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Effect of substitution ratio of wheat flour with coconut dregs and avocado seed flour as gluten-free flour on the chemical characteristics of white bread

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ABSTRACT

Analysis of the chemical properties of white bread whose formulation is modified by substitution of coconut dregs flour and avocado seed is very important to do to find out how much increase in dietary fiber content in white bread and to determine the content contained in it, which can affect the quality of the white bread. The research aimed to study the effects of coconut dregs flour and avocado seed ratios on chemical properties and daily index sufficiency of white bread. This research used a randomized block design with one factor, the ratio of white flour, coconut dregs flour and avocado seed flour is P0 (control), P1 (90%:5%:5%), P2 (85%:10%:5%), P3 (80%:15%:5%), P4 (75%:20%:5%), and P5 (70%:25%:5%). The results of the research showed that P5 white bread had the lowest water content of 35.10%, P0 white bread had the lowest ash content of 0.66%, P5 white bread had the highest fat content of 12.34%, P0 white bread had the highest protein content of 9.11%, P1 white bread has the highest carbohydrate content of 45.43%, P5 white bread has the highest crude fiber and dietary fiber content, respectively 7.78% and 17.92%. The substitution ratio of coconut dregs flour and avocado seed flour in all treatments does not significantly affect the value of the daily index sufficiency.

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INTRODUCTION

According to Food Consumption Statistics data issued by the Ministry of Agriculture, the level of consumption of white bread in Indonesia in 2017 reached 3.17 g per day. This data experienced a very significant increase in 2018, reaching 8.25 g per day, and increasing again in 2020 to 8.64 g per day. Based on these data, it is known that the need for white bread has increased every year, leading to variations in terms of taste and ingredients used to produce the desired nutritional value. However, white bread on the market tends to have high calories, so it is unsuitable for consumption by people who want to limit calorie intake, such as people with diabetes mellitus (Anggriani et al. 2020). Food supply with a high caloric and glycemic load is associated with insulin resistance caused by decreased pancreas function. There is excessive insulin production or beta cells that are not functioning properly, so it increase the production of glucose in the blood (Montherdoroa 2017).

Indonesian Central Statistics Agency (2021) reported that the level of coconut production in Indonesia in 2021 would reach 285,330,000 tons. The high production level is in line with the level of utilization that is already widespread in the community. In the coconut processing industry, 100 coconut flesh is processed into oil through wet processing to produce 19.50 kg of coconut pulp (Yulvianti et al. 2015). The high by-product of coconut pulp causes it to become a part often rarely used in the food sector. Coconut dregs are the residue from the manufacture of Virgin Coconut Oil (VCO) and the manufacture of coconut milk which has a crude protein content of 5.6%, carbohydrates of 38.1%, crude fat of 16.3%, crude fiber of 31.6%, ash content 2.6% and 5.5% moisture content (Violita et al. 2021).

Dried coconut dregs that are fat-free are considered to contain high carbohydrates, namely 93%, which consists of 61% galactomannan, 26% mannose, and 13% cellulose, where galactomannan can trigger the growth of intestinal bacteria that helps digestion and acts as dietary fiber so that it has the potential as a food source, especially source of carbohydrates (Violita et al. 2021). Coconut dregs can also be processed into flour which can be applied as a raw material or as a substitute in the manufacture of food products. Coconut dregs flour contains 20% crude fiber, 18% protein, 12.2% fat, 6.2% water, and 4.9% ash content (Violita et al. 2021). Coconut pulp flour also contains dietary fiber, Neutral Detergent Fiber (NDF) by 38.3%, Acid Detergent Fiber (ADF) by 24.2%, and hemicellulose by 14% (Violita et al. 2021)

Using avocados that are not comparable to waste seeds can be a severe problem if not handled properly. The percentage of avocado seed weight to the flesh is 13%. National production data in 2018 showed that avocado production in Indonesia reached 410,090 tons, so that avocado seed agricultural waste in that year was around 53,312 tons (Violita et al. 2021). Avocado production increased quite significantly. The production of avocados in Indonesia in 2021 was 660,830 tons, so the avocado seeds produced reached 132,166 tons (Violita et al. 2021). A lack of knowledge about using avocado seeds makes people think of avocado seeds as waste. However, avocado seeds have many health benefits, including antidiabetic (Violita et al. 2021). Avocado seeds have high antioxidant activity that can inhibit the effects of free radicals in the body and prevent complications of degenerative diseases. In addition, avocado seeds that have been processed into flour contain crude fiber content of 15.79%, where this crude fiber can control the release of glucose. Over time and helps control degenerative diseases such as diabetes mellitus (Violita et al. 2021). This is undoubtedly an excellent opportunity for the food industry to develop white bread products with high fiber content.

In a previous study regarding the chemical properties of white bread substituted with 10% coconut pulp flour by (Violita et al. 2021), the moisture content was 39.07 %, the ash content was 1.47%, the fat was 5.77%, the protein was 9.59%, carbohydrates by 44.11% and crude fiber by 5.69%. In addition, white bread substituted with 4% avocado seed flour produces a moisture content of 33.5%, which is lower than that of unsubstituted white bread, which is 35.5% (Violita et al. 2021).

The novelty of this research is high-fiber bread made by substituting coconut pulp flour and avocado seed flour. This study aimed to determine the effectiveness of coconut pulp flour and avocado seeds flour in increasing the dietary fiber content of white bread. In addition, this finding also explains the effect of the ratio substitution of coconut pulp flour and avocado seed flour on the chemical properties and value of the daily

sufficiency index of white bread to produce good quality white bread.

METHODS

Materials

This study used high protein flour, ice water, coconut pulp, sugar (Gulaku), white butter (Fortune shortening), avocado seeds, skim milk powder (Prolac), salt (Dolphin), yeast (Fermipan), and bread improver (Bakerine plus) obtained from the Landungsari market in Malang. Sodium bicarbonate (technical), aquades (technical), petroleum benzene (pro analysis), biuret (pro analysis), NaOH (pro analysis), H_2SO_4 (pro analysis), and ethanol (pro analysis).

Equipment

The equipment used in this research includes 40-mesh and 70-mesh sieve, copper, digital balance (SF-400), analytical balance (Ohaus), planetary mixer (Getra B10), bread proofer (Getra FX-15J), gas baking oven (Getra RFL-36), 200-gram bread mold, Whatman No.1 filter paper, porcelain dish, mortar and hammer, stir bar, iron spatula, crus pliers, test tube (Iwaki Pyrex), 100 mL and 500 mL Erlenmeyer (Pyrex), fat flask (Pyrex), 250 mL and 600 mL beakers (Pyrex), 100 mL measuring cups (Pyrex), 10 mL pipettes (Iwaki Pyrex), soxhlet (Pyrex), cuvette (UniversalLab), glass funnel (Pyrex), oven (Memmert Germany), muffle furnace (Thermolyne Thermo Scientific), 500 mL filtering flask with buchner funnel (Pyrex), desiccator (Dianrui), vortex (Boeco Type V 1 Plus Germany), and UV-Vis spectrophotometer (Shimadzu).

Research Design

This study used a simple randomized block design with the ratio treatment of wheat flour, coconut pulp flour, and avocado seed flour consisting of 6 treatments, namely P0 (control), P1 (90%:5%:5%), P2 (85%:10%:5%), P3 (80%:15%:5%), P4 (75%:20%:5%), and P5 (70%:25%:5%). Each treatment was performed triplicate based on the processing time, so 18 experimental units were obtained.

Production of Coconut Dregs Flour (Violita et al. 2021)

Coconuts sorted for suitability were peeled by separating the flesh from the husk and shell, then the water was removed. The peeled coconut is then grated. Next, the extraction was done by adding clean water to the grated coconut with a ratio of 2 l to 1 kg of coconut and then squeezing twice by hand to take the coconut milk. The coconut juice was stored in a plastic container, while the solid waste from the first squeeze was mixed again with clean water, then squeezed. Finally, the juice was filtered and stored in a plastic jar. The coconut dregs that have been obtained then dried in a cabinet dryer at a temperature of 60˚C for 24 hours. Coconut dregs that have gone through the drying process were mashed using copper and sieved using a 40-mesh sieve to produced coconut dreg flour.

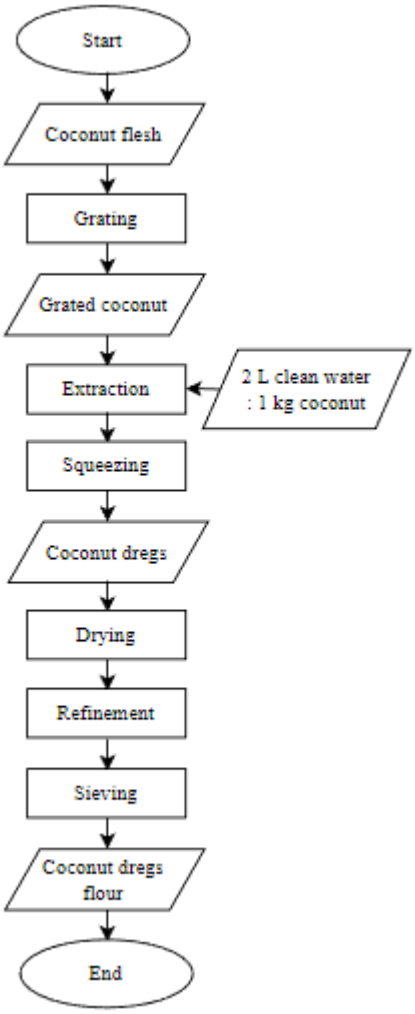

Figure 1 Flowchart Production of Coconut Dregs Flour

Production of Avocado Seed Flour (Violita et al. 2021)

Avocado seeds sorted for suitability are separated from the skin and washed with running water until clean and drained. Next, the avocado seeds are soaked in 1 g of sodium bicarbonate for

24 hours. After that, the seeds were boiled for 35 minutes and thinly sliced. The avocado seeds were then dried using a cabinet dryer at a temperature of 60˚C for 6 hours. Next, the dried avocado seeds are mashed using a blender. After that, it was sieved using a 70-mesh sieve to produced avocado seed flour.

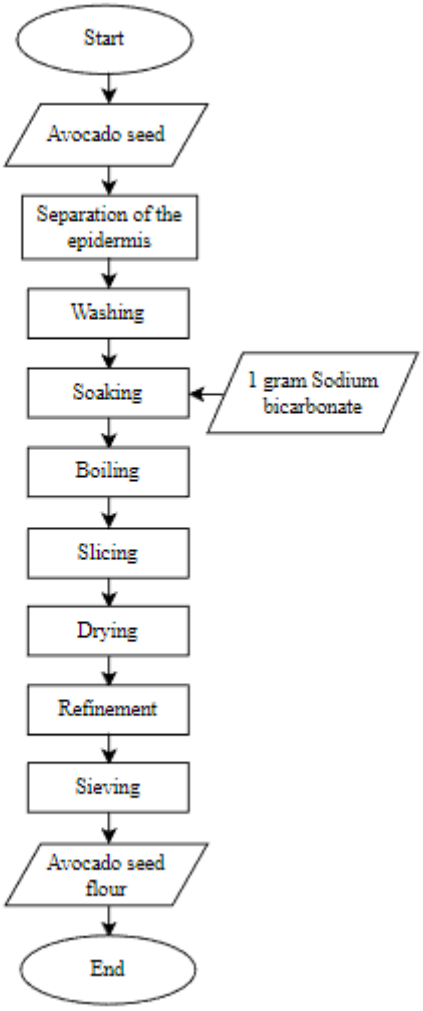

Figure 2 Flowchart Production of Avocado Seed Flour

Chemical Analysis of Raw Materials for Coconut Dregs Flour and Avocado Seeds

Testing of raw materials for coconut dregs flour and avocado seeds included yield, moisture content referring to the method (Violita et al. 2021), ash content (Violita et al. 2021), fat content (Violita et al. 2021), protein content (Violita et al. 2021), carbohydrates (by difference), and crude fiber (Violita et al. 2021).

Bread Formulation and Production (Hamidah et al., 2019)

Making white bread begins with adding dry ingredients such as wheat flour, coconut dregs flour, and avocado seed flour according to the predetermined treatment, instant yeast sugar, powdered milk, and bread improver into a bowl mixer. Next, add water and mix using a mixer until smooth. Add shortening and stir again until the dough is smooth. Add salt and stir until all the dough is well blended. The dough is removed and drained on a floured table for 20 minutes. The dough is cut and weighed according to the size of the pan, then rounded and rested for 10 minutes. The dough is flattened, degassed, rolled, and filled so it does not open during baking. The dough is put into a baking sheet smeared with shortening and fermented at 38˚C, 80% RH for 30-60 minutes. Then the dough is baked in the oven at 220˚C for 30 minutes until the skin color is slightly browned. The bread is then removed from the tin and cooled to room temperature.

Chemical Analysis of Bread

The chemical test of white bread includes moisture content referring to the method (Violita et al. 2021), ash content (Violita et al. 2021), fat content (Violita et al. 2021), protein content (Violita et al. 2021), carbohydrates (by-difference), crude fiber (Violita et al. 2021), and dietary fiber (Violita et al. 2021).

Data Analysis

The results of the analysis of the chemical properties of fresh bread were statistically analyzed (ANOVA) using SPSS 20, then further tested by the DMRT method with a confidence level of 5%.

RESULTS AND DISCUSSION

Chemical Characteristics of Raw Materials

Yield

The yield of coconut dregs flour was 13.42% (Table 1). The yield of coconut dregs flour in this study was lower than the previous study conducted by (Violita et al. 2021), which was 34.25-37.15%. The low yield produced in the process of coconut pulp into flour can be caused by the high levels of fat and dietary fiber in coconut pulp (Violita et al. 2021). At the same time, the yield of avocado seed flour produced was 51.70% (Table 1). The yield of avocado seed flour in this study was higher than in the previous study,

which was 20% (Violita et al. 2021). This is caused by soaking avocado seeds with sodium bicarbonate before being processed into flour. Soaking avocado seeds with sodium bicarbonate can increase the yield of avocado seed flour and increase sodium bicarbonate concentration in the soaking solution (Violita et al. 2021). In addition, the increase in yield was also caused by the length of soaking time. The longer soaked with sodium bicarbonate than the more sodium bicarbonate seeps into the material, the more it opens a lot of pores which results in a lot of other contents that go out, so that the resulting yield is high (Violita et al. 2021).

Moisture Content

The moisture content of coconut pulp flour produced was 2.76% (Table 1). In this study, the moisture content of coconut pulp flour was lower than in the previous study by (Violita et al. 2021), who reported that the moisture content of coconut pulp flour was 3.47-4.58%. The decrease in moisture content was proportional to the drying time. The longer the drying time, the moisture content in the material decreases, but with the speed of decreasing, the moisture content decreases. The higher the drying temperature, the time needed for the material to dry faster. The beginning of the drying process decreases the moisture content significantly compared to the final moments of the drying process (Violita et al. 2021).

The moisture content of the avocado seed flour produced was 15.59% (Table 1). In this study, the moisture content of avocado seed flour was higher than in the previous study by (Violita et al. 2021), who reported that avocado seed flour had 8.5% moisture content. Meanwhile, research by (Violita et al. 2021) shows that the moisture content in avocado seed flour is 8-12%. The high moisture content in this study was caused by the 35-minute boiling process for avocado seeds which caused the starch in the avocado seeds to swell and increase the ability to absorb water (Violita et al. 2021).

Ash Content

The results showed that the ash content of coconut pulp flour was 1.48% (Table 1). In this study, the ash content was higher than in the previous study by (Violita et al. 2021), which resulted in the ash content of coconut pulp flour of 0.98-1.10%. This is because the ash content in coconut dreg flour can be influenced by its water content; the lower the water content in coconut dreg flour, the higher the ash content produced (Violita et al. 2021). Based on Asrawaty's research (2011), the increase in ash content occurs because the longer time and the higher temperature drying, the more water will evaporate from the dried material. The amount of ash content depends on the type of material, method of ashing, time and temperature used during drying, and the lower non-mineral components contained in the material increase the relative ash percent to materials (Violita et al. 2021).

The ash content of avocado seed flour is 2.39% (Table 1). In this study, the ash content was lower than in the previous study by (Violita et al. 2021), where the ash content in avocado seed flour was 2.9%. The ash content indicates the mineral content in the avocado seed flour. Some minerals in avocado seeds include calcium, iron, sodium, phosphorus, and potassium.

Fat Content

The fat content of the coconut pulp flour produced was 52.36% (Table 1). In this study, the fat content was higher than in the previous study by (Violita et al. 2021), which obtained a 12.2% fat content of coconut pulp flour. Meanwhile, based on the results of Angelia's research (2016), the fat content of coconut pulp flour is 64.97%, which was higher than the fat content of the results of this study. On the other hand, the fat content of the avocado seed flour produced was 4.18% (Table 1). Therefore, in this study, the fat content was higher than in the previous study by (Violita et al. 2021), which obtained the fat content of avocado seed flour of 2.45-2.62%. Meanwhile, based on the research of (Violita et al. 2021), it was found that the fat content in avocado seeds was 11.40%, which was lower than our result.

The difference in the amount of fat in the two types of flour can be caused by the length of time during the drying process. The longer the drying time, the lower the fat content produced due to damage to the fat components in the material. This is reinforced by (Violita et al. 2021) statement that the heating process will cause the breakdown of fat components into volatile compounds, such as aldehydes, ketones, alcohols, organic acids, and hydrocarbons. In addition, high processing temperatures can also cause the decomposition of fat content. The presence of water content in the materials will cause hydrolyzed fat to become glycerol and fatty acids.

Table 1 Chemical Characteristics of Raw Materials

Parameters	Raw Materials	
	Coconut Dregs Flour	Avocado Seed Flour
Yield (%)	13.42 ± 0.26	51.70 ± 0.30
Moisture content (%)	2.76 ± 2.01	15.59 ± 3.10
Ash (%)	1.48 ± 1.06	2.39 ± 0.84
Fat (%)	52.36 ± 2.93	4.18 ± 1.10
Protein (%)	12.67 ± 0.40	6.71 ± 0.38
Carbohydrate (%)	30.73 ± 1.73	71.12 ± 3.1
Crude Fiber (%)	35.14 ± 2.51	14.67 ± 1.83

Protein Content

Based on Table 1, the protein content of coconut pulp flour is 12.67%. In this study, the protein content was higher than in a previous study by (Violita et al. 2021), which reported protein levels in coconut dregs flour of 2.15-3.44%. Meanwhile, based on the results of Putri's research (2014), the protein content of coconut pulp flour was 18%, which indicates higher than the protein content in this study. Meanwhile, the protein content of avocado seed flour produced in this study was 6.71%, which is lower than the previous study by (Violita et al. 2021), who reported that the protein content of avocado seed flour was 11.03-17.74%. The difference in the amount of protein content in the two types of flour is caused by the time during the drying process, where the longer drying time will cause a more prolonged browning reaction, thereby reducing the crude protein content in flour (Violita et al. 2021).

Carbohydrate

Coconut pulp flour produced carbohydrates by 30.73%, while avocado seed flour by 71.12% (Table 1). The determination of carbohydrates in this study was calculated using the by-difference method through a 100% reduction in water, ash, fat, and protein content. The higher the value of the four components, the lower the carbohydrate produced, and vice versa. The difference in the value of carbohydrates in the two types of flour is influenced by the value of water content, ash content, fat content, and protein content. In addition, the amount of carbohydrate value is also influenced by the drying process carried out, where reducing the water content during the drying process causes a food ingredient to contain carbohydrate, protein, and mineral compounds in higher concentrations but vitamins and dyes tend to decrease (Violita et al. 2021). Generally, carbohydrates in flour consist of sugars, namely pentose, dextrin, cellulose, and starch (Violita et al. 2021).

Crude Fiber

The crude fiber of coconut dreg flour is 35.14% (Table 1). The crude fiber yield of coconut pulp flour in this study was higher than the previous study by (Violita et al. 2021), which was 27.21-27.43%. The high crude fiber in this study was caused by the absence of fat extraction treatment applied, where the pretreatment treatment in the form of fat extraction on a material would affect the flour milling process to be more accessible and not sticky so that it would cause the crude fiber to be more easily mashed (Violita et al. 2021).

The crude fiber of avocado seed flour produced is 14.67% (Table 1). The results of the crude fiber in avocado seed flour in this study were lower than the previous study by (Violita et al. 2021), which was obtained by 15.79% crude fiber of avocado seed flour. This decrease in crude fiber can be caused by the temperature used during the drying process, where the breakdown of hemicellulose occurs due to reduced water content in the food matrix. The breakdown of hemicellulose causes a decrease in crude fiber, where hemicellulose is part of crude fiber. The more hemicellulose is broken or damaged, the less crude fiber is produced (Violita et al. 2021).

Bread Chemical Characteristics

Dietary Fiber

The ratio of wheat flour, coconut pulp flour, and avocado seed flour gave significantly different results to the dietary fiber of white bread (ρ<0.05).

The highest dietary fiber of white bread was obtained in the P5 treatment with the ratio of wheat flour, coconut dregs flour, and avocado seed flour at 70%:25%:5% of 17.92%, and the lowest dietary fiber was obtained in the P0 treatment (control) of 4.79% (Table 2). Therefore, the higher use of coconut pulp flour will increase the value of dietary fiber in white bread. Coconut pulp flour contains high dietary fiber, ranging from 60.9-63.24%, consisting of 56% insoluble dietary fiber and 4% soluble dietary fiber (Violita et al. 2021).

Previous research on substituting fiber sources conducted by (Violita et al. 2021) reported that white bread substituted with 20% oatmeal produced higher dietary fiber, which was 7.16%, compared to plain bread on the market, which only contained dietary fiber of 2.6%. This show that substituting fiber sources in the manufacture of white bread can increase the dietary fiber content of the white bread.

Crude Fiber

The ratio of wheat flour, coconut pulp flour, and avocado seed flour had a significant effect on the crude fiber of white bread (ρ<0.05). The highest crude fiber of white bread was obtained in the P5 treatment with the ratio of wheat flour, coconut dregs flour, and avocado seed flour at 70%:25%:5% of 7.78%, and the lowest crude fiber was obtained in the P0 treatment (control) of 1.88% (Table 2). Therefore, the higher use of coconut pulp flour will increase the value of crude fiber content in white bread. The increase in the value of crude fiber content is caused by the high content of crude fiber in coconut pulp flour, which is used as a substitute material in making white bread, which is 15.06%, while wheat flour only has a crude fiber content of 0.25% (Violita et al. 2021).

Coconut pulp flour, high in crude fiber with a low glycemic index, is a functional food that is good for health (Violita et al. 2021). In addition, avocado seeds that have been processed into flour have a crude fiber content of 15.79%. This crude fiber can control the release of blood glucose over time and helps control degenerative diseases such as diabetes mellitus (Violita et al. 2021). According to BPOM Regulation No. 13 of 2016 concerning Supervision of Claims on Processed Food Labels and Advertisements, a product can be considered high in fiber if it has a minimum fiber content of 6 g/100 g or 6%. Based on Table 2, it was found that the average crude fiber content of white bread substituted with coconut pulp flour and avocado seed flour ranged from 4.37-7.78%. This shows that substituting coconut pulp flour and avocado seed flour can increase the value of crude fiber content in white bread compared to plain bread without substitution (control), with a crude fiber content of only 1.88%. In this study, crude fiber was obtained, which was higher than the results of (Violita et al. 2021), where white bread with 10% substitution of coconut pulp flour only obtained 5.69% crude fiber.

Daily Index Sufficiency

Based on further tests, it can be seen that the treatment with various formulations of wheat flour, coconut pulp flour, and avocado seed flour gave results that were not significantly different between treatments (Table 2). Therefore, the daily sufficiency index value serves as additional information that the calories are low if a person consumes a food product high in fiber. So it is suitable for consumption by someone who wants to limit calorie intake, such as people with diabetes mellitus.

Table 2 Dietary Fiber, Crude Fiber and Daily Index Sufficiency of White Bread

The ratio of Wheat Flour : Coconut Dregs Flour : Avocado Seed Flour	Dietary Fiber (%)	Crude Fiber (%)	Daily Index Sufficiency (%)
100% (control)	4.79 ± 0.05^{a}	1.88 ± 0.50^{a}	7.98 ± 0.78^{a}
90% : 5% : 5%	7.45 ± 0.05^{b}	4.37 ± 0.35^{b}	8.21 ± 0.02^{a}
85% : 10% : 5%	10.41 ± 0.07^{c}	5.75 ± 0.44^{c}	8.39 ± 0.10^{a}
80% : 15% : 5%	11.49 ± 0.03^{d}	6.27 ± 0.06^{c}	8.54 ± 0.29^{a}
75% : 20% : 5%	14.50 ± 0.08^{e}	7.12 ± 0.10^{d}	8.30 ± 0.56^{a}
70% : 25% : 5%	17.92 ± 0.07^{f}	7.78 ± 0.39^{d}	8.42 ± 0.76^{a}

Notes: Different letters in the same row are significantly different (ρ<0.05)

Table 3 Proximate Characteristics of White Bread

The ratio of Wheat Flour : Coconut Dregs Flour : Avocado Seed Flour	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)
100% (control)	43.02 ± 5.67^{b}	0.66 ± 0.29^{a}	5.17 ± 0.16^{a}	9.11 ± 1.26^{a}	42.05 ± 6.23^{a}
90% : 5% : 5%	39.12 ± 0.62^{ab}	0.97 ± 0.16^{ab}	5.74 ± 0.42^{a}	8.74 ± 1.14^{a}	45.43 ± 2.01^{a}
85% : 10% : 5%	37.85 ± 1.28^{a}	0.90 ± 0.21^{ab}	8.11 ± 1.72^{b}	8.67 ± 0.58^{a}	44.46 ± 2.62^{a}
80% : 15% : 5%	36.47 ± 1.61^{a}	1.10 ± 0.10^{b}	8.88 ± 1.03^{b}	8.46 ± 0.55^{a}	45.08 ± 1.50^{a}
75% : 20% : 5%	36.26 ± 3.16^{a}	1.18 ± 0.17^{b}	9.77 ± 0.62^{b}	7.78 ± 0.67^{a}	44.99 ± 3.25^{a}
70% : 25% : 5%	35.10 ± 3.87^{a}	1.24 ± 0.07^{b}	12.34 ± 2.41^{c}	7.33 ± 0.46^{a}	43.98 ± 4.32^{a}

Notes: Different letters in the same row are significantly different (ρ<0.05)

Moisture Content

The ratio of wheat flour, coconut pulp flour, and avocado seed flour had no significant effect on the moisture content of white bread (ρ>0.05). The highest moisture content of white bread was obtained in treatment P0 (control) at 43.02%, and the lowest moisture content was obtained in treatment P5 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour at 70%:25%:5% of 35.10% (Table 3). The higher the coconut dregs flour used, the lower the moisture content of white bread. The low moisture content in white bread substituted with coconut pulp flour is caused by the high fiber content in coconut pulp flour, which ranges from 60.9-63.24% for dietary fiber and 15.06% for crude fiber (Violita et al. 2021). Fiber can reduce the moisture content in a food product due to its complex structure and contains many hydroxyl groups, which have a large capacity to bind water (Violita et al. 2021).

According to SNI 01-3840-1995, about the quality requirements for bread, the maximum moisture content of white bread is 40%. Based on (Table 3), it is found that white bread substituted with coconut pulp flour and avocado seed flour has a moisture content ranging from 35.10 to 39.12%, which fulfilled Indonesian National Standard. Meanwhile, plain bread without substituting coconut pulp flour and avocado seed flour (control) has a moisture content unfulfilled by the Indonesian National Standard, with a moisture content value of 43.02%. This can be caused by humidity, temperature, and time during storage (Violita et al. 2021). In this study, the moisture content was lower than (Violita et al. 2021) result, where white bread with a 10% substitution of coconut pulp flour obtained a moisture content of 39.07%.

Ash

The ratio of wheat flour, coconut pulp flour, and avocado seed flour had a significant effect on the ash content of white bread (ρ<0.05). According to SNI 01-3840-1995, about the quality requirements for white bread, the maximum ash content of white bread is 1%. Based on Table 3, it was found that white bread P0 (control), P1 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour 90%:5%:5%, and P2 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour 85%:10%:5% had ash content ranging from 0.66-0.97%, which fulfilled Indonesian National Standard. Meanwhile, white bread P3 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour 80%:15%:5%, P4 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour 75%:20%:5%, and P5 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour 70%:25%:5% had an ash content that unfulfilled the Indonesian National Standard with an ash value ranging from 1.1-1.24%. The increase in ash content was due to the use of coconut pulp flour, which has an ash content of 0.52%, avocado seed flour which has an ash content of 2.95%, and wheat flour, which has an ash content of 2.2% (Violita et al. 2021). The ash content of a food product depends on the mineral content of the raw materials and substitution materials used (Violita et al. 2021). This study found that the ash content was lower than the results of (Violita et al. 2021), where white bread with a 10% substitution of coconut pulp flour only had an ash content of 1.47%.

Fat Content

The ratio of wheat flour, coconut pulp flour, and avocado seed flour had a significant effect on the fat content of white bread (ρ<0.05). The lowest fat content of white bread was obtained in

treatment P0 (control) of 5.165%, and the highest fat content was obtained in treatment P5 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour 70%:25%:5% of 12.34% (Table 3). According to the Directorate of Nutrition of the Ministry of Health of the Republic of Indonesia (1992), the quality requirement for the fat content of white bread is a maximum of 4.2%. Based on Table 3, it was found that all treatments had a fat content that exceeded the standard limit, which was around 5.165%-12.34%. The higher use of coconut pulp flour will increase the fat content in white bread. This is due to the high-fat content in coconut dregs flour used as a substitute for making white bread, which is 64.97% (Violita et al. 2021). In this study, the fat content was higher than the results of (Violita et al. 2021), where white bread with a 10% substitution of coconut pulp flour obtained a fat content of 5.77%.

Protein Content

The ratio of wheat flour, coconut pulp flour, and avocado seed flour gave results that were not significantly different between treatments. The highest protein content of white bread was obtained in treatment P0 (control) at 9.11%, and the lowest protein content was obtained in the P5 treatment with the ratio of wheat flour, coconut dregs flour, and avocado seed flour at 70%:25%:5% of 7.33% (Table 3). The high protein content in P0 (control) white bread is caused by using 100% wheat flour. One factor affecting white bread's protein content is the type of flour used. This study used three different types of flour: wheat flour, coconut pulp flour, and avocado seed flour. In general, the wheat flour used in the manufacture of white bread is high protein flour (hard wheat) with high gluten content, so more use of wheat flour will increase the protein content of white bread (Violita et al. 2021). On the other hand, less use of wheat flour and more use of coconut pulp flour and avocado seed flour will produce white bread with lower protein content. This is caused by coconut pulp flour and avocado seed flour which are included in the type of low protein flour, where the protein content in coconut pulp flour and avocado seed flour is 5.8% and 5.64%, respectively, while in wheat flour by 13.51% (Violita et al. 2021).

In addition, the decrease in protein content can also be caused by high temperatures during the oven process. The results of research evidence this statement by (Violita et al. 2021) that high temperatures during the oven process can increase the rate of kinetic energy and cause molecules of protein constituents to quickly move so that they damage molecular bonds and make proteins become damaged, resulting in a decrease in protein content. According to the Directorate of Nutrition of the Ministry of Health (1992), the quality requirement for the maximum protein content of white bread is 9.7%. Based on (Table 3), it was found that the average protein content of white bread ranged from 7.33-9.11%. This indicates that the protein content of white bread substituted with coconut pulp flour and avocado seed flour has a protein content value close to white bread's protein content in general. In this study, the protein content was lower than the results of (Violita et al. 2021), where white bread with a 10% substitution of coconut pulp flour obtained a protein content of 9.59%.

Carbohydrate

The ratio of wheat flour, coconut pulp flour, and avocado seed flour gave results that were not significantly different between treatments. The highest carbohydrate content of white bread was obtained in treatment P1 with the ratio of wheat flour, coconut dregs flour, and avocado seed flour at 90%:5%:5% of 45.43%, and the lowest carbohydrate content was obtained in treatment P0 (control) of 42.05% (Table 3). Carbohydrates are macronutrients that act as energy producers in the body and also play a role in determining the characteristics of a material or food product. In addition, several groups of carbohydrates also produce dietary fiber, which is very good for the digestive system (Violita et al. 2021). Using coconut pulp flour and avocado seed flour can increase the carbohydrate content of white bread compared to white bread made from 100% wheat flour (Table 3). This is due to the fiber content found in coconut pulp flour which is included in complex carbohydrates (Violita et al. 2021). Then the carbohydrate content in avocado seed flour, which is high at 75.2%, also increases carbohydrate levels in white bread (Violita et al. 2021).

According to the Directorate of Nutrition of the Ministry of Health (1992), the quality requirement for the carbohydrate content of white bread is at least 45.2%. Based on Table 3, it was found that only P1 white bread had met the quality standard, while the other five treatments had not met the quality standard. The levels of other macronutrients caused the difference in

carbohydrate content in each treatment. The carbohydrate content in a food product was calculated by the difference method, namely by reducing 100% with water content, ash content, protein content, and fat content. The higher the levels of other macronutrients, the lower the carbohydrate levels and vice versa (Violita et al. 2021). In this study, carbohydrates were higher than in (Violita et al. 2021), where white bread with 10% substitution of coconut pulp flour only got 44.11% carbohydrates.

CONCLUSIONS

The results significantly affected the formulation of white bread substituted with coconut pulp flour and avocado seed flour. The increase in dietary fiber in white bread substituted with coconut pulp flour and avocado seed flour was 274%. White bread products substituted with coconut pulp flour and avocado seed flour have met the BPOM requirements to be submitted as foods with high fiber claims. The implications of this study can be stated as a literature reference regarding the development of high-fiber white bread and its application as an alternative food for people with diabetes mellitus.

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