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PHYSICAL, CHEMICAL, AND SENSORY CHARACTERISTICS OF INSTANT NOODLES MADE BY PURPLE SWEET POTATO FLOUR (*IPOMOEA BATATAS* L. POIR) AT VARIOUS CONCENTRATIONS

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ABSTRACT

Instant noodles are generally made from wheat flour as raw material. The abunandce of purple sweet potatoes can substitute the wheat flour. The purpose of this study was to determine the effect of substitution of purple sweet potato flour at various concentrations on the physical, chemical, and sensory test of instant noodles. The research was conducted at the Agro-Industry Laboratory, Faculty of Agriculture, Tadulako University, from June to December 2019. The experiment was arranged using a completely randomized design (CRD) with 1 factor, namely the substitution of instant noodle purple sweet potato flour at a concentration of 0.5, 10, 15, 20, 25, and 30%. The treatments were repeated three times so that 21 experimental units were obtained. For the sensory test using a randomized block design (RBD) with 30 panelists. The parameters of the observation consisted of the loss of solids due to cooking, water absorption, water content, ash content, and sensory tests. The results of research on substitution of purple sweet potato flour at various concentrations gave the best effect at a concentration of 30% on instant noodles produced based on physical, chemical, and sensory properties. With the highest loss of solids due to cooking, the absorption of instant noodles decreased as the concentration of purple sweet potato flour increased. Instant noodle moisture content constant tendency at each treatment. The ash content of instant noodles increased with increasing concentration of purple sweet potato flour and the sensory properties of color, texture, aroma, and taste of the instant noodles increased with the increasing concentration of purple sweet potato flour on the hedonic scale category. Noodles substituted with purple sweet potato flour can be consumed as instant noodles, such as those circulating in the market.

Keywords: Instant Noodles, Purple Sweet Potato Flour, Wheat Flour.

INTRODUCTION

Sweet potatoes originated from New Zealand, Polynesia, and Central America. Sweet potato is a tropical-subtropical plant with a distribution area of 30 ° N to 30 ° S. This area covers the scope of Indonesia which is located at 6 ° N to 11 ° S, so that

sweet potatoes are suitable to grow in Indonesia. In addition, climatic conditions in Indonesia are suitable for the growth of sweet potatoes, namely high rainfall (750-1,500 mm/year), sunlight 11-12 hours/day, and humidity (RH) 50-60%. National production reaches 2,366. 410 t in 2013, an increase from 1,947,311 t in 2009 (BPS, 2014).

Purple sweet potato (*Ipomea batatas* L. Poir) has very beneficial nutritional content, including provitamin A and vitamin C. Also, purple sweet potato has a dark purple color due to the presence of anthocyanin pigments that spread from the skin to the flesh of the sweet potato (Santosa and Estiasih, 2014).

Anthocyanin compounds are pigments that function as components of healthy food. Anthocyanins can inhibit the rate of free radical cell destruction due to nicotine, air pollution, and other chemicals. Anthocyanins play a role in preventing aging, memory loss, polyps, gout, stomach acid, coronary heart disease, cancer, and degenerative diseases, such as atherosclerosis.

Besides, anthocyanins also can be antimutagenic and anti-carcinogenic against mutagens and carcinogens found in food and processed ingredients, prevent disturbances in liver function, anti-hypertension, and reduce blood sugar levels. Almost all the nutrients contained in purple sweet potatoes support their ability to fight coronary heart attacks (Hasyim and Yusuf, 2012).

Not everyone can consume instant noodles using wheat flour or wheat flour as raw materials. One of them is people with celiac disease, known as a gluten allergy, who are intolerant of the presence of gluten in wheat flour (Fassano and Carlo, 2012).

The processing of instant noodles themselves is generally processed with wheat raw materials, and this raw material is still obtained by import, from the BPS data obtained every year, Indonesia imports at least 4.5 million tons of wheat or spends foreign exchange up to Rp. 12.2 trillion. Meanwhile, for flour, it reaches 3.5 million tons of flour with a value of Rp. 98 trillion. Data from the Central Statistics Agency (BPS 2006) mentioned, imports of Indonesian wheat commodity in September 2006 recorded the highest record, which jumped 81.04 percent to the US $ 135.6 million from the US $ 74.9 million, the increase was quite sharp above the US $ 50 million.

The raw material for wheat flour in instant noodles can be replaced with purple sweet potato flour which is richer in benefits. The fortification of instant noodles using purple sweet potato flour can also be used

as a solution for people with celiac disease because purple sweet potatoes do not contain gluten. But in fact, research on this matter is still under-researched while the advantages of purple sweet potato flour can provide added value to higher quality instant noodles. This motivated the researchers to conduct research related to the physical-chemical and sensory characteristics of instant noodles with the substitution of purple sweet potato flour (*Ipomoea batatas* L. poir) at various concentrations.

MATERIALS AND METHODS

Research design

The research was conducted at the Agro-Industry Laboratory, Faculty of Agriculture, Tadulako University. The research was conducted from June to December 2019

The experiment was arranged using a completely randomized design (CRD) with 1 factor repeated 3 times so that 21 experimental units were obtained which refers to the research of Utomo and Yulifianti (2011) with the formulation of the ingredients of wheat flour: purple sweet potato flour where the flour is symbolized by P and the purple sweet potato flour is symbolized by T. The sensory test used a randomized block design.

P0 (100% wheat flour): T0 (0% purple sweet potato flour),

P1 (95% wheat flour): T1 (5% purple sweet potato flour),
P2 (90% wheat flour): T2 (10% purple sweet potato flour),
P3 (85% wheat flour): T3 (15% purple sweet potato flour),
P4 (80% wheat flour): T4 (20% purple sweet potato flour),
P5 (75% wheat flour): T5 (25% purple sweet potato flour).
P6 (70% wheat flour): T6 (30% purple sweet potato flour),

Producing Purple Sweet Potato Flour

The process of making purple sweet potato flour (Suismono, 1995) as follows. The first stage of washing aims to clean the purple sweet potato from dirt and soil. This process is accompanied by a sorting process for purple sweet potato pests which are usually marked by the presence of small holes in the sweet potato or bruises or bruises. The second stage is peeled to get the really good quality of the raw material, because in fact, even without stripping it is still acceptable. panelists on the organoleptic test both in color and aroma. However, microbial, mold/yeast levels are more common in unpeeled products than in peeled products. The third stage is steam blanching at temperatures (70-100^{o}C), which is rapid heating to inactivate enzymes and stabilize foodstuffs during the long-term drift. long. Steam blanching can be done in water, steam, or using microwave energy. The fourth stage of slicing is a size reduction process that aims to speed up drying and simplify the pressing and pressing process. Slicing can be done manually using a knife. The fifth stage of immersion There are several methods of processing purple sweet potatoes that carry out the immersion stage in a 0.5% sulfite solution before drying. Sulfite compound 0.5% for 5 minutes to prevent browning. The production stage is drying. Drying occurs through the evaporation of the liquid by applying heat to the wet material. Compared to natural dryers (with sunlight) for 9 hours, artificial dryers have more advantages, for example, the dried material will dry faster, process faster, and avoid unwanted foreign materials, because the environmental conditions can be controlled. purple sweet potato is a flouring process using a flouring machine equipped with a sieving device with a size of 60-100 mesh.

Producing Noodles

The process of making noodles uses the method developed by Hambali et al. (2006) and a few modifications are as follows. First, mix wheat flour with purple sweet potato flour in the ratio according to treatment (total 100%). Second, the additional ingredients are added table salt (2%), eggs (20 ml), CMC (0.5%) and water (40 ml). Then stir for 20 minutes, then form a sheet of dough and mold it using ampia. Steamed using a temperature of 100 ° C for 12 minutes. Then dried in an oven at 50 ° C for 2.5 hours, and finally analyzed the dry noodles with the following parameters: water absorption, loss of solids due to cooking, moisture content, ash content, and sensory test (color, texture, aroma, and taste).

RESULTS AND DISCUSSION

Loss of Solids Due to Cooking

The effect of purple sweet potato flour concentration on solid loss can be determined by analyzing variance. The results of the analysis of variance showed that the concentration of purple sweet potato flour had no significant effect on solids loss. The average solids loss is presented in Figure 3.

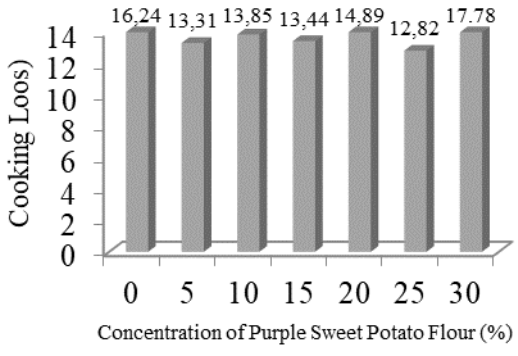

Figure 3. Average solids loss at Various Concentrations of Purple Sweet Potato Flour

Figure 3 shows that the average solids loss with the concentration of purple sweet potato flour was 30% higher and experienced a loss of solids due to cooking while for the lower the concentration of purple sweet potato was 25% compared to other concentrations of purple sweet potato.

These results indicate that the substitution of purple sweet potato flour at a concentration of 30% produces high cooking loos with a ratio of 70:30 flour usage. The higher the addition of flour and the less the addition of purple sweet potato flour, the level of the cooking loss value tends to decrease.

According to Widatmoko et al., (2015). The loss of solids due to cooking is higher due to the weak binding power of the dough components so that there are components that dissolve at the time of boiling.

Cooking loss is the number of ingredients from dry noodles that are lost during boiling. The dissolved starch component will decrease if there is gluten that covers or traps the starch. The greater the cooking loss, the less desirable the dry noodle product is, this is because a large cooking loss can cause the turbidity of the water used during cooking and feels sticky in the mouth (Uba'idillah, 2015).

Cooking loss is caused by the bursting of the swollen starch granules and then the short-chain linear starch molecules will come out of the granules and enter the stew causing the water to become cloudy. Another cause of cooking loss is the weak binding power of the dough components so that there are components that dissolve at the time of boiling. The decreased presence of gluten causes the ability to form three-dimensional networks that can inhibit the release of starch granule contents reduced (Widatmoko and Estiasih, 2015).

Water Absorption

The results showed that the concentration of purple sweet potato flour had a very significant effect on water absorption. The average water absorption capacity is presented in Table 6.

The results of the post hoc test (Table 6) show that the amount of water absorption in the treatment of purple sweet potato flour concentrations of 0%, 5%, 10%, 15%, 20%, 25%, 30% are different and the concentration of purple sweet potato flour, at Table 6 also shows that a concentration of 20% produces the highest water absorption, while a concentration of 30% purple sweet potato flour, shows the lowest water absorption.

Table 6. Average water absorption capacity at various concentrations of purple sweet potato flour.

Concentration of Purple Sweet Potato Flour (%)	Water absorb (%)	LSD 5%
0	107.54e	0.20
5	85.52b	
10	112.93f	
15	91.92c	
20	113.44g	
25	95.09d	
30	71.41a	

These results indicate that the substitution of purple sweet potato flour at a concentration of 20% high water absorption with a ratio of 80:20 flour use. This is because the high protein type of wheat flour has high water absorption. Other studies have shown that the higher water absorption value causes the noodles to soften easily when boiled (Sugiyono et al., 2011) and water absorption shows the ability of flour to absorb water (Suarni 2009).

Water content

The results showed that the concentration of purple sweet potato flour had a significant effect on water content. The average amount of water content is presented in Table 7.

The results of the Tukey' HSD test (Table 7) showed that the amount of water

content in the treatment of 0%, 15%, 20%, 25%, and 30% purple sweet potato flour concentration was not different and the concentration of purple sweet potato flour was also shown in (Table 7). that at a concentration of 10% produced the highest water content, while the concentration of 5% purple sweet potato flour and 10% different concentrations of purple sweet potato flour, showed the lowest water content at a concentration of 5%.

Table 7. The average amount of water content at various concentrations of purple sweet potato flour.

Concentration of Purple Sweet Potato Flour (%)	Water content (%)	LSD 5%
0	10.30ab	0.93
5	9.75a	
10	10.83b	
15	9.96ab	
20	10.02ab	
25	10.68ab	
30	10.57ab	

Note: The mean followed by the same letter in the same column does not differ at the level of LSD test α = 0.05

These results indicate that the substitution of purple sweet potato flour at a concentration of 10% high water content with a ratio of 90:10 flour use. The higher the addition of flour, the higher the moisture content in the instant noodles.

Widatmoko and Teti Estiati (2015). He stated that noodles made from purple sweet potato had the best moisture content treatment value, namely 4.66%, where previously the main ingredient of purple sweet potato had 5.09% moisture content and 6% wheat flour.

Moisture content is one of the most important aspects of starch-based products, as it is closely related to the shelf life of a product. Water content that exceeds 12% can stimulate microbial growth, while the lower the water content can increase shelf life (Aryee et al., 2013).

Dust Content

The results showed that the concentration of purple sweet potato flour had a very significant effect on dust content. The average ash content is presented in Table 8.

The results of the Tukey' HSD test (Table 8) show that the amount of ash content in the treatment of purple sweet potato flour concentrations of 0%, 5%, 10%, 15%, 20%, 25%, is not different and the concentration of purple sweet potato flour is (Table 8) also showed that a concentration of 0% produced the lowest ash content, while a different concentration of 30% purple sweet potato flour, showed the highest ash content.

Table 8. Average ash content at various concentrations of purple sweet potato flour

Concentration of Purple Sweet Potato Flour (%)	Dust content (%)	LSD 5%
0	28.75^{b}	3.81
5	30.86^{b}	
10	30.71^{b}	
15	31.04^{b}	
20	29.6^{b}	
25	29.67^{b}	
30	34.14^{a}	

Note: The mean followed by the same letter in the same column does not differ at the level of LSD test α = 0.05

These results indicate that the substitute purple sweet potato flour at a concentration of 30% high ash content with a ratio of 70:30 flour use. High ash content indicates high mineral content. According to Ambarsari et al, (2015). High levels of ash in a product indicate a high mineral content, and other studies have stated that mineral elements are also known as inorganic substances or ash content. Purple sweet potato flour using the

pemlanchingan process has a higher ash content when compared to purple sweet potato flour which is not carried out. This is because the blanching process uses water with mineral content contained in the water and enters the cell tissue (Winarno, 2002).

Sensory Test Analysis

Color

The results showed that the concentration of purple sweet potato flour had a very significant effect on color. The average colors are presented in Table 9.

The results of the Tukey' HSD (Table 9) showed that the level of preference for color in the treatment of 10%, 20% purple sweet potato flour concentration was not different. For the treatment, the concentrations of 25% and 30% were not different. The concentration of purple sweet potato flour, Table 9 also shows that at a concentration of 5% it produces the lowest level of color preference.

Table 9. Average colors at various concentrations of purple sweet potato flour.

Concentration of Purple Sweet Potato Flour (%)	Color (%)	LSD 5%
0	4.47ab	
5	3.87a	
10	4.80bc	
15	4.73abc	0.87
20	5.20bc	
25	5.40c	
30	5.53c	

Note: The mean followed by the same letter in the same column does not differ at the level of LSD test $\alpha = 0.05$

The results of Tukey' HSD test (Table 9) showed that the level of preference for color in the treatment of 10%, 20% purple sweet potato flour concentration was not different. For the treatment, the concentrations of 25% and 30% were not different. The concentration of purple sweet potato flour, Table 9 also shows that at a concentration of 5% it produces the lowest level of color preference. While the concentration of purple sweet potato flour was 0%, 5%, 10% which were different, indicating the level of preference for the panelists to color at the highest 30% concentration.

The more the use of purple sweet potato flour, the more anthocyanin content will be and have an impact on the color of the instant noodles produced. The purple color of the noodles comes from the purple sweet potato flour which contains anthocyanin pigments. The types of anthocyanins found in purple sweet potatoes are peonidin and cyanidin (Nintami and Rustanti, 2012). The reason for the panelists' acceptance of the color of purple sweet potato flour using the blanching process was reduced (dislike) due to a non-enzymatic browning reaction in the form of a Maillard reaction during the blanching process which uses heat and dehydration (removal of most of the water).

Texture

The results showed that the concentration of purple sweet potato flour had a very significant effect on the texture. The average texture is presented in Table 10.

The results of Tukey' HSD test (Table 10) show that the level of preference for the texture in the concentration of 0% and 5% purple sweet potato flour treatment is not different. For the treatment, the concentration of 10% and 15% purple sweet potato flour was not different, nor did the concentrations of 20% and 25% purple sweet potato flour differ.

The concentration of purple sweet potato flour in (Table 10) also shows that a concentration of 5% produces the lowest texture level, while a different concentration of 30% purple sweet potato flour shows the highest level of texture at a concentration of 30%.

Table 10. Average Texture at Various Concentrations of Purple Sweet Potato Flour.

Concentration of Purple Sweet Potato Flour (%)	Texture (%)	LSD 5%
0	4.20a	
5	4.13a	
10	4.73ab	
15	4.53ab	0.83
20	5.13bc	
25	5.27bc	
30%	5.80c	

Note: The mean followed by the same letter in the same column does not differ at the level of LSD test $\alpha = 0.05$

From the analysis, the texture preference value is influenced by the chewiness and softness of the instant noodles when chewed or touched with fingers. The sticky texture is caused by the sugar content in sweet potatoes. When heating or blanching, the starch content contained in sweet potatoes is broken down into simple sugars.

According to Anastasia and Vivian (2018). The factors forming the texture of instant noodles, namely raw materials, processing, and chemical factors. The raw materials that determine the texture of instant noodles are white sweet potato flour, Moringa leaf flour, CMC, STPP, and ash water. The flour ingredients do not contain the gluten found in wheat, which causes the texture of the noodles to be inelastic and break easily. The use of CMC and ash water which was intended to improve the texture of instant noodles did not make the noodles resemble instant noodles without the usual.

Smell

The results showed that the concentration of purple sweet potato flour had a very significant effect on the smell. The average aroma is presented in Table 11.

The results of Tukey' HSD test (Table 11) show that the level of preference for aroma in the concentration of 0% and 10% purple sweet potato flour treatment is not different. Concentrations of 5% and 15% were not different for the treatment. The concentration of purple sweet potato flour, Table 11 also shows that the concentrations of 5% and 15% produce the lowest level of flavor preference. While the concentration of purple sweet potato flour was 20%, 25%, 30% different, indicating the level of preference for the panelists to aroma at the highest 30% concentration.

Table 11. Average aroma at various concentrations of purple sweet potato flour.

Concentration of Purple Sweet Potato Flour (%)	Smell (%)	LSD 5%
0	4.07ab	
5	4.00a	
10	4.27ab	
15	4.00a	0.86
20	4.87bc	
25	4.73abc	
30	5.40c	

Note: The mean followed by the same letter in the same column does not differ at the level of LSD test $\alpha = 0.05$

The results of Tukey' HSD test in Table 11 show that the level of preference for aroma in the concentration of 0% and 10% purple sweet potato flour treatment is not different. Concentrations of 5% and 15% were not different for the treatment. The concentration of purple sweet potato flour in (Table 11) also shows that a concentration of 5% and 15% produces the lowest level of preference for aroma, while different concentrations of purple sweet potato flour are 20%, 25%, 30%, indicating the level of preference for the panelists to the smell at the highest 30% concentration.

The smell of food comes from the molecules that evaporate from the food which are captured by the nose as a sense of smell. The aroma will be felt stronger when cooking such as baking or frying because the number of molecules that

evaporate is greater. The aroma of instant noodles is also influenced by the additional ingredients that are mixed during the processing (Betty et al., 2016).

The more use of purple sweet potato flour, the aroma of instant noodles that is produced will be more flavorful of purple sweet potato. This is because purple sweet potatoes have a pleasant aroma that comes from the oxidation of fat, which causes hydroperoxide to appear during the heating process (Nintami and Rustanti, 2012).

Taste

The results showed that the concentration of purple sweet potato flour had a very significant effect on taste. The average flavors are presented in Table 12. The results of Tukey' HSD test. Table 12. show that the level of preference for taste in the treatment of concentrations of purple sweet potato flour was not different. For the treatment, the concentrations of 20% and 25% were not different.

The concentration of purple sweet potato flour in Table 12 also shows that a concentration of 10% produces the lowest taste preference level, while a different concentration of 30% purple sweet potato flour shows the level of preference for the panelists to taste at the highest 30% concentration.

Table 12. Average Flavors at Various Concentrations of Purple Sweet Potato Flour.

Concentration of Purple Sweet Potato Flour (%)	Taste (%)	LSD 5%
0	4.53[a]	
5	4.33[a]	
10	4.00[a]	
15	4.60[a]	0.94
20	5.00[ab]	
25	4.87[ab]	
30	5.67[b]	

Note: The mean followed by the same letter in the same column does not differ at the level of the LSD test $\alpha = 0.05$

The LSD test results (Table 12) show that the level of preference for taste in the treatment of 0%, 15%, 10%, 15% purple sweet potato flour concentration was not different. For the treatment, the concentrations of 20% and 25% were not different. The concentration of purple sweet potato flour in (Table 12) also shows that a concentration of 10% produces the lowest taste preference level, while a different concentration of 30% purple sweet potato flour, shows the level of preference for the panelists to taste at the highest 30% concentration.

According to Sulistiyo (2016). Whereas the main components of carbohydrates in sweet potatoes are starch, dietary fiber (cellulose, hemicellulose), and several types of soluble sugars such as maltose, sucrose, fructose, and glucose.

The analysis showed that the difference in the percentage of use of purple sweet potato flour and wheat flour in the making of instant noodles affected the taste of the instant noodles. This is because the purple sweet potato flour and wheat flour contain different carbohydrates, fats, and proteins. The sweet taste of purple sweet potato exerts an influence on this taste parameter. Purple sweet potato carbohydrates consisting of starch, sugar, cellulose, hemicellulose, and pectin (Wiguna, 2009).

CONCLUSIONS

The substitution of purple sweet potato flour at various concentrations affects the physical, chemical, and sensory properties of the instant noodles produced. The concentration of substitute purple sweet potato flour 30% gave the best effect with solid loss at17.78%, water absorption 71.41%, water content 10.57%, ash content 34.14%, and sensory test on color 5.53% level. liking scale, aroma 5.40% like scale level, taste 5.67% like scale level, and texture 5.80% like scale level. The addition of ingredients and treatment affects the yield of instant noodles.

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