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Physical Characteristics of Substituted Biscuits with Bee Pollen

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ABSTRACT: Bee pollen is one of the popular bee products besides propolis and honey. It contains good nutrition for the body and has been used to boost nutrition as a fortification or substitution ingredient in various food preparations such as biscuits. This study aims to determine the effect of storage time on the physical characteristics of a substituted biscuit with bee pollen. The experimental design was a Completely Randomized Design (CRD) with one factor as the storage time of days 0, 2, 5, 7, 9, 12, 14, 16, and 19. The result showed that the storage time significantly influenced the texture and weight change of substituted biscuits with bee pollen while the water content was not significantly affected.

Keywords: bee pollen, biscuit, substitution, texture

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INTRODUCTION

Bee pollen is one of the popular bee products besides propolis and honey. It is currently sold on the marketplace, but there are no specific details on nutrition, such as protein, vitamins, and minerals. Several types of bee pollens are from pollen with multi-floral provenance.

Rzepecka-Stojko et al. (2015) stated that bee pollen was a natural product with a high antioxidant. It also contained phenols and flavonoids (Feas et al., 2012). The phenols and antioxidants in bee pollen were found in substituted yogurt with bee pollen (Karabagias et al., 2018). Bee pollen could effectively increase the protection against free radicals in the body to prevent disease from unhealthy lifestyles. According to Nurcahyaning et al. (2018), it contains natural antioxidants that reduce blood sugar during fasting after hyperglycemia, a condition where blood sugar is too high (diabetics). Natural antioxidants could ward off radicals and regenerate cells in experiments using alloxan-induced mice. The nutrition content of bee pollen is higher than propolis (Attia et al., 2014). The high nutrition in bee pollen makes it widely used as a fortifier or substitute ingredient in food production, for example, bread (Conte et al., 2018; Mayda et al., 2020; Yan et al., 2021; Aylanc et al., 2021) and biscuits (Anis & Syafnil, 2021; Caleja et al., 2017; Krystyjan et al., 2015b; Kumar et al., 2019).

According to research by Krystyjan et al. (2015), bee pollen was a fortifying ingredient in biscuit production. It did not significantly affect the fat content, so it could be considered healthy food. The fortified biscuit with bee pollen significantly increased the sugar, protein, fiber content, and polyphenols as an antioxidant potency.

According to Anis et al. (2021), bee pollen was produced from three types of pollen: multiflora, forest flowers, and kapok, which showed different proximate contents. The study of bee pollen used to make a biscuit is rarely done, so the principal objective of this study is to determine the bee pollen substitution for the physical characteristics of biscuits. The bee pollen was from the market. The substituted biscuits

with bee pollen are expected to have a functional value and become functional food due to the antioxidants in bee pollen. It is also expected to benefit human consumption, such as antioxidants that can ward off free radicals.

MATERIALS AND METHODS

Materials

The tools were an analytical scale, oven, penetrometer (Humboldt H-1240), oven (Hock), and mixer (Philips HR 1559). The main ingredient was bee pollen from the market, harvested from the East Java area. Other ingredients were wheat flour, margarine, powdered sugar, eggs, vanilla flavor, and baking powder.

Experimental Design

The experimental design was a Completely Randomized Design (CRD) with one factor as the storage time of days 0, 2, 5, 7, 9, 12, 14, 16, and 19 repeated thrice.

Research procedure

a. Material Preparation

The ingredients in biscuit production were modified by Krystyjan et al. (2015), which were 475 g of wheat flour, 225 g of margarine, 133.5 g of powdered sugar, ±50 g of eggs, vanilla flavor, baking powder, and 25 g of bee pollen.

b. Biscuit Production

The biscuit production was modified by Krystyjan et al. (2015). It began by mixing the ingredients that followed the formula. It mixed in 10 minutes until it became homogeneous dough. Next, it was rolled to a thickness of 5 mm and was formed in the same size and shape. In addition, the topping was added to make it more attractive. Then, it was baked in the oven at 150˚C for ± 20 minutes. Lastly, the biscuits were packed into polypropylene (PP) ziplock packaging and were stored in a plastic jar at the environmental temperature for the next step to be analyzed.

Analysis Method

Water Content

To begin with, the sample was ground to become small particles. 3 g of grounded samples were poured into a cup and dried in the oven at 105˚C for 5 hours. After that, the samples were cooled in a desiccator for 30 minutes. It repeated until the weight reached a constant (the difference was less than 0.2 mg). The weight reduction was the water amount of the sample (Sudarmadji et al., 1997). The following equation analyzed the water content:

$$\%\ \text{Water Content} = \frac{(\text{Weight of material} + \text{weight of empty cup}) - \text{final weight}}{\text{weight of initial material}} \times 100$$

Weight change

The weight change was carried out by a digital scale and was analyzed by the following equation:

$$\text{Weight change} = \frac{\text{Initial weight} - \text{final weight}}{\text{initial weight}}$$

Texture

A penetrometer was used to analyze the texture of three places in a biscuit.

Data Analysis

All the data was analyzed using a one-way analysis of variance (ANOVA) to identify the storage time effect for each treatment at a significant level of 5%. A further analysis of DMRT (Duncan's Multiple Range Test) was conducted to determine the difference between each treatment.

RESULTS AND DISCUSSION

Water Content

The storage time did not significantly affect the water content during the storage period ($p>0.05$), as shown in Figure 1. The weight change in Figure 2 also supported it. The short storage time was another factor that caused the water content change of substituted biscuits with bee pollen, which was only 19 days. Based on the study by Rahman et al. (2019), the storage period was five months to know the phenomena. Hence, the water content of substituted biscuits with bee pollen in this study did not significantly change during storage.

The water content of substituted biscuits with bee pollen in 19 days of storage period was from 8.40% to 9.96%, as shown in Figure 1. It was higher than substitute biscuits with other composite flour, for example, moringa leaves, seaweed, and banana (Kusumawardani et al., 2018). Different ingredients and methods in the production caused the difference in water

content. In this study, the substituted biscuits with bee pollen production were baked in the oven at 150°C for 20 minutes (Krystyjan et al., 2015). The temperature was lower than the production for substitute biscuits with other composite flour baked in the oven at 160°C for 20 minutes (Kusumawardani et al., 2018).

The 10°C difference in this study was allegedly a factor in the higher water content than in other studies that produced the substitute biscuits with other composite flour conducted by Kusumawardani et al. (2018). The baking process heat caused the biscuits' water content to evaporate. At lower temperatures of baking at the same time, the water content of the biscuits would be higher. The evaporated water would become accessible around the product (Winarno, 2004). According to Rahman et al. (2019), the biscuits produced by baking at 120°C in 45 minutes had a lower water content compared to this study in Figure 1. In this case, the storage time also caused the water content even though the temperature was lower than in other baking methods.

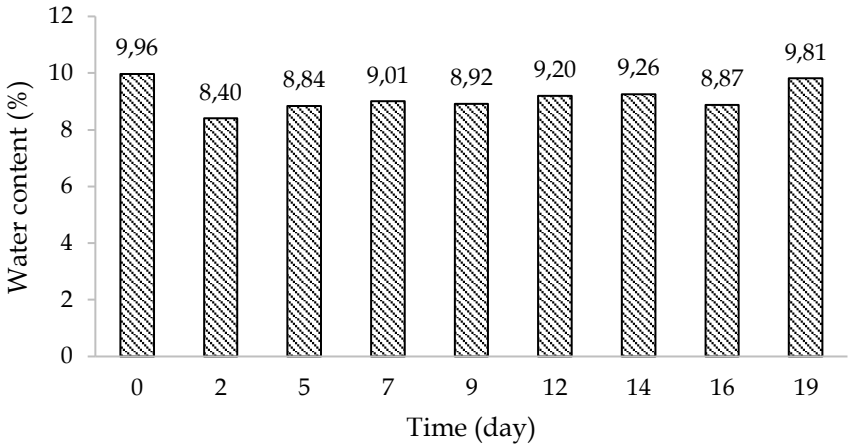

Figure 1. The water content of substituted biscuits with bee pollen during the storage period

Weight Change

The storage time significantly affects the weight change of substituted biscuits with bee pollen ($p<0.05$). The weight of samples went up from the initial day to the 19th day, as shown in Figure 2. The rise of weight change during storage time was influenced by the water content of samples and the relative humidity in the environment (Kusumawardani et al., 2018). Moreover, the increase in sample weight could be identified as a hydration phenomenon (DeMAn, 1989).

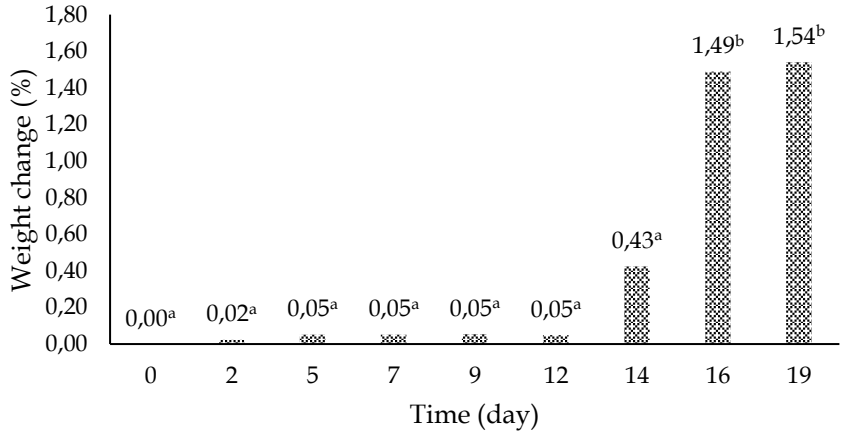

Figure 2. The weight change of substituted biscuits with bee pollen during the storage period

Texture

The storage time they significantly affected the texture of substituted biscuits with bee pollen ($p<0.05$), as shown in Figure 3. The texture of substituted biscuits with bee pollen went down from day 0. Based on the DMRT test, the texture of day 0 was significantly different from day 2 to 19. The decrease in texture meant that the samples became softer. The texture change during the storage period was caused by the packaging used, which had a high permeability (Fatharani et al., 2020). In the study conducted by Nadimin et al. (2022), the packaging had high permeability, which made the air and water accessible to pass, which affected the texture of the samples. Another study conducted by Krystyjan et al. (2015) reported that substituted biscuits with 5% of bee pollen stored for two months showed hardness.

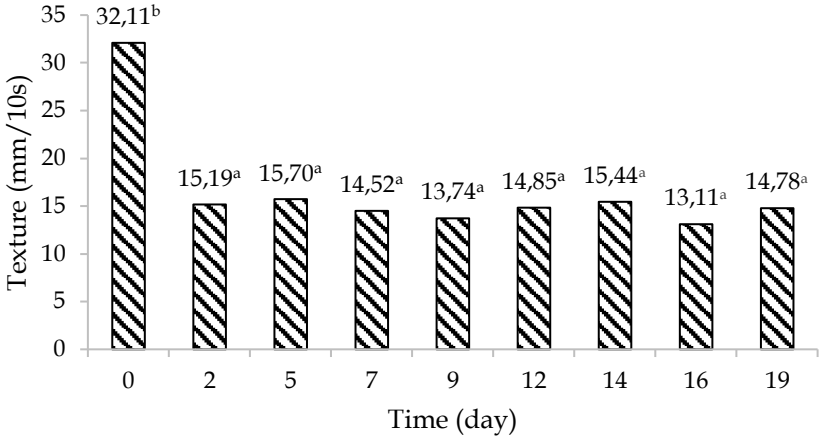

Figure 3. The texture of substituted biscuits with bee pollen during the storage period

CONCLUSION

The substituted biscuits with bee pollen within the 19-day storage period significantly affected weight change and texture parameters. The texture of day 0 was significantly different from day 2 to 19. However, the storage time had no significant effect on water content in biscuits that were substituted with bee pollen.

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