Characteristics of pensi pempek (*Corbicula moltkiana*) on tapioca flour substitution with sago flour

I Ketut Budaraga[1*], *Inawaty* Sidabalok[1], *Said Abdul* Rasyid[1]

[1]Agricultural Product Technology Study Program, Faculty of Agriculture, Ekasakti University, Padang, Indonesia

Abstract. Pempek has a particular taste, is popular with the people, and has a high economic and nutritional value. The issue remains the use of flour from other countries, so it is vital to optimize the use of local products such as sago flour and substituting pensi for mackerel. This study aimed to investigate the impact of replacing tapioca flour with sago flour on the quality of pempek pensi (*Corbicula Moltkiana*). Observational data were analyzed using ANOVA and Duncan's New Multiple Range Test (DNMRT) at a significance level of 5%. The treatment in this study was a combination of tapioca flour and sago flour, namely: A = 70% : 30%, B = 60% : 40%, C = 50% : 50%, D = 40% : 60%, E = 30% : 70%. Based on the results of organoleptic tests, Pempek Pensi (*Corbicula Moltkiana*) is most preferred by consumers, namely treatment B with a formulation of 60% tapioca flour and 40% sago flour, with an average of 4.41 organoleptically, with water content (47.43), ash content (1.75), fat content (12.32), protein content (21.56), and carbohydrate content (16.52).

1 Introduction

Pempek is a traditional Palembang, South Sumatra dish made with ground fish meat, tapioca flour or sago flour, water, salt, and additional spices to enhance flavor. Pempek is a white ground meat-based food component that takes the form of a homogenous, elastic, chewy protein gel [1]. Pempek comes in various shapes, including long huge lenjeran, short little lenjeran, submarine,, and more [2]. Pempek has a particular taste, is popular with the people, and has a high economic and nutritional value. Pempek has 4.2% protein, 1.4% fat, and 31.6% carbs from fish and tapioca flour [3].

Apart from fish, flour is one of the raw materials used to make pempek. The flour used must have starch to produce better pempek outcomes. The flour can be blended with other

* Corresponding author: iketutbudaraga@unespadang.ac.id

flours, such as tapioca and sago flour. Tapioca flour is one of the ingredients used to make pempek [4].

Tapioca flour is used in a variety of food products. Tapioca flour contains around 86.9% carbohydrate in 100 grams of flour; nevertheless, tapioca flour has only 0.4% fiber [5]. The use of tapioca flour can be minimized by focusing on elements that are abundant in Indonesia and high in fiber. Sago flour is one of the potential local resources to be used.

Sago flour pempek is a type of pempek that has the following characteristics and advantages: First, it is gluten-free. Sago flour pempek does not contain gluten because it uses sago flour as the main ingredient. This is suitable for those who have a gluten allergy or are on a gluten-free diet. Second, soft texture: Sago flour pempek has a smooth and chewy texture, so it gives a delicious sensation when bitten. Third, easy to digest: Sago flour has a high fiber content, so sago flour pempek can help in the digestive process. Fourth, savory taste: Sago flour pempek has a distinctive savory taste, accompanied by a distinctive fish taste from the main ingredient. Fifth, suitable for people with allergies to eggs: Some types of pempek have eggs as one of the ingredients. However, sago flour pempek which does not use eggs in its making is suitable for those who have allergies to eggs. Sixth, does not crumble easily: Sago flour pempek has the advantage of not easily crumbling when fried or mixed with cuko sauce, so its texture is maintained. Seventh, durable: Sago flour pempek can last longer than pempek using wheat flour because sago flour is more resistant to storage conditions [6].

2 Material and Methods

2.1 Material

The key materials utilized in this study were sago flour, tapioca flour, Pensi (Corbicula Moltkiana), water, salt, and garlic, all procured from Pasar Raya Padang. The chemicals utilized are NaOH, $Na_2S_2O_3$, Na_2SO_4, $CuSO_4$, K_2SO_4, H_3BO_3, H_2SO_4, and HCl 0.1 N.

Scales, blender, knife, plastic basin, Erlenmeyer, homogenizer, measuring cup, beaker, Soxhlet flask, Kjedahl flask, porcelain cup, Whatman filter paper no. 45, protein distillation, furnace, condenser, and stove were used in this study. Also included is a serving platter.

2.2 Methods

This study used a Completely Randomized Design (CRD) with five treatments and three replications. The treatment is a variation of the pempek pensi recipe, which uses tapioca flour and sago flour. ANOVA and Duncan's Multiple Range Test (DNMRT) were used to examine the observation data at a 5% significance level. The first step is to boil and peel the pensi (*Corbicula Moltkiana*) meat from the shell. Wash the pensi thoroughly before boiling until the shell opens. Drain the pensi until cold, then remove the shell. The pensi meat has been ground and is ready for use as a raw material in producing pempek.

The following stage is creating pempek [7], which is the substitution of tapioca flour with sago flour in the amount of (70%: 30%), (60%: 40%), (50%: 50%), (40%: 60%), and (30%:70%).

In a mixing dish, combine 50 grams of finely ground Pensi meat with the tapioca and sago flour specified in the recipe. Next, add 7 grams of acceptable salt, 3 grams of ground garlic, and 20 milliliters of water. All of the ingredients are combined and kneaded until the dough is smooth. Next, 45 grams of dough are formed into an oval 7 cm long, 3 cm wide, and 2 cm thick. Boil the pempek in water for 15 minutes, or until it floats. After the pempek has cooled, it is tested for water, ash, fat, protein, and carbohydrate content. An organoleptic test was performed on fried pempek to assess color, aroma, taste, and texture.

3 Results and Discussion

3.1 Water Content

The diversity analysis revealed that substituting tapioca flour for sago flour in pempek pensi resulted in a significant water content difference ($P<0.05$). The average water content of pempek pensi is shown in Table 1.

Table 1. Average water content of pempek pensi (*Corbicula Moltkiana*).

Treatment	Water content (%)
A = (70% : 30%)	46.07 a
B = (60% : 40%)	47.43 ab
C = (50% : 50%)	49.88 ab
D = (40% : 60%)	51.47 b
E = (30% : 70%)	52.08 b
.84%	

*The numbers in the same column are followed by different lowercase letters, indicating significantly different effects.

Table 1 demonstrates that the water content of pempek pensi ranges between 46.07% and 52.08. Treatment E (comparison of tapioca flour and sago flour 30%:70%) had the highest water content of pempek pensi, at 52.08%. Treatment A (70:30 comparison of tapioca flour and sago flour) had the lowest water content (46.07%). The water content of pempek pensi is shown in Figure 1.

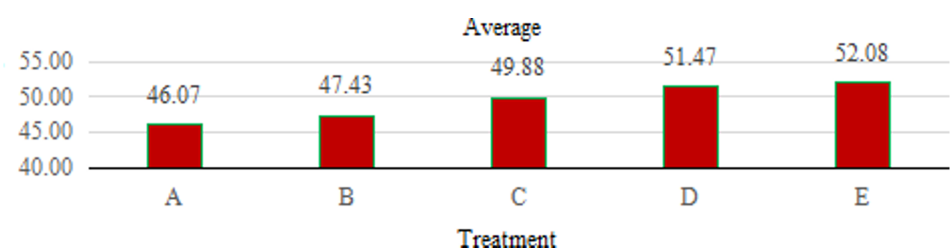

Fig. 1. Water content of pempek pensi (*Corbicula Moltkiana*).

Figure 1 demonstrates that treatment E had the highest water content in pempek pensi (*Corbicula Moltkiana*), at 52.08%, demonstrating that the more sago flour was added, the higher the water content in pempek pensi. This is because sago flour can change the water content of a product's dough; sago flour's high amylose content makes the starch less sticky and absorbs water more quickly.

Amylose is a straight chain that absorbs water, increasing the water content of sago flour [8], water molecules help to strengthen starch and protein molecules by entering them [9]. Then, when cooled, hydrogen bonds strengthen again, causing water molecules to form hydrogen bond bridges, increasing the water content. This is because sago flour has a higher water content than tapioca flour, with 14.0%, whereas tapioca flour has just 9.1% [10]. Sago flour contains amylopectin, which has hydrophilic characteristics, allowing it to retain water when cooked. The higher the amylose content, the dryer the starch is, less sticky, and more easily absorbed water. On the other side, increased amylopectin content causes the starch to be wetter and absorb less water [11].

3.2 Ash Content

The diversity analysis revealed that substituting tapioca flour for sago flour in pempek pensi had no significant influence on the ash content produced (P>0.05). The average ash content of pempek pensi is shown in Table 2.

Table 2. Average ash content of pempek pensi (*Corbicula Moltkiana*).

Treatment	Ash Content (%)
A = (70% : 30%)	1.32
B = (60% : 40%)	1.75
C = (50% : 50%)	1.82
D = (40% : 60%)	1.89
E = (30% : 70%)	2.23
2.7%	

*The numbers in the same column are followed by lowercase letters, indicating that the effect is not significantly different.

Table 2 shows the ash content ranges from 1.32% - 2.23%. The highest ash content was found in treatment E at 2.23% (Comparison of tapioca flour with 30% sago starch: 70%), and the lowest ash content was found in treatment A at 1.32% (Comparison of tapioca flour with 70% sago starch: 30%). Each treatment showed no significant difference in the ash content of pempek pensi. The ash content of pempek pensi is shown in Figure 2.

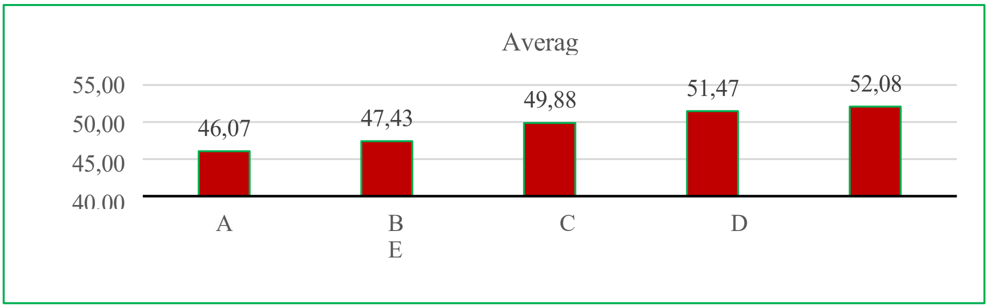

Fig. 2. Ash content of Pempek Pensi (*Corbicula Moltkiana*).

Figure 2 shows that the highest ash content in pempek pensi was in treatment E, namely 2.23%. Meanwhile, the lowest ash content in pempek pensi was in treatment A, namely 1.32%. It shows that the greater the addition of sago flour, the more ash content in pempek pensi increases. The increase in ash content occurs because the longer the material is dried, the greater the amount of water that evaporates from the dried material. In accordance with the ash content in sago flour is quite large, namely 3.18%, while the ash content in tapioca flour is 1.1% [12]. Improper handling can cause loss or even an increase in mineral content (ash) in food [13]. Ash is the residue left after a material is burned until it is free of carbon elements [14]. This residue is a mineral that comes from inorganic components of food, minerals are not affected by processing processes [15].

3.3 Fat level

The diversity analysis results showed that the difference in substituting tapioca flour with sago flour in making pempek pensi had a very significantly different effect ($p<0.05$) on the fat content produced. Based on the DNMRT test at the 5% level, all treatments showed very significant differences in the fat content of pempek pensi. The average fat content of pempek pensi is presented in Table 3.

Table 3. Average fat content of pempek pensi (*Corbicula moltkiana*).

Treatment	Fat level (%)
A = (70% : 30%)	9.26 a
B = (60% : 40%)	12.32 b
C = (50% : 50%)	15.81 c
D = (40% : 60%)	20.10 d
E = (30% : 70%)	24.58 e
94%	

*The numbers in the same column are followed by different lowercase letters, indicating a very significantly different effect according to the DNMRT test at the 5% level.

Table 3 shows that the fat content of pempek pensi produced ranges from 9.26% - 24.58%. The highest fat content was found in treatment E, namely 24.58% (Comparison of tapioca flour with sago flour 30%: 70%). Meanwhile, the lowest fat content was found in treatment A, namely 9.26% (Comparison of tapioca flour with sago flour 70%: 30%). Based on further DNMRT tests at the 5% level, each treatment showed a very significant difference in the fat content of pempek pensi. The fat content of pempek pensi is shown in Figure 3.

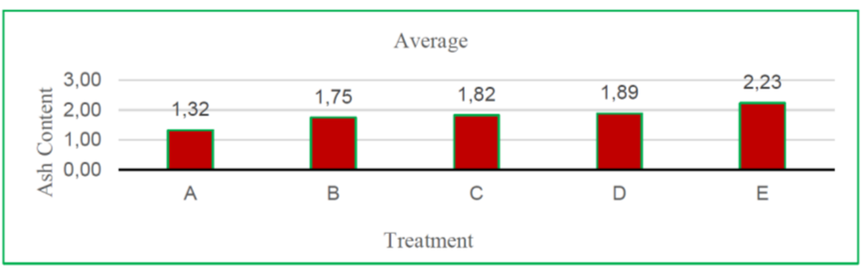

Fig. 3. Fat content of Pempek Pensi (*Corbicula moltkiana*).

Figure 3 shows that the highest fat content in pempek pensi was in treatment E, namely 24.58%. Meanwhile, the lowest fat content in pempek pensi was found in treatment A, namely 9.26%. The fat content in sago flour is around 0.2%, while the fat content in tapioca flour is around 0.5%. It is known that the fat content of pempek pensi increases along with the increase in sago starch concentration.

The presence of fat in the dough can inhibit the gelatinization process [16]. This is because fat forms a layer of fat on the surface of the granules, which hampered water penetration and increased the fat content in sago flour. The binding power of sago fat is so strong that the gelatinization process is hampered, causing the fat content in sago to increase. Meanwhile, the binding capacity of the fat in tapioca is very weak so the fat content in tapioca is easily separated/lost.

Tapioca has heat-resistant starch properties, but the binding capacity of the fat in tapioca is very weak, making the binding capacity of the fat easy to release/disappear during the heating process [17]. Meanwhile, the properties of sago starch have a slightly dark color, is high in amylose which makes the starch not too sticky, and quickly absorbs water. The binding capacity of the fat in sago is very strong so the fat content of sago is very high when heated. The fiber content in a product can also affect the fat content because fiber content can absorb liquid.

3.4 Protein Content

The diversity analysis results showed that the difference in substituting tapioca flour with sago flour in making pempek pensi had a very significantly different effect ($p<0.01$) on the protein content produced. Based on the DNMRT test at the 1% level, all treatments showed very significant differences in the protein levels of pempek pensi. The average protein content of pempek pensi is presented in Table 4.

Table 4. Average protein content of pempek pensi (*Corbicula moltkiana*).

Treatment	Protein Content (%)
A = (70% : 30%)	26.62 e
B = (60% : 40%)	21.56 d
C = (50% : 50%)	17.65 c
D = (40% : 60%)	12.18 b
E = (30% : 70%)	8.24 a
8%	

*The numbers in the same column are followed by different lowercase letters, indicating a significantly different effect according to the DNMRT test at the 1% level.

Table 5 shows that the protein content of pempek pensi produced ranges from 8.24% - 26.62%. The highest protein content was found in treatment A, namely 26.62%. Meanwhile, the lowest protein content was found in treatment E, namely 8.24%. Based on further DNMRT tests at the 1% level, each treatment showed a very significant difference in the protein levels of pempek pensi. The protein levels of pempek pensi *(Corbicula moltkiana*) are shown in Figure 4.

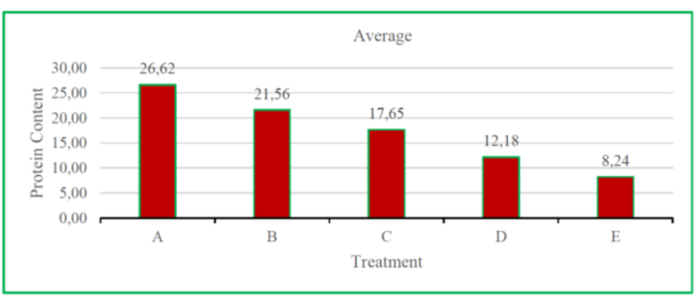

Fig. 4. Protein content of Pempek Pensi (*Corbicula moltkiana*).

From Figure 4, it can be seen that the highest protein content value for pempek pensi is 26.62%. Meanwhile, the lowest protein content was 8.24%.The protein content is lower when the amount of sago flour is greater than tapioca flour, this is because the protein content in sago flour is very small, namely around 0.7%/100g of material (Indonesian Ministry of Health, 2012), while the protein content in tapioca flour is quite high, namely around 1.1%/100 g of material [18]. The decrease in protein content was caused by the influence of water content and fat content. Protein content is influenced by water content and fat content, where there is an inverse relationship between protein and water content in the edible part [19]. The lower the protein content, the higher the water content. In accordance with the water content in Figure 4, water content greatly influences the protein content produced.

3.5 Carbohydrate

The results of the diversity analysis showed that the difference in substitution of tapioca flour with sago flour in making pempek pensi had no significant effect ($p>0.05$) on the carbohydrates produced. All treatments showed no significant differences in pempek pensi carbohydrates. The average carbohydrates for pempek pensi are presented in Table 5.

Table 5. Average carbohydrates for pempek pensi (*Corbicula moltkiana*).

Treatment	Carbohydrates (%)
A = (70% : 30%)	16.71
B = (60% : 40%)	16.52
C = (50% : 50%)	14.81
D = (40% : 60%)	14.34
E = (30% : 70%)	12.86
4.81%	

*The numbers in the same column are followed by different lowercase letters, indicating that the effect is not significantly different.

Table 5 shows that the pempek pensi carbohydrates produced range from 12.86% - 16.71%. The highest carbohydrates were found in treatment A, namely 16.71%. Meanwhile, the lowest carbohydrates were in treatment E, namely 12.86%. Each treatment showed no significant difference in pempek pensi carbohydrates. Pempek pensi carbohydrates are shown in Figure 5.

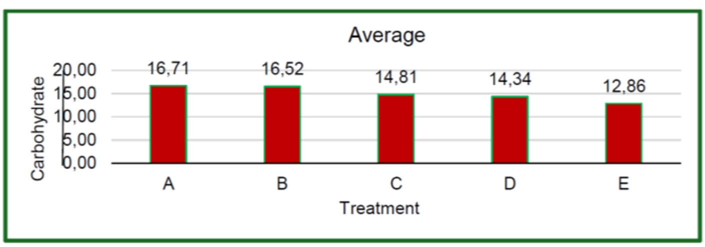

Fig. 5. Carbohydrates of pempek pensi (*Corbicula moltkiana*).

From Figure 4, it can be seen that the carbohydrate value of pempek pensi is the highest, namely 16.71%. Meanwhile, the lowest carbohydrate is 12.86%. The higher the sago flour formulation, the smaller the carbohydrates in it. The high or low carbohydrate value is thought to be due to the decomposition of starch contained in tapioca flour and sago flour, which are added when making pempek. Sago has a carbohydrate content of 51.6 grams per 100 grams, and the carbohydrate content in tapioca flour is 86.9 grams per 100 grams [20]. The content of other nutrients such as water, ash, fat, and protein dramatically influences the results of carbohydrate calculations. The higher the other nutritional content (water, ash, protein, and fat), the lower the carbohydrate content based on the calculation results. On the other hand, the lower the other nutritional content (water, ash, protein, and fat), the higher the carbohydrate content calculation results will be [21].

3.6 Organoleptic

Organoleptic testing is one of the factors that determines the quality and consumer acceptance of a product. The organoleptic test is carried out through sensory assessment, namely by tasting the taste, and observing the color, aroma, and texture of pempek pensi.

3.6.1 Aroma

The aroma of food determines the deliciousness of the food. Assessing the aroma of food cannot be separated from the function of the sense of smell. The aroma received by the nose and brain is generally a mixture of four main aromas: fragrant, sour, rancid, and burnt [22]. The results of the panelists' assessment of the aroma of pempek pensi are presented in Table 6.

Table 6. Aroma test value of pempek pensi (*Corbicula Moltkiana*).

Treatment	Aroma (%)	Information
A = (70% : 30%)	4.10	Rather like
B = (60% : 40%)	4.18	Rather like
C = (50% : 50%)	4.32	Rather like
D = (40% : 60%)	4.43	Rather like
E = (30% : 70%)	4.48	Rather like

*taste scores include 7 = strongly like 6 = much like 5 = like 4 = rather like 3 = dislike 2 = strongly dislike 1 = strongly dislike.

Table 6 shows that the panelists' highest assessment of the aroma of pempek pensi was in treatment E (30% : 70%) namely 4.48% (rather like), the lowest assessment was in treatment A (70% : 30%) namely 4.10% (rather like). The aroma of pempek pensi in each treatment was the same, with a slightly fishy aroma (The fishy smell appears when bacteria and enzymes change TMAO (Trimethylamine N-oxide) into trimethylamine (TMA), which emits a characteristic fishy odor. Pempek has a fishy aroma due to the addition of quite a lot of pensi meat (*Corbicula Moltkiana*), whose meat smells fishy. Because pensi is a type of shellfish that has a quite fishy aroma. The smell of food can determine the deliciousness of the food itself.

Smell is the main attraction in determining the delicious taste of the food product [23]. Generally, the odors received by the tongue and brain are mostly a mixture of 4 odors: fragrant, sour, rancid, and burnt [24]. The protein in pensi is quite high, so the fishy aroma feels so strong in the nose that it experiences hydrogenation (catecholase activity), affecting pempek pensi's color.

The panelists assessed that they liked pempek because the pempek's aroma was too fishy, which made the panelists dislike it. The fishy aroma comes from the pensi meat mixed into the pempek mixture, making the pempek smell fishy.

3.6.2 Color

Color is an important aspect in fulfilling human tastes, if it has an unsightly color it will give the impression that the food product has been deviated from. [25]. The results of the panelists' assessment of the color of pempek pensi are presented in Table 7.

Table 7. Color test values of pempek pensi (*Corbicula Moltkiana*).

Treatment	Color (%)	Information
A = (70% : 30%)	3.62	Rather like
B = (60% : 40%)	3.53	Rather like
C = (50% : 50%)	3.68	Rather like
D = (40% : 60%)	3.58	Rather like
E = (30% : 70%)	3.74	Rather like

*taste scores include 7 = strongly like 6 = much like 5 = like 4 = rather like 3 = dislike 2 = strongly dislike 1 = strongly dislike.

Table 7 shows the assessment of the color of pempek pensi in each treatment being the same, with colors that are not too dark and not too light. The highest rating was in treatment E (30% : 70%) namely 3.74% (rather like), while the lowest treatment was treatment B (60% : 40%) namely 3.53% (rather like). Sago flour has a darker/creamier color than tapioca flour, so it affects the color of the pempek when boiled. The effect of adding pensi meat (*Corbicula Moltkiana*) also makes the color of pempek become darker after boiling. When pempek pensi is cooked, the color changes to become darker.. Pempek is made where flour is added, and it is creamy white with salt. besides being a flavor enhancer, salt also plays a role as a color maker. Apart from that, the cooking process can also change the color or appearance of the product. Adding meat, flour and salt can influence functional properties such as color, texture and elasticity of the meat and products produced [26].

The panelists liked the pempek's color because the outer color was not too black; there was still white in it, but after cutting, the color inside the pempek was dark, which made the panelists quite like the color of the pempek.

3.6.3 Flavor

Taste is a stimulus caused by the ingredients eaten, especially felt by the sense of taste. Taste is the parameter that plays the most role in consumer acceptance of a product. The results of the panelists' assessment of the taste of pempek pensi are presented in Table 8.

Table 8. Taste test value of pempek pensi (*Corbicula Moltkiana*).

Treatment	Flavor (%)	Information
A = (70% : 30%)	5.27	Like
B = (60% : 40%)	5.48	Like
C = (50% : 50%)	5.25	Like
D = (40% : 60%)	5.08	Like
E = (30% : 70%)	5.04	Like

*Taste scores include 7 = strongly like 6 = much like 5 = like 4 = rather like 3 = dislike 2 = strongly dislike 1 = strongly dislike.

Table 8 shows that the highest assessment of the taste of pempek pensi is treatment B (60%: 40%) namely 5.48% (Like), while the lowest treatment is treatment E (30%: 70%) 5.04% (Like). Each treatment is the same, with a taste that is not much different in each treatment. The panelists liked the taste of pempek because the taste of pempek is quite delicious when eaten even though the fishy aroma of pempek is quite annoying, when eaten using *cuko* it reduces the fishy taste of pempek slightly. Taste sensing is divided into 4 (four) main tastes: sweet, salty, bitter, and sour.

Taste is the tongue's response to stimuli provided by a food. Consumers can accept or reject products with these 4 flavors [27]. Apart from functioning as a flavor enhancer, salt also plays a role in selecting desired microbes, especially the proteolytic group [28]. Protein breakdown is caused by proteolytic enzymes in the muscle/meat tissue. The slightly pleasant, delicious, and sweet taste is also influenced by 2 (two) main components, namely peptides and amino acids found in muscle/meat tissue [29]. Apart from that, the delicious taste is influenced by the amino acids glutamate and aspartate.

3.6.4 Texture

Texture is everything related to mechanics, taste, touch, and sight, and it includes assessments of wetness, dryness, hardness, smoothness, roughness, and oiliness [30]. Texture factors include hand feel, softness, and easy chewing [31]. The results of the panelists' assessment of the texture of pempek pensi are presented in Table 9.

Table 9. Pempek pensi texture test values*(Corbicula Moltkiana)*.

Treatment	Texture (%)	Information
A = (70% : 30%)	4.27	Rather like
B = (60% : 40%)	4.48	Rather like
C = (50% : 50%)	4.25	Rather like
D = (40% : 60%)	4.08	Rather like
E = (30% : 70%)	4.04	Rather like

*taste scores include 7 = strongly like 6 = much like 5 = like 4 = rather like 3 = dislike 2 = strongly dislike 1 = strongly dislike.

Table 9 shows that the assessment of the texture of pempek pensi in each treatment is the same, with the highest texture assessment found in treatment B (60% : 40%) namely 4.48 (rather like). while the lowest texture assessment was in treatment E (30%: 70%) namely 4.04 (rather like). The combination of tapioca flour and sago flour makes Pempek's somewhat dense and chewy texture is thought to be related to tapioca flour and sago flour which function as food thickeners, so that the combination of these flours becomes chewier and denser.

The higher the water binding capacity, the higher the elasticity that will be formed [32]. This is because less water comes out during the cooking process, which makes the final product more compact. Adding gelatinization to pempek is divided into two types, namely protein and starch gelatinization, but starch gelatinization is the most dominant in forming the elasticity of pempek. In gelatinization, water is bound by a network formed from starch or protein molecular chains. The process of gel strengthening is caused by fillers, where the fillers will absorb water into the product. Starch functions as a simple protein gel filler, not interacting directly with the protein matrix or changing protein formation [33]. Gel formation depends on forming a three-dimensional muscle network resulting from protein-protein and protein-water interactions, which change a rigid structure. Gel formation results from hydrogen bonds, ionic and hydrophobic interactions, van der Waals forces, and covalent disulfide bonds [34].

The cross-links formed are a determining factor in making gel; the more gel is formed, the greater the elasticity of the texture is. It was added that the protein capacity of pensi meat *(Corbicula Moltkiana)* in forming gel during the processing of meat products is an essential functional property that plays a role in textural and structural properties. It is also suspected that the density/hardness and compactness of pempek is due to the denaturation of the collagen protein of pensi meat *(Corbicula Moltkiana)* which is added during cooking, so that more gel formation and cross-links are formed. The texture is denser and more compact. Collagen protein will be denatured and shriveled by heat at around 65^{0}C and form a gel [35]. The panelists liked the texture of pempek because it was very chewy and dense but required extra effort to chew it because its density meant that the pensi had to be chewed longer to swallow it.

4 Conclusion and Suggestions

4.1 Conclusion

The conclusions of this research are: The substitution of tapioca flour with sago flour has a substantial influence on water content, although the difference in fat and protein content is quite considerable, but the difference in ash and carbohydrate content is not significant. Based on the results of chemical and organoleptic tests, the highest treatment is treatment B with a formulation of 60% tapioca flour and 40% sago flour, with an average of 4.4%1 organoleptically, with chemical content, namely: water content (47.43%), ash content (1.75%), fat content (12.32%), protein content (21.56%), and carbohydrates (16.52%).

4.2 Suggestion

Suggestions for this research include observing the shelf life of pempek pensi and including additional tests such as testing for microbiological contamination, metal contamination, and so on, in compliance with SNI 7661:2019 in pempek manufacturing.

References

1. Prima, Asti. (2018). "Pembuatan Pempek Tepung Sagu dengan Penambahan Tepung Terigu dan Pati Modifikasi". Jurnal Teknologi Pangan dan Gizi, Vol. 15 No. 2
2. Alhanannasir., Dasir., and Derta B. 2018. Physical Characteristics, Aroma and Protein of Pempek Lenjer Using the Ice Water Washing Frequency Method. Faculty of Agriculture, Food Science and Technology, Muhammadiyah University, Palembang. Urecol Proceedings. 135-143.
3. Murtado, AD and AV Yani. 2014. Hedonic Quality of Empek-Empek with the Addition of Kappa Carrageenan and Flour Porridge, J. Food Sci. Qual. Manag., vol. 34, pp. 1–6.
4. Efrianto, Z. Zubir, and Maryetti. 2014. Inventory of Palembang Pempek Cultural Works, Padang Cultural Value Preservation Center.
5. Utomo, WD, Rekna, and W. Rakhmad. 2013. Utilization of Snakehead Fish (Ophiocephalus striatus) to Make Meatballs in the Context of Improving Community Nutrition and Efforts to Increase Its Economic Value, Faculty Thesis. Agriculture. Univ. Yudharta Pasuruan, Pasuruan. DOI:10.35891/tp.v1i1.476
6. Anwar, Aulia. (2019). "Inovasi Pembuatan Pempek dari Tepung Sagu". Jurnal Inovasi Pangan, Vol. 6 No. 2.
7. Jayanti, U, Dasir, Idealistuti. 2017. Study of the use of tapioca flour from various varieties of cassava (Manihot esculenta crantz.) and types of fish on the sensory properties of pempek. Palembang Journal, VI -1: 59-62.
8. Akbar, Usaid Muhammad, Riza Taufik, Dedi Gusnadi. 2021. Addition of Mackerel Fish Bone Meal to Sago Flour in Making Pempek. Journal of e-Proceeding of Applied Science: Vol.7, No.4.
9. Laiya, N., R.M., and. NY 2014. Formulation of Snakehead Fish Crackers Substituted with Sago Flour. Nike`: Scientific Journal of Fisheries and Marine Affairs. Volume II, Number 2.
10. [BSN] National Standardization Agency. (2019) Frozen boiled fish pempek SNI 7661.
11. Gunawan, Ivan. (2015). "Penerapan Tepung Sagu dalam Pembuatan Pempek". Jurnal Pangan dan Gizi, Vol. 12 No. 1.
12. Hadi, Johan. (2017). "Pempek Tepung Sagu sebagai Alternatif Pangan Lokal di Indonesia". Jurnal Ilmiah Pangan Lokal, Vol. 9 No. 3.
13. Winarno FG. 2004. Food Damage and Processing Methods. Department of Agricultural Technology. Bogor Agricultural Institute.

14. Manullang. M, M. Theresia and HE Irianto., 1995. The Effect of Tapioca Starch and Sodium Tripolyphosphate Concentrations on the Quality and Durability of Coconut Stingray Kamaboko (Trygon sephen). Food Technology and Industry Bulletin. 6 (2) : 21 - 26.
15. Damapoli. R, Assa. J, R, Kandou, J. Organoleptic and Chemical Characteristics of Tilapia Fish Meatballs (Oreochromis Mossambicus) Substituted with Sago Flour (Metroxylon Sago) as a Filling Material. Thesis. Sam Ratulangi University
16. Harsono, W. (2006). The Effect of the Comparison of Catfish Meat with Tapioca Flour on the Quality of Fish Crackers Produced. Skipsi Agricultural Cultivation Department, FAPERTA UNJA, Jambi.
17. Narwastu, Wahyu. (2020). "Optimasi Pembuatan Pempek Tepung Sagu dengan Metode Response Surface Methodology". Jurnal Teknologi Pangan, Vol. 17 No. 4.
18. [BSN] National Standardization Agency. (2019) Frozen boiled fish pempek SNI 7661.
19. Budiyanto, MAK 2002. Basics of Nutrition Science. UMM Press Journal. Poor.
20. [BSN] National Standardization Agency. (2019) Frozen boiled fish pempek SNI 7661.
21. Novitasari R, and Hermiza M. 2020. Making snakehead fish meatballs using sago flour which is a local potential natural resource in Indragiri Hilir Regency. "Vol. 9, no. 2, 2020." 9(2): 71–78.
22. Novianti. E. 2019. Study of the formulation of jelawat fish pempek (leptobarbus haovenii) with the addition of different sago flour on consumer acceptance. Thesis. Fishery Product Technology, Faculty of Fisheries and Marine Affairs, Riau University.
23. Soekarto ST, Hubeis M. 2000. Organoleptic Assessment Methodology. Laboratory Instructions. Bogor: Inter- University Center for Food and Nutrition, Food Science Study Program, Bogor Agricultural Institute.
24. Suroto, Alip., Suwandojo DPE Hery. 2023. ABiblio analysis of metrics for the use of sago in food processing. Journal of Research Innovation. Vol.3 No.8 . DOI:https://doi.org/10.47492/jip.v3i8.2481
25. Talib and MT 2015. Organoleptic and chemical characteristics of skipjack tuna empek-empek products, Agrikan J. Fisheries Agribusiness., vol. 8, y6no. 1, pp. 50–59, 2015, doi: 10.29239/j.agrikan.8.1.50-59.
26. Prayitno E. 2003. Study of the nugget process from surimi and catfish (Arius thallasinus) with the addition of gelatin from tuna skin [thesis]. Bogor: Postgraduate program, Bogor Agricultural Institute.
27. Winarno FG. 2004. Food Damage and Processing Methods. Department of Agricultural Technology. Bogor Agricultural Institute.
28. Salamah, E., & Purwaningsih. 2012. Mineral Content of Mussels (Corbicula moltkiana Prime) Due to Processing. J. Aquatics, vol. III(I). 74–83.
29. Soekarto ST, Hubeis M. 2000. Organoleptic Assessment Methodology. Laboratory Instructions. Bogor: Inter- University Center for Food and Nutrition, Food Science Study Program, Bogor Agricultural Institute.
30. Meilgaard M, Civille GV, Carr BT. 1999. Sensory Evaluation Techniques. 3rd ed. Florida: CRC Press.
31. Suroto, Alip., Suwandojo DPE Hery. 2023. ABiblio analysis of metrics for the use of sago in food processing. Journal of Research Innovation. Vol.3 No.8 . DOI:https://doi.org/10.47492/jip.v3i8.2481
32. Winarno FG. 2004. Food Damage and Processing Methods. Department of Agricultural Technology. Bogor Agricultural Institute.

33. Narwastu, Wahyu. (2020). "Optimasi Pembuatan Pempek Tepung Sagu dengan Metode Response Surface Methodology". Jurnal Teknologi Pangan, Vol. 17 No. 4.
34. Soekarto ST, Hubeis M. 2000. Organoleptic Assessment Methodology. Laboratory Instructions. Bogor: Inter- University Center for Food and Nutrition, Food Science Study Program, Bogor Agricultural Institute.
35. Zayas JF. 1997. Functionality of protein in Food. Springer, Germany.