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Antioxidant Activity and Lovastatin Content in *Garaetteok* (Korean Rice Cake) with Angkak Powder as Food Colouring

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Abstract. Angkak is known as fermented rice produced by *Monascus purpureus*, which has many health benefits. One of them is the antioxidant activity found in angkak. Antioxidants are compounds that can inhibit oxidation which are currently being developed and added to food products. In Angkak also found lovastatin compounds which can prevent the formation of cholesterol. The addition of angkak powder that contains antioxidants and lovastatin in foods has the potential to make these foods as functional foods. One food that has the same raw materials as angkak is *garaetteok*. Korean traditional food that is now starting to be popular in Indonesia. The objectives of this research is to determine the best concentration of angkak powder addition to produce *garaetteok* which has antioxidant activity and lovastatin content so that it can be used as functional food. In this experiment, the addition of Angkak powder was given at 5 concentrations (0, 0.5, 1, 1.5, 2%). *Garaetteok* which has the highest antioxidant activity is the addition of 2% Angkak powder which is 8.41% (at concentration of 100000ppm) and lovastatin content of 19.20 ppm.

Keywords: Antioxidant, Lovastatin, *Garaetteok*, Angkak

1. Introduction

Angkak is a product of rice fermentation by *Monascus purpureus*. Angkak fermentation process produces secondary metabolites including pigments and statins. The pigment produced by angkak fermentation is a natural pigment, non-toxic and not interfere with the immune system. The use of angkak as a source of natural dyes can reduce the use of synthetic dyes which tend to have an adverse effect on health. Angkak produces cholesterol-reducing compounds in the form of lovastatin or menivalin [1]. Lovastatin is HMG-CoA reductase enzyme inhibitor, an enzyme that acts as a catalyst in cholesterol biosynthesis. Another advantage of Angkak is the antioxidant activity. The use of Angkak powder in passion fruit jam product has been proven to increase antioxidant activity in passion fruit jam [2].

Garaetteok is a type of traditional Korean rice cake in the shape of a long white cylinder. *Garaetteok* is produced from dry rice flour by being steamed and molded into chewy, white, and rod-shaped cakes. *Garaetteok* is used in various Korean dishes, such as spicy tteokbokki and traditional tteokguk soup [3]. The similarity of raw materials for making *garaetteok* with raw materials for making Angkak makes interested in applying Angkak powder directly as coloring agent for *garaetteok*.



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The stability of Angkak pigment is also the reason for the use of Angkak powder as a coloring agent in the making garaetteok. Garaetteok is made by heating at high temperatures ($\pm 100^{\circ}\text{C}$). Heating Angkak at high temperatures for 1 hour there is still pigment intensity in angkak, so angkak pigment tends to be stable [4].

The addition of angkak powder in garaetteok is expected to improve the physical appearance of garaetteok (colour). The red colour of Angkak is expected to make Garaetteok's appearance more attractive. The lovastatin content of angkak is also expected to make garaetteok as a healthy product because it contains lovastatin which acts as an inhibitor of the HMG-CoA reductase enzyme, an enzyme that acts as a catalyst in cholesterol biosynthesis.

2. Methods

2.1. Materials

The materials used in this study were isolates of *Monascus purpureus* (IPBCC, Bogor) which were cultivated in Potato Dextrose Agar, IR 42 rice, rice flour, tapioca flour, and salt. The chemical materials used in this study were sterile aquades, methanol, DPPH, acetonitrile, and phosphoric acid. The equipments used in this study were steamer, molds, aluminum plates, desiccators, measuring cups, test tubes, petri dishes, erlenmeyer, stirring rods, ose needle, goblets, 80 mesh sieves, analytical scales, incubators, hot plate strirrers, spectrophotometers, High Performance Liquid Chromatography, filter paper, cabinet dryer, blender, laminar flow, micro pipette, and spectro-colorimeter.

2.2. Design and Data Analysis

This study was designed using Completely Randomized Design with 5 treatments (difference concentration addition of angkak powder: 0%, 0.5%, 1%, 1.5%, and 2%) and 3 replications. Data were submitted to Analysis of Variance and Duncan's Multiple Range Test.

2.3. Process of Garaetteok Making

Garaetteok is made by mixing rice flour, tapioca flour, salt and Angkak powder. The percentage of Angkak powder added is calculated from the total weight of the material used. Then doused with hot water ($\pm 100^{\circ}\text{C}$). The mixture is stirred until smooth. After that the mixture is steamed for ± 8 minutes. The dough that has been steamed is then molded into a cylindrical shape.

2.4. Observation

The Observation on Angkak powder and garaetteok produced including color, antioxidant activity [5] and lovastatin content [6].

3. Results and Discussion

3.1. Angkak

Observations made on angkak powder include antioxidant activity and lovastatin content. The results of observation of Angkak rice powder can be seen in Table 1.

Table 1. The Antioxidant Activity and Lovastatin Content of Angkak Powder

Analysis Component	Result
Antioxidant Activity (%)	2,64 \pm 0,64*
Lovastatin Content (ppm)	23,59

Note: * at concentration of 10000 ppm

The antioxidant activity of Angkak powder in this study was 2.64% at a concentration of 10,000 ppm. This is not the same as the antioxidant activity of Angkak powder in previous study [2] which is 16.29% at a concentration of 10,000 ppm. This is also not the same as the other study [7], where the antioxidant activity of angkak produced reached 25.38% at a concentration of 2000 ppm. Lovastatin is

one of the secondary metabolites produced by angkak. From the research conducted, it was found that lovastatin content in Angkak was 23.59 ppm. This is lower than the lovastatin content in angkak at other study [2] which is 26.31 ppm.

3.2. Garaetteok

Antioxidants are chemical substances that can inhibit the initiation or slow the speed of oxidation in easily oxidized materials [8]. Angkak has various antioxidants such as dimeric acid, tannin and phenol [9]. The antioxidant activity of garaetteok with the addition of angkak can be seen in Table 2.

Table 2. The Antioxidant Activity of Garaetteok

Angkak Powder Addition (%)	Antioxidant Acitivity (%)*
0	0.00 ± 0,00 a
0.5	1.80 ± 0,99 b
1.0	4.09 ± 0,43 c
1.5	4.78 ± 0,29 c
2.0	8.41 ± 0,78 d

Note: SD is Standard Deviation; * at concentration of 100000 ppm

3.2.1. Antioxidant Activity

The results of analysis of variance showed that the addition of angkak powder had a significant influence on the antioxidant activity of the garaetteok produced. In garaetteok without the addition of angkak powder does not have antioxidant activity. Addition of angkak powder can provide antioxidant activity in garaetteok. The percentage of the addition of Angkak powder used in garaetteok making is small, so that the antioxidant activity in the garaetteok (addition with angkak powder) is lower than the antioxidant activity in the rice Angkak powder. In addition, the antioxidant activity of angkak powder that is used is also not too high. However, the addition of Angkak rice powder has given antioxidant activity to garaetteok. Antioxidant activity of garaetteok in line with angkak powder addition and color of garaetteok. The more percentage of angkak powder additon, the higher antioxidant activity and more red garaetteok produced. Garaetteok with angkak powder addition can be seen in Figure 1.



Figure 1. Garaetteok with the addition of Angkak powder before molding

3.2.2. Color

Analysis of variance showed that the addition of angkak powder had a significant influence on the value of °Hue and L (lightness) of garaetteok produced. The higher the percentage of angkak powder added the smaller the value °Hue and L (lightness) produced. The color description of °Hue indicates that the addition of angkak powder gives a red color to the garaetteok produced. However, the concentration of 1-2% was not significantly different in further tests. This means that the addition of Angkak powder with this concentration does not have a significant effect on the color change of garaetteok. The addition of Angkak rice powder significantly affected the L (lightness) or brightness value of the garaettok produced. The higher addition concentration of angkak powder in garaetteok, the less brightness of the garaetteok produced. Color description, °Hue, and lightness of garaetteok can be seen in Table 3.

Table 3. Color, °Hue, and Lightness of Garaetteok

Angkak Powder Addition (%)	°Hue	Lightness	Color
2.0	21.00 a	46.87 a	Red

1.5	22.13 a	50.20 b	Red
1.0	24.43 a	51.90 b	Red
0.5	39.20 b	61.23 c	Red
0	109.63 c	70.37 d	Yellow

3.2.3. Lovastatin Content

Lovastatin is one of the secondary metabolites produced by *Monascus purpureus*. The lovastatin content in the best product (garaetteok with the addition of rice powder 2%) is 19.20 ppm. Lovastatin found in garaetteok is lower than lovastatin in angkak powder. This is because the small percentage of angkak powder added to garaetteok. However, the lovastatin content of the product (garaetteok) is higher than the lovastatin content in other product with angkak powder addition. The lovastatin content found in jam product is 3.09 ppm [2]. This is presumably because the concentration of angkak powder added is different and the treatment of angkak is also different. In jam product [2] the concentration of Angkak powder added to the best jam product was 1%, while in this study it was 2%. Angkak powder in jam product [2] carried out sterilization with a temperature of 160°C for 1 hour, while in this study angkak was dried at 40-50°C for 48 hours. This is thought to be the cause of the different lovastatin content found in the product.

4. Conclusion

The addition of angkak powder on garaetteok provides color change, antioxidant activity and lovastatin content in garaetteok produced. Antioxidant activity and lovastatin content in garaetteok produced makes it potentially to be used as functional food.

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