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PERTANIAN TROPIK

Purple Sweet Potato Flour Substitution And Fermentation Time In White Bread Modification

Aprilawati, Muji Paramuji* , Tommi Ardiansyah Purba

Program Studi Teknologi Pertanian, Fakultas Pertanian UISU, Medan

* Corresponding Author: paramuji2@gmail.com

ARTICLE INFO

Article history:
Received: 21 January 2024
Revised: 19 March 2024
Accepted : 24 Agustus 2024
Available online
https://talenta.usu.ac.id/jpt

E-ISSN: 2356-4725
P-ISSN: 2655-7576

How to cite:
Aprilawati, et al. (2024) Purple Sweet Potato Flour Substitution and Fermentastion time in white Breas Modification. Jurnal Pertanian Tropik 11(2), 22-28

ABSTRACT

Wheat flour is used throughout the world to produce food in the form of bread, noodles, dry bread and other products. However, wheat plants are not suitable for development in Indonesia's tropical nature and climate. The step taken to overcome this is to find a solution from regional wisdom by substituting wheat flour with flour from other food sources such as purple sweet potato flour, which has quite high levels of production and nutritional content. The aim of this research is to find the best treatment combination of substitution of purple sweet potato flour with wheat flour and fermentation time in modified white bread. The study used a factorial completely randomized design (CRD) with two (2) replications. Factor I: Substitution of purple sweet potato flour with wheat flour (S) consisting of 4 levels: S1 (5% : 95%), S2 (15%: 85%), S3 (25%: 75%), S4 (35 % : 65%). Factor II: Fermentation time (L) which consists of 4 levels: L 1 (1 hour), L2 (2 hours), L3 (3 hours), L4 (4 hours). The parameters observed include bread riseability, water absorption capacity, water content, organoleptic color, aroma, taste, and texture. The results showed that the combination of substitution of purple sweet potato flour and fermentation time had a significant effect on bread rise, water absorption capacity, water content and organoleptic texture and had no significant effect on organoleptic color, taste and aroma. The best combination of S1L4 for bread rise, and S1L1 for water absorption, water content, and organoleptic texture. Substituting purple sweet potato flour with wheat flour (5%:95%) and a fermentation time of up to 4 hours can produce good quality modified white bread.

Keywords: Fermentation Time, Purple Sweet Potato Flour, Substitution, White Bread

ABSTRAK

Tepung terigu digunakan di seluruh dunia untuk memproduksi pangan berupa roti, mie, roti kering dan produk lainnya. Tetapi, tanaman gandum kurang cocok dikembangkan pada alam dan iklim tropis Indonesia. Langkah yang diambil untuk mengatasi hal tersebut adalah mencari solusi dari kearifan wilayah melalui substitusi tepung terigu dengan tepung sumber pangan lain seperti tepung ubi jalar ungu yang tingkat produksi dan kandungan gizinya cukup tinggi. Tujuan dari penelitian ini adalah menemukan kombinasi perlakuan terbaik substitusi tepung ubi jalar ungu dengan tepung terigu dan lama fermentasi pada modifikasi roti tawar. Penelitian menggunakan rancangan acak lengkap (RAL) faktorial dengan dua (2) ulangan. Faktor I : Subtitusi tepung ubi jalar ungu dengan tepung terigu (S) yang terdiri dari 4 taraf : S1 (5% : 95%), S2 (15% : 85%), S3 (25% : 75%), S4 (35% : 65%). Faktor II : Lama fermentasi (L) yang terdiri dari 4 taraf :I1(1 jam), L2 (2 jam), L3 (3 jam), L4 (4 jam). Parameter yang diamati meliputi daya kembang roti, daya serap air, kadar air, organoleptik warna, aroma, rasa dan tekstur. Hasil penelitian menunjukkan bahwa kombinasi substitusi tepung ubi jalar ungu dan lama fermentasi berpengaruh nyata terhadap daya kembang roti, daya serap air, kadar air dan organoleptik tekstur serta berpengaruh tidak nyata terhadap organoleptik warna, rasa dan aroma. Kombinasi S1L4 terbaik untuk daya kembang roti, S1L1 untuk daya serap air, kadar air dan organoleptik tekstur. Substitusi tepung ubi jalar ungu dengan tepung terigu (5%:95%) dan lama fermentasi sampai 4 jam dapat menghasilkan modifikasi roti tawar bermutu baik.

***Kata Kunci** : Lama Fermentasi, Roti Tawar, Substitusi, Tepung Ubi Jalar Ungu*

https://doi.org/10.32734/jopt.v11i2.15921

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1. Introduction

The wheat flour industry is an important focus of attention for food businesses throughout the world, for example in the Americas, Europe, Asia, and Australia. Currently, the wheat flour trade has also penetrated countries such as Indonesia, India, Brazil, and the Philippines. to produce food in the form of white bread, cakes, cookies, and other dry bread. This condition is due to the nature of wheat flour which has the properties and functional protein which are very suitable to nutritional needs and adequacy (Tharise *et al*., 2014). Indonesia's consumption of wheat flour is 6.66 tons per year and the growth in population demand for wheat flour from 2014 to 2018 reached 19.92 percent (Akbara and Levyda, 2022). Information on the marked increase in the use of wheat flour shows that the engagement is ongoing. This is because processed food products that use wheat flour are quite high, so it is necessary to use flour from local raw materials to explore food potential (Utomo and Octasari, 2023).

White bread is a food made by mixing wheat flour, water, yeast, and other ingredients into a dough which is then fermented and baked (Syamsir, 2014). Furthermore, Brown (2015) stated that in producing white bread, wheat flour with a high gluten content is needed which aims to ensure optimal bread development. Paying attention to the characteristics of the types of local materials that provide benefits as a partial substitute for wheat flour and to meet the increasing demand of the population, it is very important to look for substitute raw material options that are commensurate with wheat flour from other sources, for example, taro, purple sweet potato, pumpkin. yellow and breadfruit which can produce cakes, candy, and cakes as food diversification in Indonesia (Minah *et al*., 2015). Arif *et al*., (2018) have explained that the characteristics of quality bread are that it has relatively high rising power, golden brown outer skin, and elastic filling, homogeneous pores, smooth and soft texture and firmness, special aroma. The step taken to overcome this is to find a solution from regional wisdom by substituting wheat flour with flour from other food sources such as purple sweet potato flour which has quite high production and nutritional content. This is because purple sweet potato flour contains 24.79% amylose and 49.79% amylopectin, which is almost the same as wheat flour which contains 28% amylose and 72% anilopectin (Fairus *et al*., 2021).

The characteristics of purple sweet potato flour are almost the same as the characteristics of wheat flour, namely the presence of starch, carbohydrates, and protein, however, purple sweet potato flour has lower protein than wheat flour, so purple sweet potato flour is not a source of staple material in white bread production process but is used sparingly as an exchange or substitute for wheat flour (Nur'utami *et al*., 2020). Based on the description above, purple sweet potato flour is expected to be able to reduce attachment to wheat flour. Apart from that, it can increase the variety of white bread on the market and add nutritional value which is more beneficial for health. This research aims to obtain a combination of substitution treatment for purple sweet potato flour with wheat flour and fermentation time to modify white bread.

2. Materials and Method

This research was carried out from August to September 2023 at the Laboratory Teknologi Hasil Pertanian, Fakultas Pertanian Universitas Islam Sumatera Utara Medan. The ingredients used in this research were purple sweet potatoes, wheat flour, yeast, sugar, salt, water, and butter. The tools used in this research were knives, basins, spoons, and plastic wrap. digital scales, stopwatch, measuring cups, baking sheet, and oven.

The model that is used in this research is a completely randomized design (CRD) factorial consisting of Factor I (S = substitution of purple sweet potato flour with wheat flour), namely S1 (5%:95%), S2 (15%:85%), S3 (25%:75%), S4 (35%:65%). Factor II (L = dough fermentation time), which consists of L 1 (1 hour), L2 (2 hours), L3 (3 hours) and L4 (4 hours). The research stages start with the production of purple sweet potato flour is done by sorting sweet potatoes sweet potato purple, cleaning, peeling, and then washing them with water flow. Purple sweet potato is cleanly chopped and placed on a baking dish lined with aluminum foil, dried in the oven at temperature 70^0C for 7 hours. The dried purple sweet potatoes are then crushed with a blender and sifted with a sieve of 80 mesh.

The stage of making bread starts with flour wheat added flour sweet potato sweet potato purple (according to treatment) with a total weight of 100 gr, 2 gr salt. Enter 10 gr sugar into 60 ml, stir in the water, add 5 grams of yeast, and let sit for 3 minutes. Next, pour in the ingredients, substituting as time as possible 5 minutes then add 10 grams of butter, then homogenize again for 5 minutes until the mixture is smooth. Although fermented (according to treatment) in a temperature room. After fermentation is complete, the dough is baked in an oven

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at 190 ^{0} C for 40 minutes. The resulting white bread is cooled and then observations and parameter analysis are carried out.

Observation and analysis parameters include power development bread is the ability bread to experience increased size before and after process roasting. The rising power of bread is measured from the difference in the bread disability using the formula (Surono *et al* ., 2017), water absorption (modified from Valdez-Niebla et al. (1993), and Ju and Mittal (1995) in Rauf and Sarbini (2015)), water content (method oven), organoleptic tests of color, aroma, taste, and texture (hedonic and numerical scale method Soekarto 1985). Statistical analysis of data using ANOVA (Analysis of variance). Treatments that show a real effect on parameters are then tested using Duncan's Multiple mean difference test (DMRT).

3. Results And Discussion

Table 1 Results different average interaction influence sweet potato flour substitution purple and fermentation time on bread riseability, water absorption, water content, and texture organoleptic tests

Bread Riseability (%)		Water Absorption Capacity (ml/g)		Water content (%)		Organoleptic Texture	
Treatment	Average	Treatment	Average	Treatment	Average	Treatment	Average
S1L4	8.97 ^{A}	S1L1	3.73 ^{A}	S1L1	33.00 ^{A}	S1L4	3, 8 0 ^{A}
S2L4	8.12 ^{B}	S1L4	3.53 ^{B}	S1L2	32.70 ^{B}	S1L3	3, 8 0 ^{A}
S1L3	8.10 ^{B}	S1L2	3.30 ^{C}	S2L1	32.55 ^{B}	S1L2	3, 80 ^{A}
S1L2	7.04 ^{C}	S2L4	3.30 ^{C}	S2L2	32.20 ^{C}	S1L1	3.8 0 ^{A}
S2L3	6.75 ^{CD}	S2L3	3.28 ^{CD}	S1L3	32.10 ^{C}	S2L4	3.40 ^{B}
S3L3	6.38 ^{D}	S1L3	3.25 ^{D}	S2L3	32.10 ^{C}	S2L3	3.20 ^{C}
S3L4	6.36 ^{D}	S4L3	2.98 ^{E}	S1L4	31.75 ^{D}	S2L2	3.00 ^{D}
S2L2	5.60 ^{E}	S3L3	2.95 ^{E}	S2L4	31.70 ^{DE}	S2L1	2.80 ^{E}
S3L2	5.42 ^{E}	S3L4	2.88 ^{F}	S3L1	31.55 ^{EF}	S3L4	2.60 ^{F}
S1L1	5.39 ^{E}	S2L2	2.8 5 ^{FG}	S3L2	31.5 0 ^{F}	S3L1	2.40 ^{G}
S2L1	4.37 ^{F}	S3L2	2.83 ^{GH}	S3L3	30.20 ^{G}	S3L2	2.40 ^{G}
S4L4	4.23 ^{F}	S4L2	2.80 ^{H}	S3L4	29.90 ^{H}	S3L3	2, 4 0 ^{G}
S4L3	4.20 ^{F}	S4L4	2.75 ^{I}	S4L1	29.60 ^{I}	S4L4	2 ,0 0 ^{H}
S4L2	4.13 ^{F}	S2L1	2.68 ^{J}	S4L2	29.45 ^{I}	S4L3	1 .80 ^{I}
S3L1	4.08 ^{F}	S3L1	2.15 ^{K}	S4L3	29.20 ^{J}	S4L2	1.60 ^{J}
S4L1	4.03 ^{F}	S4L1	2.10 ^{L}	S4L4	29.00 ^{K}	S4L1	1.55 ^{K}

Information: Different letters in the same column of notation show significantly different effects at the level 1%.

3.1 Bread Riseability

Table 1 shows that the combination of substitution and fermentation time has a significantly different effect ($p \leq 0.01$) on the riseability of bread. The S1L4 treatment combination produced the highest value, namely 8.97%, and the lowest value was found in the S4L1 treatment combination, 4.03%. In the form of a combination graph substitution for purple sweet potato flour with time fermentation bread swell is served in Figure 1.

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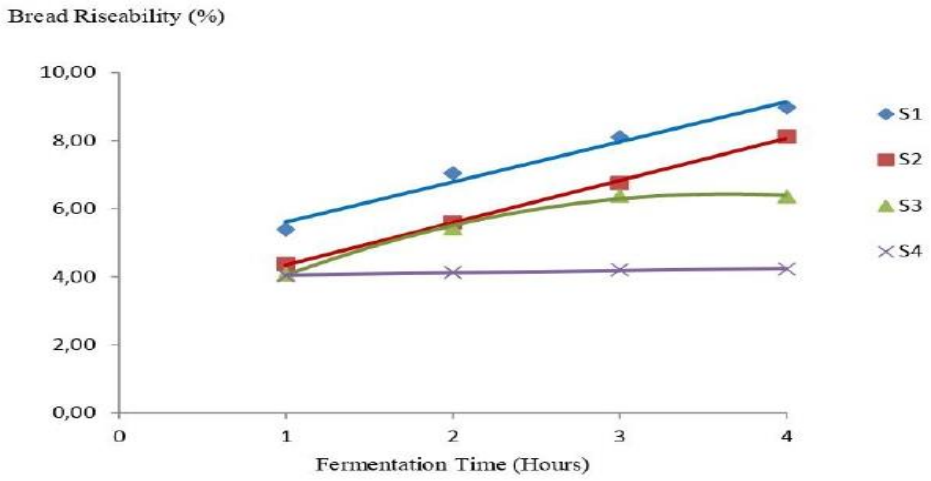

Figure 1. Combination of Purple Sweet Potato Flour Substitution Treatment with Fermentation Time on the Bread Riseability

Figure 1 shows that the S1L4 treatment combination produces the highest Bread Riseability. This is because the gluten content in wheat flour experiences very optimal development resulting in starch swelling, crystalline melting, starch dissolution, spreading, expanding, and expanding. During fermentation, the dough lacks water, causing the gluten walls to absorb and release steam by forming a protective layer that changes into a more stable foam and the dough expands. On the other hand, as more and more purple sweet potato flour is used, the riseability of bread becomes lower (Mayasari *et al*., 2017; Rismaya *et al*., 2018).
Table 1 shows that the S1L1 treatment combination produced the highest water content, namely 33%, and the S4L4 treatment combination, namely 29%. In graphic form, the combination of purple sweet potato flour

3.2 Water Absorption Capacity

Table 1 shows that the combination of purple sweet potato substitution with fermentation time has an effect significant ($p \leq 0.01$) on water absorption capacity. The S1L1 combination produces the highest value, namely 3.73 ml/gr, and the lowest value is found in S4L1, namely 2.10 ml/gr for water absorption capacity. In graphic form, the combination of purple sweet potato flour substitution treatments with time fermentation water absorption capacity is presented in Figure 2.

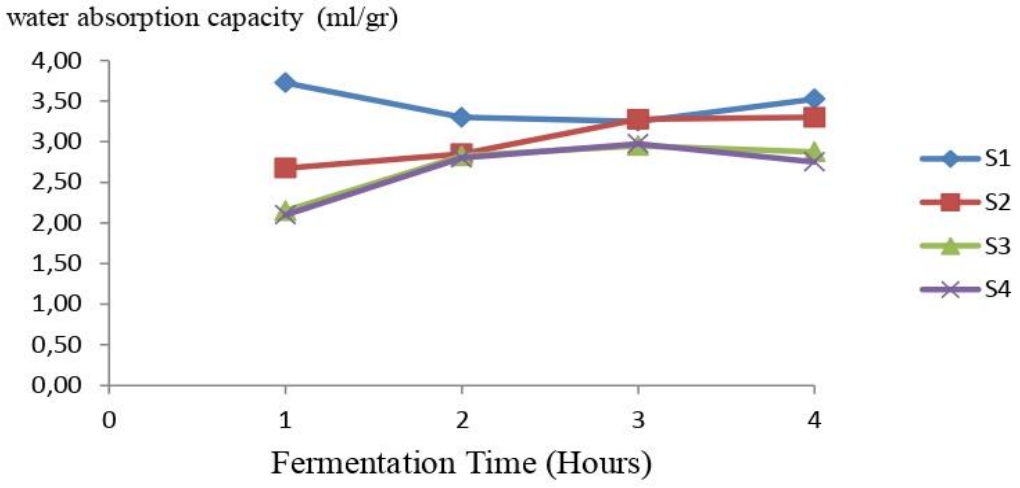

Figure 2. Combination of Purple Sweet Potato Flour Substitution Treatment with Fermentation Time On Water Absorption Capacity.

Figure 2 shows that the combination of S1L1 is the best for water absorption capacity. This is because the high percentage of wheat flour results in high levels of gluten. This gluten can the ability to bind as much CO2 gas as possible from the fermentation reaction, thereby increasing the elasticity of the dough, this condition gives rise to increased swelling power and increased water absorption capacity. From the research results of

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Muthoharoh and Sutrisno (2017), it has been confirmed that white bread produced using more purple sweet potato flour has a relatively small water absorption capacity.

3.3 Water content

Figure 3 shows that the S1L1 treatment combination has the highest water content. This is because white bread is made with a high percentage of wheat flour, whereas natural wheat flour has a high water-holding capacity and can create more pores. The fermentation process requires a long time interval to penetrate the pores of the food resulting in a lot of water vapor being released, so the water content in the food decreases (Handayani *et al.*, 2017).

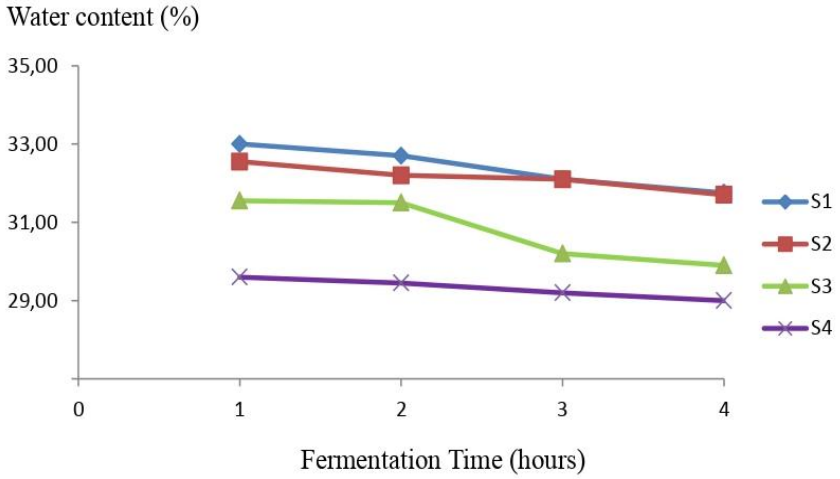

Figure 3. Combination of Purple Sweet Potato Flour Substitution Treatment with Fermentation Time on Water Content

3.4 Organoleptic Texture

Table 1 shows that the S1L4 treatment combination produced the highest organoleptic texture. In the form of a combination graph substitution for purple sweet potato flour and fermentation time. Textural organoleptics are presented in Figure 4.

Figure 4 shows that the substitution of purple sweet potato S1 with all long fermentation treatments is the best treatment combination for texture organoleptic. The organoleptic texture is positively correlated with the percentage of development. Increasing the percentage of expansion will increase the elasticity value of white bread. This is in line with the opinion of Pricilia (2016) who states that fermentation time and protein are the main components of wheat flour which form gluten that can produce dough that is elastic and can withstand gas (CO2) so that it can produce a good texture in bread products. With an increase in sweet potato substitution, the percentage of swelling decreases and will reduce the level of elasticity of white bread, and hardness will increase, so that the panelists' assessment of the organoleptic texture decreases (don't like it).

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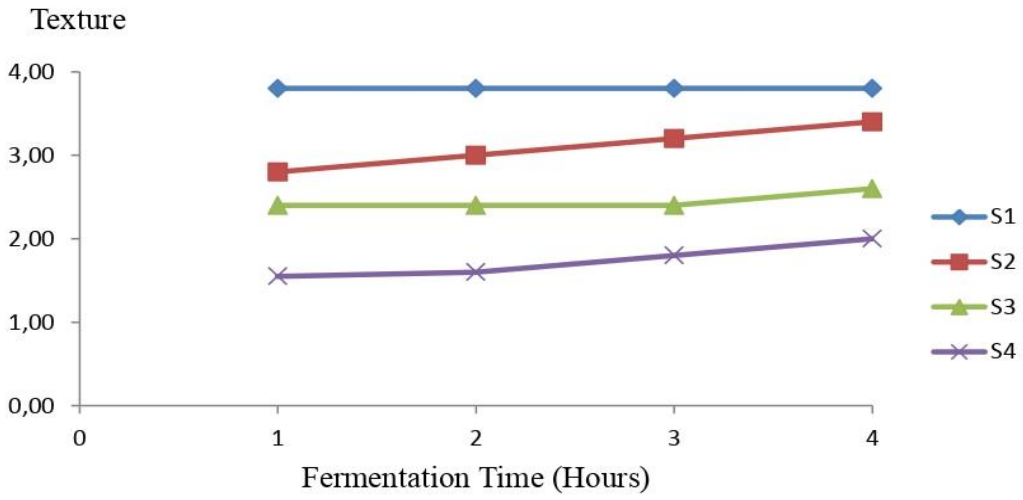

Figure 4 Combination of Purple Sweet Potato Flour Substitution Treatment with Fermentation Time on Organoleptic Texture

4. Conclusions And Recommendations

4.1 **Conclusions**

From the results of the research and discussion of purple sweet potato flour substitution and fermentation time in modified white bread, it can be concluded that the combination of purple sweet potato flour substitution treatment with fermentation time has a significant effect ($p \leq 0.01$) on bread's rising ability, water absorption capacity, content water, and organoleptic texture and its influence is not significantly different on organoleptic color, taste, and aroma.

4.2 R**ecommendations**

To produce good and popular white bread, it can be made using a combination of substitution treatment of 5% purple sweet potato flour and 95% wheat flour with a fermentation time of 4 hours.

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