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## The Enrichment of Calcium with Duck Eggshell and Sensory Characteristic on Product Based on Corn Sprout Flour and Soybean Sprout Flour

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### Abstract

Eggshell duck is one of the ingredients that can be used for supplementation enriching calcium in food products. Corn flour and soybean (kejale) formulation have contribute to health. Enrichment of calcium with eggshell duck will be improve the quality kejale. This study aims to evaluate the levels of calcium and the sensory characteristics of cookies products, steamed cakes and kejale based cereals, enriched with eggshell duck as a source of calcium. The results showed that the enrichment treatment of eggshell duck influenced the calcium cookies, steamed cakes and cereals ( $p = 0,00$ ). Levels of calcium cookies and steamed cakes are higher than cereals. The sensory characteristics showed that the enrichment of eggshell duck doesn't affect the taste, smell and texture but affect the color. Being on eggshell duck affects the color, smell and texture, but no effect on taste. Eggshell duck concentration at 15% concentration provides the highest levels of calcium and acceptable sensory characteristics.

**Keywords:** Calcium, eggshell duck, sensory, corn flour, soybean flour

### 1. Introduction

Osteoporosis is one of the public health problems in the world because it has a considerable number of events. More than 200 million people worldwide suffer from osteoporosis. In the United States and Europe, 30% of all postmenopausal women experience osteoporosis, while for men between 15-30%. In Indonesia 2 out of 5 people have a risk of osteoporosis (Menkes RI, 2008). Osteoporosis is caused by several factors such as lack of calcium intake (Permatasari, 2011).

Several studies have shown a lack of calcium intake in some societies such as the results of the study: Meikawati (2009) that 55% of adolescents in senior high school Semarang consume less calcium than nutritional numbers. Similarly, Permatasari's study, showed that as many as 6.3% in early adulthood suffered from osteoporosis and 51.1% suffered from osteoponea (170 respondents). Of this number of respondents as much as 59.2% calcium intake <80% of Nutritional Numbers (AKG).

Calcium is an essential mineral for physiological processes throughout the body. Bone serves as a reservoir that ensures the availability of calcium. Optimizing bone mineral during peak bone mass development has a positive effect on bone health and prevents future osteoporosis (Zemel, 2017). Calcium is only available from food and is the largest mineral that is about 1.5-2% of adult or adjacent body weight in a homeostatic state with plasma calcium at concentrations of 2.25 to 2.60 mmol / l (9-10.4 / 100 MI) (Almatsier, 2001).

Several studies have shown the potential of eggshell as a source of calcium that can be applied in food products. Meikawati and Suyanto, 2014 reported that eggshell fortification in MOCAP flour, applied in brownis products can increase calcium and have acceptable organoleptic characteristics (Meikawati & Suyanto, 2014). Similarly, Rahmawati and Nisa (2015) reported that the addition of 15% eggshell on cookies production resulted in optimal chemical and physical characteristics (Rahmawati & Nisa, 2015).

Corn Flour and Soybean components better whole grains (Aminah and Wikanastri, 2012; Bandeira, et.al., 2012; Bhattacharyya, 2007). Soybean also have components of isoflavones, antioxidant activity and other phenolic components, which are higher than other soy products (Devi, et.al., 2009). Aminah and Santosa, 2014 reported that the mixture of corn flour and soybean (Kejale) have chemical composition for bone health.

Enrichment of eggshell duck as a source of calcium in corn flour and soybean (kejale) will be able to improve the quality of the product kejale. This study aims to evaluate the levels of calcium and the sensory characteristics of Kejale-based products enriched with eggshells duck as a source of calcium. Making products



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using the method of baking (cookies), steaming (steamed cake) and extrusion (cereals).

## 2. Methods

### 2.1 Materials

Materials used are Corn Bima 19 varieties from Seed Office Gunung Kidul Yogyakarta and soybean varieties Anjasmoro from Research and Development of nuts and tubers office (Balitkabi), Kendalpayak Malang East Java. Eggshell Duck is obtained from seller martabak in Kedungmundu urban village, Semarang city.

### 2.2 Instrument

Equipment required for the manufacture of sprouts, sprout flour, egg shell and product manufacturing in this study: cabinets, dryer, disc factory, sieve, oven, gas stove, extruder, risopan. Equipment for calcium analysis and sensory testing include: muffle furnace, analytical scales, Atomic Absorption Spectrometry (AAS: Pin AAcle 900 T), sensory assay form

### 2.3 Procedures (or research design)

#### 2.3.1 Sprouts and sprout flour production

Corn and soybeans were washed, then soaked in 2% NaCl solution for 8 hours, then washed in drained, precisely on a plastic sheet with tissue paper. Furthermore, germination for 36 hours in dark conditions. During the spraying done spraying with aquadest every 6 hours.

Sprouts then dried using a cabinet dryer for 12 hours and dipmered using a diskmill then sifted (80 mesh), packed in polypropylene plastic then stored in the freezer until the formulation and processing of the product.

#### 2.3.2. Eggshell Duck flour production

Duck shell was washed, then the size reduction. Then immersed in aquadest temperature 100°C, for 15 minutes, drained and continued immersion using 2 N acetic acid (CH<sub>3</sub>COOH) solution, at 60°C for 3 hours. Eggshell duck lifted drained and washed with aquadest, and dried using cabinet dryer at temperature ± 50°C for 3 hours. The sieve was performed using diskmill and sieved (80 mesh).

#### 2.3.3. Manufacture of processed products

Processing product of sprout flour (KJ) and soybean flour (KK) using 3 methods are baking with oven (cookies), steaming (steamed cake) and extrusion (cereals). Raw materials are formulated by comparison: KJ: KK = 50%: 50%. KJ: KK formula was then added duck eggshell flour (TCB) with 3 treatment concentrations: 5%, 10% and 15%. KJ Formula: KK: TCB, processed in accordance with the method of processing.

#### 2.3.4. Analysis of calcium levels (AOAC, 2005)

Eggshell duck flour samples were consumed at 550°C. The result of the spraying was poured on 50 ml measuring flask, added HNO<sub>3</sub> solution. Calcium content is read using Atomic Absorption Spectrophotometer (AAS) with 422,7 nm long wave.

#### 2.3.5. Testing of sensory characteristics (scoring, Rahayu, 1998)

Testing of sensory characteristics can describe consumer acceptance of the product being tested. Panelists in this test included in the rather well-trained category of 22 people. Pegujian use scoring method with a scale of 1 to 6 on color, taste, crispness (for cereal), texture (for cookies and steamed cakes) and smell.

#### 2.3.6. Data analysis

The calcium level data were analyzed using Analysis of Variant (Anova), with Tukey HSD advanced test. Sensory characteristics test data were analyzed using Friedman's statistical analysis, followed by Wilcoxon test. Data analysis using SPSS 18 software.

## 3. Results

### 3.1 Calcium levels

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Calcium level analysis was performed on a formula of raw materials enriched with eggshell flour and processed products (cookies, steamed cakes and cereals). An analysis of the calcium content of corn starch and soybean flour starch formulas can be seen in Figure 1. Consecutively the calcium content in Figure 1 shows an increasing trend of eggshell concentration with the lowest concentration (5%) to the highest (15%). The higher the increase in eggshell concentration the higher the level of calcium.

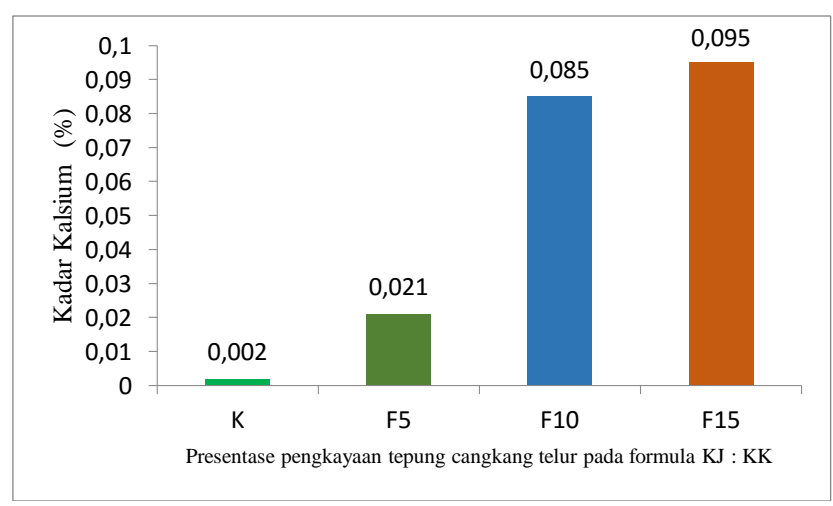


Figure 1. Percentage of egg shell flour enrichment on starch and soybean flour formula

K (kontrol 0%); F5 ( 5 %); F10 (10 %); F15 (15%); KJ: corn sprouts flour; KK: soybean sprouts flour

Levels of calcium in cookies, steamed cakes and cereals showed a tendency of higher levels of egg shell enrichment, higher calcium levels. This is very possible because of the calcium content of duck egg shells. The mean rate of calcium in cookies, steamed cakes and cereals is presented in Figure 2.

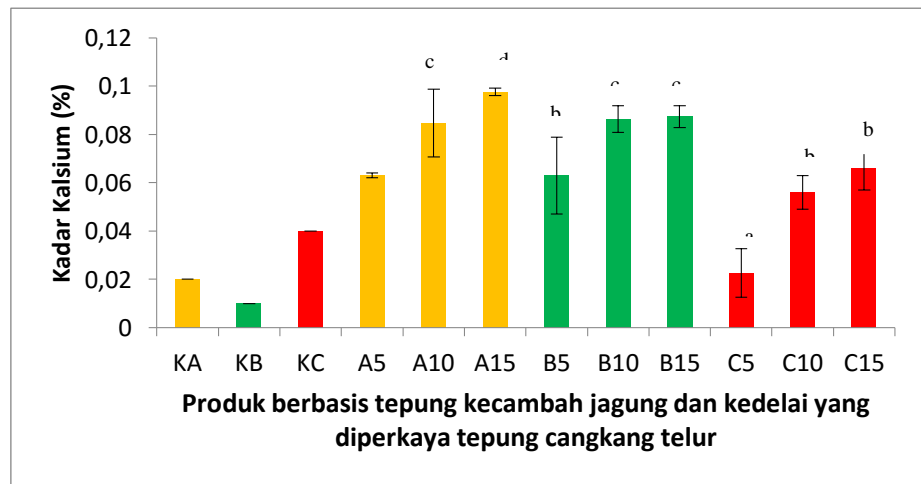


Figure 2. Average Calcium Rate on processed products based on corn flour and soybean sprout flour

Data is mean + SD, image beams with different supersript letters show significant differences  
 K. Controls (A: cookies; B: steamed cakes; C: cereals)  
 A: Cookies (A5: addition of 5% TCB; A10: 10% TCB addition; A15: addition of 15% TCB)  
 B: Steamed Cakes (B5: TCB add 5%; B10: 10% TCB addition; B15: addition of 15% TCB)  
 C: Cereal: (C5: addition of TCB 5%; C10: addition of 10% TCB; C15: addition of TCB 15%)

Figure 2 shows that the average rate of calcium in controlled product (without the addition of shell flour) is highest in cereal products and the lowest in steamed cake products. Treatment of eggshell duck enrichment in cookies product formula, steamed cakes and cereals showed a significant effect ( $p = 0,00$ ) on calisum content of

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product. Duck shell flour 15% creates the highest levels of calcium in cookies products. The lowest calcium content in cereal products with 5% duck egg shell enrichment. In general, the results showed that more egg shell concentrate concentration added higher the level of calcium.

### 3.2 Sensory Characteristics

#### 3.2.1 Cookies

The egg flour enrichment treatment (TCB) showed an effect on the color of cookies ( $p = 0,003$ ), and had no effect on taste, texture and flavor ( $p > 0,05$ ). Significant color differences seen in the enrichment treatments were 15%, while the enrichment of 5% and 10% had no effect. Eggshell duck flour is greenish, so the more additions, the greenish color will be more clear, and affect the color of cookies. The color of cookies with the addition of 15% shell flour has the highest score. Figure 3 is the result of testing the sensory characteristics of cookies.

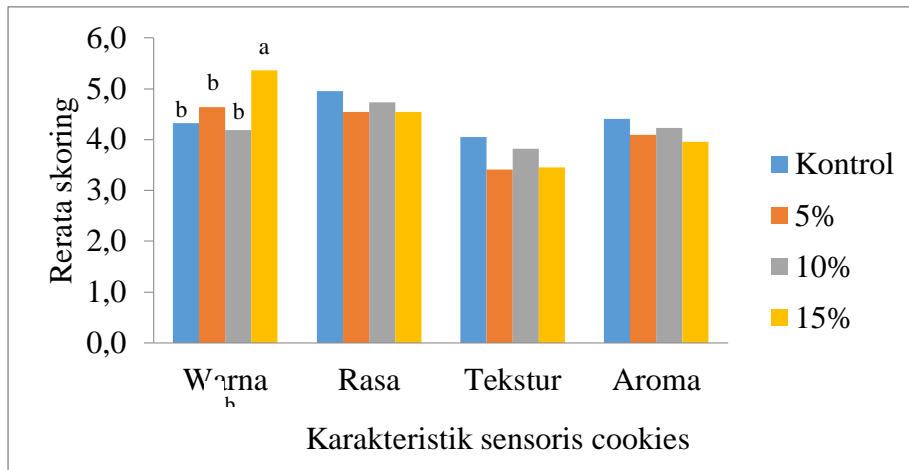


Figure 3. Graph Score average to the sensory characteristics of cookies products  
 Data is mean + SD, image beams with different superscript letters show significant differences

#### 3.2.2 Steamed cakes

This steamed cakes is made with different formulas with cookies, because the characteristics of the two are different, requiring additional ingredients such as margarine and different eggs. The composition of this material will certainly affect the characteristics of sensory, nutritional components and calcium products. The result of sensory test on the steamed cake (Figure 4) showed that egg shell addition did not affect the taste, smell and texture ( $p > 0,05$ ), but the effect on the color of the steamed bun ( $p = 0,003$ ).

Highest score for color on treatments of 10% TCB addition. Panelists gave no different scores on the color of steamed buns, TCB treatments 5% and 15%. Likewise skore to taste, smell and texture. Additions

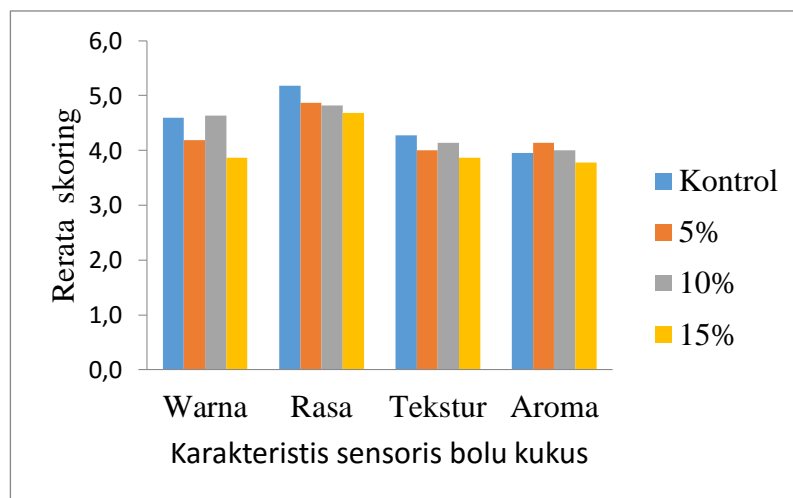


Figure 4. Graph Score average to the sensory characteristics of steamed cakes products

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### 3.2.3 Cereal

Cereal processing using extruder, with formula only from flour KJ, KK and TCB. There is no addition of other ingredients as well as cookies and steamed cakes. Figure 5 is the mean of a panelist score against the sensory characteristics of cereals. The TCB enrichment treatments on cereal product formulas give effect to the color, taste and texture of cereal ( $p = 0,00$ ) but do not give effect to cereal smell ( $p = 0,07$ ).

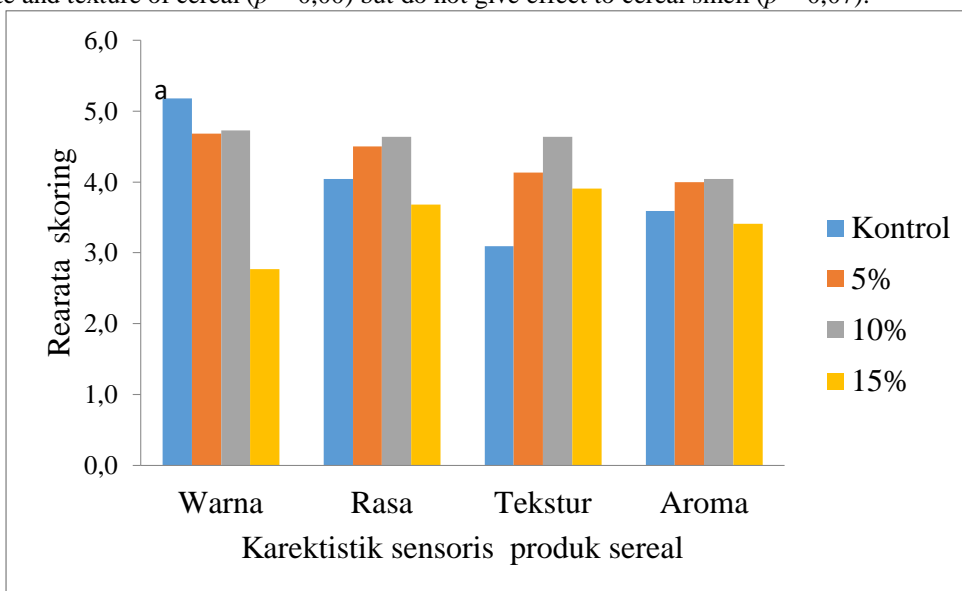


Figure 5. Graph Score average on the sensory characteristics of cereal products

Data is mean + SD, image beams with different superscript letters show significant differences

The scores on cereal color characteristics in the 5% and 10% TCB enrichment treatments were not different from the controls, and the 15% treatments had the lowest scores, and showed differences with both controls and other treatments. The taste and texture that has the highest score is on the 10% treat.

## 4. Discussion

Corn flour and soybean sprouts (kejale) have potential for bone health, and can be used as raw material for various products. The addition of eggshell can increase the calcium content of the product, thus reinforcing the product potential of the kejale formula as a food product for bone health. The eggshell is one of the best sources of natural calcium (Murakami, et.al., 2007; Bee, 2011; Dolińska, et.al., 2016). Nurlela, et al., 2014 also reported that duck egg shells become one of the sources of calcium that can be utilized as bone mineral synthesis.

The results showed that the higher the addition of TCB on starch-based flour formulas and soybean sprouts (kejale), the higher the level of calcium. It is influenced by the level of calcium in TCB. The addition of more and more will contribute to the increasing levels of calcium as well. Calcium content of eggshell flour according to Aminah and Meikawati (2016) as much as 23.67%. Previous research supports the results of this study, as reported by Rahmawati and Nisa (2015), that the addition of eggshell flour as much as 15% in the formula cookies produces the best chemical characteristic of cookies. Meikawati and Suyanto (2014) also reported almost the same thing, that eggshells chicken can increase the calcium content of brownis products. Increased levels of calcium in egg-supplemented biscuits were also reported by Hasan (2015), that eggshell supplementation at concentrations of 3, 6 and 9% could produce biscuits with calcium levels of 607.33, 1378.11 and 2175.23 mg / 100g, respectively Calcium in the control biscuit as much as 43,9 mg / 100 g.

Figure 2 shows that cookies and steamed bunu have higher kalsium content than cereal products. Cookies and steamed cakes require additional helpers to form textures and flavors. The ingredients are chicken eggs, sugar and margarine. Calcium levels in cookies and steamed cakes may be influenced by the addition of chicken eggs and margarine. Moderate cereal products there is no addition of auxiliary materials. Chicken and margarine eggs contain calcium around 86 mg / 100 g and 20 mg / 100 g.

The enrichment of TCB on cookies and steamed sponges, affects only the color, and does not affect the





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taste, flavor and texture. This may be influenced by the method of processing and the addition of egg and margarine auxiliaries. In general, the processing process causes changes in sensory characteristics. Processing using high temperatures can cause a mailard reaction that is the reaction between amino acids and reducing sugars. Mailard and caramelization reactions are capable of producing fragrance components in bakery products such as cookies (Tamanna and Mahmood, 2015). The process of caramelization is formed from the sugars and dextrin becomes furfural, the carbonation of sugars, fats and proteins (Fellow, 1990).

The use of eggs, sugar and margarine, yields distinctive aromas, textures and flavors, so as to mask the presence of tuberculosis supplementation. In addition to providing flavor and nutritional value, eggs have functional characteristics as developers (Koswara, 2009), thus giving effect to the texture of a more tender product or krispi. However eggshell flour color does not change during processing, thus affecting the color of the product. The higher the TCB enrichment percentage, the more greenish the product will be. In contrast to chicken eggshell egg supplementation done by Hasan (2015), did not give effect to the color of biscuits, because eggshells whitish color. Hasan (2015) also reported that the addition of egg shell flour to 6% on biscuits gave sensory characteristics that were not different from the controls. Similarly, reported by Brun, el. Al, that the supplementation of eggshell flour as a source of calcium in pizza or spagetry products only slightly changed the texture but no effect on flavor.

Cereal in this study is one extrudate product that is processed without the addition of auxiliary materials. Development or texture formation occurs during processing through the gelatinization mechanism of starch. So the starch content in raw materials is a very important factor (Ahza, 1996). The addition of non-starchy ingredients such as eggshells affects sensory characteristics. As obtained in this study, enrichment of duck egg shells affect the color, taste and texture, and no effect on the aroma.

Eggshell duck flour is not flavorful, so it does not give effect to the aroma of the product supplemented. While the sense of possibility is influenced by the impression of sandy on cereal products, and caused because the taste of this product comes only from raw materials. In contrast to cookies and steamed cakes, sandy flavor can be covered by ingredients. After taste of sandy on egg-shelled products also found by Rahmawati and Nisa (2015).

## 5. Conclusions

Eggshell duck has the potential as a source of natural calcium, which can be used on food products. Corn starch-based flour and soybean flour products enriched with eggshell flour have potential as an alternative food for health. Egg shell flour processing up to 15% is still acceptable by panelists. The method of treatment has no effect on calcium levels, but the use of additional ingredients in cookies and steamed cakes may contribute to calcium levels.

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