Proportion of Wheat (Triticum aestivum L.) and Kimpul (Xanthosoma sagittifolium) Flours and Dragon Fruit (Hylocereuscostaricensis) Substitution on Wet Noodle

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Proportion of Wheat (*Triticum aestivum* L.) and Kimpul (*Xanthosoma sagittifolium*) Flours and Dragon Fruit (*Hylocereuscostaricensis*) Substitution on Wet Noodle

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ABSTRACT

Wet noodle is a food product that is liked by all levels of society. The main ingredient for making wet noodle is wheat flour which must be imported from other countries. For this reason, it is necessary to look for other alternative raw materials, namely kimpul flour. Red dragon fruit can be used to increase nutritional value because it contains antioxidant and improves product appearance because it contains natural dyes. The purpose of the study was to determine the effect of the proportion of wheat and kimpul flours, as well as the concentration of dragon fruit on the quality of dragon fruit wet noodle. This study used a factorial randomized block design (RBD) with the first factor being the proportion of wheat flour and kimpul flour (T1 = 40%:60%, T2 = 50%:50% and T3 = 60%:40%) and the second factor was dragon fruit concentration (N1 = 20% and N2 = 30%) with 3 replications. The results showed that the proportion of wheat flour and kimpul flour had a significant effect on protein content, elasticity, and organoleptic tests. While the concentration of dragon fruit significantly affected the water content, carbohydrate content, elasticity, and organoleptic tests. The conclusion of this research was the treatment of T3N2 (proportion of wheat flour and kimpul flour 60%: 40% and dragon fruit concentration 30%) became the selected treatment with parameters of water content 48.51%, ash content 1.72%, protein content 6 0.04%, fat content 2.64%, carbohydrate content 41.09%, and elasticity of 0.39, and has a total preference percentage of 100% color, 96.7% aroma, 100.0% taste and 96.7% texture.

Keywords: *Dragon Fruit; Kimpul Flour; Quality; Wet Noodle*

INTRODUCTION

Noodle are food products made from wheat flour and widely consumed because they are quite easy to be served and can be used as a substitute for rice. Noodle products are generally used as an source of energy because of their relatively high carbohydrate content (Pranoto, 2011). One of the popular types of noodle is wet noodle. Wet noodle are fresh noodle that have been boiled and are usually lightly oiled to prevent the noodle from sticking together. The water content can reach 52% so that the shelf life is relatively short, which is 40 hours at room temperature. Wet noodle do not need to be boiled before use, just brewed with hot water or washed with boiled water to remove the remaining flour or oil (Astawan, 2008).

Wheat import data in 2019 has increased, from 10,096,299.2 kg in 2018, increasing to 10,692,978.0 kg in 2019 (BPS, 2020), so it is necessary to look for alternative food ingredients as a substitute flour. The type of tuber that has potential as a source of carbohydrates in the manufacture of wet noodle is kimpul tuber (*Xanthosoma sagittifolium*). The biggest components of kimpul taro tubers are water and carbohydrate so they have the potential to be developed as a processed noodle product (Jatmiko and Estiasih, 2014). Referring to research of Revitriani et al. (2013), kimpul flour that can be used to substitute wheat flour for wet noodle processing with high quality product is 10%. The chemical composition of kimpul is water 63.1%, protein 1.2%, fat 0.4%, carbohydrates 34.2%, starch 70.73%, fiber 1.5%, ash 1.0%,

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vitamin C 2.0/100g, calcium 26.0 mg/100g and Fe 1.4 mg/100g (Ridal, 2003). The advantage of kimpul tubers is that it contains diosgenin which is useful as an anti-cancer, inhibits cell proliferation, and has a hypoglycemic effect.

Dragon fruit has a deep red color so it can produce a more attractive noodle color. According to Jafar, Ali, Nazri, and Khairuddin (2009), in 100 g of dragon fruit, it contains 60 kl of calories, 0.53 g of protein, 11.5 g of carbohydrates, 0.71 g of fiber, calcium 134.5 mg, phosphorus 87 mg, iron 0.65 mg, vitamin C 9.4 mg and the water content is 90 g. Red dragon fruit also contains flavonoids as much as 7.21 ± 0.02 mg CE/100 grams (Wu et al., 2005), niacin, vitamin C and dietary fiber in the form of pectin (Kristanto, 2008), antioxidant phytoalbumin, polyunsaturated fatty acids, iron, calcium, phosphorus, protein (Ariffin et al., 2008). Other food substances contained in dragon fruit are fiber, calcium, iron, and phosphorus which are useful for preventing hypertension (Zainoldin and Baba, 2009 in Putri, 2017). The research of Wahyuningsih et al. (2021) showed that 500 g of dragon fruit juice was effective for increasing hemoglobin levels.

Dragon fruit is widely used as an additive or substitute for wheat flour in wet noodle products because of its fiber content, antioxidant content, natural dye content and antimicrobial activity. In accordance with the content of natural coloring agents, fiber, and antioxidant and antimicrobial activity, dragon fruit is becoming popular as an additional source or substitute for wheat flour in wet noodle products. The substitution of dragon fruit skin can increase the sensory hedonic of wet noodle products (Engelen, 2019), fruit skin to increase the shelf life of wet noodle. However, with the increasing concentration of the solution, it will affect the smell and taste of wet noodle which become unpleasant (Enjelina et al., 2019). The results of Savitri and Suwita's research (2017) show that an increase in the proportion of red dragon fruit peel can increase crude fiber levels and increase antioxidant activity as well. Meanwhile, research by Yuliani et al. (2021) showed that dragon fruit peel substitution will increase sensory hedonic in wet noodle products.

Noodle and their processed products are quite popular in Indonesia. Therefore, noodle products must be made using local raw materials in this case kimpul flour and dragon fruit substitution to improve the quality of the noodle produced. The purpose of the study was to determine the effect of the proportion of wheat and kimpul flours, as well as the concentration of dragon fruit on the quality of dragon fruit wet noodle.

METHODS

Materials

The ingredients used in wet noodle processing are dragon fruit, wheat flour, kimpul flour, tapioca flour, eggs, whiting water and salt. Chemicals used for analysis included petroleum ether (Merck, GR), H2SO4 (Merck, GR), NaOH (Merck, GR), boric acid (Merck, GR), methylene blue (Merck, GR), and HCl (Merck, GR).

Tools

The tools are used in the processing of wet noodle are noodle maker machine, stoves, steaming pans, baking sheets, and scales. The tools used for analysis include analytical balance (Ohaus), drying oven (Binder), muffle furnace (Wisd), water bath (Memerth), and glassware (pyrex).

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Research Design

This study used a factorial randomized block design (RBD) with treatment factors for the proportion of wheat flour and kimpul flour (T) with 3 levels, namely T1 = 40%:60%, T2 = 50%:50%, and T3 = 60%:40 % and the second factor is the concentration of dragon fruit (N) with 2 levels, namely N1 = 20% and N2 = 30%. Each treatment was repeated three times.

Test Parameters

Tests were carried out to measure the quality of wet noodle in this test include elasticity (Effendi, Z., et al., 2016), water content (AOAC, 1995, Nielsen, 2019), fat content (AOAC, 1995, Nielsen, 2019), protein content (AOAC, 1995, Nielsen, 2019), ash content (AOAC, 1995, Nielsen, 2019), carbohydrate content by difference (Winarno, 2008), and organoleptic tests (Stone and Joel, 2004).

Data Analysis

The data were analyzed using analysis of variance and if there was a significant difference, it was continued with Duncan's test. Organoleptic test data is non-parametric data so that the data were analyzed using descriptive test and Friedman test.

Alternative Selection

Alternative selection was done to choose the best treatment with the expected value method. The criteria considered were carbohydrate content, aroma, protein content, water content, taste, color and texture. To determine the weight of each criterion, the Analytical Hierarchy Process (AHP) method was used.

RESULT AND DISCUSSIONS

Chemical Characteristics of Wet Noodle

The results in the chemical analysis of wet noodle can be seen in Table 1.

Table 1. Chemical characteristics of wet noodle

Treatment	Water Content (%)	Ash Content (%)	Protein Content (%)	Fat Content (%)	Carbohydrate Content (%)	Elasticity Value
T1N1	40.89	1.79	3.15	2.75	51.42	0.18
T2N1	42.11	1.91	4.40	2.10	49.47	0.34
T3N1	41.58	1.91	6.89	2.32	47.30	0.65
T1N2	46.63	1.80	3.24	2.23	46.10	0.14
T2N2	47.09	1.88	3.13	2.27	45.62	0.28
T3N2	48.51	1.72	6.04	2.64	41.09	0.39

Water Content

The results in the analysis of variance showed that there was no interaction between factors, the proportions of wheat flour and kimpul flour had no significant effect on the water

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content of dragon fruit noodle, while the concentration of dragon fruit significantly affected the water content of dragon fruit noodle. The increase in the amount of water content was due to the water content in dragon fruit which was large enough so that an increase in the concentration of dragon fruit will increase the water content of dragon fruit noodle products. According to Ide (2009), 100 g of dragon fruit contained 96 g of water. Based on SNI 2987-2015, the maximum water content standard for cooked wet noodle is 65%. While the results of the water content test of dragon fruit noodle in all treatments had values below the maximum standard of SNI, namely T1N1 of 40.89%, T2N1 of 42.11%, T3N1 of 41.58%, T1N2 of 46.63%, T2N2 of 47, 09%, and T3N2 at 48.51%. Therefore, it can be concluded that all treatments are included in the SNI standard.

Ash Content

The results of the analysis of variance showed that there was no interaction between factors, the proportion of wheat flour and kimpul flour and the concentration of dragon fruit had no significant effect on the ash content of dragon fruit noodle. This is due to the small amount of ash content in each ingredient so it doesn't really affect the ash content in dragon fruit noodle products. The ash content in kimpul flour is 3.59% (Minantyo et al., 2017), wheat flour is 0.46%,and 0.28% in dragon fruit (Ide, 2009).

Fat Content

The results in the analysis of variance showed that there was no interaction between factors, the proportion of wheat flour and kimpul flour and the concentration of dragon fruit had no significant effect on the fat content of dragon fruit noodle. This is due to the small amount of fat content in each ingredient so it does not really affect the fat content of dragon fruit noodle products. The fat content in kimpul flour is 0.06% (Minantyo et al., 2017), 1.20% wheat flour, and dragon fruit 0.21%-0.61% (Ide, 2009).

Protein Content

The results in the analysis of variance showed that there was no interaction between factors, the proportions of wheat flour and kimpul flour had a significant effect, while the concentration of dragon fruit had no significant effect on the protein content of dragon fruit noodle.

Table 2. Duncan test results in the proportion factor of wheat and kimpul flours on protein levels of dragon fruit noodle

Treatments (Wheat Flour:Kimpul Flour)	Protein (%)
T1=40%:60%	3.1950 [b]
T2=50%:50%	3.7650 [b]
T3=60%:40%	6.4633 [a]

Note: different letters in the same column indicate a significant difference at α = 5%

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In Table 2, it can be seen that the more the amount of wheat flour used, the higher the protein content in dragon fruit noodle products. The increase in protein content was due to the higher protein content of wheat flour than the protein content of kimpul flour. The amount of protein in wheat flour was 11.80%, while according to Minantyo et al. (2017) the protein content in kimpul flour was 7.8%. The amount of protein contained in the noodle will also determine the elasticity value of the noodle. Where the higher the protein content of the noodle, the higher the elasticity value of the noodle. This is in accordance with research by Umri et al. (2017) which explains that the lower the protein content in noodle, the elasticity value will also decrease. This is because the peptide bonds are short, so it doesn't take a lot of energy to break the bonds. Based on SNI 2987-2015 regarding wet noodle, the standard minimum protein content of cooked wet noodlewas 6.0%. The treatments that met the SNI criteria were the T3N1 treatment with a protein moisture content of 6.89% and the T3N2 treatment which had a protein content of 6.04%. While the T1N1, T2N1, T1N2 and T2N2 treatments had protein levels of 3.15%, 4.40%, 3.24% and 3.13%, respectively, which did not meet the criteria for the maximum protein content of SNI 2987-2015.

Carbohydrate Content

The results of the analysis of variance showed that there was no interaction between factors, the proportion of wheat flour with kimpul flour had no significant effect, while the concentration of dragon fruit had a significant effect on the carbohydrate content of dragon fruit noodle. This decrease in carbohydrate content was caused by the addition of more dragon fruit, the percentage of the amount of flour (wheat flour and kimpul flour) in the dough will decrease so that the carbohydrate content will decrease as well. In addition, the high-water content in dragon fruit affects the amount of carbohydrate contained in dragon fruit noodle. The more amount of dragon fruit used, the higher the water content in dragon fruit noodle, so that the carbohydrate content in the product will decrease because of the reduction in water content in the calculation of the greater carbohydrate content. According to Winarno (2008) Carbohydrate content was determined from the results of a 100% reduction with water content, ash content, fat content and protein content (by difference). So the carbohydrate content was very dependent on the reduction factor. This is in accordance with the results of the analysis of dragon fruit noodle products which show that there was an increase in water content along with the addition of dragon fruit concentration.

Elasticity

Strain test is a test that aims to determine the level of elasticity/stretch/ elongation of wet noodle after being boiled / cooked. The greater the breaking power of the noodle, the noodle will have a chewy texture and are usually preferred by consumers (Effendi et al., 2016). The results of the analysis of variance showed that there was no interaction between the 2 factors, but the proportions of wheat flour and kimpul flour and the concentration of dragon fruit had a significant effect on the elasticity of dragon fruit noodle.

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Table 3. Duncan test results of the proportion factor of wheat flour and kimpul flour on elasticit of dragon fruit noodle

Treatments (Wheat Flour:Kimpul Flour)	Elasticity
T1=40%:60%	0.1600 c
T2=50%:50%	0.3083 b
T3=60%:40%	0.5200 a

Note: different letters in the same column indicate a significant difference at α = 5%

The increase in elasticity of dragon fruit noodle along with the addition of the proportion of wheat flour was due to the fact that wheat flour had a higher protein content than kimpul flour. According to Astawan (2008), high protein flour (hard wheat) contains 12-13% protein. Hard wheat flour is able to absorb large amounts of water, can achieve the right dough consistency and has good elasticity. The amount of protein contained in the noodle will also determine the elasticity value of the noodle. Where the higher the protein content of the noodle, the higher the elasticity value of the noodle. This is in accordance with research by Umri et al (2017) which explains that the lower the protein content in noodle, the elasticity value will also decrease. This was because the peptide bonds are short, so it doesn't take a lot of energy to break the bonds.

According to Permatasari et al. (2009), wheat flour contains a lot of gluten or wheat protein. Gluten consists of gliadin and glutenin. Gliadin has a function as an adhesive and makes the dough elastic while glutenin has the function of making the dough firm and holding CO_2 gas so that the dough can expand and will form pores. The reduced amount of wheat flour in the dough for making noodle will result in a decrease in elasticity in wet noodle products. The decrease in elasticity of dragon fruit noodle was caused by the increasing concentration of dragon fruit, due to the high amount of water contained in dragon fruit. The more dragon fruit used in the manufacture of dragon fruit noodle, the water content in dragon fruit noodle will increase as well. With the increase in water content in dragon fruit noodle products, dragon fruit noodle break easily. This was supported by the statement of Billina et al. (2014) which states that increasing the water content in wet noodle will result in the physical properties of noodle such as water absorption, noodle expansion power and noodle elasticity decrease. The more ingredients other than flour are added to the noodle dough, the less flour will be. The reduced flour causes a reduction in the gluten content and will affect the noodle to become inelastic.

Organoleptic Characteristics of Noodle

The organoleptic characteristics of color, aroma, taste, and texture of wet noodle can be seen in Figure 1.

Color

Friedman test results showed that there was a significant effect between the proportion of wheat flour and kimpul flour and the concentration of dragon fruit on the color of dragon fruit noodle products. The color difference in each treatment was due to the difference in the

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number of dragon fruit used, the more dragon fruit used, the redder the color of the dragon fruit noodle produced. The addition of red dragon fruit extract showed pink noodle with different brightness colors, according to the volume of dragon fruit extract added. This pink color was due to the color component found in the skin of the red dragon fruit, namely betacyanin (Oktiarni, 2012).

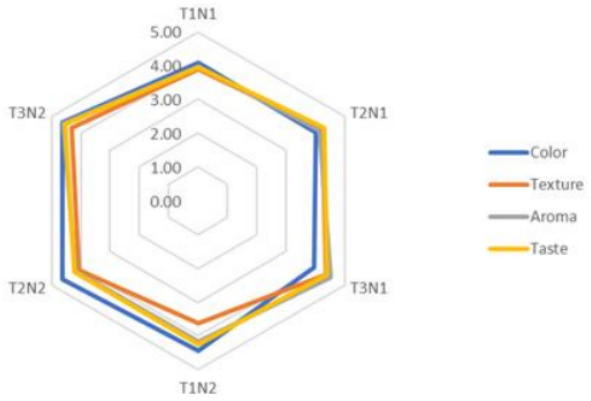

Figure 1. Graph of wet noodle organoleptic data

Aroma

Friedman test results showed that there was a significant effect between the proportion of wheat flour and kimpul flour and the concentration of dragon fruit on the aroma of dragon fruit noodle products. The difference from aroma in each treatment was due to the difference in the amount of dragon fruit used, because the more dragon fruit was added, the more distinct the taste of dragon fruit that appears. The aroma indicated the level of freshness and authenticity of the raw materials (amount) used. The difference from water content also determines the aroma of dragon fruit noodle products. The formation of aroma is also influenced by the water content in the ingredients, the formation of aroma with a high-water content tends to be slower than the dough which has a low water content.

Taste

Friedman test results showed that there was a significant effect between the proportions of wheat flour and kimpul flour and the concentration of dragon fruit on the taste of dragon fruit noodle products. The difference from each treatment was due to differences in protein in each treatment because the higher the protein content, the stronger the flavor formed. The components that make up the taste of foodstuffs were related to protein in food, the more protein contained, the more delicious the product will taste. This is in accordance with the results of the analysis of the protein content of dragon fruit noodle products which showed a significant difference between treatments.

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Texture

Friedman test results showed that there was a significant effect between the proportions of wheat flour and kimpul flour and the concentration of dragon fruit on the texture of dragon fruit noodle products. Suprapti (2005) explained that the role of protein in wet noodlewas to form a more chewy texture. This protein component contained in wheat flour is in the form of gluten. Gluten is elastic so it will affect the elasticity of wet noodle products. The protein in wheat in the form of gluten plays a role in determining the elasticity of food.

Alternative Selection

Alternative selection is carried out with the aim of choosing the best treatment from several existing treatments (Siagian, 2008). Decision making is a process of selecting the best treatment systematically. Determination of the importance of each parameter is carried out using the Analytical Hierarchy Process (AHP). As for determining the selection of the best treatment based on the Expected Value method.

Importance Weight of Dragon Fruit Noodle Parameters

The importance weight of the dragon fruit noodle parameters was determined using the Analytical Hierarchy Process (AHP) method. Analytical Hierarchy Process is a decision-making algorithm for multi-criteria problems (Saaty, 1993). The weight of importance of noodle parameters from each parameter can be seen in Figure 2.

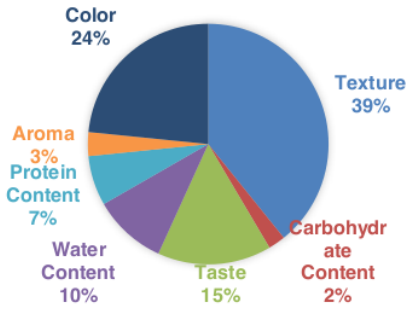

Figure 2. Importance weight of dragon fruit noodle parameters

Expected Value

Expected value is the sum of the values that are expected to occur with a probability. The basis of calculation for the selection of the best treatment is the result of product quality for each parameter and the weight of importance of each of these parameters. The best alternative is the treatment that has the highest expected value score. The results of the calculation of the expected score for each treatment are shown in Table 4. Based on Table 4, the highest

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expected score was found in the T3N2 treatment (proportion of wheat flour and kimpul flour 60%: 40% and dragon fruit concentration 30%) with an expected value score of 7.63.

Table 4. Expected value for each treatment

Treatments	Expected Value
T1N1	2.98
T2N1	4.36
T3N1	6.40
T1N2	3.07
T2N2	5.91
T3N2	7.63

CONCLUSION

The results showed that there was no interaction between factors. The proportion of wheat and kimpul flours had a significant effect on protein content, elasticity, and organoleptic tests (color, aroma, taste, and texture). While the dragon fruit concentration factor significantly affected the chemical tests (water content and carbohydrate content), elasticity, and organoleptic tests (color, aroma, taste, and texture). Treatment T3N2 (proportion of wheat flour and flour kimpul 60%: 40% and concentration of dragon fruit 30%) became the selected treatment with an expected value of 7.63. This treatment had water content 48.51%, ash content 1.72%, protein content 6.04%, fat content 2.64%, carbohydrate content 41.09%, and elasticity of 0.39, and has a total preference percentage of 100% color, 96.7% aroma, 100.0% taste, and 96.7% texture.

In this study, the product shelf life and color resistance test have not been carried out. Therefore, there are still opportunities for further research to conduct studies related to shelf life and methods to maintain the color of wet noodle products produced with the addition of dragon fruit.

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