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Effect of Substitution of Wheat Flour and Pedada Flour (*Sonneratia caseolaris)* to Characteristic of White Bread

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A B S T R A C T

White bread is a food product generally derived from wheat flour that is consumed by the majority of people around the world. Innovations continue to be made to increase the nutritional value of bread. The use of pedada fruit (Sonneratia caseolaris) as a local food rich in fiber is an alternative to mixing with wheat flour. This study was conducted to determine the physical and organoleptic properties of wheat flour white bread with pedada flour. Organoleptic quality assessment was conducted with the participation of 25 panelists. Sensory attributes that are referenced by panelists include color, aroma, taste, texture, and overall. Data analysis used a T-test to determine the real difference between two treatments with a significant level (<0.05) including development volume, number of pores, texture, and organoleptic test. White Bread with a proportion of 80% wheat flour and 20% pedada produced a loaf volume (138.04%), porosity (11,722/cm^2), and texture with texture analyzer (5,892 gf). The organoleptic test showed that the bread with 80% wheat flour and 20% pedada flour received positive ratings in terms of color and aroma, but received low ratings in terms of texture and taste.

1. INTRODUCTION

1.1. Research Background

The consumption of wheat flour in foodstuffs in 2023 reached 16.9 kg per capita per year [1]. However, to meet the high public demand for wheat flour, Indonesia has imported from several world-producer countries such as the United States, Argentina, Ukraine, Brazil, and Australia [2]. Currently, the use of composite flour is being pursued as an alternative to reduce dependence on wheat flour in the manufacture of food products.

Composite flour is flour made from two or more types of food ingredients [3]. Composite flour minimizes dependence on imported products and also increases the potential of local food ingredients in Indonesia. Making composite flour aims to improve the physical, chemical appearance and nutritional content of the product produced. Composite flour has been applied in making bread products, pastries, noodles and snacks. Research related to composite flour has been carried out previously with various kinds of food ingredients such as cereals, nuts, tubers [4].

Wheat flour based on protein content is divided into 3 namely low-protein wheat flour, medium-protein wheat flour, and high-protein wheat flour. Wheat flour has a content that plays an important role in the product, namely gluten. Gluten is a protein found in grains and cereals such as wheat and barley. Gluten gives elastic properties and cannot dissolve in water [5]. In addition, wheat flour contains carbohydrates in the form of starch where the amylose content is around 25% and amylopectin as much as 75% [6]. Wheat has good functional characteristics in the application of products. Gluten is unique because of its ability to form a visco-elastic network that can hold gas so that it gives a development effect on bread products [7].

Bread has a variety of flavors and shapes and is practical and filling. The content of bread generally contains 248 kcal of energy, 8 g of protein, 1.2 g of fat, and 50 g of carbohydrates. The characteristics of good bread include sufficient development volume, golden brown skin color and bright inside, uniform pores with thin pore walls, smooth and soft texture and not crumbly, and a fragrant bread aroma [8]. Bread generally comes from wheat flour with a protein content of 12-14% protein [9]. The high protein content allows the dough to develop optimally during the fermentation process, making it ideal for bread making. The high gluten content also plays a role in strengthening the dough structure and increasing the development volume [10].

The utilization of pedada fruit flour is based on its content, namely 11.30% water content, 4.7% fat content, and 6.20% protein content [11]. Dietary fiber content of pedada fruit flour is 63.70%. Consumption of high dietary fiber can have a preventive effect on colon cancer because fiber can form lubricating fluids in the colon which accelerate the process of expelling feces. Dietary fiber is also able to reduce cholesterol levels in the blood and prevent inflammation of the colon wall [12]. Pedada flour has a pectin content of 11.99-13.10% [13].

Previous research was carried out by conducting amylography testing using RVA (Rapid Viscosity Amylograph). This test was carried out to determine the resistance of composite flour to the heating, cooling and stirring processes. Based on [14], the pasting properties of pedada flour with wheat flour produce the best pasting properties in a formulation of 80% wheat and 20% pedada. The pasting properties obtained were peak viscosity of 5679 cP, breakdown of 2902 cP, setback of 1161 cP, and a pasting temperature of 68°C which was suitable for application in bread. Peak viscosity, final viscosity, breakdown and setback are high in bread processing [15].

Flour that is suitable for making bread generally requires a high water absorption capacity compared to making noodles and biscuits [16]. Pedada flour has a high fiber content so it can increase the water absorption capacity of the flour. According to [17] states that soluble fibers such as pectin and some hemicelluloses can retain water.

This innovation in making bread from pedada flour has never existed before. Therefore, pedada bread has an update in the use of pedada flour. This research aims to determine the characteristics of bread made from wheat flour and pedada flour

1.2. Literature Review

1.2.1 Pedada (*Sonneratia caseolaris*)

Fig 1. Pedada Fruit (*Sonneratia caseolaris*)

Morphology Sonneratia caesolaris grows on the banks of river estuaries, especially in areas with low salinity with a mixture of freshwater [18]. This plant can grow to a height of 5-20 meters, with a stem structure consisting of roots, stems, twigs, leaves, flowers, and fruit. The many-seeded fruit is a flat ball, green, 5-7.5 cm in diameter and 3-4 cm high, located above the almost flat calyx taju. The flesh is yellowish, salty sour, and has a foul odor [19].

Pedada fruit has the highest yield in pedada fruit and seeds which is 73%, skin 15%, and petals 12%. Pedada fruit contains water content (wb) 77.10%, ash content (db) 3.85%, fat content (db) 0.86%, protein content (db) 2.24%, and carbohydrate content (wt) 15.95% [11]. The application of pedada flour as a food product has been carried out such as making syrup [20], biscuits [11], dan brownies [21]. According to [21], the application of pedada flour in brownies shows that brownies are high in fiber and low in calories.

Pedada flour has a low gluten content so the texture of the bread is hard and dense. An alternative to overcome deficiencies in the texture aspect is using an emulsifier. One of them uses Glycerol monostearate. Glycerol can reduce excessive dough work and reduce hardening that occurs during storage. The compliance of bread crumbs with the ideal profile developed by the panel and consumer preferences is generally higher for bread formed by the dough division process and for bread formed by extrusion containing 4 or 6% glycerol [22]. The role of glycerol monostearate in the production of white bread is to produce a complex reaction with starch, thereby slowing down the rate of retrogradation and protecting the bread from becoming too hard and brittle [23]. Making white bread from composite wheat flour and cassava flour using 6% glycerol monostearate provides nutritional content, rising volume, texture and bread that consumers like [24].

1.2.2 Composite flour

The purpose of making composite flour is to obtain material characteristics that are suitable for the desired processed product and/or to obtain certain functional properties. In food politics, the goal is to substitute or even replace wheat. Each product is required to have its characteristics which are taken into consideration when choosing the type of flour to produce appropriate product characteristics. In general, wheat-based products are divided into two, namely products that require development and products that do not require development [3].

Currently in the world, cuisine has many recipes with composite flour, such as various forms of noodles or pasta, pastries, bread, pastries, snacks and others. For example, soy beans or quinoa bread have excellent sources. protein and nutrition, and in some developing countries, it is considered a modern food [4].

Several studies on composite flour in bread products have been carried out. Mixing 90% wheat flour: 10% tofu dregs flour by [25] shows the characteristics of bright white bread in the crumb part and slightly brownish in the crust part, has a typical white bread aroma, tastes quite good, and has a soft texture. Composite flour bread with a mixture of wheat flour and barley flour at 80:20 has the effect of increasing fiber content from 1.63% to 3.54% and produces color, taste, texture, and pore uniformity that suits consumer tastes [8].

1.2.3 Bread

Bread is one of the most widely consumed foods globally and can be enjoyed at any time. The primary ingredient in making bread is wheat flour, specifically high-protein wheat flour. The process of making bread involves kneading, fermentation (development), and baking in the oven [26]. The development process in bread can be influenced by several factors, including raw materials, the dough formation process, and the duration of fermentation. The use of wheat flour as a raw material in making bread can lead to good development, indicating quality bread. This is because wheat flour contains gluten, which is essential for producing good development in the dough [27]. Quality bread is characterized by a good development volume, savory taste, distinct aroma, golden outer skin color, bright interior color, soft, smooth texture, and uniform pores [28].

The stages involved in bread making play a crucial role in determining the quality of the final product. The bread-making process typically includes mixing, fermentation, shaping, and baking [29]. Mixing serves the purpose of creating and developing the adhesive properties of gluten, which are not inherently present in flour. When water is added to wheat flour and mixed, gluten formation occurs [30]. Fermentation occurs as yeast enzymes interact with starch and sugar, resulting in the production of carbon dioxide gas. This gas development causes the dough to rise, resulting in a lighter and larger dough. Baking involves a series of complex factors, including temperature variations, mass transfer, and physical, chemical, and biochemical reactions that alter the properties of the dough. These reactions include volume expansion, water evaporation, formation of porous structures, changes in proteins, starch gelatinization, crust formation, and browning reactions [31].

1.3. Research Objective

This study aims to compare the differences between white bread made by mixing wheat flour: pedada flour with wheat flour (control)

2. MATERIALS AND METHODS

2.1. Material

The main ingredient used was Cakra Kembar brand, while the Pedada fruit originated from the Wonorejo Mangrove in Surabaya. Other bread-making ingredients included yeast, sugar, milk cream, shortening, eggs, and glycerol monostearate (GMS).

The tools utilized in the study comprised an 80-mesh sieve, cabinet, analytical balance, blender, desiccator, electric oven, measuring cylinder, micro pipette, pH meter, water bath, thermometer, furnace, weighing bottle, Erlenmeyer flask, and texture analyzer.

2.2. Composite Flour Preparation Procedure

The process of making flour from pedada fruit begins with the selection of suitable fruits. The next step involves removing the skin and blanching the fruits at 80°C for 5 minutes to maintain quality and cleanliness. Subsequently, the fruits are crushed to pulp and subjected to a screening process to separate the pulp from the seeds. Following this stage, the pulp is dried using a cabinet dryer at temperatures ranging from 50 to 60°C for 15 to 18 hours to reduce moisture content significantly. Once dried, the pedada pulp is finely pulverized using a blender to produce flour. The final step involves sifting the flour through an 80-mesh sieve to ensure its quality and fineness [11]

To make composite flour, 80% wheat flour and 20% pedada flour are weighed and mixed using a blender for consistent results.

2.3. Procedure for making bread

The bread-making process commences with precise weighing of ingredients. In the first mixing stage, wheat flour is substituted with pedada flour in a ratio of 80:20. Additionally, 16 grams of sugar, 2 grams of yeast, 6% glycerol monostearate (GMS), egg yolk, and water are gradually added until a dough with an even texture is formed. Subsequently, the second mixing stage entails the addition of 16 grams of shortening, 1 gram of salt, 2 grams of bread improver, and 10 grams of skim milk. The dough is kneaded until it achieves a smooth consistency. Following this, the dough undergoes fermentation at 27ºC for 30 minutes under a damp cloth cover to facilitate the fermentation process. The gas produced during fermentation is then removed by rolling the dough with a rolling pin to form a sheet. Subsequently, the dough is kneaded again and subjected to a second fermentation at 27ºC for 60 minutes under the same conditions. Once the second fermentation process is complete, the dough is baked for 30 minutes at 180ºC. After baking, the white bread is spread with butter on top and then cooled before serving [24].

2.4. Analytical methods

2.4.1 Loaf Volume of Bread

Measure the volume of bread dough before baking by measuring length x width x height using a ruler. The bread that has been baked is cooled for 20 minutes. Calculate the volume of the sponge cake by measuring the length x width x height of the bread [32].

$$Loaf\ volume = \frac{Volume\ of\ Bread}{Volume\ of\ Dough}\ x\ 100\%$$

2.4.2 Texture

For bread, the probe used was a cylindrical type with a diameter of 28 mm. After the probe is installed, the material to be tested is placed on the test table, then the computer is turned on to run the texture analyzer expert program. The results will come out in the form of a graph and can be used for further data processing. Sampling is done randomly. The graph consists of the x-axis which is the measurement time (seconds) and the y-axis which is the force (g) [33].

2.4.3 Porosity

The top, bottom, right side, and left side of the bread were taken. Next, the paper is cut to the size of the surface of the bread, then given a 1x1 cm box, each paper 4 boxes. Then manually count the pores in 1x1 cm size. Finally, repeating for each part of the bread then the average pores of each are summed and averaged again to determine the porosity of the bread [34].

2.4.4 Analysis of Sensory

Organoleptic tests were conducted to assess the quality and hedonic properties of white bread. The testing involved 25 panelists who filled out evaluation forms using a scoring method ranging from 1 to 5, where 1 indicates 'very dislike,' 2 indicates 'dislike,' 3 indicates 'neutral,' 4 indicates 'like,' and 5 indicates 'very like' [35].

2.4.5 Data Analysis

The analysis utilized a paired sample t-test with the following formula:

$$\textit{Paired Sample t-Test} : t_{hit} = \frac{D}{\frac{SD}{\sqrt{n}}}$$

T_{hit} = Calculated t value
D = Average difference between measurement 1 and 2
SD = Standard deviation of the difference Between measurement 1 and 2
n = Number of samples

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3. RESULT AND DISCUSSION

3.1 *Loaf Volume*

Based on Table 1, it is observed that the bread made from composite flour (a mixture of wheat flour and pedada flour) exhibits a lower quality compared to the control bread. This difference can be attributed to the reduction in protein content in the flour. Pedada flour possesses unique properties that make it challenging to integrate smoothly with other flours, resulting in a dough that lacks smoothness and elasticity. Based on research [36] suggests that the dough tends to crack easily due to weak bonds between flour particles, making it susceptible to pressure from the CO2 gas produced during fermentation. In contrast, dough made from wheat flour maintains its integrity better due to the presence of gluten proteins, which form an elastic network. However, dough from local flour mixtures, such as pedada flour, tends to have lower gluten and amylopectin content, which serve as binding agents. As a result, these doughs may not expand easily and are prone to cracking. The mechanism of volume development in bread involves several processes: the formation of a gluten network and the entrapment of air bubbles during kneading, the production of CO2 gas during fermentation, the absorption of CO2 gas into the gluten network, which causes the dough to expand like foam, the transformation of gluten into an elastic film that maintains the presence of CO2, the formation of pores that allow for further dough development, and the stabilization of the structure during baking through gluten coagulation and starch gelatinization, resulting in a soft texture [37].

Table 1. Analysis of Loaf Volume

Treatment	Loaf Volume (%)	Uji T		
		t table	t Count	Sig
Wheat	170,82±0,0497	4,30	4,6395	0,0435
Wheat: Pedada	138,04±0,1710			

3.2 *Texture*

Hardness is the force required to bite the food for the first time and is usually shown at the first peak of the graph. Based on the average hardness results, Table 1 shows that there is a significant difference between the control bread and the composite flour bread (wheat flour 80: pedada flour 20).

Table 2. Texture Analysis Results

Treatment	Texture (gf)	Uji T		
		t tab	t Hit	sig
Wheat	1,753±0,62	12,7062	-24,427	0,026047
Wheat: Pedada	5,892±0,26			

Based on Table 2, the higher the hardness value, the harder the material [38]. According to [39] the use of non-gluten flour results in the development of white bread that cannot be maximized so that the resulting white bread becomes denser and harder. In making white bread, gluten is one of the main factors in forming the framework of white bread dough. Gluten has visco-elasticity and can bind gas so that the dough framework can form, expand, and produce a texture that is not hard. Without gluten in the making of white bread, the dough framework cannot be formed perfectly so white bread has a small development and hard texture. The hardness of white bread is also influenced by the fiber content in the flour used. Research cited in [40] suggests that the presence of high fiber content in bread leads to a harder texture. Based research on [41] indicate a significant positive correlation between moisture content and dietary fiber in bread ingredients. As fiber content increases, more water is absorbed, reducing the amount of water available for dough formation. Consequently, this decrease in water availability results in decreased dough sturdiness and volume, ultimately leading to a harder texture in the resulting bread.

3.3 *Porosity*

Table 3. Analysis of Porosity

Treatment	Porosity(/cm^2)	T-Test		
		t table	t count	sig
Wheat	24,1667±0,12	4,30	22,31735	0,002
Wheat: Pedada	11,722±0,134			

According to Table 3, it is evident that the white bread made from composite flour (a blend of wheat flour and pedada flour) exhibits lower quality compared to the control white bread. This disparity can be attributed to the decrease in gluten content, resulting in reduced gas absorption and the formation of fewer and less consistent pores in the dough. Research by [42] suggests that the presence of non-uniform pores in the bread is due to the initial dough structure not being solid enough, allowing gas to escape and join other structures, eventually forming large pores. The uniformity of pores is maintained when gluten in the dough can adequately stretch and hold the gas. However, decreased gluten elasticity leads to large and non-uniform pores, as the gluten cannot effectively trap the escaping gas, resulting in its redistribution and the formation of irregular pores. Porosity in bread is influenced by various factors throughout the dough formation, fermentation, and baking processes. During fermentation, the development of fresh bread increases due to the production of CO_2 gas and the gluten content in the dough. Gluten serves to keep the dough firm and can hold CO2 gas during the fermentation process. In making white bread, glutenin determines the mixing time and dough development, while gladin determines the volume of white bread. When baked, the dough will form a sponge-like structure that has pores. [43]

3.4 Sensory Properties

3.4.1 *Taste*

Based on Table 4, there is a significant difference between the control white bread and the composite flour white bread (wheat flour 80: pedada flour 20) on the sensory properties of taste. Friedman's test showed that panellists disliked the taste of composite flour fresh bread (wheat flour and pedada flour) because pedada flour has a sour taste. Fresh bread with a mixture of wheat flour and pedada fruit flour still leaves a sour or astringent taste. This is because pedada fruit has tannin content.

Table 4. Results of Organoleptic Analysis of Taste

Treatment	Average	Rank	T-Test		
			t-table	t count	Sig.
Wheat	4,24	49	2.063	10.154	0,0003
Wheat: Pedada	2,68	26			

Research of [44] pedada fruit flour has a high tannin content which causes an astringent and bitter taste in food ingredients that can form protein bonds. According to the panelists, the resulting taste was sour so the panelists suggested the addition of flavors to reduce the astringency of the bread.

3.4.2 *Aroma*

The results of the paired sample T test can be seen that Table 5 shows that there is a significant difference between the control white bread and the composite flour white bread (wheat flour 80: pedada flour 20) on the aroma sensory properties. Based on the Friedman test, the aroma of white bread that is more favored by panelists is the control white bread with a value of 4.32. Composite flour white bread has a slightly sour aroma compared to the control white bread. Research of [45], he aroma of food products can be influenced by the ingredients used and the processing process. The use of high temperature in making biscuits.

Table 5. Results of Organoleptic Analysis of Aroma

Treatment	Average	Rank	T-Test		
			t-table	t count	Sig.
Wheat	4,32	44,5	2,063	4,381	0,0002
Wheat: Pedada	3,52	30,5			

The use of high temperatures in biscuit-making leads to the loss of volatile compounds through evaporation. These volatile compounds are the constituents of aroma, which easily evaporate at elevated temperatures. According to panelists, the composite flour white bread exhibits a slightly disturbing aroma, although it remains acceptable to them.

3.4.3 *Color*

The results of the paired sample T-test, as shown in Table 6, indicate a significant difference between the control white bread and the composite flour white bread (80% wheat flour and 20% pedada flour) in terms of color sensory properties. According to the Friedman test, panelists tend to prefer the color of the control white bread, which exhibits a white color both on the inside and outside. In contrast, the composite white bread has a dark brown color, attributed to the presence of pedada flour, which inherently has a brick red color. The baking process of composite flour white bread results in a dark brown color due to the Maillard reaction.. The Maillard reaction, as stated in [46], occurs when reducing sugars and proteins interact, leading to browning, along with caramelization of sugars, under thermal processing conditions such as baking. Despite the darker color, panelists find the color of the composite flour white bread to be very attractive and still acceptable.

Table 6. Results of Organoleptic Analysis of Color

Treatment	Average	Rank	T-Test		
			t-table	t count	Sig.
Wheat	4,16	45	2,063	4,883	0,00005
Wheat: Pedada	3,48	30			

3.4.4 *Texture*

Table 7. Results of Organoleptic Analysis of Texture

Treatment	Average	Rank	T-Test		
			t-table	t count	Sig.
Wheat	4,16	49	2,063	9,165	0,00002
Wheat: Pedada	2,76	26			

Table 7 presents the results of the Organoleptic Texture Analysis, revealing a significant difference between the control white bread and the composite flour bread (80% wheat flour: 20% pedada flour) in terms of texture sensory properties, as indicated by the paired sample T-test. The Friedman test further confirms that panelists preferred the control bread over the composite flour bread he texture of the composite flour bread tends to be harder and denser, attributed to the reduction in gluten content resulting from the addition of pedada flour. A decrease in the ability of the gluten network to expand leads to smaller volume development, thereby resulting in a harder texture [47] Panelists noted that the texture of the composite flour white bread was slightly hard, which diminished the level of panelist preference. According to [27], the hardness of bread stems from a decrease in volume caused by reduced development, resulting in decreased gluten content and decreased gas retention. In cases where the amount of gluten in the dough is minimal, the dough lacks the ability to retain gas, leading to the formation of smaller pores. Consequently, the dough fails to expand adequately post-baking, resulting in a hard product [48].

3.4.5 *Overall*

Evaluation of overall acceptance is crucial in determining consumer acceptance of a product [49]. Table 8 illustrates the results of the paired sample T-test, indicating a significant difference between the control white bread and the composite flour white bread (80% wheat flour: 20% pedada flour). The control bread emerged as the preferred option among panelists, with an overall organoleptic value of 4.04. This preference aligns with the panelists' favorable ratings for aroma, texture, color, and taste in the control bread.

Table 8. Results of Organoleptic Overall Analysis

Treatment	Average	Rank	T-Test		
			t-table	t count	Sig.
Wheat	4,04	48	2,063	8,084	0,00002
Wheat: Pedada	2,76	27			

While the composite flour bread (a blend of wheat flour and pedada flour) garnered acceptable results among panelists, there is room for improvement, particularly in flavor parameters, which are crucial in assessing the quality of bread products. According to panelists, enhancing flavor and texture parameters may involve incorporating additional food additives or reducing the proportion of pedada flour. This adjustment is deemed necessary as taste and texture significantly influence the liking level of composite white bread.

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4. CONCLUSION

The treatment of control bread (wheat flour) with composite flour bread (wheat flour and pedada flour) showed that there were significant differences in development volume, pore test, hardness, and organoleptic test (color, taste, aroma, texture, overall). Result of composite flour bread (wheat flour high protein-pedada flour) is loaf volume (138,04%), porosity (11,722 cm^2), texture (5,892 gf), taste 2,68 (neutral), aroma 3,52 (like), texture 2,76 (neutral), color 3,48(like) and overall 2,76 (neutral)Based on the organoleptic results, the panelists preferred the control bread (wheat flour) compared to the composite flour bread (wheat flour and pedada flour).

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REFERENCE

[1] Badan Pangan Nasional. 2023. Situasi Pangan dan Strategi Badan Pangan Nasional Menjaga Stabilitas Pangan Nasional. [diakses: 10 Juni 2023]

[2] Kementerian Perdagangan Republik Indonesia. 2020. Analisis Perkembangan Harga Bahan Pokok Di Pasar Domestik dan Internasional. Pusat Pengkajian Perdagangan Dalam Negeri

[3] Bentacut, T dan Saptana. 2014. Politik Pangan Berbasis Industri Tepung Komposit. Forum Penelitian Agro Ekonomi. 32(1).

[4] Engindeniz dan Bolatova, Z. 2019. A Study on Consumption of Composite Flour and Bread in Global Perspective. British Food Journal. 123(5): 1962–73.

[5] Ihromi. 2018. Formulasi Tepung Pisang dan Tepung Mocaf Terhadap Mutu Cake. Mataram: Jurnal AGROTEK Vol.5 No.1, Februari 2018. ISSN 2356-2234

[6] Yuliana dan Novitasari, R. 2014. Pengaruh subtitusi tepung gandum dengan tepung pisang kepok (Musa paradisiacal forma typica) terhadap karakteristik mie kering yang dihasilkan. Jurnal Teknologi Pertanian 3(1):1-14.

[7] Arendt E K, Renzetti S., dal Bello F. 2009. Struktur mikro adonan dan aspek tekstur roti dan biskuit ragi bebas gluten. Dalam: Gallagher E., editor. *Ilmu dan Teknologi Pangan Bebas Gluten.* Wiley-Blackwell; Oxford, Inggris: 107–129.

[8] Arif, D. Z., Cahyadi, W., Firdhausa, A. S. 2018. Kajian Perbandingan Tepung Terigu (Triticum aesticum) Dengan Tepung Jewawut (Setaria italica) Terhadap Karakteristik Roti Manis. Pasundan Food Technology Journal. 5(3) : 180-189.

[9] Handayani, S. dan R.A Wibowo. 2014. Koleksi Resep Kue Kering. PT Kawan Pustaka. Jakarta. 200 hal

[10] Kusnedi, R. 2021. Pengaruh Penambahan Pengembang Roti Terhadap Parameter Organoleptik Pada Pembuatan Roti Manis. Program Studi D3 Seni Kuliner. Universitas Pradita. Jurnal British. Volume 1, No 2; pp.60-75.

[11] Jariyah, Simon, B., Widjanarko, Yunianta, T., Estiasih. 2014. Hypoglycemic Effect of Pedada (*Sonneratia caseolaris*) Fruit Flour (PFF) in Alloxan-Induced Diabetic Rats. International Journal of PharmTech Research. 7(1):31-40

[12] Masrul, M. 2018. Pengaruh Konsumsi Serat Dengan Pengurangan Risiko Kanker Kolon di Negara Barat: Studi Meta Analisis. Jurnal Kesehatan Masyarakat Andalas. Vol. 12, No. 2

[13] Jariyah, Sudaryati, R. Yulistiani dan Habibi. (2015). Ekstraksi Pektin Buah Pedada (*Sonneratia caseolaris*). J. Rekapangan, 9(1), 28-33.

[14] Jariyah, Widjanarko, S. B., Yunianta, Estiasih, T., & Sopade, P. A. 2014. Pasting properties mixtures of mangrove fruit flour (Sonneratia caseolaris) and starches. *International Food Research Journal*, *21*(6), 2161–2167

[15] Parwiyanti, Pratama F., Wijaya, A. dan Malahayati, N. 2016. Profil *Pasting* Pati Ganyong Termodifikasi Dengan Heat Moisture Treatment Dan Gum Xanthan Untuk Produk Roti. Jurnal Teknologi dan Industri Pangan 27(2): 185–92.

[16] Ulyarti, U., Surhaini, S., Sri Wahyuni, Y., & Nazarudin, N. 2022. Sifat Fisiko-Kimiawi Dan Fungsional Tepung Uwi (Dioscorea Spp.) Yang Di Modifikasi Menggunakan Cairan Sauerkraut. *Jurnal Teknologi Pertanian*, *23*(1), 73–88

[17] Santoso, Agus. 2011. Serat Pangan (*Dietary Fiber*) dan Manfaatnya bagi Kesehatan. Magistra No. 75 Th. XXIII 35 ISSN 0215-9511

[18] Mangrove Information Center, 2009. Nipah, Denpasar, Bali.

[19] Santoso N, Kusmana C, Sudarma D dan Sukmadi R. 2008. Ekologi tumbuhan pidada (*Sonneratia caseolaris*) pada kawasan Muara Angke propinsi daerah khusus ibu kota Jakarta. Jurnal

[20] Setiawan, E. 2016. Pemanfaatan Buah Pedada (Sonneratia caseolaris) Dalam Pembuatan Selai. Skripsi. Fakultas Pertanian. Universitas Riau. Pekanbaru

[21] Harahap, K. S., & Mujianti, A. 2020. Nutrisi Brownies Tepung Buah Mangrove (Avicennia officinalis) dan Tepung Kacang Merah Sebagai Pangan Fungsional. Jurnal Airaha, 9(02), 191-20

[22] Barrett, A. H., Cardello, A. V., Mair, L., Maguire, P., Lesher, L. L., Richardson, M., Briggs, J. dan Taub, I. A., 2000. Textural optimization of shelf-stable bread: Effects of glycerol content and dough-forming technique. Cereal chemistry. 77(2): 169-176

[23] Hidayat, R. 2006. Pembuatan Roti Tawar (Kajian Substitusi Tepung Tapioka dan Penambahan Glieserol Monostearat). Skripsi. UPN "Veteran" Jawa Timur.

[24] Dian P.S, R., & Rosida, D.F. 2023. Study of Wheat Flour and Tubers with the Addition of Glycerol Monostearate. AGRITEPA, Vol.10, No.1, Januari–Juni 2023. p-ISSN : 2407–1315, e-ISSN : 2722-1881

[25] Silaen, Michael. 2018. Substitusi Parsial Tepung Terigu Dengan Tepung Ampas Tahu Dan Penambahan Baking Powder Dalam Pembuatan Roti Tawar. Skripsi. Bengkulu: Universitas Bengkulu.

[26] Pratiwi A, Ansharullah A, Baco A R. 2017. Pengaruh Subtitusi Tepung Talas (Colocasia esculenta L. Schoott) Terhadap Nilai Sensorik Dan Nilai Gizi Roti Manis. Jurnal Sains dan Teknologi Pangan.Vol. 2. No. 4.

[27] Hidayati. F. U. N. 2013. Daya Pembengkakan (Swelling Power) Campuran Tepung Kimpul (Xanthosoma Sagittifolium) Dan Tepung Terigu Terhadap Tingkat Pengembangan Dan Kesukaan Sensorik Roti Tawar. Program Studi Gizi, Fakultas Ilmu Kesehatan. Universitas Muhammadiyah Surakarta.

[28] Syarbini, M. 2013. Referensi Komplet A-Z Bakery Fungsi Bahan, Proses Pembuatan Roti, Panduan Menjadi Bakepreneur Cetakan Ke-1. Tiga Serangkai Pustaka Mandiri. Solo.

[29] Arwini, N. P. D. 2021. Roti, pemilihan bahan dan proses pembuatan. Jurnal Ilmiah Vastuwidya. 4(1): 33–40.

[30] Koswara, S. 2009. Teknologi Pengolahan Umbi-Umbian. Institut Pertanian Bogor: IPB.

[31] Vanin F M, Lucas T and Trystram G. Crust formation and its role during bread baking. Trends in Food Science and Technology 20 (2009): 333-343

[32] Hartajanie, L., dan Rhanie A. 2010. Peningkatan Kualitas Roti Non Terigu Berbasis Tepung Ubi Kayu (Menihot utilissima) Menggunakan Hidrokoloid dan Enzim. Tesis. Universitas Katolik Soegijapranata. Semarang.

[33] Rianti, A. W. 2008. Kajian formulasi cookies ubi jalar (Ipomoea batatas L.) dengan karakteristik tekstur menyerupai cookies keladi. Skripsi. IPB. Bogor. Bentacut dan Saptana. 2014

[34] Surono, D. I., E. J. N. Nurali., dan J. S. C. Moningka. 2017. Kualitas Fisik dan Sensori Roti Tawar Bebas Gluten Bebas Kasein Berbahan Dasar Tepung Komposit Pisang Goroho (Musa acuminate L). Jurnal Teknologi Pertanian. Vol 1(1):1-12.

[35] Arbowati, J. L., Mulyani, S. dan Hintono A. 2021. Pengaruh Kualitas Telur Terhadap Sifat Fisik dan Sifat Organoleptik Sponge Cake. Jurnal Teknologi Pangan dan Gizi, 20 (1): 27-33.

[36] Kartiwan, Z., Hidayah dan Badewi, B. 2015. Metoda Pembuatan Adonan Untuk Meningkatkan Mutu Roti Manis Berbasis Tepung Komposit yang Difortifikasi Rumput Laut. Partner No. 1: 39-47.

[37] Syamsir, E., Hariyadi, P., Fardiaz, D., Andarwulan, N. dan Kusnandar, F. 2012. Pengaruh proses heat - moisture treatment (HMT) terhadap karakteristik fisikokimia pati. Jurnal Teknology dan Industri Pangan 28(1) 100- 106.

[38] Durgadevi M and Shetty P H. 2012. Effect of Ingredients on Texture Profile of Fermented Food.190–8.

[39] Wang, R., Zhou, W. Isabelle, M., 2006. Comparison Study of the Effect of Green Tea Extract (GTE) on the Quality by Instrumental Analysis and Sensory Evaluation. Food Research International 40 pp. 470-479.

[40] Yulifianti, R., Erliana, G., & Amin, N. (2017). Karakteristik Roti Manis Berbahan Baku Ubi Jalar dan Tepung Gandum Lokal. Buletin Palawija Vol. 15 No.2 : 49 – 56.

[41] Kurek, M and Jarosław W. 2015. The Application of Dietary Fiber in Bread Products. Journal Food Process Technol. Vol 6 (5) : 1-4.

[42] Lembong E, 2011. Peningkatan Fungsionalitas Karbohidrat Tepung Sorgum dan Tepung Terigu oleh enzym αamylase dan Glukoamilase dari Ragi Saccharomycopsis fibuligera pada pembuatan roti. Universitas Padjadjaran Bandung.

[43] Adiwijaya, E. 2003. Pengaruh Waktu Dan Kondisi Fermentasi Serta Waktu Penyimpanan Terhadap Sifat Fisik Roti Tawar. Program Studi Teknologi Pangan Fakultas Teknologi Pertanian Universitas Katolik Soegijapranata Semarang.

[44] Awika, J. M., Yang, L., Browning, J. D., & Faraj, A. (2009). Comparative antioxidant, antiproliferative and phase II enzyme inducing potential of sorghum (Sorghum bicolor) varieties. LWT-Food Science and Technology, 42(6), 1041–1046. https://doi.org/10.1016/j.lwt.2009.02.003

[45] Mayasari, R. 2015. Kajian Karakteristik Biskuit yang dipengaruhi Perbandingan Tepung Ubi Jalar (Ipomea batatas L.) dan Tepung Kacang Merah (Phaseolus vulgaris L). Program Studi Teknologi Pangan. Fakultas Tenik. Universitas Pasundan. Bandung.

[46] Usman, M., Ahmed, S., Mehmood, A., Bilal, M., Patil, P. J., Akram, K., & Farooq, U. (2020). Effect of apple pomace on nutrition, rheology of dough and cookies quality. Journal of Food Science and Technology, 57(9). https://doi.org/10.1007/s13197-020-04355-z

[47] Nur'aini, A. 2011. Aplikasi Millet (Pennisetum spp) Merah dan Millet Kuning Sebagai Subtitusi Terigu dalam Pembuatan Roti Tawar : Evaluasi Sensoris Dan Fisikokimia. Skripsi. Surakarta: Universitas Sebelas Maret

[48] Handayani R dan Aminah S. 2011. Variasi Substitusi Rumput Laut Terhadap Kadar Serat dan Mutu Organoleptik Cake Rumput Laut (Eucheuma cottonii). Jurnal Pangan dan Gizi Vol. 02 No. 03. Universitas Muhammadiyah. Semarang

[49] Jayasena, V., Tah, W. Y., & Nasar-Abbas, S. M. (2014). Effect of coagulant type and concentration on the yield and quality of soy lupin tofu. Quality Assurance and Safety of Crops and Foods, 6(2), 159–166. http://dx.doi.org/10.3920/QAS2012.0176