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# Innovation in making wet noodles chia seed flour on chemical, physical, and organoleptic quality for the prevention of obesity

*Inovasi pembuatan mi basah tepung biji chia terhadap mutu kimia, fisik dan organoleptik untuk pencegahan obesitas*

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## Abstract

Excessive fat accumulation due to a prolonged imbalance of energy intake and energy expenditure. Obesity can be controlled with foods high in fiber. The addition of chia seed flour is a food preparation that increases dietary fiber and reduces the risk of obesity. The aim is to determine the effect of adding chia seed flour on physical, chemical, and organoleptic characteristics. This research is a completely randomized design research design. Research location of STIKes Panti Rapih Yogyakarta Culinary Nutrition Laboratory and research time April-August 2022. Data collection technique through tensile strength analysis using the Universal Testing Machine, water content gravimetric method, Soxhlet method fat content test, Kjehdahl method protein test, carbohydrate method by. difference, and testing total dietary fiber content using the AOAC method, determining energy value by calculating the composition of carbohydrates, fats, and proteins, and organoleptic testing using the Hedonic Test. Data were analyzed using ANOVA, Kruskall Wallis, Mann Whitney, Friedman, and Wilcoxon. Statistical results of tensile strength (p=0.546), water content (p=0,066), ash (p=0,101), fat (p=0,297), protein (p=0,244), carbohydrates (p=0,052), energy (p= 0,268), aroma (p=0,181), texture (p=0,358) and taste (p=0,355), dietary fiber (p=0,019), organoleptic appearance (p=0,002) and overall liking (p=0,038). In conclusion, there is an effect of adding chia seed flour on food fiber content, appearance, and overall.

**Keywords:** Chia seeds, dietary fiber, wet noodles, tensile strength

## Abstrak

Penumpukan lemak yang berlebihan karena ketidakseimbangan asupan energi dan pengeluaran energi yang berkepanjangan. Obesitas dapat dikendalikan dengan makanan tinggi serat. Penambahan tepung biji chia merupakan salah satu olahan pangan yang dapat meningkatkan serat pangan dan mengurangi risiko obesitas. Tujuan penelitian untuk mengetahui pengaruh penambahan tepung biji chia terhadap karakteristik fisik, kimia dan organoleptik. Penelitian ini merupakan penelitian dengan rancangan penelitian Rancangan Acak Lengkap (RAL). Lokasi penelitian di Laboratorium Gizi Kuliner STIKes Panti Rapih Yogyakarta dan waktu penelitian April-Agustus 2022. Teknik pengumpulan data melalui analisis kekuatan tarik menggunakan Universal Testing Machine, uji kadar air metode gravimetri, uji kadar lemak metode Soxhlet, uji protein metode Kjehdahl, uji karbohidrat metode by difference, dan uji kadar serat pangan total menggunakan metode AOAC, penentuan nilai energi dengan menghitung komposisi karbohidrat, lemak, dan protein serta pengujian organoleptik menggunakan Uji Hedonik. Data dianalisis menggunakan ANOVA, Kruskall Wallis, Mann Whitney, Friedman, dan Wilcoxon. Hasil statistik kekuatan tarik (p=0,546), kadar air (p=0,066), abu (p=0,101), lemak (p=0,297), protein (p=0,244), karbohidrat (p=0,052), energi (p 268), aroma (p=0,181), tekstur (p=0,358) dan rasa (p=0,355), serat pangan (p=0,019), tampilan organoleptik (p=0,002) dan kesukaan secara keseluruhan (p=0,038). Kesimpulan, terdapat pengaruh penambahan tepung chia seed terhadap kandungan serat pangan, penampilan dan kesukaan keseluruhan.

**Kata Kunci:** Biji chia, mie basah, *tensile strength*, serat pangan

## Introduction

Indonesia is currently facing nutritional problems, including obesity (Dwimawati, 2020). Obesity is an excessive accumulation of fat due to a prolonged imbalance between energy intake and expenditure (Kemenkes RI, 2018). Obesity is a risk factor for coronary heart disease, stroke, diabetes mellitus, and high blood pressure (P2PTM Kemenkes RI, 2019). According to 2016 WHO data, the prevalence of obesity (BMI >30 kg/m2) was 11% (male) and 15% (female). Riskesdas data also show that the prevalence of obesity in adults over 18 years of age is increasing, that is, 10,5% (2007), 14,8% (2013), and 21,8% (2018).

Obesity is caused by genetic factors, nutritional intake, physical activity, medications, and hormones (Kemenkes, 2018). Excessive energy intake can also lead to obesity. Food types with high energy density (high fat, high sugar, and low fiber) lead to an energy imbalance (Kemenkes RI, 2018). High fiber intake helps with weight control, because the energy produced will not be greater (Thasim et al., 2013). Foods with high fiber content provide much less energy than foods with high fat and sugar contents. Additionally, fiber can lead to longer satiety, which can reduce food intake (Putri et al., 2023).

The average fiber consumption of Indonesians is 10,5 g per day (Istianah et al., 2022). Meanwhile, according to the Regulation of the Head of the Food and Drug Administration of the Republic of Indonesia Number 9 of 2016 concerning Nutrition Label Reference (ALG), the recommended fiber sufficiency for the general public is 30 g per day. One of the steps to overcome obesity is nutritional intervention in the form of high-fiber foods (Ambari et al., 2018). Chia seeds (*Salvia hispanica L.*) are a natural ingredient that can be used as a functional food alternative and has a positive impact on health (Safari et al., 2016). According to USDA (2018), 100 g of chia seed flour contains 41,7 g carbohydrates, 25 g protein, 25 g fat, and 33,3 g dietary fiber.

Noodles are among the most popular foods. The types of noodles that are usually eaten are wet, dry, and instant noodles (Maryam, 2022). Noodles are usually made from flour and undergo gelatinization during processing, so that they have chewy and elastic properties (Juwitaningtyas & Khairi, 2021). Wet noodles are raw noodles that have undergone boiling before being marketed (Maryam, 2022). The nutritional content in 100 g of wet noodles is 88 kcal of energy, 0,6 g of protein, 3,3 g of fat, 14 g of carbohydrates, and 0,1 g of fiber (Ntau et al., 2022).

The research conducted by Paramita et al. (2020), showed that the addition of chia seeds as much as 5% was preferred because it produced good viscosity in smoothies and had a significant effect on the aroma and color of smoothies. In a study conducted by Naumova et al. (2017), the substitution of 10% chia seed flour in pasta resulted in a change in product color from yellow to yellowish gray, the taste was still acceptable, and an increase in nutrients occurred in Ca, Mg, phosphorus, Cu, Zn, and Fe. Substitution of chia seed flour with as much as 15% in pasta is less favorable. A study conducted by Rasbawati & Irmayani (2021) found that the formulation of 80% wheat, 20% mocaf, 1% kansui, and 15% chia seed powder is the best wet noodle because of its high water absorption, textural properties, and protein content comparable to the control wet noodles, but the color tends to be dark. Research conducted by Levent (2017) showed that the addition of 30% chia seed flour to noodles reduced the surface smoothness, appearance score, and chewiness score of cooked noodles.

In a study conducted by Sofyaningsih & Arumsari (2021), croissants substituted with 10% sesame and chia flours were similar to the control croissants in terms of texture and flavor. The substitution of sesame and chia flours significantly affected the level of liking, except for aroma. In addition, the substitution of sesame flour and chia flour affected the nutritional values (proximate, fiber, calcium, total energy, and energy from fat), except for the carbohydrates of the croissants. The addition of 15-20% chia seed flour increased the total fiber content and decreased the glycemic index in corn tortilla supplement formulations (Rendón-Villalobos et al., 2012).

Noodles are chewy, elastic, and not easily broken (Juwitaningtyas & Khairi, 2021). Measurement of the tensile strength value aims to determine the strength and elasticity of the wet noodles produced (Angelica, 2019). The tensile strength is closely related to the protein content (Umri et al., 2015). Research results (Bintang et al., 2024), The most preferred wet noodles are mocaf flour substitution wet noodles with 20% moringa leaf extract added, producing 8,07% protein and a tensile strength value of 0,029 MPa. Research conducted (Metta Angelica, 2019), The treatment of wet noodles substituting 10% rice bran with 20 g pumpkin paste produced tensile strength (0,035 MPa), moisture content (35%), ash (2,6%), fat (6,8%), protein (6,3%), dietary fiber (1,3%) and carbohydrates (49,3%). This study aimed to examine the effect of the addition of chia seed flour (*Salvia hispanica L.*) on the physical, chemical, and organoleptic characteristics of wet noodles. The addition of chia seed flour in making wet noodles can be one of the processed foods that can increase food fiber and reduce the risk of obesity.

## Methods

**Design, place, and time**

In this study, wet noodles were prepared with a 100% wheat flour formulation and the addition of 0%, 5%, 10%, and 15% chia seed flour. The type of research was experimental, with a completely randomized design (CRD) and three repetitions.

The research period from preparation to observation and data collection is approximately four months, starting from April-August 2022. This research was conducted in several places, namely: (1) the Culinary Nutrition Laboratory of STIKes Panti Rapih Yogyakarta, (2) the Laboratory of Gadjah Mada University Yogyakarta, and (3) the Laboratory of Yogyakarta Agricultural Institute.

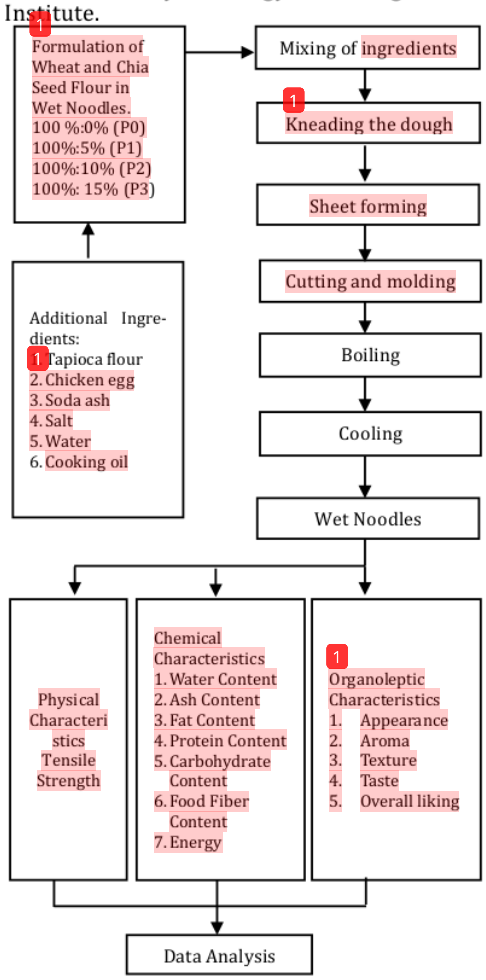


**Figure 2.** Research flow chart

**List of wet noodle-making tools**

The equipment used in the processing of noodles included scales, a wok, a stove, a blender, a 60 mesh sieve, a plastic box, a measuring cup, a kom, a noodle mill, a plate, and a boiling pot. The laboratory tools used were a Universal Testing Machine (UTM), porcelain cup, oven, desiccator, analytical balance, muffle, Soxhlet extraction tube, thimble, condenser, bottle, water bath, boiling flask, volumetric flask, Erlenmeyer flask, and burette.

**Ingredients for making Wet Noodles**

The ingredients used for noodle processing were chia seed flour, wheat flour, tapioca flour, table salt, soda ash, chicken eggs, water, and coconut oil. The chemicals used were sand that had been fired, petroleum ether solvent, sulfuric acid, distilled water, NaOH 40%, $NH_3$, boric acid saturated solution, Conway indicator, phosphate buffer, alpha-amylase enzyme, HCL 1 N, 1% pepsin enzyme, NaOH 1 N, beta-amylase enzyme, filter paper, ethanol, and acetone.

**Research Procedure**
This study was conducted in several stages.

**Making Chia Seed Flour**
Chia seed flour was prepared by roasting 250 g of chia seeds over low heat for 6 min while stirring evenly. After roasting, the chia seeds were blended until smooth and then sifted with a 60-mesh flour sieve (Arumsari & Sofyaningsih, 2020).

**Figure 1.** Chia seeds (*Salvia hispanica L.*)

**Wet Noodle Making**
Wet noodle production includes the stages of mixing, resting, sheet forming, molding, cutting, and boiling. The first stage of wheat flour was mixed with tapioca and chia seed flours (0, 5, 10, and 15 g). Next, the table salt, soda ash, and chicken eggs were added. Water was then added and mixed evenly for 20 min until homogeneous. After smoothing, the dough was rested for 10 min for further thinning, forming noodle sheets, printing, and cutting (noodles were cut + 15 cm) with a pasta maker. The noodles were sprinkled with wheat flour. The noodles were boiled for 5 min with coconut oil. The cooked noodles were drained and wet noodles were obtained (Maryam, 2022).

**Physical and Chemical Tests**
Physical test using Texture Universal Testing Machine (UTM) method, moisture content (gravimetric), ash (gravimetric), fat (soxhlet), protein (Kjeldahl), carbohydrate (by difference), dietary fiber (multienzyme) and energy (Atwater factor).

**Organoleptic Test**
An organoleptic test was conducted to determine the panelist acceptance of wet noodle samples. The organoleptic test was conducted using the scoring method on 30 untrained panelists, namely nutrition students of STIKes Panti Rapih Yogyakarta. The value given is in the range of 1-5, namely, 1 for the lowest value and 5 for the highest value.

**Data Analysis**
Physical, chemical, and organoleptic data with a significant value (>0,05) were declared normally distributed, and the variance of each sample was the same (homogeneous); therefore, it was feasible to conduct a test of variance (ANOVA). If the test obtained a value of p <0,05, the Duncan test was used to determine the real difference between samples. All analysis results used a 95% confidence level. However, if the physical and chemical test data were not normally distributed, the data were tested using the Kruskal-Wallis test. If the test obtained a p-value <0,05, it was continued with the Mann-Whitney test to determine the real difference between samples. Organoleptic test data that were not normally distributed were analyzed using the Friedman test. If the test obtained a value of p <0,05, then the Wilcoxon test was used to determine the real difference between samples. In this study, the data that were normally distributed were physical and chemical test data, whereas those that were not normally distributed were organoleptic data.

## Result and Discussion

The data in this study were obtained from the physical, chemical, and organoleptic tests. Physical testing of tensile strength. Chemical testing included (water content, ash, fat, protein, carbohydrates, dietary fiber, and energy). Organoleptic testing includes the appearance, aroma, texture, taste, and overall preference.

**Physical Analysis**
Tensile Strength
Based on the results of the Kruskal–Wallis test, there was no effect of the addition of chia seed flour on the tensile strength of wet noodles. This could be because of the use of the same amount of wheat flour. This is supported by

research conducted (Putri & Sayuti, 2017) on the combination of papaya leaves and surian leaves on wet noodles, and the amount of wheat flour used in the same amount so that the gluten that plays a role in making wet noodles was also not significantly different. Tensile strength is closely related to protein content (Umri et al., 2015). Gluten is a protein component that is found only in wheat flour (Kurniawan et al., 2015). Gluten affects the formation of a chewy texture in wet noodles, which may be because the gluten matrix can form ties between starch granules more tightly, making the starch gel stronger and resistant to pulling (Safriani et al., 2013).

**Table 1.** Results of physical analysis of wet noodles

| Physical Analysis | Treatment<br>P0<br>(Mean ± SD) | P1<br>(Mean ± SD) | P2<br>(Mean ± SD) | P3<br>(Mean ± SD) | p-value |
|---|---|---|---|---|---|
| Tensile Strength (MPa) | 0,064 ± 0,029 [a] | 0,043 ± 0,005 [a] | 0,051 ± 0,001 [a] | 0,046 ± 0,012 [a] | 0,546 |

Note:
Numbers with the same notation in the same row are not significantly different (p>0,05).
P0= Wet noodles without chia seed flour; P1= Wet noodles with 5% chia seed flour; P2= Wet noodles with 10% chia seed flour; P3 = Wet noodles with 15% chia seed flour.

The tensile strength of wet noodles does not have a specific standard, but according to Dewi and Anak Agung Nanak Antarini (2010), good wet noodles are not easily broken, and according to Rahma and Widjanarko (2014), a lower tensile strength indicates that the wet noodles produced are easily broken.

## Chemical Analysis

**Table 2.** Results of Chemical Analysis of Wet Noodles

| Chemical Component (%) | Treatment<br>P0<br>(Mean ± SD) | P1<br>(Mean ± SD) | P2<br>(Mean ± SD) | P3<br>(Mean ± SD) | P-value | SNI Raw Wet Noodles (%) |
|---|---|---|---|---|---|---|
| Water Content | 28,69 ± 0,80[a] | 30,16 ± 0,83[a] | 28,87 ± 0,45[a] | 29,83 ± 0,41[a] | 0,066 | Maks, 35 |
| Ash Content | 3,41 ± 0,17[a] | 3,61 ± 0,09[a] | 3,56 ± 0,007[a] | 3,62 ± 0,02[a] | 0,101 | Maks, 0,5 |
| Fat | 3,22 ± 0,19[a] | 4,43 ± 0,25[a] | 3,74 ± 1,28[a] | 3,55 ± 0,61[a] | 0,297 | |
| Protein (%) | 9,65 ± 0,21[a] | 9,48 ± 0,45[a] | 10,06 ± 0,42[a] | 9,83 ± 0,07[a] | 0,244 | Min, 9,0 |
| Carbohydrate (%) | 55,01 ± 0,53[a] | 52,30 ± 0,81[a] | 53,75 ± 1,45[a] | 53,14 ± 0,91[a] | 0,052 | |
| Dietary Fiber (%) | 1,50 ± 0,28[a] | 6,01 ± 2,45[b] | 5,61 ± 1,41[b] | 4,05 ± 0,46[b] | 0,019 | |
| Energy (kcal) | 287,73 ± 3,26[a] | 288,06 ± 0,80[a] | 288,94 ± 4,68[a] | 283,93 ± 2,00[a] | 0,268 | |

Note:
Numbers with the same notation in the same row are not significantly different (p>0,05).
P0= Wet noodles without chia seed flour; P1= Wet noodles with 5% chia seed flour; P2= Wet noodles with 10% chia seed flour; P3 = Wet noodles with 15% chia seed flour.

### Water Content

Based on the ANOVA test results, chia seed flour addition had no effect on the moisture content of wet noodles. This is following research that the addition of chia seed flour does not affect the bread moisture content of 43,48% - 43,83% (Romankiewicz et al., 2017) & 35,3% - 36,3% (Guiotto et al., 2020). Other studies (Isye Selvianti, 2017) on the ability of wet noodles to bind water are caused by gluten in wheat flour. Water acts as a reaction medium between gluten and carbohydrates, dissolves salt, and can impart the chewy properties of gluten (Nurjannah et al., 2019). The greater the amount of water absorbed by gluten, the higher the water content in the wet noodles.

Based on the results of this study, the moisture content of the wet noodles produced ranged from 28,69% to 30,16%. According to SNI 2987-2015, the moisture content of raw wet noodles is the maximum. 35% So, the wet noodle treatments P0, P1, P2, and P3 met the

SNI standards and were suitable for consumption.

**Ash Content**

Based on the ANOVA test results, chia seed flour addition had no effect on the ash content of wet noodles. This is supported by research (Riza Waty, 2009) showing that during combustion, some minerals are lost. The ash content is not always equivalent to the basic ingredients used because some minerals are lost during combustion. The ash content that remains in the combustion results is the mineral content of food ingredients that are not flammable and evaporate during incineration (Ratnasari and Yunianta, 2015). Research (Rendón-Villalobos et al., 2012) on corn tortillas with the addition of chia seed flour (5, 10, 15, and 20%) did not affect ash content. The high ash content can be caused by the presence of wet noodle ingredients that contain minerals. Eggs and flour contain minerals; therefore, the more eggs and flour added to wet noodles, the higher the ash content (Nurjannah et al., 2019).

The ash content is also related to the appearance of the resulting product. Sofyaningsih and Arumsari (2021) stated that the higher the ash content, the darker the croissants with substitutions of chia seed flour and sesame flour.

Based on the results, the ash content of the wet noodles produced ranged from 3,41% to 3,62%. According to SNI 2987-2015, the ash content of raw wet noodles is the maximum. 0,5%. However, in SNI, the ash content was calculated based on the acid-insoluble ash content, whereas in this study, it was calculated based on the total ash content. The acid-insoluble ash content results in more sand or contamination of the product (Rahmi et al., 2019).

**Fat Content**

Based on the ANOVA test results, the addition of chia seed flour had no effect on the fat content of wet noodles. This is supported by research conducted (Coorey et al., 2012) on the addition of chia seed flour to chips, in which the strong water binding of chia interferes with the fat extraction process, resulting in incomplete fat extraction. Similarly, Castejón et al. (2017) reported that chia contains water-soluble fiber or gel that can affect fat extraction. According to Widyaningtyas & Susanto (2015), trapping of fat in the gel matrix also causes fat to not differ significantly. Chia gel can bind fat; therefore, it is good for obese people because it can cause a longer feeling of satiety in the body (Toscano et al., 2014).

Based on the Regulation of the Head of BPPOM Number 9 of 2016 concerning Nutrition Label Reference (ALG), fat for the general group is 67 g. Wet noodles (P0) contributed to the daily fat intake (4,82%), P1 (6,62%), P2 (5,58%), and P3 (5,30%).

**Protein Content**

Based on the results of the ANOVA test, the addition of chia seed flour had no effect on the protein content of wet noodles. Research conducted (Barros, 2019) on the substitution of chicken skin with chia seed flour has no effect on nugget protein levels, with an average protein content of 34%-37%. Gluten is the main protein in wheat flour and plays a role in making noodles. Gluten is produced from gliadin (prolamin in wheat) and glutenin. Wheat protein in making noodles must be in a high enough amount (14 %) so that the noodles can be elastic and resistant to pulling (Nurjannah et al., 2019). The protein content of the wet noodles was not significantly different because the total weight of the wet noodles resulting from mixing all the ingredients was approximately 150 g, which added chia seed flour (5%, 10%, and 15%) only increased by approximately (1,25 g, 2,5 g, and 3,75 g) protein. The protein content of chia seed flour per 100 g is 25 g (Usda, 2013).

Based on the Regulation of the Head of BPPOM Number 9 of 2016, the Nutrition Label Reference (ALG) protein for the general group was 60 g. Wet noodles (P0) contributed to daily protein intake (16%), P1 (15,8%), P2 (16,78%), and P3 (16,40%). Based on the research results, the wet noodle protein produced ranged from 9,48% to 10%. According to SNI 2987-2015, the protein content of the raw wet noodles was 9.0%. Therefore, the wet noodle treatments P0, P1, P2, and P3 met SNI standards.

**Carbohydrate Content**

Based on the ANOVA test results, chia seed flour addition had no effect on the carbohydrate content of wet noodles. The content of the treated wet noodles can be lower than that of the control wet noodles because the measurement of carbohydrates is determined by calculating the carbohydrates by difference, not by testing the carbohydrate content directly.

Therefore, the carbohydrate content automatically decreases if there is an increase in the levels of other nutrients ( Angelica, 2019).

This is supported by research conducted (Sofyaningsih & Arumsari, 2021), which showed that the carbohydrate content of croissants with substitutions of chia flour and sesame flour is not significantly different because carbohydrates are determined using the difference in carbohydrate content.

Based on the Head of BPPOM Regulation Number 9 of 2016 concerning Nutrition Label Reference (ALG), carbohydrates for the general group is 325 g. Wet noodles (P0) contributed to daily carbohydrate intake (16,93%), P1 (16,10%), P2 (16,54%), and P3 (16,35%).

**Dietary Fiber Content**

Based on the ANOVA test results, the addition of chia seed flour had an effect on the food fiber content of wet noodles. This is because chia contains 33,61 g/100 g of fiber (Usda, 2013). The analysis was then continued with the Duncan Test, the results of which showed differences in food fiber between P0 wet noodles and P1, P2, and P3 wet noodles. This can be attributed to the control of wet noodles without chia seed flour.

In this study, wet noodles supplemented with chia seed flour had higher dietary fiber content than the control wet noodles. This is similar to previous research (Iglesias-Puig & Haros, 2013); bread with the addition of 5% chia can increase dietary fiber levels (6,82%) in the final product compared to the control sample (5,04%), Oliveira et al. (2015) reported that pasta with the addition of 7,5% chia increased the nutritional value of dietary fiber by 11,68% when compared to the control product (2,90%).

Water-soluble fiber content slows down gastric emptying and shortens the transit time in the intestine, resulting in little glucose absorption. The formation of a gel in the stomach lengthens its emptying time in the stomach longer. In people who consume fiber, chyme from the stomach travels more slowly towards the intestines. This causes food to be held longer in the stomach area, so that the sensation of fullness is also longer (Nintami & Rustanti, 2012). The crude fiber content of chia can also minimize the occurrence of obesity. According to Sudargo et al. (2014), foods with high crude fiber content usually contain low energy, sugar, and fat contents to reduce obesity.

Based on the Regulation of the Head of BPPOM Number 9 of 2016 concerning Nutrition Label Reference (ALG), the food fiber for the general group is 30 g. Wet noodles (P0) contributed to the daily dietary fiber intake (5%), P1 (20%), P2 (18,71%), and P3 (13,53%). Consuming 100 g of wet noodles with the addition of chia seed flour in our diet can contribute to the amount of fiber, although it is not yet optimal. Consumption of vegetables and fruits can result in fiber deficiencies (Anen, 2018).

**Energy**

Energy is obtained from carbohydrates, fat, and proteins in food (Yolanda et al., 2018). The energy value of carbohydrates and protein is 4 kcal/g, whereas that of fat is 9 kcal/g (Wityadarda et al., 2023). Based on the results of the ANOVA test, the addition of chia seed flour had no effect on the energy of wet noodles. This is supported by research (Ilminingtyas et al., 2020) on the application of lindur flour in wet noodles that the measured wet noodle energy from this study is the total of the chemical energy of the wet noodles. In addition, the calculation of carbohydrates is performed by calculating carbohydrate by difference, not by testing the carbohydrate content directly (Metta Angelica, 2019). The main carbohydrate content in chia is dietary fiber, which does not produce calories. Therefore, the calculation of carbohydrates by difference is less able to describe the actual energy content of the wet noodles.

Based on the Head of BPPOM Regulation Number 9 of 2016 concerning Nutrition Label Reference (ALG), the energy for the general group was 2150 g. Wet noodles (P0) contributed to the daily energy intake (13,38%), P1 (13,40%), P2 (13,43%), and P3 (13,20%).

**Chemical Test and Organoleptic Analysis**

**Appearance**

Appearance is the first impression seen by panelists when consuming a product. Appearance plays a major role in the appearance of food. Food that appears delicious if its appearance is not attractive when served can result in a reduced panelist appetite (Khasanah Via, 2019).

Based on the results of the Friedman test, the addition of chia seed flour had an effect on the appearance of wet noodles. The results of the panelist assessment in Table 3 show that the highest appearance was found in P0 wet noodles (without the addition of chia seed flour), with an average of 4,07 attractive categories. The lowest wet noodle appearance value was found in P3 (15% chia seed flour), with an average of 3,30 unattractive categories. The greater the addition of chia seed flour, the less attractive it is because it has a brownish color compared to wet noodles without the addition of chia seed flour, which tends to be yellow. This is supported by research (Naumova et al., 2017) that the addition of chia seed flour (0%, 5%, 10%, 15%) causes changes in the color of the pasta from yellow to darker, making it less attractive to panelists. Research conducted by Levent (2017) reported that noodle samples containing chia seed flour showed a darker color than the control sample and a decrease in appearance with the addition of chia seed flour (Levent, 2017).

**Table 3.** Organoleptic analysis results

| Organoleptic Analysis | Treatment | | | | P-value |
|---|---|---|---|---|---|
| | P0 (Mean ± SD) | P1 (Mean ± SD) | P2 (Mean ± SD) | P3 (Mean ± SD) | |
| Appearance | 4,07 ± 0,78 [a] | 3,97 ± 0,71 [a] | 3,43 ± 0,67 [b] | 3,30 ± 1,11 [b] | 0,002 |
| Aroma | 4,00 ± 0,87 [a] | 3,87 ± 0,73 [a] | 3,80 ± 0,84 [a] | 3,83 ± 0,91 [a] | 0,181 |
| Texture | 3,90 ± 0,75 [a] | 3,80 ± 0,61 [a] | 3,77 ± 0,85 [a] | 3,53 ± 0,77 [a] | 0,358 |
| Taste | 3,40 ± 0,81 [a] | 3,10 ± 0,84 [a] | 3,13 ± 0,81 [a] | 3,00 ± 0,87 [a] | 0,355 |
| Overall Favorability | 3,50 ± 0,73 [a] | 3,23 ± 0,56 [a] | 3,13 ± 0,73 [a] | 2,93 ± 0,82 [b] | 0,038 |

Note:
Numbers with the same notation in the same row are not significantly different (p>0,05).
P0= Wet noodles without chia seed flour; P1= Wet noodles with 5% chia seed flour; P2= Wet noodles with 10% chia seed flour; P3 = Wet noodles with 15% chia seed flour.

Wilcoxon test results showed that the appearance of wet noodles with the addition of chia seed flour showed that wet noodles P0 and P1 were significantly different from wet noodles P2 and P3. However, wet noodles P0 and P1 were not significantly different as well as wet noodles P2 and P3. This is supported by previous research (Coorey et al., 2012); in terms of appearance, the sample of chips with the addition of 5% chia seed flour is the same as the control sample and is significantly higher than other treatment chip samples. The samples with the addition of 10% and 15% chia flour were not significantly different because their appearance tended to be darker (Rendón-Villalobos et al., 2012).

**Aroma**

Aroma is an organoleptic parameter that detects odors when inhaling a product by the sense of smell; it is important to detect volatile vapors released by the product (Setiawati et al., 2018). Based on the results of the Friedman test, the addition of chia seed flour had no effect on the aroma of wet noodles. This is consistent with the fact that the addition of chia seed flour does not affect the aroma of pasta (Aranibar et al., 2018), wheat bread (Romankiewicz et al., 2017), or corn tortillas (Rendón-Villalobos et al., 2012). This may be due to the neutral aroma of chia (Myseeds Chia Test Kitchen 2013).

In the present study, the aroma produced tended to originate from additional ingredients in the form of chicken eggs. According to Kurniawati and Ayustaningwarno (2012), egg aroma in wet noodles is caused by the activity of the enzyme lipoxygenase, which hydrolyzes polyunsaturated fatty acids and produces volatile compounds, especially ethyl phenyl ketone.

**Texture**

Texture is a quality requirement that play a role in determines the characteristics of wet noodles. The texture parameter can be felt as soft, chewy, sticky, soft, hard, or smooth in wet noodles (Hasmawati et al., 2020). A good wet noodle texture is chewy (Juwitaningtyas and Khairi, 2021).

Based on the results of the Friedman test, the addition of chia seed flour had no effect on the texture of wet noodles. This is also supported by the test results that chia seed flour does not affect the tensile strength of the wet noodles. The chewiness of noodles is determined by the wheat protein in the form of gluten (Gultom et al., 2015). In addition, the addition of chia seed flour did not affect the texture of pasta

(Aranibar et al., 2018), sausage (Arifin et al., 2021), and bread (Guiotto et al., 2020). Aranibar et al. (2018) found that all cooked pasta samples had the same texture.

Wityadarda et al. (2023) stated that wet noodles substituted with mocaf flour with the addition of moringa leaf extract made using the same amount of wheat flour and mocaf flour would produce the same noodle texture, which is rather chewy. This is because of the gluten compound from the flour with the same amount. The chewiness of noodles is influenced by the composition of gluten and amylopectin fractions in wheat flour (Nintami & Rustanti, 2012). The amylopectin fraction of wheat flour can be an adhesive for the components in the noodles so that it can strengthen the molecular bonds that prevent the noodles from being easily disconnected. Chewy noodles can be formed by starch gelatinization and gluten coagulation during heating (Nurjannah et al., 2019).

**Taste**

Taste is an important organoleptic parameter because foods with a good taste are attractive to panelists. The taste of a product can come from its food ingredients or additives during manufacture, which can cause a sharp enough taste or vice versa to be reduced (Rosniar, 2016). Based on the results of the Friedman test, the addition of chia seed flour had no effect on the taste of wet noodles. This is consistent with the fact that the addition of chia seed flour does not affect the taste of pasta (Naumova et al., 2017), chips (Coorey et al., 2012), wheat bread (Romankiewicz et al., 2017), or corn tortillas (Rendón-Villalobos et al., 2012).

The absence of differences in taste between treatments was due to the neutral taste of chia (Myseeds Chia Test Kitchen, 2013). In addition, the taste of wet noodles in this study tended to be influenced by the addition of salt in making wet noodles. According to Thasim et al. (2013), the addition of salt to wet noodles produces a savory taste.

**Overall Favorability**

Overall liking is a parameter of organoleptic product acceptance, which is seen in the overall organoleptic, consisting of appearance, aroma, texture, and taste (Hasmawati et al., 2020). Based on the results of the Friedman test, the addition of chia seed flour had an effect on the overall liking of wet noodles. The results of the panelists' research on overall liking in Table 3 show that the highest assessment of overall liking was in the P0 treatment (without the addition of chia seed flour) with an average of 3,50 in the like category. The lowest value of overall liking was found in P3 wet noodles (15% chia seed flour addition), with an average of 2,93 in the mildly liked category. The Wilcoxon test results showed that the overall liking of wet noodles with the addition of chia seed flour showed that wet noodles P0, P1, and P2 were not significantly different, and that the three samples were significantly different from wet noodles P3. This is supported by research (Barros, 2019), which states that the addition of up to 15% chia seed flour to chicken nuggets is less preferred due to the darker appearance of the product. In addition, according to a study by Naumova et al. (2017), 15% chia seed flour substitution in pasta is also less favorable because pasta tends to be darker. Handayani et al. (2019) stated that the higher the organoleptic assessment of food ingredients, the higher the chance of product acceptance. The results of the organoleptic evaluation showed that wet noodle treatment with the addition of 5% chia seed flour was preferred in second place, so it has the potential to be a healthy alternative food.

The limitations of this study include the criteria for assessing the aroma parameters, and the results are not optimal because it is expected that panelists already know the typical aroma of wet noodles in general. In the carbohydrate test using the by-difference method instead of testing carbohydrates directly, even though the main carbohydrate in chia is dietary fiber, which does not produce calories, the energy produced in each sample does not reflect the actual energy content, because energy is influenced by carbohydrates, proteins, and fat nutrients.

## Conclusion

Based on the results of the research and discussion, it can be concluded that the addition of chia seed flour (*Salvia hispanica L.*) affects the tensile strength, moisture content, ash, fat, protein, carbohydrates, energy, and organoleptic (aroma, texture, and taste) properties of wet noodles. In addition, there is an effect of the addition of chia seed flour to the dietary fiber and organoleptic (appearance and overall liking) properties of wet noodles.

Suggestions for further research are the need to add a higher percentage than 5%, 10%, and 15%, and for carbohydrate and energy testing to be carried out directly so that it can describe the actual number of calories of wet noodles.

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