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The Characteristics of Biscuit Quality with Coffee (*Coffea Arabica* L.) Silver Skin Flour Substitution

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ABSTRACT

Coffee silver skin flour can be effortlessly converted into various items, and its nutritional quality remains constant. Thus, exploring novel methods of utilizing it could result in sustainable and innovative products with consistent nutritional advantages. This study investigated the impact of using coffee silver skin flour on the quality of biscuits. This study used a completely randomized design (CRD) consisting of 5 levels of treatment and three replications. The percentages of wheat flour substituted with coffee silver skin flour were 0, 20, 40, 60, and 80%. Observation data were analyzed using ANOVA with F test and continued with Duncan's New Multiple Range Test (DNMRT) test at 1% significance level. The result showed that substituting wheat flour with coffee silver skin flour considerably altered the flour's moisture, ash, protein, and fat content. With increasing amounts of coffee silver skin flour, the moisture and ash contents increased, while the protein and fat contents decreased. Biscuits that were most favored by panelists were in treatment A (100% wheat flour with 0% coffee silver skin flour) with moisture, ash, protein, and fat content of 1.31, 0.25, 18.50, and 19.45%, respectively. Biscuits made from coffee silver skin flour meet the quality requirements set by SNI 2973:2011, except for treatment E (0% wheat flour with 100% coffee silver skin flour), as the moisture content exceeds the specified criteria.

1. INTRODUCTION

Biscuits or pastries are one form of snack that people are interested in. Biscuits are described as dry baked products created by baking dough made from wheat flour, with or without wheat flour alternatives, oil/fat, with or without adding other food ingredients and approved food additives. The Indonesian National Standard for Biscuits (SNI 2973:2011) outlines essential requirements for ensuring the quality and safety of biscuits. These requirements include a minimum protein content of 7%, a fat content not exceeding 20%, a moisture content of less than 5%, and, ideally, a fiber content above 2%

(BSN, 2011). Additionally, the absence of preservatives and harmful coloring agents and free from microbial contamination is crucial in ensuring that the final product is safe for human consumption (Shenashen *et al*., 2022). Compliance with these standards can be valuable in producing high-quality and safe biscuits. Wheat flour, powdered sugar, eggs, vanilla, margarine, cornstarch, baking powder, and instant milk powder are typically used to make biscuits (Mutmainna, 2013; Setyowati & Nisa, 2014). As the public's consumption of biscuits increases, so does the need for wheat flour (Irawan *et al*., 2014).

Wheat flour is flour or fine powder from pulverized wheat grains commonly used for making noodles, cakes, and biscuits. Wheat flour contains a high concentration of starch, a complex carbohydrate insoluble in cold water (Sumardiono *et al*., 2017). Wheat flour contains gluten, formed when the two protein fractions, gliadin and glutenin, meet water and cross-link to form long chains (Coltelli *et al*., 2015). This gives wheat-based foods a chewy texture (Parimala & Sudha, 2015). To reduce wheat imports and flour consumption, indigenous culinary ingredients can be developed. One material that can substitute wheat flour is coffee silver skin flour (*Coffea arabica* L.) (Lestari *et al*., 2015).

The coffee silver skin (*Coffea arabica* L.) is a byproduct of the processing of coffee beans. Up to 40-50% of coffee skin waste could be discarded during coffee processing, amounting to 300 thousand tons of waste (BPS, 2017). The potential of coffee bean skin waste as food is not yet explored; even though it is typically utilized for compost, bio absorbent, or caffeine extraction (Setyobudi *et al*., 2019), and animal feed. The failure to maximize the usage and processing of coffee silver skin waste is due to a lack of public knowledge and information about the advantages of applications of coffee silver skin waste (Juwita *et al*., 2017; Suloi, 2019).

Until now, coffee silver skin waste has been left to decompose, stack, and burn, which severely impacts the environment and requires the consideration of countermeasures. People are unaware of the usefulness and potential of the nutritional value of coffee silver skin, which results in their rarely used. The advantages of coffee silver skin are its high fiber content, protein, and antioxidants that can improve the nutritional quality and shelf life of food products and provide a unique flavor and aroma to biscuits (Garcia-Serna *et al*., 2014). Additionally, its use can help reduce waste and improve the sustainability of the coffee industry. Coffee silver skin can be ground into flour and are nutrient-rich, particularly in protein (Gemechu, 2020). One solution that can be done is utilizing these natural resources for various products (diversification) that may have high selling value (Garcia-Serna *et al*., 2014; Salman *et al*., 2022).

The silver skin of coffee beans contains chlorophyll and other pigments. The pulp consists of two components: the outer part, denser and firmer, and the inner part, which resembles gel or mucus (Biao *et al*., 2020). This mucilage layer contains 85% water in bound form and 15% non-water-containing colloidal particles. This portion is a hydrophilic colloid comprised of approximately 80% pectin and 20% sugar. This layer comprises cellulose, hemicellulose, lignin, amino acids, fatty acids, trigonelline, and caffeine (Wang *et al*., 2021).

Coffee silver skin flour is easily transformed into different products, and the nutritional value of coffee silver skin flour is primarily stable or unaltered (Gocmen *et al*., 2019). Cakes made from coffee skin flour have the potential to attract coffee lovers' attention due to their unique taste, which is enhanced using the flour. In addition to its promising growth potential, coffee silver skin flour offers a high nutrient content, specifically 4140 kcal/kg of energy (Garing *et al*., 2020). Coffee silver skin serves as a food ingredient that contains bioactive compounds such as 42.2% chlorogenic acid, 21.6% epicatechin, and 2% catechin while also featuring a complete nutrient composition that includes carbohydrates, proteins, fats, fibers, vitamins, and minerals (Arifin, 2020; Arpi *et al*., 2018). Coffee silver skin contains 10.4% crude protein, 2.13 % crude fat, 17.2% crude fiber (including lignin), 7.34 % ash, 0.48 % calcium, 0.04% phosphorus, and 14.34 kg of metabolic energy (Nugroho & Kusumaningtyas, 2021; Simanihuruk & Sirait, 2010).

Incorporating coffee silver skin as an ingredient in biscuit production offers a novel approach to enhance the nutritional quality of the product, minimize waste in the coffee industry, and impart a distinctive taste and aroma to the final biscuit product. This approach can create more innovative and sustainable biscuit products that deliver higher value to consumers. The hallmark of superior-quality biscuits is their ability to adhere to stringent quality and safety standards prescribed by industry benchmarks (Reardon & Farina, 2001). Critical determinants of biscuit quality include meeting appropriate protein, fat, fiber, and moisture levels while also being free from harmful microbial contaminants and additives. Adopting such exacting standards is poised to produce biscuits that provide consumers with optimal nutritional benefits while ensuring the safety of their consumption.

More research is needed to fully understand the impact of utilizing coffee silver skin flour as a substitute for wheat flour in processed foods. Specifically, the sensory and nutritional properties of resulting products require further investigation. Despite this research gap, incorporating coffee silver skin flour in processed foods can increase product variety and provide a sustainable use for this waste product. Furthermore, coffee silver skin can potentially increase the variety of foods offered. In this study, coffee silver skin waste product was ground into flour and used as a substitute for wheat flour to produce processed food in biscuits.

2. MATERIALS AND METHODS

2.1. Materials and Tools

The primary materials used in this study were coffee silver skin obtained from UD Serba Guna, Oikhoda Gunung Sitoli coffee refinery and wheat flour (Segitiga Biru brand). Materials used for chemical analysis were: 1) Protein content: H_2SO_4, HgO, K_2SO_4, NaOH, $Na_2S_2O_3$, H_3BO_3, HCl, boiling stones, and distilled water; and 2) Fat content: n-hexane.

The tools used in making biscuits were knives, scales, ovens, stirrers, pans, molds, and mixers. While the tools used for chemical analysis were analytical scales, porcelain cup, desiccator, scissors, porcelain cup, furnace and scissors, 500 mL Kjeldahl flask, distillation apparatus, 50 mL burette, 5 mL measuring pipette, 50 mL Erlenmeyer, drop pipette, 250 mL beaker glass, and fume hood, Soxhlet with a condenser, electric heater, analytical scales, electric oven, and filter paper.

2.2. Research Design

The design used in this study was a completely randomized design (CRD) with five levels (n=3). The data obtained were analyzed statistically with analysis of variance (ANOVA) and Duncan's New Multiple Range Test (DNMRT) at a 1% significance level.

The treatment in this study was the level of substitution of wheat flour with coffee silver skin flour as follows: A (100% wheat flour : 0% coffee silver skin flour), B (80% wheat flour : 20% coffee silver skin flour), C (60% wheat flour : 40% coffee silver skin flour), D (40% wheat flour : 60% coffee silver skin flour), and E (20% wheat flour : 80% coffee silver skin flour).

2.3. Research Stages

2.3.1. Preparation of Coffee Silver Skin Flour

The coffee silver skin was separated from the coffee beans, washed, and then sun-dried for two hours. Then, the cleaned coffee silver skin was crushed or blended until smooth then dried for four hours at 60 °C. After that, the dried material was ground with a hammer mill and passed through a 60-mesh sieve size (PUSLITKOKA, 2006).

2.3.2. Biscuit Making

Butter, egg yolks, salt, and sugar were combined and stirred with a mixer until smooth, then baking soda and flour were combined and blended until evenly distributed. After thoroughly mixing Dough 1 and Dough 2, water was added, and the mixture was churned until smooth. This dough was then shaped with a thickness of 3 mm and a diameter of 3 cm. After placing the molds on a prepared baking sheet, they were baked at 160 °C for 15 minutes (Wulandari, 2018).

2.4. Observation Variables

Observations were made on moisture, ash, protein, and fat (AOAC, 2005), then a sensory test was conducted to see respondents' preferences for biscuits made from coffee silver skin (Setyaningsih *et al*., 2014).

2.4.1. Analysis of Moisture Content Using Oven Method

Moisture content analysis is the process of measuring the amount of moisture present in a substance or material. Weight loss due to water evaporation in materials dried in an oven at 105 °C for 20 min was measured. Samples weighing 5 g were crushed and then placed in a cup with a known weight that had been dried in an oven. The sample-containing cup was sealed and baked for one hour at 105 °C. The cup is then placed in a desiccator and weighed again (done until the weight is constant) (Andarwulan *et al*., 2011).

$$\%\ \text{Moisture content} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100\% \qquad (1)$$

2.4.2. Analysis of Ash Content Using Dry Ignition Method

Ashes are an inorganic byproduct of combustion or the decomposition of organic components with strong acids. This inorganic residue consists of numerous minerals whose composition and quantity depend on the type of food heated to > 450 °C. Approximately 5 g of mashed samples were weighed, placed in an ash cup, heated at 600 °C for one hour to create ash, cooled in a desiccator, and weighed (until constant weight) (Andarwulan *et al*., 2011).

$$\%\ \text{Ash content} = \frac{\text{Ash weight (g)}}{\text{Sample weight (g)}} \times 100\% \qquad (2)$$

2.4.3. Analysis of Protein Content using Micro Kjeldahl Method

Protein analysis aims to determine a substance's crude protein content. In protein analysis, deconstruction, distillation, and titration are performed in many steps. As many as 1 g of the sample was transferred to a 500 mL Kjeldahl flask and added with

2.5 g of a combination of K_2SO_4 and $CuSO_4.5H_2O$ (1:1). Then, 15 mL of concentrated H_2SO_4 was added, followed by two to three hours of deconstruction until the color turned transparent green. After that, 100 mL of distilled water was added and allowed to cool, then 10 mL of 40% NaOH was added until a black color was formed. The flask was then connected to the Kjeldahl flask on the distillation apparatus, accommodated with an Erlenmeyer containing 10 mL of 0.1 N H_2SO_4 standard, and 2-3 drops of hinge indicator was added until the distillate volume reached 10 mL. The distillate was titrated using 0.1 N HCl (Andarwulan *et al*., 2011).

The following formula is an equation used to determine protein content in a sample. The letter A in the formula represents the volume of HCl solution used to neutralize the ammonia produced during the sample protein digestion; B represents the volume of HCl solution used to neutralize the control solution (without sample); N represents the normality of the HCl solution; F represents the conversion factor used to convert the total nitrogen found in the sample to the amount of protein; W represents the weight of the sample in grams; and the number 14 refers to the average amount of nitrogen (N) contained in each amino acid molecule in the protein.

$$\text{Protein content} = \frac{(A-B)\times N\times 14\times F}{\text{W}\times 100} \times 100\% \quad (3)$$

2.4.4. Fat Content Analysis using Soxhlet Method

The sample was dried at 50 °C for 15 minutes, weighed, placed in a filter paper sleeve, extracted with n-hexane solution using soxhlet for 4 hours, and then dried at 105 °C for 3 hours. The substance was then placed in a desiccator for 15 minutes before being weighed until the weight remained steady. The percentage of fat extracted is proportional to the difference between the pre-and post-extraction sample weights (Andarwulan *et al*., 2011).

$$\text{Fat content} = \frac{a-b}{a} \times 100\% \quad (4)$$

where *a* and *b* are sample weights before and after extraction, respectively.

2.4.5. Sensory Test

The applied sensory test is a favorability test regarding a person's product evaluation (Vivek *et al*., 2020). In this test, panelists were asked to evaluate the level of preference for the flavor, aroma, and color of the cookies created. A total of 25 panelists participated in this test by choosing the available scores based on their preferences. Sensory value determination, namely the Hedonic Scale Criteria and Numeric Scale with a range of Extremely dislike (1), Dislike (2), Somewhat dislike (3), Neither like nor dislike (4), Somewhat like (5), Like (6), and Extremely like (7).

2.5. Data Analysis

The data collected from observations on moisture, ash, protein, and fat contents were statistically analyzed using Analysis of Variance (ANOVA). Duncan's New Multiple Range Test (DNMRT) was conducted at a significance level of 1% if the F value exceeded the F table. Meanwhile, sensory analysis was performed by comparing the average scores obtained from the panelists' scoring of the taste, aroma, and color of the biscuit.

3. RESULTS AND DISCUSSION

In general, the results demonstrated that replacing wheat flour with coffee silver skin flour significantly altered the quality characteristics of biscuits. Table 1 presents the effect of wheat flour substitution with coffee silver skin flour on the observed parameters.

Table 1. The effect of substituting wheat flour with coffee silver skin flour on the parameters observed

Treatment (wheat flour : coffee silver skin flour)	Moisture content (%)	Ash content (%)	Protein content (%)	Fat content (%)
A = 100% : 0%	1.31[a]	0.25[a]	18.50[a]	19.45[a]
B = 80% : 20%	2.70[b]	0.37[b]	16.60[b]	17.20[b]
C = 60% : 40%	4.25[c]	0.43[c]	14.06[c]	15.65[c]
D = 40% : 60%	4.57[d]	0.48[d]	12.87[d]	13.35[d]
E = 20% : 80%	6.05[e]	0.56[e]	10.25[e]	11.17[e]

Note: The numbers in the same column followed by different superscript lowercase letters indicate significant differences based on the DMRT test results at a significance level of 1%.

3.1. Moisture Content

The results indicate that an increase in the proportion of coffee silver skin flour increases the biscuit's moisture content. This is consistent with the findings of Sitohang *et al*. (2021), who found that the biscuits' moisture content increases in proportion to the amount of coffee silver skin flour used. According to Costa *et al*. (2018), untreated coffee silver skin contains 4.76% moisture content. Meanwhile, David *et al*. (2015) reported that soft wheat flour has a lower moisture content than coffee silver skin, with a value of 3.33%. The moisture content of biscuits in all treatments was evaluated according to the quality standards outlined in SNI 2973-2011 for biscuits, which sets a maximum moisture content of 5% (Wijaya & Aprianita, 2010). Analysis of the obtained data indicates that all treatments met the quality standard except for treatment E.

3.2. Ash Content

Based on the results, increasing the proportion of coffee silver skin flour will increase the ash content in the biscuits. Substituting coffee silver skin flour in biscuit production alters the biscuits' ash content. This is because coffee silver skin flour contains more ash than wheat flour. The ash content in this current study is lower than that in a study by Ramadhan (2022), who made cookies from coffee silver skin with a 2% ash level. According to Winarno (2002), the ash content of raw coffee silver skin flour was 0.73%, while the ash content of pure wheat flour was 0.54%. According to SNI 2973-1992, biscuits must have a maximum of 1.6% ash. Therefore, the ash content obtained in this study satisfies this standard.

3.3. Protein Content

The protein level of the biscuits decreases when the percentage of coffee silver skin flour increases. This is because coffee silver skin flour contains less protein than wheat flour. This is consistent with studies by Sitohang *et al*. (2021), which reveal that biscuits with a composition of 90% wheat flour and 10% coffee silver skin flour had the maximum protein content. According to the study by Ocheme *et al*. (2017), pure wheat flour contains 14.70% protein, while according to Wen *et al*. (2020), untreated coffee silver skin flour contains 14.62% protein. Although the protein value content is nearly identical, wheat flour may contain protein levels that are not degraded by bacteria or hydrolysis reactions (Joye, 2019). As a result, the final protein content will be higher in a mixture that contains more wheat flour than a mixture with less wheat flour. The protein content of the biscuits in this current study for all treatments met the SNI 2973 -2011 quality criteria.

3.4. Fat Content

The fat content of biscuits reduced as the percentage of coffee silver skin flour increased. These findings are consistent with Sitohang *et al.* (2021), who found that fat content decreased when coffee silver skin flour increased. This is because coffee silver skin flour has a lower fat content than wheat flour. The fat percentage of coffee silver skin flour is 1.07%, compared to 1.5% for wheat flour (Winarno, 2002). According to the findings, all treatments of the biscuits produced in the current study met the quality standards set by SNI 2973-2011, which requires the fat content to be less than 20%.

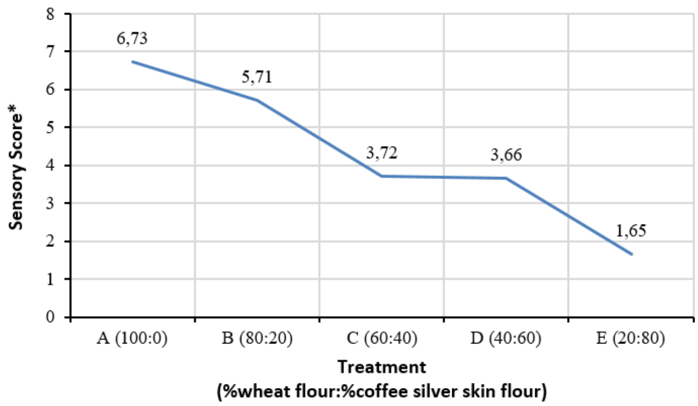

Figure 1. Sensory test results. (Note: *the displayed sensory score is the average score from the panelists for 3 indicators, namely flavor, aroma, and color)

3.5. Sensory Test (Flavor, Aroma, and Color)

The results of the sensory test show that as the percentage of coffee silver skin flour increases, the biscuits' sensory values (taste, aroma, and color) decrease. Based on Figure 1, the highest sensory score was obtained in the treatment using 100% wheat flour and 0% coffee silver skin flour, which was 6.73. This is due to the Maillard reaction, which imparts biscuits with a brownish flavor, aroma, and color. The Maillard process is a non-enzymatic browning reaction caused by the reaction of reducing sugars with the amine groups of amino acids or proteins. In agreement with Hustiany (2016) assertion regarding food ingredients, the Maillard reaction can lead to aroma formation and caramelization. In addition, the presence of caffeine and tannin in the coffee silver skin results in a bitter flavor and strong aroma. This may not be suitable for certain consumers who do not prefer these characteristics in their food products. It may be beneficial to conduct further research into alternative methods for enhancing the aroma of food products without introducing unwanted bitter flavors or strong aromas. This could potentially lead to the development of new and innovative techniques that enhance aroma without compromising on flavor.

4. CONCLUSION

According to the study's results on the quality characteristics of biscuits made with coffee silver skin flour, substituting wheat flour with various coffee silver skin flour has a considerably different effect on the moisture, ash, protein, and fat contents. In addition, treatment A (100% wheat flour : 0% coffee silver skin flour) shows the most optimum sensory value compare to other treatments. Based on moisture, ash, protein, and fat contents, all treatments satisfy SNI 2973-2011 quality criteria for biscuits, except treatment E (0% wheat flour : 100% coffee silver skin flour). However, the sensory test results indicate that panelists did not prefer the addition of coffee silver skin flour due to its bitter aroma. Therefore, exploring the use of masking agents may be a potential approach to address this issue. Future research could investigate the effectiveness of natural masking agents like herbs, spices, or fruits, or artificial masking agents like modified starches or gums, in reducing the bitter flavor and enhancing the overall flavor profile of biscuits made with coffee silver skin flour.

REFERENCES

Andarwulan, N., Kusnandar, F., & Herawati, D. (2011). *Analisis pangan*. Jakarta: Dian Rakyat.

AOAC. (2005). *Official method of Analysis. 18th Edition, Association of Officiating Analytical Chemists*.

Arifin, M. (2020). Analisis Kandungan Antioksidan pada Kulit dan biji Kopi sebagai Sumber Belajar. [*Undergraduate Thesis*]. Universitas Muhammadiyah Malang.

Arpi, N., Rasdiansyah, R., Widayat, H. P., & Foenna, R. F. (2018). Pemanfaatan limbah kulit buah kopi arabika (*Coffea arabika* L.) menjadi minuman sari pulp kopi dengan penambahan sari jeruk nipis (*Citrus aurantifolia*) dan lemon (*Citrus limon*). *Jurnal Teknologi dan Industri Pertanian Indonesia*, ***10***(2), 33–39. https://doi.org/10.17969/jtipi.v10i2.12593

Ateş, G., & Elmacı, Y. (2019). Physical, chemical and sensory characteristics of fiber-enriched cakes prepared with coffee silverskin as wheat flour substitution. *Journal of Food Measurement and Characterization,* ***13***(1), 755-763. https://doi.org/10.1007/s11694-018-9988-9

BSN (Badan Standarisasi Nasional Indonesia). (2011). *SNI 2973:2011 Biskuit*. Badan Standarisasi Nasional Indonesia, Jakarta: 1–46.

Biao, Y., Chen, X., Wang, S., Chen, G., Mcclements, D. J., & Zhao, L. (2020). Impact of mushroom (*Pleurotus eryngii*) flour upon quality attributes of wheat dough and functional cookies-baked products. *Food Science & Nutrition*, ***8***(1), 361–370. https://doi.org/10.1002/fsn3.1315

BPS. (2017). *Statistik Kopi Indonesia 2017 - Indonesian Coffee Statistics 2017.* Badan Pusat Statistik, Jakarta: 81 pp.

Coltelli, M.B., Wild, F., Bugnicourt, E., Cinelli, P., Lindner, M., Schmid, M., Weckel, F., Müller, K., Rodriguez, P., Staebler, A., Rodríguez-Turienzo, L., & Lazzeri, A. (2015). State of the art in the development and properties of protein-based films and coatings and their applicability to cellulose based products: An extensive review. *Coatings,* ***6***(1), 1-59. https://doi.org/10.3390/coatings6010001

Costa, A.S.G., Alves, R.C., Vinha, A.F., Costa, E., Costa, C.S.G., Nunes, M.A., Almeida, A.A., Santos-Silva, A., & Oliveira, M.B.P.P. (2018). Nutritional, chemical and antioxidant/pro-oxidant profiles of silverskin, a coffee roasting by-product. *Food Chemistry,* ***267***, 28-35. https://doi.org/10.1016/j.foodchem.2017.03.106

David, O., Arthur, E., Kwadwo, S.O., Badu, E., & Sakyi, P. (2015). Proximate composition and some functional properties of soft wheat flour. *International Journal of Innovative Research in Science, Engineering and Technology,* ***4***(2), 753-758. https://doi.org/10.15680/IJIRSET.2015.0402097

Garcia-Serna, E., Martinez-Saez, N., Mesias, M., Morales, F., & Castillo, M. (2014). Use of Coffee Silverskin and Stevia to Improve the Formulation of Biscuits. *Polish Journal of Food and Nutrition Sciences*, ***64***(4), 243–251. https://doi.org/10.2478/pjfns-2013-0024

Garing, Y., Poli, Z., Nangoy, F.J., & Montong, P.R.R.I. (2020). Pengolahan limbah kulit kopi (*Coffea Sp*) secara sederhana untuk menggantikan sebagian jagung dan pengaruhnya terhadap kualitas karkas ayam pedaging. *Zootec*, ***40***(1), 271. https://doi.org/10.35792/zot.40.1.2020.27185

Gemechu, F.G. (2020). Embracing nutritional qualities, biological activities and technological properties of coffee byproducts in functional food formulation. *Trends in Food Science & Technology,* ***104***, 235-261. https://doi.org/10.1016/j.tifs.2020.08.005

Gocmen, D., Sahan, Y., Yildiz, E., Coskun, M., & Aroufai, İ. A. (2019). Use of coffee silverskin to improve the functional properties of cookies. *Journal of Food Science and Technology,* ***56***, 2979-2988. https://doi.org/10.1007/s13197-019-03773-y

Hustiany, R. (2016). *Reaksi Maillard Pembentuk Citarasa dan Warna pada Produk Pangan*. LMU Press, Banjarmasin: 139 pp.

Irawan, F.M., Ishartani, D., & Affandi, D.R. (2014). Pemanfaatan tepung umbi garut (*Maranta arundinacea* L) sebagai pengganti terigu dalam pembuatan biskuit tinggi energi protein dengan penambahan tepung kacang merah (*Phaseolus vulgaris* L). *Jurnal Teknosains Pangan*, ***3***(1), 3-14.

Joye, I. (2019). Protein digestibility of cereal products. *Foods*, ***8***(6), 199. https://doi.org/10.3390%2Ffoods8060199

Juwita, A.I., Mustafa, A., & Tamrin, R. (2017). Studi pemanfaatan kulit kopi arabika (*Coffee arabica* L.) sebagai mikro organisme lokal (MOL). *Agrointek: Jurnal Teknologi Industri Pertanian*, ***11***(1), 1–8.

Lestari, N., Syarif, W., & Holinesti, R. (2015). Substitusi tepung talas terhadap kualitas cookies. *Home Economics and Tourism: A Social Sciences Journal*, ***8***(1), 1-16.

Manley, D. (2000). *Technology of Biscuits, Crackers and Cookies.* Woodhead Publishing Ltd, Cambridge, UK: 588 pp.

Muaris, H. (2007). *Healthy Cooking-Biskuit Sehat*. Gramedia Pustaka Utama, Jakarta: 36 pp.

Mutmainna, N. (2013). *Aneka Kue Kering Paling Top*. Dunia Kreasi, Jakarta: 60 pp.

Nugroho, S.A., & Kusumaningtyas, R.N. (2021). Pemanfaatan limbah kulit kopi sebagai tepung roti untuk pemberdayaan ibu rumah tangga di Desa Kemuning Lor Kabupaten Jember. *Prosiding Seminar Nasional Terapan Riset Inovatif (SENTRINOV)*, ***7***(3), 39–49.

Ocheme, O.B., Adedeji, O.E., Chinma, C.E., Yakubu, C.M., & Ajibo, U.H. (2018). Proximate composition, functional, and pasting properties of wheat and groundnut protein concentrate flour blends. *Food Science & Nutrition,* ***6***(5), 1173-1178. https://doi.org/10.1002/fsn3.670

Parimala, K.R., & Sudha, M.L. (2015). Wheat-based traditional flat breads of India. *Critical Reviews in Food Science and Nutrition,* ***55***(1), 67-81. https://doi.org/10.1080/10408398.2011.647121

PUSLITKOKA. (2006). *Pedoman Teknis Tanaman Kopi*. Pusat Penelitian Kopi dan Kakao Indonesia, Jember.

Ramadhan, B.G. (2022). Pemanfaatan Kulit Kopi Varietas Robusta dan Arabika dalam Pembuatan Cookies Fungsional. [*Undergraduate Thesis*]. Universitas Muhammadiyah Malang.

Reardon, T., & Farina, E. (2001). The rise of private food quality and safety standards: illustrations from Brazil. *The International Food and Agribusiness Management Review, **4***(4), 413-421. https://doi.org/10.1016/S1096-7508(02)00067-8

Salman, S., Sinaga, K., Indriana, M., & Maharani, S. (2022). Pengaruh fermentasi tepung kulit kopi oleh *Aspergillus niger* dengan penambahan dua variasi konsentrasi urea dan amonium sulfat menggunakan dua teknik fermentasi terhadap serat kasar. *Journal of Pharmaceutical and Sciences*, ***5***(2), 156–169.

Setyaningsih, D., Apriyantono, A., & Sari, M.P. (2014). *Analisis Sensori untuk Industri Pangan dan Argo*. IPB Press, Bogor: 180 pp.

Setyobudi, R.H., Zalizar, L., Wahono, S.K., Widodo, W., Wahyudi, A., Mel, M., Prabowo, B., Jani, Y., Nugroho, Y.A., & Liwang, T. (2019). Prospect of Fe non-heme on coffee flour made from solid coffee waste: Mini review. *IOP Conference Series: Earth and Environmental Science*, ***293***(1), 012035. https://doi.org/10.1088/1755-1315/293/1/012035

Setyowati, W.T., & Nisa, F.C. (2014). Formulasi biskuit tinggi serat (Kajian proporsi bekatul jagung: tepung terigu dan penambahan baking powder). *Jurnal Pangan dan Agroindustri*, ***2***(3), 224–231.

Shenashen, M.A., Emran, M.Y., El Sabagh, A., Selim, M.M., Elmarakbi, A., & El-Safty, S.A. (2022). Progress in sensory devices of pesticides, pathogens, coronavirus, and chemical additives and hazards in food assessment: Food safety concerns. *Progress in Materials Science,* ***124***, 100866. https://doi.org/10.1016/j.pmatsci.2021.100866

Simanihuruk, K., & Sirait, J. (2010). Silase kulit buah kopi sebagai pakan dasar pada kambing boerka sedang tumbuh. *Seminar Nasional Teknologi Peternakan Dan Veteriner*, 557–566.

Sitohang, A., Sihombing, D.R., Daniela, C., & Einsten, A. (2021). Pengaruh variasi konsentrasi tepung kulit ari kopi pada tepung terigu terhadap mutu biskuit. *Jurnal Riset Teknologi Pangan dan Hasil Pertanian (RETIPA)*, ***2***(1), 93–101.

Suloi, A.N.F. (2019). Pemanfaatan limbah kulit kopi sebagai upaya pemberdayaan ibu-ibu rumah tangga di Desa Latimojong, Kabupaten Enrekang. *Agrokreatif: Jurnal Ilmiah Pengabdian Kepada Masyarakat*, ***5***(3), 246–250.

Sumardiono, S., Pudjihastuti, I., Budiyono, Hartanto, H., & Sophiana, I.C. (2017). Combination process method of lactic acid hydrolysis and hydrogen peroxide oxidation for cassava starch modification. *AIP Conference Proceedings, **1840**,* 060006. https://doi.org/10.1063/1.4982286

Vivek, K., Subbarao, K.V., Routray, W., Kamini, N.R., & Dash, K.K. (2020). Application of fuzzy logic in sensory evaluation of food products: A comprehensive study. *Food and Bioprocess Technology, **13***, 1-29. https://doi.org/10.1007/s11947-019-02337-4

Wang, X., Hong, D.F., Hu, G.L., Li, Z.R., Peng, X.R., Shi, Q.Q., & Qiu, M.H. (2021). Morphological changes and component characterization of coffee silverskin. *Molecules, **26***(16), 4914. https://doi.org/10.3390/molecules26164914

Wen, L., Álvarez, C., Zhang, Z., Poojary, M.M., Lund, M.N., Sun, D.W., & Tiwari, B.K. (2021). Optimisation and characterisation of protein extraction from coffee silverskin assisted by ultrasound or microwave techniques. *Biomass Conversion and Biorefinery, **11***, 1575-1585. https://doi.org/10.1007/s13399-020-00712-2

Wijaya, H., & Aprianita, N. (2010). *Kajian Teknis Standar Nasional Indonesia Biskuit SNI 01-2973-1992*. Balai Besar Industri Argo, Kementrian Perindustrian.

Winarno, F.G. (2002). *Kimia Pangan dan Gizi.* PT Gramedia, Jakarta.

Wulandari, E.S. (2018). Pengaruh Lama Blanching dan Lama Pemanggangan Terhadap Karakteristik Cookies Ganyong (*Canna edulis* Ker) Difortifikasi Iodium. [*Doctoral Dissertation*]. Engineering Faculty, Universitas Pasundan.