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Substitution of Soybean Dregs Flour and Addition of Guar Gum on the Chemical and Organoleptic Properties of Wet Noodles

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ABSTRACT

Wet noodles made with soybean pulp flour break easily and have less elasticity, so guar gum is needed to improve the quality of the wet noodles. The purpose of this study is to determine the effect of interaction and the best combination of soybean dregs flour and wheat flour with guar gum on wet noodles' quality, including chemical and organoleptic aspects. To conduct the research, soy milk dregs flour was dehydrated at 60ºC for 4 hours. Wet noodles were then made with a wheat flour substitution formulation containing soy milk dregs flour and guar gum, then chemical and organoleptic tests were conducted. This study employed a Completely Randomized Design (CRD) with a factorial pattern consisting of two variables. The first factor (A) is the proportion of wheat flour and soybean dregs, with three levels: A1 (60%:40%), A2 (50%:50%), and A3 (40%:60%). The second factor (B) guar gum concentration has two levels: B1 (0.5%) and B2 (1%). The data were analyzed using ANOVA. The study's findings revealed that there was a significant interaction between the proportion of soybean dregs flour and the quantity of guar gum added on water content, ash content, protein content, texture, color, aroma, and taste, but no significant interaction on fiber content. The treatment with the proportion of wheat flour and soybean dregs was 50%:50%, and the addition of 0.5% guar gum was the selected treatment with parameters: texture = 4 (like), color = 4 (like), aroma = 4 (like), taste = 4 (like), water content = 62.52%, ash content = 0.94%, protein content = 19.34%, fiber content = 12.70%.

Keywords*: Soybean Dregs; Guar Gum; Wet Noodles*

INTRODUCTION

Wet noodles are a dish manufactured from wheat flour that is quite popular among people since it is very filling, easy to obtain, inexpensive, and can be eaten with a number of food options. (Reubun and Herdini, 2021). One hundred g of wet noodles contains 80 mg of water, 14 g of carbohydrates, 3.3 g of fat, 0.6 g of protein and 0.1 g of fiber. The protein and fiber content in wet noodles is quite low, to meet the body's metabolic needs (Yolanda et al., 2018). Innovation is needed to improve the quality of the nutritional value of wet noodles, one of which is by substituting soybean dregs flour.

Soy dregs are a by-product of processing tofu or soy milk which has a relatively high nutritional content, but has a short shelf life (Yustina and Abadi, 2012). Processing soybean dregs into flour can extend the shelf life. Soybean dregs flour contains a lot of dietary fiber, high protein, and can be used as a substitute to make wet noodles better in terms of nutrition and quality (Auliana, 2012). Soybean dregs have high nutrition, including crude fat 2.95%, crude protein 27.62%, ash 2.96%, crude fiber 13.81%, P 0.04%, and Ca 0.09%. In addition, soybean dregs contain 5.52% amino acids, vitamin B, lysine and methionine (Ijabadeniyi et al., 2023).

Several studies related to wet noodles with soybean dregs flour as a substitute for wheat have been reported: Hidayatullah et al (2017) stated that the best treatment for wet noodles with a substitute for soybean dregs flour is 10%. Soybean dregs flour affects the quality of food fiber and protein; nevertheless, as the usage of added soybean dregs flour increases, panelists' preferences for the organoleptic quality of wet noodles decrease.

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According to (Yustina and Abadi, 2012), wet noodles substituted with soybean dregs flour have properties that break easily with low elasticity, this is because soybean dregs flour is unable to form a gel, which results in the dough becoming less elastic. It is necessary to add additional food ingredients. to improve the texture of wet noodles. Guar gum is used in the food industry as a food additive to help stabilize food and provide fiber (Morris, 2010). Gums or hydrocolloids are widely used in starch-based products to increase stability, change texture, and make processing easier. According to Sabbatini et al's (2014) report, adding 2% guar gum from corn starch to wet noodles results in a noodle texture that does not easily break. Based on the foregoing, it is required to undertake research on the effect of the interaction between the amount of soybean dregs flour and the addition of guar gum on the quality of wet noodles, including chemical and organoleptic characteristics.

METHODS

Material

The main ingredient used for the process of making wet noodles consists of soybean dregs obtained from "Kaligoro Household Industries". Guar gum was obtained from the online shop "my_snackhut". The supporting materials used were twin cakra brand wheat flour, tapioca flour, eggs, water, oil and salt obtained from the "Nasya Tart" cake shop in Mojokerto.

Materials used for chemical analysis include: Soybean dregs noodle samples, 3.25% and 30% NaOH solutions, 96% ethanol, 1.25% H_2SO_4 and concentrated H_2SO_4 solutions, K_2SO_4, 4% H_3BO_3, and 0.01 N HCl solution.

Tool

The tools used include: food dehydrator, analytical scales, measuring cups, spatulas, noodle makers, ovens, stoves, aluminum pans and plastic.

Tools for chemical analysis include: Porcelain crucibles, desiccators, ovens, analytical balances, crucible clamps, furnaces, filter paper, electric heaters, Kjeldahl flasks, distillation tools, burettes, volumetric flasks, beakers, boiling stones, coolers, funnels Buchner, vacuum pump, measuring pipette, Erlenmeyer, beaker glass, dropper pipette, measuring cup, aluminum foil, electric/Bunsen bath.

Making Soybean Dregs Flour

The soybean dregs are squeezed using gauze to reduce the water content in the soybean dregs. Then the soybean dregs are dried using a food dehydrator at a temperature of ±60˚C for 4 hours. After the soybean dregs are dry, grind them using a blender at speed 3 for 2 minutes. Soybean dregs that have been refined to become flour need to be sifted using a 100 mesh sieve.

Making Wet Noodles

Making wet noodles begins by preparing the ingredients, namely twin cakra brand wheat flour, soybean dregs flour, tapioca flour, eggs. Additional ingredients used are guar gum, water, oil and salt. Then mix the ingredients, namely wheat flour, soybean dregs flour, tapioca flour, eggs, water, salt and oil. Then stir the ingredients until evenly mixed manually. Add water mixed with guar gum, add little by little while stirring until mixed well until the dough becomes smooth and elastic. The noodle dough that has become smooth is left to rest for 30 minutes, covered with plastic wrap or a clean cloth. Roll or make sheets of noodle dough using a tool with the thinnest thickness. Printing noodle dough sheets using a noodle printer. The wet noodle strands that come out are sprinkled with tapioca flour so they don't stick, then boil the wet noodles.

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Research Design

This study employed a completely randomized design (CRD) with a factorial pattern comprised of two treatment components combined. The first factor (A) percentage of wheat flour and soybean dregs has three levels: A1 (60%:40%), A2 (50%:50%), and A3 (40%:60%). The second factor (B) guar gum concentration has two levels: B1 (0.5%) and B2 (1%).There were six treatment combinations, each of which was performed three times, totaling 18 experimental units.

Test Parameters

To assess the quality of wet noodles, tests were performed on protein content (SNI 01-2891-1992 method), crude fiber content (SNI 01-2891-1992 extraction method), water content (SNI 01-2891-1992 gravimetric method), ash content (SNI 01-2891-1992 gravimetric method), and organoleptic tests using the Hedonic/Like Test covering texture, taste, aroma, and color (Ayustaningwarno, 2014).

Data Analysis

Data were analyzed using analysis of variance (ANOVA), if there were significant differences between treatments, the Duncan test (DMRT) was continued at the 5% level. Organoleptic tests are analyzed based on the panelists' preferences, to determine whether or not there is an effect of a treatment on organoleptic tests carried out using the Kruskall Wallis test.

RESULT AND DISCUSSIONS

Chemical Properties of Wet Noodles

Water Content

This study's analysis of variance revealed a significant interaction between flour proportion and guar gum concentration on the water content of wet noodles. Duncan's test results are shown in Table 1.

Table 1. Duncan test results for the proportion of flour and guar gum concentration factors on water content

Flour Proportions (A) (Wheat flour: Soybean dregs flour)	Guar Gum Concentration (B)	
	B1 (0,5%)	B2 (1%)
A1 (60% : 40%)	68.24±0.780^{bB}	61.74±0.452^{aA}
A2 (50% : 50%)	62.52±0.475^{a}	61.99±0.502^{a}
A3 (40% : 60%)	63.82±0.831^{a}	62.23±0.325^{a}

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test. Lowercase letters represent horizontal calculations. Capital letters mean vertical calculations.

According to the research results, the water content of wet noodles ranged from 61.99% to 68.24%. Almost all treatments on wet noodles meet the requirements of SNI No. 2987-2015, which must have a maximum water content of 65%, there is one treatment whose value exceeds SNI, namely with a water content of 68.24%. (A1B1). Wet noodles with a maximum water content of 65% have an ideal texture in accordance with SNI provisions. The wet noodles produced are cooked wet noodles that have undergone a complete gelatinization process and have absorbed more water during the boiling process. Water content needs to be determined because it has a significant impact on the material's shelf life. The higher the water content of a substance, the more likely it will be destroyed or not last long.

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The results of this study show that the amount of water content in the wet noodles is attributable to the protein content in soybean dregs flour and the use of guar gum, which may bind water. According to Andarwulan, et al (2011), the ability of food ingredients to bind water cannot be separated from the involvement of protein, where the more protein contained in a flour, the more carboxyl groups there are so that more water can be absorbed. This is in line with Suprapti's (2005) statement, namely that soybean dregs flour per 100 g has a high protein content of around 17.4 g. Guar gum is able to bind and mobilize large amounts of water, which can affect viscosity. The advantages of guar gum are that it dissolves easily in cold water, has high viscosity, can maintain an emulsion, and is able to improve gel strength (Picauly, 2022).

Ash Content

The analysis of variance from this study revealed that there is an interaction between flour proportion and a significant increase in guar gum concentration on wet noodles' ash content. Duncan's test results are shown in Table 2.

Table 2. Duncan test results for flour proportion factors and guar gum concentration on ash content

Flour Proportions (A) (Wheat flour: Soybean dregs flour)	Guar Gum Concentration (B)	
	B1 (0,5%)	B2 (1%)
A1 (60% : 40%)	2.64±0.273^{cC}	4.68±0.066^{cC}
A2 (50% : 50%)	0.94±0.005^{b}	0.31±0.072^{b}
A3 (40% : 60%)	0.37±0.075^{a}	0.11±0.040^{a}

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test. Lowercase letters represent horizontal calculations. Capital letters mean vertical calculations

The ash level of wet noodles generated in this research ranged from 0.11% to 4.68%. The lowest ash content value is 0.11% and the highest ash content value is 4.68%. According to Indonesian National Standard (SNI) No. 2987-2015, the quality requirement for wet noodles is that they must have a maximum ash content of 0.05%. This shows that each of the treatments above does not meet the SNI requirements for wet noodles that have been set because the ash content produced is more than 0.05%.

The results of this research indicate that the increase in the amount of ash content in the wet noodles was caused by the addition of soybean dregs flour and the use of guar gum. Ash content can be used as an index of minerals contained in food ingredients apart from being influenced by increasing temperature and water content. The ash content produced from wet noodles is also influenced by the ingredients that make it up. Quantitatively, the ash content value in soybean dregs noodles produced comes from the minerals in soybean dregs (Putri, 2018).

Protein Content

The analysis of variance from this study revealed an interaction between the proportion of flour and a substantial increase in guar gum concentration on the protein content of wet noodles. Table 3 shows Duncan's test results.

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Table 3. Duncan test results for the proportion of flour and guar gum concentration factors on protein content

Flour Proportions (A) (Wheat flour: Soybean dregs flour)	Guar Gum Concentration (B)	
	B1 (0,5%)	B2 (1%)
A1 (60% : 40%)	14.08±0.050^{a}	14.96±0.096^{a}
A2 (50% : 50%)	19.34±0.180^{cC}	17.15±0.087^{bB}
A3 (40% : 60%)	15.67±0.150^{b}	15.24±0.221^{a}

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test. Lowercase letters represent horizontal calculations. Capital letters mean vertical calculations

Based on the research results, it was found that the protein content of wet noodles ranged from 14.08% - 17.15%. The lowest protein content value, namely 14.08% and the highest protein content value, namely 17.15%. According to Indonesian National Standard (SNI) No. 2987-2015, the quality requirement for wet noodles must be a minimum protein content of 6.0%. This shows that each of the treatments above has met the SNI requirements for wet noodles that have been set because the protein content produced is more than 6.0%.Based on the results of this research, it shows that wet noodles have increased protein levels due to the high protein contained in soybean dregs flour. This is in accordance with the statement (Yustina and Abadi, 2012) that soybean dregs have the potential to be an alternative high protein food raw material. Substitution of soybean dregs flour will cause an increase in protein levels because some proteins in soybean dregs flour are higher than wheat flour.

Crude Fiber Content

The analysis of variance from this study revealed that there is an interaction between the flour proportion and a substantial increase in guar gum concentration on the Crude Fiber content of wet noodles. Table 4 shows Duncan's test results.

Table 4. Results of Duncan's test on the influence of flour proportion factors on crude fiber content

Flour Proportions (A) (Wheat flour: Soybean dregs flour)	Average
A1	12.50±0.122^{b}
A2	12.06±0.045^{a}
A3	13.16±0.045^{c}

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test.

Table 5. Duncan test results on the influence of guar gum concentration factors on crude fiber content

Guar Gum Concentration (B)	Average
B1	13.23±0.055^{b}
B2	11.92±0.196^{a}

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test.

The research results indicate that there is no interaction between components. The amount of flour and the addition of guar gum have a considerable impact on the fiber content of wet noodles. The increase in fiber content in wet noodles was caused by the increasing number of soybean dregs flour substitutes added. Likewise, the addition of guar gum can increase the total fiber content of wet noodles. Soy dregs are an alternative source of fiber (Adhimah et al., 2017).

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Dried soybean dregs contain 52.3% dietary fiber (Li et al., 2012). Guar gum is used in the food industry as a food additive to help stabilize food and provide fiber (Morris, 2010).

The quality requirements for wet noodles according to SNI do not include a minimum or maximum limit for fiber content because the SNI 2987-2015 quality requirements use wheat flour. Wet noodles made from soybean dregs contain high levels of crude fiber, where according to Santoso (2011) half of the crude fiber content is dietary fiber which can be useful in reducing cholesterol levels in the body.

Organoleptic Characteristics of Wet Noodles

Texture

The Kruskal Wallis test findings demonstrate that the proportion of wheat flour and soybean dregs, as well as the concentration of guar gum added, have a substantial influence on the texture of wet noodles. Table 6 presents the median hedonic scale for the texture of soybean dregs wet noodles.

Table 6. Median value of soybean dregs wet noodle texture

Ttreatment	Hedonic Scale
A1B1 (60%:40%:0.5%)	4±0.240[b]
A1B2 (60%:40%:1%)	4±0.042[b]
A2B1 (50%:50%:0.5%)	4±0.537[b]
A2B2 (50%:50%:1%)	3±0.127[a]
A3B1 (40%:60%:0.5%)	3±0.098[a]
A3B2 (40%:60%:1%)	3±0.014[a]

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test.

The table above shows that treatments A1B1, A1B2, A2B1 give a texture value of 4 which is rated as liked by the panelists, while treatments A2B2, A3B1, A3B2 give a value of 3 which is rated as somewhat liked by the panelists. The addition of guar gum in making wet noodles can improve the texture of the noodles. Gums or hydrocolloids are widely used in starch-based products to increase stability, change texture, and make processing easier. Guar gum has a tendency to form strong hydrogen bonds in water which makes it a new thickener and stabilizer. Guar gum solutions in water are very thick (Mudgil et al., 2014).

Color

According to the Kruskal Wallis test results, the proportion of wheat flour and soybean dregs flour, as well as the concentration of guar gum, have a substantial influence on the color of the wet noodles. The median hedonic scale for the hue of soybean dregs wet noodles is shown in Table 7.

Table 7. Median value of soybean dregs wet noodle color

Ttreatment	Hedonic Scale
A1B1 (60%:40%:0.5%)	4±0.183[b]
A1B2 (60%:40%:1%)	4±0.000[b]
A2B1 (50%:50%:0.5%)	4±0.226[b]
A2B2 (50%:50%:1%)	4±0.282[a]
A3B1 (40%:60%:0.5%)	3.5±0.197[a]
A3B2 (40%:60%:1%)	3±0.296[a]

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test.

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The table above showed that treatment A1B1, A1B2, A2B1, A2B2 gives a color value of 4 which is rated as liking by the panelists, while treatment A3B1 gives a value of 3.5 which was rated as somewhat liked by the panelists. Treatment A3B2 gave a score of 3 which was rated as somewhat favorable by the panelists. The addition of guar gum does not affect the color of the wet noodles. The color of wet noodles tends to turn brownish and pale with the amount of soybean dregs flour substituted. This is because the color of soybean dregs produced from flour was brownish white which affects the color change of the wet noodles. The addition of soybean dregs to food products could reduce the brightness of the product color (Yustina and Abadi, 2012).

Aroma

Based on the results of the Kruskal Wallis test, it shows that there is a significant influence between the proportion of wheat flour and soybean dregs flour and the addition of guar gum concentration on the aroma of wet noodles. The median hedonic scale for the aroma of soybean dregs wet noodles can be seen in Table 8.

Table 8. Median value of soybean dregs wet noodle aroma

Ttreatment	Hedonic Scale
A1B1 (60%:40%:0.5%)	4±0.226[b]
A1B2 (60%:40%:1%)	4±0.000[b]
A2B1 (50%:50%:0.5%)	4±0.989[b]
A2B2 (50%:50%:1%)	4±0.311[a]
A3B1 (40%:60%:0.5%)	3±0.169[a]
A3B2 (40%:60%:1%)	3±0.282[a]

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test.

The table above shows that treatments A1B1, A1B2, A2B1, A2B2 have an aroma value of 4 and were regarded as liked by the panelists, but treatments A3B1, A3B2 had a value of 3 and were assessed as moderately liked. The wet noodles' scent was unaffected by the addition of guar gum. The aroma of wet noodles becomes more pleasant when the percentage of soybean dregs flour is substituted. The addition of soybean dregs flour will raise the levels of chemicals that produce unpleasant odors by raising the number of off-flavor compounds (Hidayatullah et al., 2017). This odor was created by the oxidation of unsaturated fatty acids (PUFA), which occurs in soybeans. Oxygen may be implicated in this oxidation reaction after the lipoxygenase enzyme catalyzes unsaturated fatty acids, particularly linoleic acid, which has a cis 1,4 pentadiene group (Suprapti, 2005).

Flavor

The Kruskal Wallis test findings showed that the proportion of wheat flour and soybean dregs flour, as well as the concentration of guar gum added, have a considerable influence on the taste of wet noodles. The median hedonic scale for the flavor of soybean dregs wet noodles is shown in Table 9.

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Table 9. Median value of soybean dregs wet noodle flavor

Ttreatment	Hedonic Scale
A1B1 (60%:40%:0.5%)	4±0.141[b]
A1B2 (60%:40%:1%)	4±0.014[b]
A2B1 (50%:50%:0.5%)	4±0.739[b]
A2B2 (50%:50%:1%)	4±0.381[a]
A3B1 (40%:60%:0.5%)	3±0.169[a]
A3B2 (40%:60%:1%)	3±0.268[a]

Note: letters behind the numbers with the same notation in each column indicate there is no difference in the Duncan α = 5% test.

The table above shows that treatments A1B1, A1B2, A2B1, A2B2 give a taste value of 4 which is rated as liking by the panelists, while treatments A3B1, A3B2 give a taste value of 3 which was rated as somewhat favorable by the panelists. The addition of guar gum does not affect the taste of the wet noodles. The taste of wet noodles increasingly tastes typical of soybeans as the percentage of soybean dregs flour substitute increases. The addition of soybean dregs flour can increase off-flavor compounds, which can cause an unpleasant taste, bitter taste and chalky taste due to glycoside compounds (Hidayatullah et al., 2017).

CONCLUSION

The results revealed that there was a significant interaction between the proportion of soybean dregs flour and the concentration of guar gum added on water content, ash content, protein content, texture, color, aroma, and taste, but no significant interaction on fiber content. The treatment with the proportion of wheat flour and soybean dregs was 50%:50%, with the addition of 0.5% guar gum as the selected treatment with parameters, namely texture = 4 (like), color = 4 (like), aroma = 4 (like), taste = 4 (like), water content = 62.52%, ash content = 0.94%, protein content = 19.34%, fiber content = 12.70%.

Soybean dregs flour can be used to make wet noodles in place of 50% wheat flour, with 0.5% guar gum (A2B1) added for the optimum texture. This formulation produces wet noodles with a high protein and fiber content, resulting in chemically high-quality wet noodles.These soybean dregs wet noodles offer sensory traits that panelists enjoy, such as a chewy texture that does not break easily, a color that is similar to wet noodles made entirely of wheat flour, and a distinct taste and aroma

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