

# Physical Properties and Consumer Acceptance of White Bread with The Substitution of Coconut Dregs and Avocado Seed Flour

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## ABSTRACT

Analysis of the relationship between physical properties and consumer acceptance, which is commonly influenced by sensory properties is crucial in delivering a high-quality food product. Therefore, this study aimed to analyze the effect of physical properties, including hardness, adhesiveness, dough expansion, specific volume, color intensity ( $L^*$ ,  $a^*$ ,  $b^*$ , and  $^{\circ}\text{hue}$ ), browning index, and analysis of consumer acceptance by employing Partial Least Squares (PLS) regression. The analysis focused on high-fiber white bread made by substituting coconut dregs and avocado seed flour with different ratios, denoted as P0 (control), P1 (90% wheat flour: 5% coconut dregs flour: 5% avocado seed flour), P2 (85% wheat flour: 10% coconut dregs flour: 5% avocado seed flour), P3 (80% wheat flour: 15% coconut dregs flour: 5% avocado seed flour), P4 (75% wheat flour: 20% coconut dregs flour: 5% avocado seed flour), and P5 (70% wheat flour: 25% coconut dregs flour: 5% avocado seed flour). The results showed that consumer preferences had a positive correlation with the physical properties of white bread, including hardness, adhesiveness, dough expansion, specific volume, as well as colors  $L^*$ , and  $^{\circ}\text{hue}$ , while,  $a^*$ ,  $b^*$ , and had a negative correlation with the browning index. The circular correlation analysis between physical properties and consumer acceptance indicated that the substitution of 25% coconut dregs flour and 5% avocado seed flour in white bread was accepted by consumers.

**Keywords:** coconut dregs, high fiber, PLS, sensory analysis, sensory properties

## INTRODUCTION

Bread is a processed food made from wheat, which is widely consumed by the larger community (Pusuma et al., 2018). Recent data in 2020 shows that the average consumption of white bread for Indonesians per week reached 340 packs (BPS, 2020). This phenomenon is

triggered due to the practicality, filling nature, and healthy benefits of bread (Ratri, 2019), almost shifting the position of rice as a staple food (Pusuma et al., 2018). Consequently, the sales of white bread sold in the market are increasingly varied, from taste, color, and aroma to adding ingredients such as wheat fiber, chocolate, and raisins (Ratri, 2019).

Despite its popularity, the market is still mainly dominated by plain (white) bread, which is low in fiber, with a high Glycemic Index (IG) of 70, causing a problem for diabetes patients (Hamidah et al., 2019). To address this issue, there is a growing need for product innovation development to produce healthier bread with increased fiber content. Increasing bread fiber content is very important to reduce IG (Noviasari et al., 2015), making it a suitable alternative food for people with diabetes and aiding in blood glucose level control (Soviana & Maenasari, 2019). Furthermore, fiber content in food absorbs much fluid in the stomach, forming a more dense food that slows down the process of glucose absorption, leading to reduced blood glucose levels (Soviana & Maenasari, 2019).

Coconut dregs containing 30.58% crude fiber, 4.65% water content, 4.11% protein, 15.89% fat, 79.34% carbohydrates, and 0.66% ash (Putri, 2014), has a high potential as a substitute food ingredient in white bread dough. In 2019, coconut production in Indonesia reached 15.2 billion pieces (Putri, 2014), resulting in 19.50 kg of dregs from the wet processing of coconut oil from 100 pieces (Prasetyo et al., 2014). However, the large amount of dregs produced indicated limited processing. A previous study has shown that avocado seeds contain a high fiber content of 15.79% (Zai & Sidabalok, 2021), 39.45% water content, 1.66% ash content, 8.24% crude protein, and 0.43% crude fat (Pusuma et al., 2018). The production of avocado seeds in Indonesia in 2018 reached 410,090 tons, with a by-product of 53,312 tons (Zai & Sidabalok, 2021). Therefore, substituting coconut dregs and avocado seed flour will produce high-fiber and low-glycemic bread as an alternative food for people with diabetes (Pusuma et al., 2018).

Innovations in high-fiber white bread are great significance for study on physical properties and

consumer acceptance, as fiber affects the texture and hardness of bread (Kaseke, 2018). This aligned with the study of, Pusuma et al. (2018), who argue that the substitution of 30% fiber affected hardness, adhesiveness, dough expansion, specific volume, color intensity, and consumer acceptance of white bread. The substitution of 15% coconut dreg flour resulted in a bread texture that was harder than the control (Kaseke, 2018). Additionally, the substitution of 5% avocado seed flour produced a hard bread structure due to the high starch content of 80.1% in the seed (Zai & Sidabalok, 2021). Iswara et al. (2019) also reported that 30% fiber substitution could increase the adhesiveness of bread.

Maharani (2019) conducted a similar study and found that 25% fiber substitution reduced the dough expansion of white bread. This percentage of fiber substitution is still acceptable to consumers due to the attractive color and the resulting solid texture (Chandra et al., 2021). Therefore, it is essential to assess consumer acceptance of high-fiber white bread, with several parameters that may affect consumer preferences, including hardness, adhesiveness, dough expansion, specific volume, L\* color, and °hue color, which the correlation are analyzed with the regression Partial Least Squares (PLS). In this study, the substitution of wheat by coconut dregs and avocado seed flours as a source of fiber was carried out to determine the physical properties and consumer acceptance of white bread.

**METHODS**

**Material**

The materials used included high protein flour (PT Indofood Sukses Makmur Tbk, Indonesia), coconut dregs (Landungsari Market, Malang), avocado seeds

Table 1. White bread formula 200 g

Composition (%)	P0	P1	P2	P3	P4	P5
Wheat flour	100	90	85	80	75	70
Coconut dregs flour	0	5	10	15	20	25
Avocado seed flour	0.08	0.08	0.08	0.08	0.08	0.08
Sugar	0.03	0.03	0.03	0.03	0.03	0.03
Milk powder	0.012	0.012	0.012	0.012	0.012	0.012
Yeast	0.002	0.002	0.002	0.002	0.002	0.002
Bread improver	0.55	0.55	0.55	0.55	0.55	0.55
Ice water	0.06	0.06	0.06	0.06	0.06	0.06
White butter	0.014	0.014	0.014	0.014	0.014	0.014
Salt						

(Landungsari Market, Malang), water (PT Sariguna Primatirta Tbk Pasuruan, Indonesia), white butter (PT Indofood Sukses Makmur Tbk, Indonesia), sugar (PT Indofood Sukses Makmur Tbk, Indonesia), milk powder (PT Indofood Sukses Makmur Tbk, Indonesia), salt (PT Indofood Sukses Makmur Tbk, Indonesia), yeast (PT Indofood Sukses Makmur Tbk, Indonesia), and bread improver (PT Indofood Sukses Makmur Tbk, Indonesia).

This study used a simple Randomized Block Design with a ratio of wheat, coconut dregs, and avocado seed flour consisting of six treatments, which were repeated three times, as shown in Table 1.

### **Making of Coconut Dregs Flour (Pusuma et al., 2018)**

The coconut was peeled by separating the flesh from the coir skin and shell, followed by placing the sample in a container to be grated. The extraction was carried out by adding clean water to the grated coconut with a ratio of 2 liters to 1 kg of coconut, and the mixture was squeezed twice to obtain the coconut milk. The solid waste from the first squeeze was mixed again with clean water, squeezed, and the juice was filtered and stored in a plastic jar. Subsequently, the juice was pressed again using a hydraulic pump and repeated twice. Finally, the coconut dregs were dried in a cabinet dryer at a temperature of 60 °C for 24 hours. The coconut dregs passed through the drying process were ground using copper and sieved using a 40-mesh sieve to produce the flour form.

### **Making of Avocado Seed Flour (Zai & Sidabalok, 2021)**

Avocado seeds were cleaned from the epidermis and washed with clean water to remove any dirt attached. The clean avocado seeds were cut into small pieces of 0.5 cm and dried using an oven at 60 °C for 6 hours. Subsequently, the dried seeds were mashed using a blender and sieved with a 60-mesh sieve to produce avocado seed flour.

### **Making White Bread Substitutions with Coconut Dregs Flour and Avocado Seed Flour (Hamidah et al., 2019)**

The white bread formula consisted of six different formulations, including control, and 5% avocado seed flour with 5%, 10%, 15%, 20%, and 25% coconut dregs flour, respectively, as shown in Table 1. The procedure for making white bread refers to the study method by Handajani et al. (2017). The first step involved mixing dry ingredients (wheat flour, coconut

dregs flour, avocado seed flour, sugar, yeast, milk powder, bread improver) and water, followed by stirring with a dough mixer (low speed, ± 10 minutes), adding salt and butter, as well as stirring at high speed (±20 minutes). Subsequently, the dough was weighed with a weight of 200 g, followed by fermentation (10 minutes) by placing it on a baking sheet covered with plastic wrap, proofing (50 minutes), and baking in the oven (25 minutes).

### **Analysis of the Characteristics of Bread**

The analysis of the characteristics of white bread included bread texture, dough expansion, specific volume, color intensity, *browning index*, porosity, and sensory evaluation.

### **Texture analysis (Putri et al., 2022)**

The bread was measured for hardness and adhesiveness, followed by placing it on the sample table texture analyzer (Shimadzu EZ-100 Test Model SM-500N-168, Japan) with a knife probe installed. The Texture Analyzer mode was set to test (normal), trigger (0.5 g), deformation (30 mm), and speed (0.5 mm/s). The compression applied produced a curve showing the relationship between the force and the distance. The highest value of the first peak was indicated by breaking or splitting the piece of bread at one point. Subsequently, the appropriate force value was measured as hardness and adhesiveness.

### **Dough expansion (Surono, 2017)**

Dough expansion was calculated by dividing the volume of bread by the volume of dough, the volume of expansion was calculated in percent (%). The volume of white bread was calculated by the formula ( $p \times l \times t$ ), while the calculation of dough expansion was carried out using Equation 1.

$$\text{Dough Expansion} = \frac{\text{Volume of bread after proofing}}{\text{Volume of dough before proofing}} \times 100\% \quad (1)$$

### **Specific volume (Sutriyono et al., 2016)**

The dough expansion of white bread was measured by determining the middle of the loaf perimeter. Subsequently, data on height and width were collected by splitting the bread vertically and measuring using a centimeter-scale ruler. The volume of white bread was calculated using the formula ( $p \times l \times t$ ), while the specific volume calculation was carried out using Equation 2.

$$\text{Specific volume} = \frac{\text{Bread volume}}{\text{Bread weight}} \times 100\% \quad (2)$$

**Color intensity and browning index (Mukhtarom et al., 2016)**

*Browning index* (brown index) and color measurements were carried out using a chromameter (Minolta CR200). The resulting color data was expressed by the L\* value for brightness, which had a value from 0 (black) to 100 (white). The a\* value represented the reflected light that produced a mixed red-green chromatic color with a +a (positive) value of 0-100 for red and a -a (negative) value of 0-(-80) for green. The b\* value represented the chromatic color of the blue-yellow mixture with +b (positive) from 0-70 for yellow and -b (negative) value of 0-(-70) for blue. Calculation of the value of °hue and *browning index* was carried out using Equations 3, 4, and 5.

$$\text{°hue} = \tan^{-1}(b/a) \tag{3}$$

$$BI = \frac{100(x-0,3)}{0,1752} \tag{4}$$

$$X = \frac{(a* + 1,75 L*)}{(5,645 L* + a* - 3,012 b*)} \tag{5}$$

**Porosity (Surono, 2017)**

The bread was divided into three parts, namely top, bottom, and middle. The HVS paper was cut to the size of the bread surface, given four 1 x 1 cm squares of paper each. Subsequently, the number of pores on each box was measured, summed, and averaged. This process was repeated for each part of the bread, the average pores were summed and averaged again to determine the porosity of the bread.

**Sensory evaluation (Sandri & Lestari, 2020)**

Hedonic sensory evaluation was carried out by 50 untrained panelists, who were asked to provide personal responses about likes or dislikes spontaneously by filling out the hedonic test score sheet. The scale ranged from

(1) dislike extremely, (2) dislike very much, (3) dislike, (4) neither like nor dislike, (5) like, (6) like very much, to (7) like extremely.

**Statistic Analysis**

The analysis results of the physical properties of white bread were statistically analyzed (ANOVA) using SPSS 20. Further tests were carried out using the DMRT method with a 5% confidence level and correlation analysis with *Partial Least Squares* (PLS) Excel version of STAT 2022.

**RESULTS AND DISCUSSION**

**Hardness**

The results showed that substituting wheat flour with coconut dregs and avocado seed flour affected the hardness of white bread (Table 2). Sample P1 (90% wheat flour: 5% coconut dregs flour: 5% avocado seed flour) was not significantly different from P0 (100% wheat flour substitution). The control was different from P5 (70% wheat flour: 25% coconut dregs flour: 5% avocado seed flour), which was the treatment with the highest fiber substitution ratio. This was supported by the results of Kaseke (2018), where 15% fiber substitution produced harder bread. According to Zai & Sidabalok (2021), 5% avocado seed flour substitution contributed to an increase in bread hardness due to the high starch content of 80.1%, yielding a hard bread structure. Fiber substitution produced harder bread because an increase in coconut dregs flour substitution reduced the amount of gluten protein in the dough, leading to a less optimal texture compared to white bread substituted with 100% wheat flour (Pusuma et al., 2018).

The starch content in avocado seed flour also affected the hardness of white bread. When wheat flour was substituted into the dough, there was a decrease in gluten, causing the dough to be more hydrophilic.

Table 2. Physical properties of white bread

Treatments	Hardness (N)	Adhesiveness (J)	Dough expansion (%)	Specific volume (%)
P0	5.38±1.34 <sup>b</sup>	-0.0012±0.0007 <sup>ab</sup>	279.67±0.51 <sup>c</sup>	5.96±0.61 <sup>c</sup>
P1	5.94±1.07 <sup>b</sup>	-0.0012±0.0005 <sup>ab</sup>	278.33±0.36 <sup>c</sup>	5.77±0.63 <sup>c</sup>
P2	4.02±0.31 <sup>a</sup>	-0.0003±0.0002 <sup>b</sup>	250.00±0.19 <sup>bc</sup>	4.59±0.37 <sup>bc</sup>
P3	3.91±0.18 <sup>a</sup>	-0.0010±0.0011 <sup>b</sup>	191.00±0.39 <sup>ab</sup>	3.86±0.26 <sup>ab</sup>
P4	4.09±0.15 <sup>a</sup>	-0.0032±0.0023 <sup>a</sup>	169.00±0.42 <sup>ab</sup>	3.22±1.23 <sup>ab</sup>
P5	8.48±0.03 <sup>c</sup>	-0.0005±0.0003 <sup>b</sup>	154.33±0.62 <sup>a</sup>	2.67±1.20 <sup>a</sup>

Note: Different letters in the same row are significantly difference (p>0.05)



Therefore, stronger interactions occurred between starch granules, leading to a harder texture of the bread (Pusuma et al., 2018). As shown in Table 2, the results indicated that the hardness value of 8.48 N was lower compared to a similar investigation conducted by Iswara et al. (2019), with a hardness value of 9.81 N, which decreased from P1 to P4. However, at the same time, the value increased at P5 because the substitution ratio of coconut dreg flour was higher, resulting in harder bread.

The hardness values of P1 and P0 were not significantly different because the substitution ratio of coconut dregs flour varied only by 5%, along with the same avocado seed flour ratio, thereby not significantly affecting the hardness value of P1 bread with P0. Pusuma et al. (2018) also stated that the substitution of coconut dregs flour containing 15.89% influenced the hardness value of the resulting bread. Moreover, the formation of white bread pores occurred when air entered the dough and dispersed into fine bubbles during the mixing of coconut dregs flour with water, affecting the bread hardness level (Putri, 2014).

### Adhesiveness

Adhesiveness is an important property of white bread and is determined by the curve being below the line and having a negative value. A previous study found that the adhesiveness value increased as the measurement approached positivity (Iswara et al., 2019). The substitution of coconut dregs and avocado seed flour affected the adhesiveness of white bread (Table 2). This occurred due to the fiber content in coconut dregs flour, which increased the adhesion between the components of wheat flour and water, resulting in the formation of polymers and a film layer enhancing the adhesiveness of white bread (Iswara et al., 2019). In addition, the gluten content in wheat flour also caused an increase, as the heating of gluten-containing dough leads to the formation of adhesive properties (Iswara et al., 2019). In this study, it was discovered P1 was not different from P0, which exhibited a significant variation from P5.

This study found the highest adhesiveness value at P4, which was -0.0032 J (Table 2), compared to the -0.0005 J in P5 due to the greater substitution ratio of P4 wheat flour. The gluten content in wheat flour which was caused the heating of the dough, leading to adhesion (Iswara et al., 2019). The substitution of avocado seed flour with the same ratio of 5% did not affect the adhesiveness of bread (Zai & Sidabalok, 2021). However, Iswara et al. (2019) reported that amylopectin contained in starch in avocado seeds increased the adhesion of white bread due to the ability of amylopectin to dissolve or mix with water. The importance of study on adhesiveness had also

been highlighted, where the value showed the texture of white bread substituted with fiber from coconut pulp flour which affected the adhesion of bread. This study indicated that the adhesiveness value of P4 was -0.0032 J lower than the -2.4126 J obtained by Iswara et al. (2019). A previous investigation reported that substituted wheat flour, coconut dregs flour, starch, and purple sweet potato anthocyanin pigment triggered an increase in the adhesiveness value of bread.

### Dough Expansion

P1 treatment was not significantly different from P0 (100% wheat flour), while P0 was varied from P5 (Table 2). The results indicated that P1 has the highest dough expansion value at 278.33% because the greater wheat flour containing gluten increased the swelling power of white bread (Iswara et al., 2019). Substitution using coconut dregs flour reduced the dough expansion of white bread due to the absence of gluten content. Moreover, the gluten components consisted of gliadin and glutenin, affecting the elasticity in the dough and food or producing viscoelasticity, thereby causing expansion (Riyansah et al., 2019). Maharani (2019) stated that adding coconut dregs and wheat flour as a source of fiber would reduce the dough expansion of white bread. Substituting coconut pulp flour as a source of fiber in making white bread also reduced dough expansion by 113.4% compared to the control (Aryani et al., 2019).

The dough expansion of bread decreased along with an increase in the substitution ratio of coconut dregs flour due to the reduction in the gluten content contained in the fiber-rich white bread dough (Pusuma et al., 2018). Additionally, gluten significantly influenced bread dough expansion due to its ability to maintain the gas for achieving the desired volume and texture in the dough system (Pusuma et al., 2018). The dough expansion was also closely related to the ability to hold CO<sub>2</sub> bubbles during the fermentation process, which was influenced by the amount of water bound, thereby causing water loss during the baking process (Pusuma et al., 2018). In this study, P0 and P1 indicated that the substitution of avocado seed flour with a ratio of 5% did not affect the expansion of white bread dough.

### Specific Volume

This study indicated that white bread P1 had a specific volume value of 5.77% (Table 2), which was not significantly different from P0 (100% wheat flour), with a specific volume value of 5.96%. However, P0 significantly differed from P5 with a specific volume value of 2.67%. These results showed that the substitution ratio of coconut dregs flour from 5% - 25% could reduce the specific volume of white bread by 0.19% - 3.29% compared to

Table 3. Color intensity and browning index

Treatments	Crumb Color Intensity				Browning index
	L	a	b	hue (°)	
P0	74.07±0.64 <sup>d</sup>	1.73±0.06 <sup>a</sup>	11.03±0.06 <sup>ab</sup>	81.03±0.29 <sup>d</sup>	0.34±0.0000 <sup>a</sup>
P1	70.33±1.89 <sup>c</sup>	3.23±0.12 <sup>b</sup>	10.47±0.25 <sup>a</sup>	72.87±0.25 <sup>c</sup>	0.34±0.0006 <sup>b</sup>
P2	69.23±2.14 <sup>c</sup>	3.87±0.21 <sup>c</sup>	11.80±0.30 <sup>b</sup>	72.03±0.67 <sup>bc</sup>	0.35±0.0026 <sup>c</sup>
P3	67.97±2.25 <sup>bc</sup>	4.03±0.07 <sup>c</sup>	11.83±0.81 <sup>b</sup>	71.20±1.31 <sup>b</sup>	0.35±0.0012 <sup>c</sup>
P4	66.10±1.11 <sup>b</sup>	4.67±0.21 <sup>d</sup>	15.37±0.45 <sup>c</sup>	67.87±0.29 <sup>a</sup>	0.35±0.0026 <sup>d</sup>
P5	60.47±0.78 <sup>a</sup>	6.27±0.06 <sup>e</sup>	10.93±0.38 <sup>a</sup>	66.97±0.40 <sup>a</sup>	0.37±0.0010 <sup>e</sup>

Note: Different letters in the same row are significantly difference ( $p>0.05$ )

the control. The higher substitution ratio of coconut dregs flour and the decrease in wheat flour caused a reduction in the specific volume of white bread. Coconut dregs responsible for this reduction did not contain gluten, which increased the specific volume due to its gliadin content as an adhesive, that making the bread dough elastic (Aryani et al., 2019). Additionally, gluten retained CO<sub>2</sub> gas produced by yeast, facilitating dough expansion and pore formulation (Putri et al., 2022).

Sarofa et al. (2014) reported that the substitution of 7.5% fiber reduced the specific volume of white bread by 5.38% compared to the control. However, the substitution of avocado seed flour with the same ratio of 5% at P0 and P1 did not affect the specific volume, while P2, P3, P4, and P5 had a significant impact. This was because of the high starch content in avocado seeds, which was 80.1%, resulting in increased adhesion of bread through the formation of a film layer on the polymers between the components of the bread dough, thereby reducing the specific volume of the bread (Zai & Sidabalok, 2021).

### Brightness (L\*)

As shown in Table 3, P0 white bread had the highest brightness of 74.07, while P5 exhibited the lowest at a value of 60.47. The results indicated that the substitution of coconut dregs and avocado seed flour affected the brightness level (L\*) of white bread. This was because the higher substitution of coconut dregs flour produced darker bread (Pusuma et al., 2018) due to the high-fat content of 15.89% (Putri, 2014), which easily oxidized and change the color of the fat to be more concentrated (Panjaitan et al., 2020). The substitution of 5% avocado seed flour also affected the brightness of white bread. This was due to the presence of a total tannin content of 20.85 mg/kg in avocado seeds, which imparted a dark brown or red color, thereby reducing the brightness of the baked bread generated (Prambandita et al., 2022).

### Redness (a\*)

Table 3 showed that P5 had the highest redness level of 6.27, while P0 exhibited the lowest at 1.73. The results indicated that the substitution of different ratios of coconut dregs flour affected the level of redness (a\*) of white bread, while the same ratio of avocado seed flour 5% did not affect the redness level of bread. This occurred due to the higher percentage or composition of coconut dregs flour. Putri (2014) reported that the protein, which was high enough in coconut dregs was 18.2%, causing the reaction between the primary amine groups of the protein to intensify, resulting in a more pronounced red color.

### Yellowness (b\*)

P4 had the highest yellowness level of 15.37, while P1 exhibited the lowest at 10.47, as shown in Table 3. The results indicated that the substitution of coconut dregs flour with different ratios affected the level of yellowness (b\*) of white bread, while the ratio of 5% avocado seed flour did not have a significant effect. This occurred because the higher addition of coconut dregs flour produced white bread with a high level of yellowness (Pusuma et al., 2018). The level of yellowness of white bread was influenced by non-enzymatic browning reactions. The reaction began with the condensation of the free amino group with the carbonyl group of the reducing sugar to form a colorless glycosamine, followed by the breakdown of the product to generate a dark yellow compound (Fransiska et al., 2021).

### Color (°hue)

The hue value had been defined as a color characteristic based on the light reflected by the object, encompassing the overall value dominated by a product or its main color (Pusuma et al., 2018). The results of the measurement of the highest hue value were

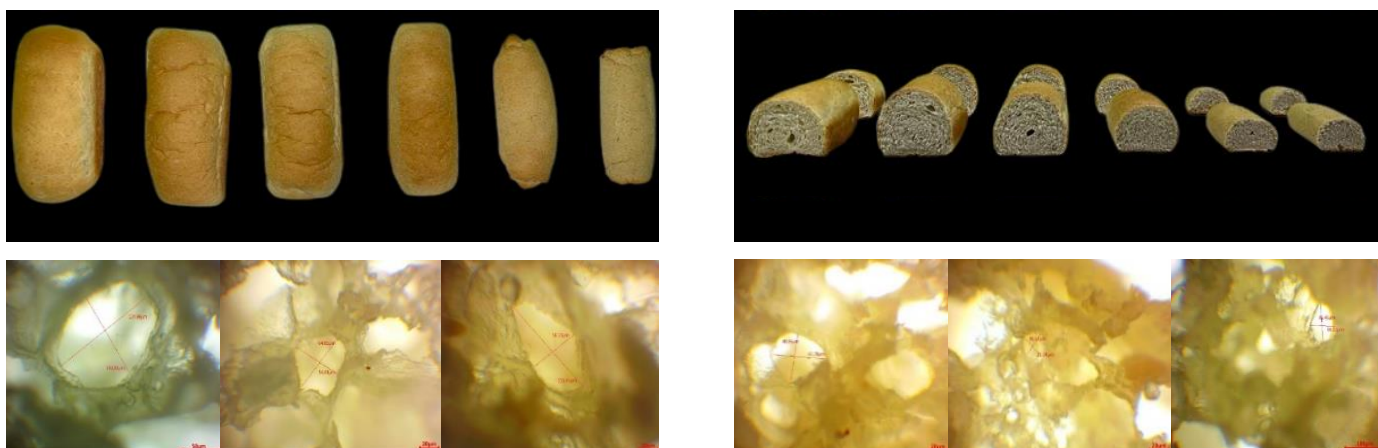


Figure 1. With six treatments include (P0): (Control) 100% wheat flour, (P1): (90% wheat flour: 5% coconut dregs flour: 5% avocado seed flour), (P2): (85% wheat flour: 10% coconut dregs flour: 5% avocado seed flour), (P3): (80% wheat flour: 15% coconut dregs flour: 5% avocado seed flour), (P4): (75% wheat flour: 20 % coconut dregs flour: 5% avocado seed flour), (P5) (70% wheat flour: 25% coconut dregs flour: 5% avocado seed flour), l: length of pores, and w: width of pores

highest at 81.03°, as obtained in P0, while P5 had the lowest value of 66.97°. Similarly, a previous analysis of diversity showed that the highest °hue value of P0 and the lowest value obtained in P5 had the same color criteria, namely yellow-red (YR) (Zaharami, 2020).

### Browning Index

P5 exhibited the highest browning index (BI) value of 0.37, while the lowest value of 0.34 was obtained in the substitution of P0 and P1. The results showed that P0 was significantly different from samples P1, P2, P3, P4, and P5 due to the substitution of coconut dregs and avocado seed flour, which affected the browning index value of white bread. Additionally, a previous study showed that coconut dregs flour contained high fiber and fat 15.89% (Putri, 2014). Fats and oils are easily oxidized to form free radicals in the unsaturated fatty acid group of the fat molecule (RH), causing the color to darken (Yustinah & Hartini, 2011). Prambandita et al. (2022) reported that the total tannin content of 20.85 mg/kg in avocado seeds substituted in the manufacture of white bread contributed to brown coloration which increased the browning index value of bread. Putri (2014) also showed that the protein content of 18.2% in coconut dregs flour contributed to the Maillard reaction. This occurred due to the presence of free amino groups from proteins that bind to the hydroxyl groups of reducing sugars, leading to the formation of melanoidin compounds.

### Porosity

Porosity also known as bread pores are holes or air cells found in bread and are formed during the

fermentation or baking process. This porosity is divided into three based on diameter, namely large (> 2 mm), medium (1-2 mm), and small (< 1 mm) (Kartiwan et al., 2015). The porosity results from six treatments of white bread with the same formulation of 200 g showed that the pores were included in the diameter < 1 mm (small pore size) category. Substitution of coconut dregs flour, which did not contain gluten content, led to shrinkage of the white bread pores (Aryani et al., 2019). This was because the CO<sub>2</sub> gas produced during the fermentation process affected the formation of bread pores. Similarly, (Karimi, 2012) stated that the decrease in the ability of the dough to withstand CO<sub>2</sub> gas was influenced by gluten content, leading to sub-optimal expansion, and decreased or uneven pore homogeneity.

### Correlation Analysis of Physical Properties and Consumer Acceptance

Sensory analysis of white bread scores showed that the increase in the percentage of non-wheat flour substitution had no significant effect on the preferences of the panelists, as presented in Figure 2. Sari et al. (2015) concluded that the preference of the panelists for white bread was influenced by both taste and texture.

Partial Least Square (PLS) regression on Y variable 50 panelists and nine variables X physical properties (hardness, adhesiveness, dough expansion, specific volume), color intensity (L\*, a\*, b\*, °hue), and browning index was presented in Figure 3. The results of the correlation analysis showed that P1 had hardness and adhesiveness characteristics, which were located in quadrant 1, indicating a positive correlation with the

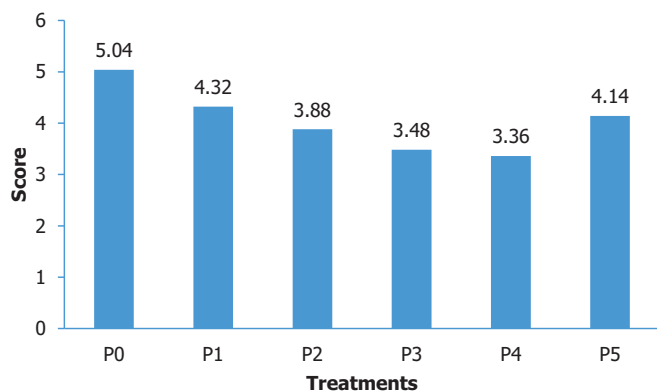
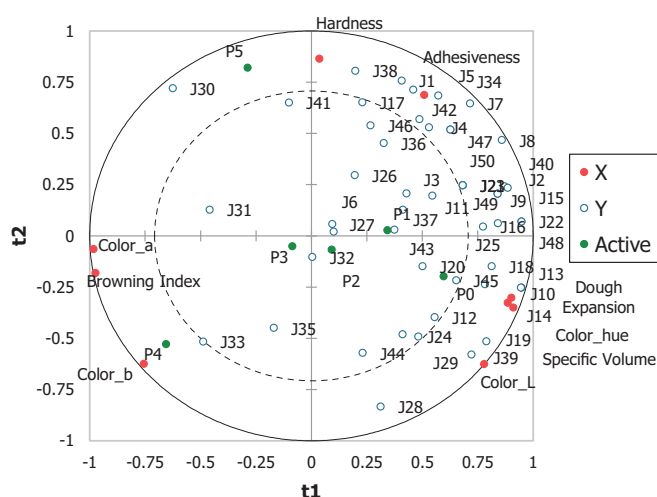


Figure 2. Overall sensory evaluation

preferences of the panelists. P5 was located in quadrant 2, where there was no positive correlation, while P0 and P2 had similar characteristics of dough expansion, specific volume, and L\* color, as located in quadrant 4. However, the two products exhibited significantly different characteristics with P3 and P4, which had a color a\*, color b\*, and browning index in quadrant 3, indicating a negative correlation with the preferences of the panelists (Figure 3).



Note: J1-J50: number of panelists; 1 digit letter and 1 digit number (P0, P1, P2, P3, P4, P5): treatments; the numbers on the X and Y axes are R-squares showing 0.75 (strong), 0.5 (moderate), and 0.25 (weak) (Ghozali, 2016).

Figure 3. Circle of correlation between physical characteristics, preference (overall), panelists, and samples of white bread

The results of correlation analysis using Partial Least Squares (PLS) showed a significant relationship between liking (overall) and the identified parameters

closely associated with the product quality analysis. This indicated the significance of the relationship between physical properties and liking (overall) of a food product by the research team and product manufacturers. Therefore, this analysis can predict product quality and an important variable in the level of consumer acceptance of the sample measurement (Moghaddam et al., 2016).

## CONCLUSION

In conclusion, this study showed that the substitution of 25% coconut dregs flour and 5% avocado seed flour on white bread fulfilled consumers acceptance. The results highlight that substituting wheat flour by coconut dregs and avocado seed flour increased the hardness and adhesiveness of white bread, while the dough expansion, specific volume, and pores size decreased. Furthermore, the substitution for avocado seed flour reduced the brightness of the bread and increased the browning index value.

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