



Substitution of Desiccated Coconut on The Physicochemical and Organoleptics of Crispy Cookies

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ABSTRACT

Research on coconut flour and desiccated coconut substitution cookies has been conducted by several researchers, but variations of desiccated coconut crispy cookies have not been widely developed. The nutritional content of desiccated coconut can be used as a source of fiber when substituted in crispy cookies products. The purpose of this study was to determine the effect of desiccated coconut substitution in making crispy cookies on physicochemical and organoleptic characteristics, and obtain the best desiccated coconut substitution. This study used a Complete Randomized Design (RAL) with one factor, namely the ratio of the percentage of desiccated coconut and wheat flour with 6 treatment levels (0:100), (25:75), (50:50), (75:25), (85:15), and (100:0) with 3 repeats. The data obtained were analyzed using the ANOVA test ($\alpha=5\%$). If the effect is significant ($\text{Sig} < 0.05$), then proceed with the Honest Real Difference Test (BNJ) with a test level of 5%. Analysis of sensory characteristics data using the Kruskal Wallis test. The best treatment is tested using an effectiveness index test. This study obtained the best sensory and physicochemical characteristics of desiccated coconut crispy cookies in treatment (25%: 75%). The physicochemical characteristics produced are crude fiber content of 2.73%, fat content of 30.43%, ash content of 1.52%, water content of 16.86%, carbohydrate content of 51.11%, and protein content of 0.08%. The resulting sensory characteristics are taste 4.36 (prefer), aroma 4.13 (prefer), color 3.97 (like), and texture 4.26 (prefer).

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Key Messages:

- This study uses SNI references for standard cookies and not crispy cookies.
- The design in this study is recommended to use a Randomized Block Design (RAK)

Introduction

Cookies based on industry standards are snacks made from soft dough that contains wheat flour, developer, high fat content, crispy and when broken the texture is less dense. One type of cookie that is quite popular is crispy cookies, this is due to its crispy texture and sweet and savory taste, making it a prima donna both among teenagers and adults (1). According to Goldstein (2022) (2), crispy cookies are the result of cookie dough with a high fat and sugar content, as well as low moisture content. According to Mustinda (2016) (3), crispy cookies are generally round and thin in shape that are baked in the oven until browned, to produce cookies with a crispy texture can be made by using a lot of butter, additional milk or water, and made from room temperature ingredients. In making cookies, it is best to use low-protein wheat flour.

Research on coconut flour substitution cookies and desiccated coconut has been carried out by several researchers, but the crispy variation of desiccated coconut cookies has not been widely developed. Desiccated coconut is a grated coconut produced from the flesh of white coconut through the stages of the grating process with a size that is in accordance with its specifications (medium 2.90 mm, fine 1.40 mm, extra fine 0.60 mm), followed by a sterilization, drying, sifting and packaging process which is processed in a way or under high hygienic conditions for food raw materials (4). Desiccated coconut can be used as an ingredient for making cakes, namely by processing it into flour or as a topping with a distinctive coconut aroma. The nutrient content of dried grated coconut per 100 grams of ingredients is 683 calories, 67.2g fat, 7.4g protein, 7.9g carbohydrates, 14g fiber (5), 2% water, and 2.4% ash (6). The fiber content in coconut includes soluble fiber and insoluble fiber. Soluble fiber consists of

0.12% pectin and 7.73% hemicellulose, while insoluble fiber consists of 6.14% lignin and 7.64% cellulose (7). The nutritional content of desiccated coconut can be used as a source of fiber when substituted in crispy cookie products.

Fiber has various benefits for health, including to improve digestion and prevent colon cancer, lower blood glucose levels, function as a prebiotic, control obesity and obesity and reduce cholesterol levels in the blood (8). Foods that contain a lot of fiber will take longer to digest in the stomach, then fiber will attract water and give a feeling of fullness for longer, preventing to consume more food. In addition, crude fiber in food ingredients is very important in assessing the quality of food ingredients because this number is an index in determining the nutritional value of food. Coarse fibers can also be used to determine the purity of materials and process efficiency. Fiber is closely related to health, fiber is able to expel feces that settle in the body, where the feces that settle will be absorbed and excreted through feces (9).

Based on the explanation above, this study aims to determine the effect of desiccated coconut suspension in the manufacture of crispy cookies on physicochemical and organoleptic characteristics, and to obtain the best desiccated coconut substitution. This study is expected to inform the physicochemical characteristics of desiccated coconut crispy cookies, and inform the best substitution for desiccated coconut crispy cookies.

Methods

This research was carried out from April to August 2023 at the Laboratory of Food Chemistry, Food Design, Agronomy and Climatology of the Food Science and Technology study program, Faculty of Agriculture, Tanjungpura University, Pontianak and the Pontianak State Polytechnic Laboratory. The experimental design used in this study is a Complete Random Design (RAL) with one factor, the comparison of the percentage of desiccated coconut and wheat flour with 6 levels of treatment (Table 1).

Table 1. The comparison of the percentage of desiccated coconut and wheat flour with 6 levels of treatment

Desiccated Coconut (%)	Wheat Flour (%)
0%	100%
25%	75%
50%	50%
75%	25%
85%	15%
100%	0%

This treatment was repeated 3 times, so that $6 \times 3 = 18$ experimental units were obtained.

The ingredients used in making crispy cookies are wheat flour, desiccated coconut, butter, margarine, powdered sugar, egg whites, and full cream milk powder. The materials for chemical analysis are aquades, n-Hexane, biuret reagents, BSA (Bovine Serum Albumin), H₂SO₄ 1.25%, NaOH 3.25%, and ethanol 96%. The tools used are basins, trays, teaspoons, cookie molds, spatula, mixers, ovens, analytical scales, drying ovens, kilns, soxhlet, vacuum filtration apparatus, UV-VIS spectrophotometers, desiccants, Whatman No. 41 paper, micro pipettes, and hot plates.

The stages of making crispy cookies use the modified (10) method. In mixing I, butter, margarine and powdered sugar are homogenized using a mixer at 3/medium speed (170 rpm) for 6 minutes. In mixing II, egg whites are added and re-homogenized using a mixer at 1/low speed (60 rpm) for 3 minutes. After that, in mixing III, powdered milk, desiccated coconut, and wheat flour are added according to the treatment. In this stage of mixing, it is homogenized by stirring using a stirring spatula for 1 minute. Crispy cookies are printed using the drop cookies method, where the dough is taken and then dropped and flattened using a teaspoon to adjust the cookie mold in a round shape with a diameter of 6 cm and a height of 0.3 mm. Crispy cookies are baked in an oven at 150°C for 20 minutes.

The parameters to be studied include water content (11), ash and fat content (12), protein content by spectrophotometry method (13); (14), carbohydrate content by difference, crude fiber content of the acid-base method (15), sensory tests of the hedonic method including texture, color, aroma, and taste (16). The chemical analysis data of crispy cookie products was statistically analyzed using Analysis of Variance (ANOVA) with a test level of 5% to find out whether it had a real effect or not. If it has a real effect of Sig < 0.05, then it will be continued with the Honest Real Difference (BNJ) test with a test level of 5%. The data from the organoleptic test results were analyzed using the Kruskal-Wallis method. The determination of the best treatment was analyzed using the method effectiveness index test (17).

Results

Physicochemical Characteristics

Table 2 shows the results of parameter calculations of physicochemical characteristics. Numbers followed by the same letter in the same row indicate no significant difference with the 5% BNJ test.

Table 2. Physicochemical characteristics of desiccated coconut crispy cookies

Parameter	Treatments					
	0:100	25:75	50:50	75:24	85:15	0:100
Moisture content	14,71 ± 0,84	16,86 ± 1,42	16,43 ± 1,64	17,24 ± 1,89	15,86 ± 1,91	16,38 ± 1,15
Ash content	2,12 ± 0,14	1,52 ± 0,76	1,84 ± 0,45	2,13 ± 0,23	2,10 ± 0,20	2,10 ± 0,15
Fat content	27,78 ± 0,99 ^a	30,43 ± 0,47 ^b	34,45 ± 0,28 ^c	36,05 ± 0,18 ^d	37,58 ± 0,12 ^e	39,16 ± 0,18 ^f
Protein content	0,37 ± 0,00 ^a	7,74 ± 0,31 ^a	3,62 ± 0,17 ^a	4,92 ± 0,10 ^a	21,22 ± 6,57 ^b	24,72 ± 9,70 ^b
Carbohydrate content	55,02 ± 0,58 ^c	43,46 ± 0,50 ^{bc}	43,65 ± 1,26 ^{bc}	39,79 ± 1,91 ^b	23,24 ± 7,13 ^a	17,65 ± 10,04 ^a
Crude fiber content	0,50 ± 0,00 ^a	2,73 ± 0,03 ^b	5,75 ± 0,12 ^c	5,98 ± 0,00 ^c	6,96 ± 0,06 ^d	10,71 ± 0,28 ^e

Moisture content is the amount of water contained in food. The moisture content of the resulting crispy cookies ranged from 14.71-17.24% (Table 2). The results of the ANOVA test showed that the suspension of desiccated coconut had no real effect on the moisture content of crispy cookies (0.449) > (0.05). When compared to SNI, the moisture content of desiccated coconut crispy cookies from this study tends to be high, which is more than 5%, so it does not meet the SNI requirement, which is a maximum moisture content of 5%.

The ash content of crispy cookies produced ranged from 1.52-2.11% (Table 2). The results of the ANOVA test showed that the suspension of desiccated coconut had no real effect on the ash content of crispy cookies (0.424) > (0.05). Desiccated coconut crispy cookies with ash content of 1.52%, 1.84%, and 1.99% meet the SNI requirement, namely a maximum ash content of 2%, while desiccated coconut crispy cookies with an ash content of more than 2% do not meet the SNI requirement.

The results of the ANOVA test showed that the suspension of desiccated coconut had a real effect on the fat content of crispy cookies (0.000) < (0.05), and continued with the BNJ test at the 5% test level. Based on Table 1, the highest fat content is 39.15% in the formulation of 100% desiccated coconut: 0% wheat flour, and the lowest fat content is 27.78% in the formulation of 0% desiccated coconut: 100% wheat flour. The fat content from the results of the analysis of all desiccated coconut crispy cookies treatment on the quality of cookies meets the SNI requirements, which is a minimum fat content of 9.5%.

The results of the ANOVA test showed that the suspension of desiccated coconut had a real effect on the protein content of crispy cookies (0.000) < (0.05), and continued with the BNJ test at the 5% test level. Based on Table 2, the highest protein content is 24.72% in the formulation of 100% desiccated coconut: 0% wheat flour, and the lowest protein content is 0.37% in the formulation of 0% desiccated coconut: 100% wheat flour. Desiccated coconut crispy cookies with protein content of 7.74%, 21.22%, and 24.72% meet the SNI requirement, namely a protein content of at least 6%, while desiccated coconut crispy cookies with a protein content of less than 6% do not meet the SNI requirement.

The results of the ANOVA test showed that the suspension of desiccated coconut had a real effect on the carbohydrate content of crispy cookies (0.000) < (0.05), and continued with the BNJ test at the 5% test level. Based on Table 2, the highest carbohydrate content is 55.02% in the formulation of 0% desiccated coconut: 100% wheat flour, and the lowest carbohydrate content is 17.65% in the formulation of 100% desiccated coconut: 0% wheat flour. The carbohydrate content from the results of the analysis of all treatments of desiccated coconut crispy cookies on the quality of cookies does not meet the SNI requirements, namely the carbohydrate content of at least 70%.

The results of the ANOVA test showed that the suspension of desiccated coconut had a real effect on the crude fiber content of crispy cookies (0.000) < (0.05), and continued with the BNJ test at the 5% test level. Based on Table 1, the highest crude fiber content is 10.71% in the formulation of 100% desiccated coconut: 0% wheat flour, and the lowest average value of crude fiber content is 0.50% in the formulation of 0% desiccated coconut: 100% wheat flour. Desiccated coconut crispy cookies with a crude fiber

content of 0.5% meet the SNI requirement, which is a maximum crude fiber content of 0.5%, while desiccated coconut crispy cookies with a crude fiber content of more than 0.5% do not meet the SNI requirements.

Sensory Characteristics

Table 3 shows the calculation results of the sensory characteristic parameters. Hedonic value; 1= dislike, 2= dislike less, 3= like, 4= prefer, 5= like very much.

Table 3. Sensory characteristics of desiccated coconut crispy cookies

Parameter	Treatments					
	0:100	25:75	50:50	75:25	85:15	100:0
Texture	4,20	4,26	4,00	3,70	3,70	3,70
Color	3,83	3,97	4,03	3,73	3,27	3,80
Aroma	3,73	4,13	4,30	3,96	4,13	4,10
Taste	3,90	4,36	4,30	3,90	4,13	3,93

The results of the hedonic test of desiccated coconut crispy cookies were obtained with an average hedonic value for the textures are between 3.70 - 4.26 (likes – prefers) (Table 3). The results of the preference test showed that the KW of the textures: 14.87; Chi square : 11.07; because $KW > X^2$ is 0.05 which is $14.87 > 11.07$ so the formulation of desiccated coconut : wheat flour as a substitution ingredient has a real effect on the texture of desiccated coconut crispy cookies. 25% desiccated coconut treatment: 75% wheat flour was the most preferred treatment by the panelists with a hedonic score of 4.26 (preferred).

The results of the hedonic test of desiccated coconut crispy cookies were obtained with an average hedonic value for color between 3.27 - 4.03 (likes – prefers) (Table 3). The results of the preference test showed that the color KW: 14.83; Chi square : 11.07; because $KW > X^2$ is 0.05 which is $14.83 > 11.07$, then the formulation of desiccated coconut: wheat flour as a substitution material has a real effect on the color of desiccated coconut crispy cookies. 50% desiccated coconut treatment: 50% wheat flour is the most preferred treatment by the panelists with a hedonic score of 4.03 (preferred).

The results of the hedonic test of desiccated coconut crispy cookies were obtained with an average hedonic value for aroma between 3.73 - 4.30 (likes – prefers) (Table 3). The results of the preference test showed that KW aroma: 7.35; Chi square : 11.07; because $KW < X^2$ is 0.05 which is $7.35 < 11.07$ so the formulation of desiccated coconut: wheat flour as a substitution ingredient has no real effect on the aroma of desiccated coconut crispy cookies. 50% desiccated coconut treatment: 50% wheat flour was the most preferred treatment by the panelists with a hedonic score of 4.30 (preferred).

The results of the hedonic test of desiccated coconut crispy cookies were obtained with an average hedonic value for taste between 3.90 - 4.36 (like – prefer) (Table 3). The results of the preference test showed that KW taste: 7.35; Chi square : 11.07; because $KW < X^2$ is 0.05 which is $7.64 < 11.07$ then the formulation of desiccated coconut: wheat flour as a substitution ingredient has no real effect on the taste of desiccated coconut crispy cookies. 25% desiccated coconut treatment: 75% wheat flour is the most preferred treatment by the panelists with a hedonic score of 4.36 (preferred).

Determining the Best Treatment

Table 4 shows the results of calculating the best treatment value with the treatment value (NP)

Table 4. Test of the effectiveness index of desiccated coconut crispy cookies

Desiccated Coconut (%) : Wheat Flour (%)	NP
0 : 100	0,60
25 : 75	1,17
50 : 50	0,76
75 : 25	0,38
85 : 15	0,33
100 : 0	0,26

The determination of the best treatment in the results of the research on crispy cookies as a substitute for desiccated coconut was carried out by the De Garmo et al. (1984) method (17).

Discussion

Physicochemical Characteristics

The high moisture content in the cookies of this study is suspected to be due to the hygroscopic nature of crispy cookies or during storage of crispy cookies experiencing an equilibrium of moisture content, and the content of crude fiber in the ingredients. According to Mrak et al (2023) (18), moisture equilibrium is the moisture content of food when the vapor pressure of the material is in a condition in equilibrium with the environment where the product has not changed or reduced the weight of the product. Hood (1980), stated that the fibers in a material can bind water and even if it is heated, the evaporated water is relatively small and the water content left in the material is still there (19). This condition produces moisture content that has an insignificant effect on desiccated coconut crispy cookies. The increase in moisture content is caused by the higher humidity of the storage room of the product so that the product will absorb water resulting in high moisture content of the product. The increase in moisture content is caused by the higher humidity of the storage room of the product so that the product will absorb water resulting in high moisture content of the product. The high air humidity of the storage room causes the process of absorbing water vapor from the air to the cookies which results in an increase in moisture content (20). According to Herawati et al (2008) (21), the processing process, the ability to absorb water from food and water evaporation during baking affect the moisture content of cookies.

The ash content of a food ingredient shows the total minerals contained in the food ingredient (22). In terms of ash content, it is suspected that what affects the ash content of crispy cookies products is that the ash content in the raw materials is quite low, namely the ash content of desiccated coconut 2.4% and the ash content of wheat flour 1.0%. This factor provides the results of ash content that has an insignificant effect on desiccated coconut crispy cookies with variations in the ratio of desiccated coconut and wheat flour. The results of this study are in line with research by Sudirman et al (2015) (23), which in the manufacture of cookies with the addition of coconut pulp flour with tapioca flour containing ash content of 1.29 – 1.46%. Based on Global Grains & Ingredients data (24), the minerals contained in desiccated coconut include calcium 9.35mg, iron 1.3mg, magnesium 43mg, phosphorus 85mg, and manganese 0.8mg.

Fat is an important nutrient in maintaining the health of the body because fat is one of the sources of calories needed by the human body. Fat in food serves to improve the physical structure of foodstuffs, add nutritional and calorie value, and give food a savory taste (25). The results of the analysis of the fat content of crispy cookies, it is suspected that the data shows a trend that the more desiccated coconut is added, the more fat content increases. The increase in the fat content of crispy cookies is due to the raw materials used. Desiccated coconut has a fat content of 67.2%, higher than the fat content in wheat flour which is 1.0%, so the more desiccated coconut is added, the higher the fat content. The results of this study are in line with what was reported by Wanti et al (2019) (26), which in the manufacture of cookies using yellow sweet potato puree and 24 desiccated coconut pulp containing fat content ranging from 18.45-27.42%. Polii (2017) reported that pastries with 0% substitution coconut flour contain 24.24% fat and with 100% substitution coconut flour contain 31.91% fat (27).

Protein functions to help cell development and maintain the body's defenses (14). The results of the analysis of the protein content of crispy cookies, it is suspected that the data shows a trend of adding more desiccated coconut, the protein content tends to increase. It is suspected that the data shows a trend that the more desiccated coconut is added, the protein content tends to increase. This is because the raw materials used, which wheat flour contain a protein content of 9% and desiccated coconut contain a protein content of 7.4%. The results of this study are in line with what was reported by Wanti et al (2019) (26), and Polii (2017) (27) with the increasing use of desiccated coconut pulp in cookies, the protein content is also increasing.

Carbohydrates are the main source of calories for humans. As much as 60-80% of the calories obtained by the human body come from carbohydrates (28). The results of the calculation of carbohydrate levels, it is suspected that the data shows a trend that the more desiccated coconut is added, the lower the carbohydrate content. The calculation of carbohydrate content by difference is

greatly influenced by other levels of crispy cookie content such as water content, ash content, fat content, and protein content. The higher the element contained from other elements, the lower the carbohydrate content, and vice versa, the lower the element contained by other elements, the higher the carbohydrate content. The results of this study are in line with what was reported by Sudirman et al (2015) (23), the higher the use of dried coconut pulp, the lower the carbohydrate content. Polii (2017) (27) reported that the carbohydrate content of pastries with 0% substitution of coconut flour contains carbohydrates of 55.41% and with 100% substitution of coconut flour contains carbohydrates of 45.14%.

Crude fiber is a collection of all indigestible fibers, the components of coarse fiber consist of cellulose, pentose, lignin and other components. This component of crude fiber has no nutritional value, but this fiber is very important to facilitate the digestive process in the body. The main role of fiber in food is in its ability to bind water, cellulose, and pectin. Fiber helps accelerate food scraps through the digestive tract to be secreted out (9).

The results of the crude fiber analysis of crispy cookies, it is suspected that the data shows a trend of adding more desiccated coconut, the higher the crude fiber content increases. The increase in crude fiber content of crispy cookies is suspected to be caused by the raw materials used. Desiccated coconut has a fiber content of 14%, higher than wheat flour with a fiber content of 0.30%. The results of this study are in line with what was reported by Sudirman et al (2015) (23) in the manufacture of cookies with dried coconut pulp containing crude fiber ranging from 6.54-9.50% along with the increasing addition of dried coconut pulp used. Polii (2017) reported that pastries with 0% substitution coconut flour contain 2.52% crude fiber and with 100% substitution coconut flour contains 8.48% crude fiber (27).

Sensory Characteristics

Texture hedonic testing, it is suspected that the increasing use of desiccated coconut in crispy cookies results in cookies textures that tend to be less dense, have cavities and have high crispiness. According to Wanti et al. (2019), dried coconut pulp contains high fiber and granules from dried coconut pulp that are less fine so that the texture becomes coarse (26). This is in accordance with the statement of Khasanah (2003), which states that the increase in coarse fiber causes the product to tend not to expand so that it has a high crispiness (29).

The crispy cookies product in this study produced colors from bright yellow to brownish yellow along with the increase in desiccated coconut used. Based on the results of the hedonic assessment, the panelists preferred products with bright yellow colors over brownish yellow colors. The discoloration of crispy cookies is suspected to be due to a caramelization reaction and the addition of desiccated coconut. The use of sugar in baked cookie dough results in a change in the color of the cookies to dark to brown. In addition, sugar plays a role in the color formation process because it reacts with amino acids in wheat flour and desiccated coconut so that the Maillard reaction occurs (30). The addition of desiccated coconut and the reduction of wheat flour results in a smaller moisture content of cookies, so that the color of the cookies is darker. Desiccated coconut has a fairly low moisture content of 2.0%, meanwhile, the moisture content in wheat flour is 11.8%.

According to Fatty (2012), the aroma arises during baking due to the Maillard reaction that occurs between reducing sugars and amino acids that produce volatile compounds so that they will produce an aroma in cookies (31). The type of aroma produced depends on the combination of fats, amino acids and sugars found in the cookie processing ingredients. Based on a descriptive assessment, the panelists stated that the crispy cookies product in this study had a strong butter and coconut aroma. The results of the analysis of aromatic compounds in coconut meat by Mahayothee et al. (2015), include salicylic acid, p-hydroxy benzoate acid, syringic acid acid, m-coumaric acid, p-coumaric acid, gallic acid, caffeic acid, and catechins (32).

The ingredients for making crispy cookies include sugar and margarine to give the cookie product a flavor. The use of sugar gives the cookies a sweet taste. This is supported by Mudjajanto et al. (2006) who stated that the function of adding sugar in food products includes providing aroma and sweetness. The use and margarine also add a savory taste to the cookie product (33). This is supported by Rosida et al. (2020) who stated that margarine has a fat and protein content that causes a savory taste in the

resulting cookies (34). This is in line with the research reported by Polii (2017), where the panelists gave the highest rating on the formulation of 25% coconut flour: 75% wheat flour in cookie products (27).

Determining the Best Treatment

The best treatment analysis used an effectiveness index test based on the physicochemical and sensory characteristics of desiccated coconut crispy cookies. The effectiveness index method is carried out by assigning weights or scores to each parameter based on its standards and level of importance. The results of the calculation of the best treatment value with the treatment value (NP) are presented in Table 3. The best treatment is indicated by the highest treatment value (NP). Based on Table 3, the results of the effectiveness index test show that the best treatment of sensory and chemical characteristics is found in the treatment with the substitution of 25% desiccated coconut: 75% wheat flour.

Conclusion

The substitution of desiccated coconut in crispy cookies has no obvious effect on moisture content and ash content, but has a significant effect on fat content, carbohydrate content, protein content and crude fiber content of crispy cookies. The physicochemical and sensory characteristics of desiccated coconut crispy cookies in this study obtained the best treatment in the formulation of crispy cookies 25% desiccated coconut: 75% wheat flour. The physicochemical characteristics produced were crude fiber content of 2.73%, fat content of 30.43%, ash content of 1.52%, moisture content of 16.86%, carbohydrate content of 43.46%, and protein content of 7.74%. The resulting sensory characteristics were taste 4.36 (preferred), aroma 4.13 (preferred), color 3.97 (preferred), and texture 4.26 (preferred). Consuming desiccated coconut crispy cookies is expected to be a source of fiber intake in snacks that can be enjoyed by all ages.

Conflicts of Interest: This research does not contain any elements of conflict of interest that are unprofessional as academics.

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