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Physical and Organoleptic Characteristics of Poultry Eggshell Powder Extracted with CH_3COOH and NaOH

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Abstract

As food waste poultry eggshells contain harmful components, organic compounds, hard physical characteristics, rough, flavorful fishy and has a less attractive color when used as food. Extraction process with CH_3COOH and NaOH is known to improve physical and organoleptic characteristics of egg powder eggshell. The general purpose of the research is to know the effect of CH_3COOH and NaOH extraction on physical and organoleptic characteristics of egg powder eggshell. The research method was experimental design using random complete factorial design, which consisted of 2 factors and 16 treatments is solvent type (Control, H_2O, CH3COOH, and NaOH) and poultry eggshell (duck, quail, chicken race, and free-range chicken). Each treatment was repeated 3 times, so that 48 units of experiments were obtained. The result data of physical characteristic test was analyzed using Anova statistic method followed by further test of DMRT, while the test result of organoleptic characteristic was analyzed using Friedman statistic method followed by Wilcoxon test. The results showed that eggshell chicken eggs extracted with CH_3COOH solution produces the best physical and organoleptic characteristics of eggshell flour.

Keywords: *Egg Shell, CH_3COOH, NaOH, Physical, Organoleptic*

1. Introduction

The production of poultry eggs in Indonesia each year has increased. In 2015 the production of poultry eggs in Indonesia reached 1,795,711 tons. [1] A total of 10% of the egg is an egg shell. [2] So in one year the number of egg shells in Indonesia is estimated to reach 179,571 tons. Currently eggshell is still a waste that has the potential to cause pollution due to microbial activity in the environment. The eggshell is the outermost part of a calcareous and porous egg with a thickness of 0.2-0.4 mm. Each type of egg has a different surface and shell color. Chicken eggshells are white to yellow to brown, duck eggs are greenish white and quail egg shell color is marked by the spots with certain color. [3]

The poultry eggshell has a hard, rugged, aquatic charred structure and has an unattractive color that is less desirable when used as food. [4] Egg shell can be processed into flour, so it can be used as food through the method of extraction using chemical solutions. The extraction method is known to improve the physical and organoleptic structure of egg shells, as well as reduce harmful components and remove organic compounds from eggshells. [5] There are several fairly effective chemical solutions that can be used in improving the physical and organoleptic characteristics of eggshell flour, such as the use of CH_3COOH solution on soaking shrimp waste, [7] and NaOH on local gravy waste. [8]

Each solvent has the same principle that will cause the pores of the open shell, so that the spaces formed make it easier to be achieved by the solvent, resulting in the mineral-bound compound easily released by the optimum. [9] The binding of the shell compound compound by the solvent is influenced by the value of the dielectric constant. The higher the dielectric constant value of a solvent then the solvent is increasingly polar. The degree of polarity of a solvent, will affect the effectiveness of the solvent in attracting or dissolving some components and compounds in the eggshell. [10]

Data related to the effectiveness of extraction of CH_3COOH and NaOH on physical and organoleptic characteristics of eggshell flour is not available yet. Thus, this study aims to determine the physical and organoleptic characteristics of egg powder eggshell extracted with CH_3COOH and NaOH.

2. Methods

2.1.Material and Tools

The raw materials used in this study are eggshells which include: duck egg shell obtained from martabak egg traders around the campus of UNIMUS, quail eggshell obtained from the merchant quail egg traders in Pedurungan Market, chicken race eggshell obtained from the shop Safina bread, and free-range chicken eggshell obtained from herbal medicine traders in Kedungmundu. All locations are located in Semarang City, Central Java. The chemicals used consist of: CH_3COOH, NaOH, and aquades. The tool used in this research is water bath, cabinet dryer, diskmill, 100 mesh sieve, and Chromameter Minolta CR-130

2.2. Extraction Procedure and Egg Shell Sacking

The process of making egg powder eggshell is the result of modification. [11] [12] Each eggshell is cleaned, after which the size reduction is done. The eggshell was then soaked using aquades at 100^0 C for 15 minutes in different containers, the soaking water was thrown away. Furthermore, each egg shell was soaked using a solvent in water bath at 60^0 C for 3 hours, with a shell ratio: the solvent was 1:2 (w/v). The soaking shell is cooled, and cleaned with aquades. Egg shell that has been cold then dried using cabinet dryer at temperature ± 50^0 C for 3 hours. The dried shell is then pinned using a diskmill, then sieved using a 100 mesh sieve.

2.3. White Degrees, Textures and Aroma Analysis

The White Degrees were measured using the Hunter method. [13] The texture and aroma are measured using hedonic and scoring methods. [14]

2.4 Data Analysis

Analysis of white degree data using Analysis of Varian (Anova) with the help of SPSS version 20 software, followed by Duncan's Multiple Range Test (DMRT). Texture and flavour data using Friedman test, then continued with Wilcoxon test.

3. Results

Test results of physical and organoleptic characteristics of egg powder eggshell extracted with acid-base sailors are as follows:

3.1 White Degrees

Test results of white powder eggshell flour which is extracted with CH_3COOH and NaOH sago can be seen in Figure 1.

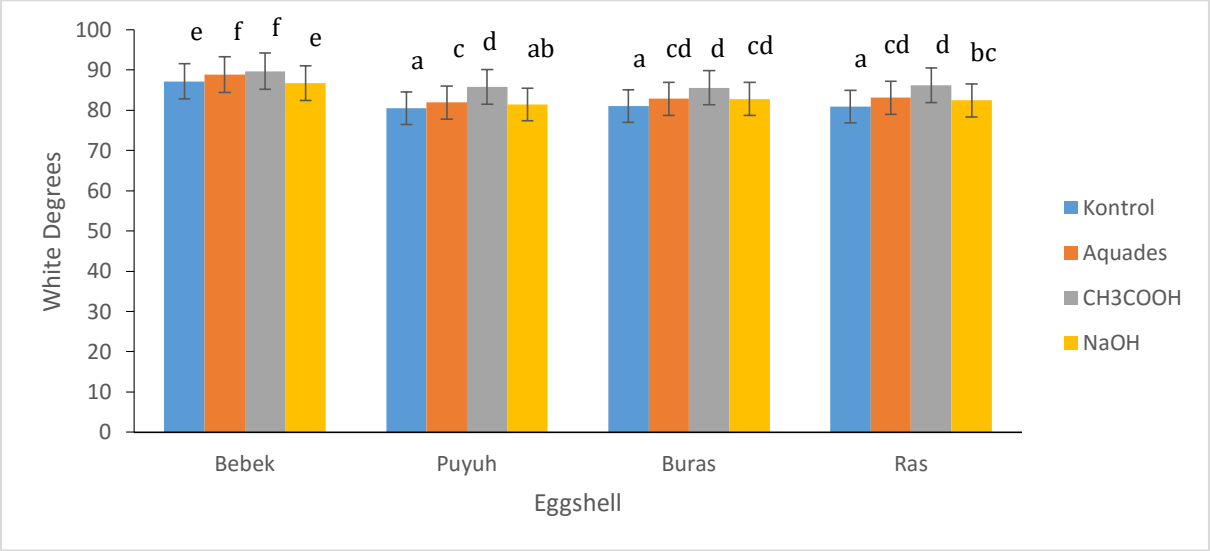

Figure 1. The value of white powder eggshell flour

Description: Different superscripts show significant differences ($p \leq 0.05$); Value 0 = Black; Value 100 = White

Figure 1 shows that shell and solvent type treatments have a very significant effect (p = 0.00), while the interaction between shell and solvent type has significant effect (p = 0.028) to the value of white powder egg flour degree. The average degree of egg white flour shell in a row from the highest is the duck egg shell flour, chicken race, free-range chicken and quail. While the most effective solvent in increasing the degree value of white shell flour is CH_3COOH. The interaction between two treatments, duck eggshell flour soaked with CH_3COOH solvent yielded the best white grades (89.72). However, it was not significantly different from duck egg shells extracted with aquades (88.86), and significantly different from poultry eggshells with other solvents.

3.2 Texture

The test result of eggshell flour texture extracted with CH_3COOH and NaOH sailor can be seen in Figure 2.

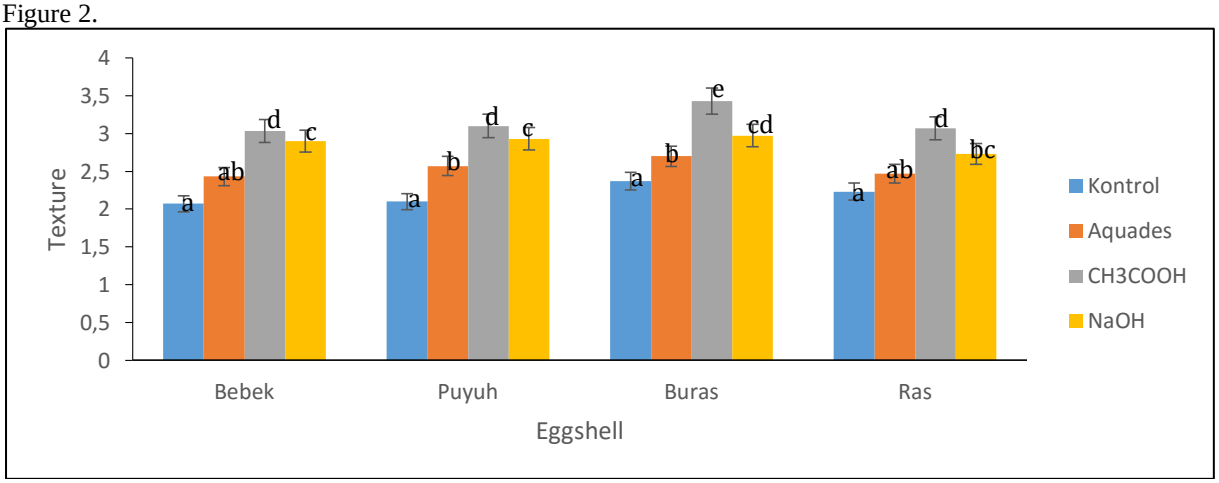

Figure 2. The texture value of poultry egg shell flour

Description: Different superscripts show significant differences (p ≤ 0.05); 1 = Very rough; 2 = Rough; 3 = Soft; 4 = Very soft

Figure 2 shows that there is an effect (p ≤ 0.05) between the type of shell and the type of solvent to eggshell texture. Eggshell chicken egg extracted with CH_3COOH solution produces eggshell flour with a soft texture. Statistically different with all treatments. The most effective type of solvent to panelist favorites is CH_3COOH, whereas eggshell species is not significantly different.

3.3. Flavour

The result of the test of flavor of egg powder flour extracted with CH_3COOH and NaOH sailor can be seen in Figure 3.

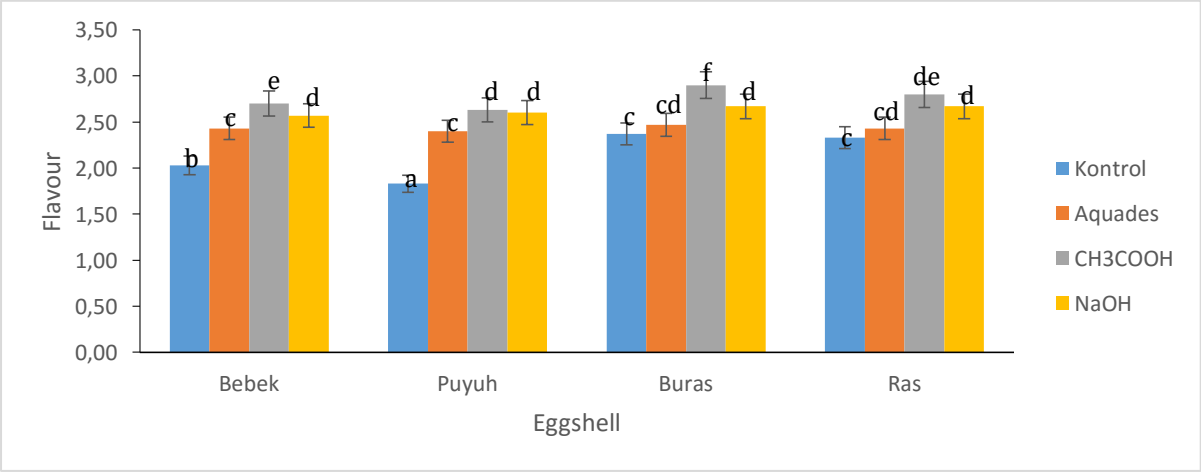

Figure 3. The value of flour eggshell powder

Description: Different superscripts show significant differences (p ≤ 0.05); 1 = Very fishy; 2 = Amis; 3 = Little fishy; 4 = Not fishy

Figure 3 shows that there is an effect ($p \leq 0.05$) between the type of shell and the type of solvent to the eggshell flour scent. chicken race eggshell extracted with CH_3COOH solution produces eggshell flour with a slightly fishy scent. Statistically different with all treatments. The most effective type of solvent to panelist favorites is CH_3COOH, whereas eggshell species is not significantly different.

4. Discussion

4.1 White Degress

White degree is used to distinguish white color from one material to another. Value of white degree of flour can be analyzed quantitatively by using Hunter method where this method will yield 3 notation value that is L*, a*, and b*. The value of L* denotes the reflected light resulting in a white, gray and black acromatic color, whereas the a* denotes the red-green chromatic color, and the value b* denotes the blue yellow chromatic color. The higher the value of L*, the color of the sample will be white and the color will darken if the L* value is smaller. [15]

Figure 1 shows, the duck eggshell produces the best white eggshell flour degree. Duck egg shell flour has a higher L * (brightness) value, with a turquoise-green chromatic color caused by biliverdin pigment in the shell. [16] The color of duck eggshells tends to turn into a whitish blue. This change is due to the pigment deposition process of biliverdin in the shell. [17] This is what causes during the immersion process, the color of the duck egg shell will be easily degraded to be brighter (white), compared to egg white and brown egg shell flour which is slightly brownish-brown and the shrimp egg whale flour is white-gray.

Overall, the value of the egg white flour degree increased with decreasing pH value of the immersion solution. The lower the pH value of a solution, will increase the degree of white flour produced. [18] This condition is influenced by the type and concentration of the pigment from the eggshell ie the porphyrin compound. The porphyrin compounds present in the eggshell, race and quail shells contain tertiary nitrogen on two pyrolysed rings and carboxyl groups on the side chain causing weakly acidic compounds. The porphyrin compound has an isoelectric point at pH 3.0 - 4.0. In this condition, the porphyrin compound in the eggshell decomposes and then dissolves optimally. [19] [20] This is what causes eggshell eggshells, poultry and quail have a higher degree of white when soaked with a solution of CH_3COOH (2 N) which has a pH of 2.39. [21]

4.2 Texture

Soaking poultry eggshell in CH_3COOH solution will cause egg eggshell matrix. [22] The observation results, when the immersion takes place most of the shells are seen to float and a small part breaks down into powder. This is thought to cause the size of CH_3COOH soaking flour granules to be smaller, so they have a softer texture and are favored by the panelists. The poultry eggshell extracted with NaOH solution will result in a less coarse shell flour fraction, but it is still slightly coarse compared to extraction in CH_3COOH solution.

The texture of poultry eggshell flour is also influenced by protoprpirin pigments which are known to have a close relationship with the thickness of the eggshell. Pigemn protoporpirin has a function in the formation of shell structure strength. The higher the content of protoporphrine compounds in the shell, resulting in a thicker shell structure. [23] [24]

4.3. Flavour

Flavour Aroma is the result of chemical stimulation of the olfactory nerves located at the end of the nasal cavity, a smell that smells because of its volatile (volatile). [25] The panelist's favorite level of eggshell flavour can be seen in Figure 3. The observed average value of the panelist's favorite level on the flavour of eggshell powder extracted from CH_3COOH and NaOH solution ranged from 1.83 (dislike - 2,90) Eggshell flour extracted with CH_3COOH solution produces shell flour with a slight fishy flavour, while egg powder eggshell flour has a fishy aroma.

Soaking eggshells in a CH_3COOH solution will result in swelling of the tissue, so that the compounding compounds including the flavoring compounds in the shell become loose and soluble. The decomposition and solubility of the shell compound is due to the increase of H ions, which results in more and more dissolved and dissolved compounds. [26]

5. Conclusions

There is an influence of the type of solvent and type of poultry eggshell on the physical and organoleptic characteristics of eggshell flour. The best shell flour is obtained from the eggshell of the domestic chicken extracted with CH_3COOH solution.

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