zeaxanthin) which give a yellowish color. The use of liquid egg yolk can increase the pigment content which contributes to the increase of L (brightness), a* (bluish-reddish), and b* values in sponge cake. In addition, liquid egg yolk can influence the Maillard reaction, which plays a role in color formation during baking. This reaction will run more evenly, resulting in a more intense cake color. This is in accordance with previous research stating that a* color has a value ranging from 7-15 [12] while b* color has a value ranging from 66.57 -74.00 [13].

Table 1. Quality of Sponge Cake using Liquid Egg Yolk

Variable	Treatments				
	SPC_0 ± SD	**SPC_1 ± SD**	**SPC_2 ± SD**	**SPC_3 ± SD**	**SPC_4 ± SD**
Expandabillity (%)	5.95 ± 0.58^{a}	6.95 ± 0.29^{b}	7.05 ± 0.31^{b}	7.35 ± 0.13^{bc}	8.00 ± 0.26^{c}
Texture (N)	4.05 ± 0.53^{a}	4.14 ± 0.28^{a}	4.33 ± 0.60^{a}	5.23 ± 0.22^{a}	5.83 ± 0.18^{a}
Protein Content (%)	9.25 ± 0.15^{a}	10.29 ± 0.18^{b}	12.87 ± 0.40^{c}	14.36 ± 0.27^{d}	15.96 ± 0.26^{e}
Fat Content (%)	9.38 ± 0.56^{a}	10.23 ± 0.30^{ab}	10.96 ± 0.45^{bc}	11.80 ± 0.58^{cd}	12.43 ± 0.53^{d}
Moisture Content (%)	32.30 ± 0.68^{a}	33.23 ± 0.57^{ab}	33.37 ± 0.65^{ab}	33.91 ± 0.38^{b}	34.47 ± 0.74^{b}
Lightness (L)	79.09 ± 0.89^{a}	81.23 ± 0.73^{ab}	84.55 ± 0.97^{bc}	87.46 ± 0.95^{c}	89.92 ± 0.77^{d}
Redness (a)	2.75 ± 0.27^{a}	4.04 ± 0.26^{ab}	5.51 ± 0.70^{bc}	7.32 ± 0.85^{c}	10.30 ± 0.89^{d}
Yellowness (b*)	59.36 ± 0.82^{a}	62.56 ± 0.76^{ab}	65.09 ± 0.59^{c}	69.25 ± 0.68^{c}	70.50 ± 0.94^{d}

**a, b, c, d shows a very significant effect*

4. CONCLUSION

The use of liquid egg in making sponge cake can improve the texture produced.

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The use of liquid egg as much as 100% in sponge cake can improve quality based on expandability, texture, protein content, fat content, moisture content and color values. The percentage of different liquid egg usage can have a very significant effect on each variable. Further research needs to be done on the safety of sponge cake with the use of liquid egg.

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