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The Impact of Various Concentration of Maizena Flour on the Physicochemistry and Organoleptic Properties of Petis

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Abstract

Shrimp is a fishery product that has a specific aroma and has a high nutritional value. Petis derived from the body fluids of fish or shrimp through a prolonged boiling process so that it becomes denser like pasta. This study aims to determine the influence of cornstarch concentration as a binder and filler material for physical, chemical and organoleptic characteristics of shrimp petis. A Completely Randomised Design was used, with 1 factor, namely the concentration of maizena flour with 5 treatments, namely P0 (100 g shrimp broth and 0 g maizena flour); P1 (100 g shrimp broth and 2 g maizena flour); P2 (100 g shrimp broth and 4 g maizena flour); P3 (100 g of shrimp broth and 6 g of maizena flour); P4 (100 g shrimp broth and 8 g maizena flour) and 4 replications. The results showed that the treatment had an effect ($p < 0.05$) on all observation variables i.e., chemical properties (water content, ash content, protein content), physical properties (viscosity), and organoleptic properties (taste, color, aroma, and texture). The P3 treatment was chosen as the best treatment because it approached the quality requirements of shrimp paste according to SNI (Indonesian National Standard) with characteristics of water content 48.29%, ash content 1.10%, protein content 20.95%, viscosity 91.01 Cp, and taste organoleptic 4.50 (rather savory), color 4.10 (dark), aroma 1.85 (rather fishy), and texture 4.05 (thick).

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Introduction

Petis is a semi-wet food product in the form of a paste which is a byproduct of meat, fish or shrimp. Indonesian people, especially the island of Java, recognize petis as a seasoning that gives traditional food a distinctive taste. In general, the raw material for making petis is shrimp, fish, or meat waste (Firdaus et al*.,* 2016).

In general, fillers are often added in making petis to accelerate the thickening process (Sari, et al., 2015). The quality of the petis itself is also influenced by the addition of fillers. The addition of fillers is intended to increase the quantity, quality, level of consumer acceptance and the selling value of petis products. Various kinds of starch are used, such as wheat flour, tapioca flour, cornstarch and others (Isnaeni, 2014). According to the research of Firdaus *et al.,* 2016, the principle of petis processing is the heating process of meat broth with the addition of starch, resulting in a gelatinization process. Flour is a source of starch used in making petis. The interaction between starch and protein has a very significant role on the structure and palatability of petis.

According to Fajrita et al., (2016) the results of research with the addition of 0%, 2%, 4%, 6%, 8% tapioca flour to the milkfish paste, the best treatment at 4% is the most preferred treatment for panelists. It has a mixture of savory, salty and sweet obvious flavors. In addition, it has distinctive aroma of brown sugar and distinctive aroma of fish stock with a blackish brown color.

Cornstarch is very good for emulsion products because it is able to bind and hold water during cooking. Cornstarch contains 71.3-73% amylopectin and 26,6-28.7% amylose. Cornstarch produces a slightly cloudy paste with a stiff viscosity and gel (Guo et al., 2020; Nalin et al., 2015). The functions of cornstarch, among others, are to improve texture, taste, water-holding capacity, and improve elasticity in final products (Sari, et al.,2015).

In this research, we study the impact of cornstarch concentrations at 0%, 2%, 4%, 6%, 8% on the physical, chemical and organoleptic characteristics of shrimp paste. Like the starch group in general, cornstarch is a glucose homopolymer with α-glycosidic. Maizena consists of two fractions that can be separated in hot water; the soluble fraction named amylose and the insoluble fraction named amylopectin. The comparison of amylose and amylopectin affects the properties of starch. Maizena produces a slightly cloudy and stiff/viscous paste. The functions of cornstarch include improving texture, flavor, water-holding capacity, and improving elasticity in the final product (Sari, et al., 2015). According to Firdaus et al., (2016) The difference in the content of amylopectin and amylose found in flour affects the viscosity of meat paste, amylopectin has more of an effect on the thickening of the dough compared to amylose. According to research by Fajrita et al., (2016), An increase in viscosity and density of shrimp paste can occur due to the presence of high amylopectin content. Amylopectin has a long branch chain and has a strong tendency to form a gel (Fajrita et al., 2016). Cornstarch contains 74-76% amylopectin and 24-26% amylose. The use of cornstarch produces a slightly cloudy paste and stiff.

According to Isnaeni et al., (2014), petis is a processed or preserved product that is included in the group of sauces that resemble thick, tough and elastic porridge, black or brown depending on the type of material used and is a food product that resembles a semi-solid texture (Intermediate Moisture Food). Petis comes from the body fluids of fish or shrimp that have been formed during the salting process and then evaporated through a further boiling process so that it becomes denser like paste (Sari, et al.,2015).

At this time, there are three types of petis, namely shrimp paste, fish paste, and meat paste. The principle of processing a meat paste is the process of heating the meat broth with the addition of starch, so that there is a gelatinization process. Flour is a source of starch used in making petis (Firdaus et al., 2016). Petis is usually also added with fillers, but there is also processing of petis without fillers. Petis without fillers has a pungent fishy smell. Petis without fillers is also considered less effective because the processing takes about 10 hours to complete. It is required to understand the effect of adding fillers on the quality and nutritional content of petis products (Isnaeni et al., 2014).

Materials and Methods

Materials

This research was conducted in December 2018 - January 2019 at the Food Engineering Laboratory, Food Chemistry Laboratory and Sense Test Laboratory, University of Semarang. The ingredients required for making petis are fresh shrimp, cornstarch, brown sugar, salt, water, squid ink. The materials needed for analysis are H_2SO_4, K_2SO_4, NaOH, indicators of PP and HCl. The tools used for making shrimp paste are stoves, basins, digital scales, knives, cutting boards, Teflon. The tools used for the analysis are porcelain plates, desiccators, ovens, measuring cups, dropper pipettes, test tubes, measuring flasks, Kjeldahl flasks, texture analyzers.

This research utilizes experimental design CRD (completely randomized design) with 5 treatments and repeated 4 times. Determination of treatment refers to research (Irma Fajrita, 2016) which has been modified. The treatments are as follows:

P0 : 100 g shrimp stock and 0% (0 g) cornstarch
P1 : 100 g shrimp stock and 2% (2 g) cornstarch100 g
P2 : 100 g shrimp stock and 4% (4 g) cornstarch
P3 : 100 g shrimp stock and 6% (6 g) cornstarch
P4 : 100 g shrimp stock and 8% (8 g) cornstarch

It has to be noted that in this research, the same amount of heat and period of heating time apply to all treatments during the cooking process. These variables are not part of observation in this research.

The observation variables are physical properties (viscosity), chemical properties (moisture content, protein content, and ash content), and organoleptic properties (taste, color, aroma, and texture) of shrimp paste.

The data obtained were analyzed using ANOVA (Analysis of Variance) analysis using SPSS version 23 software. Input Completely Randomized Design (CRD). If impacts are observed, a further Honestly Significant Difference (HSD) / Tukey test will be carried out at 5% level.

Results and Discussion

Water Content of Shrimp Paste

To avoid confusion, it must be noted that the authors in this article refer petis term to shrimp paste. In other words, these terms have the same meaning. Figure 1 shows that the water content is lower at higher cornstarch concentration. The more cornstarch added, the higher the resulting viscosity value (P0 - P4). This is because at higher cornstarch concentration, more starch available to bind free water to the paste so that the petis becomes thicker or more viscous. The starch molecule that plays a role in this water binding process is amylopectin. Its branched carbon chain allows the water molecules binding process to occur. Water content in shrimp paste P3 (48.29%) and P4 (42.99%) meets the Indonesian National Standard (SNI) quality requirements of *petis,* which is between 20% - 50%.

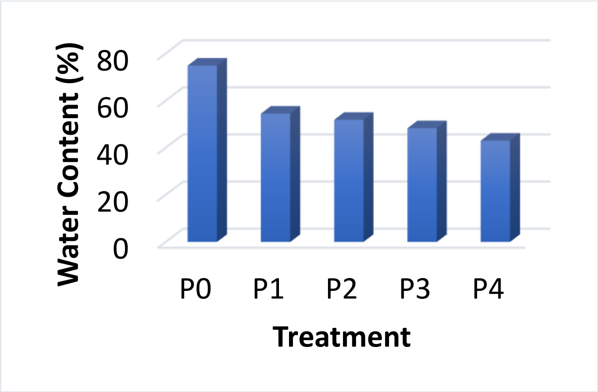

Figure 1. Water Content of Petis

Ash Content of Shrimp Paste

Figure 2 shows that the ash content is a material that remains when a food sample burnt completely in a furnace. In addition, the ash content describes the amount of minerals that do not burn into volatile substances (Hutomo et al., 2015). Ash content of shrimp paste is mainly obtained from shrimp and cornstarch. Shrimp itself contains a lot of organic mineral salts such as calcium (37 mg) and phosphorus (36 mg), as well as iron (2.8 mg). Cornstarch also contains mineral salts such as 20 mg calcium, 2 mg iron, and 30 mg phosphorus, this makes the ash content of shrimp paste increases (P0 - P4). The ash content produced by shrimp paste meets Indonesian National Standard (SNI) at P0 (Max. 1 %), while those that are close to the SNI requirements are P1 (1.03%), P2 (1.07%), and P3 (1.10%).

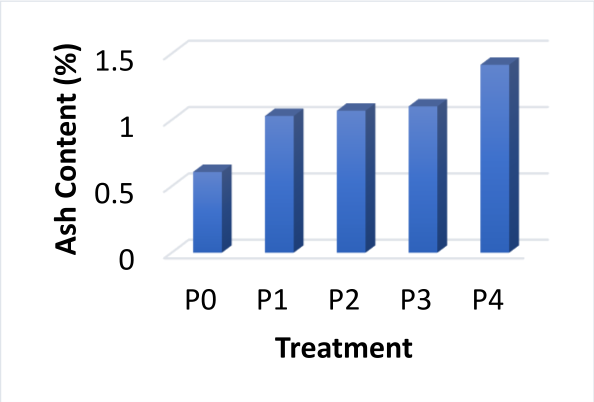

Figure 2. Ash Content of Petis

Protein Content of Shrimp Paste

Figure 3 shows that the protein content produced by shrimp paste in this study meets the SNI quality requirements which stipulate the protein content of shrimp paste is at least 15%. Among those, the best protein content was in P3 (20.95%) and P4 (20.99%). Petis protein produced in this study was higher than the protein produced from Fajrita et al., (2016), which was 8%. The higher cornstarch concentration, the higher the protein content and the darker the color on the resulting shrimp paste.

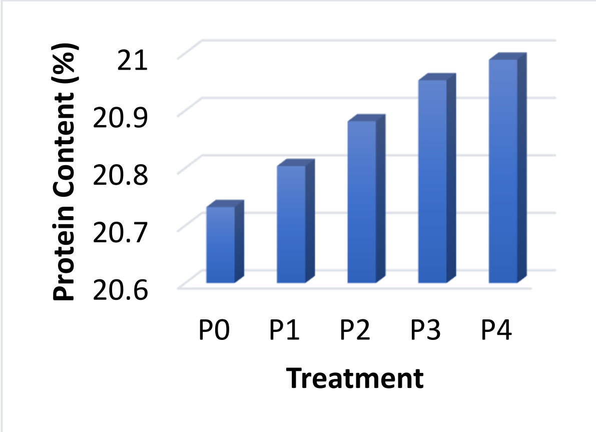

Figure 3. Protein Content of Petis

Viscosity

Figure 4 shows that the more cornstarch added, the higher the resulting viscosity value (P0 - P4). This is because more starch available to bind more free water so that the petis becomes firmer and stickier. The starch molecule that plays a role in this water binding process is amylopectin. Its branched carbon chains allow the binding process of water molecules to occur. The viscosity of comestibles that use cornstarch as a filler will produce a "thicker" and "stickier" texture. Apart from being caused by the low protein content, this is also due to the high amylopectin content in cornstarch. Amylopectin with its high ability to bind water (technically the ability to bind H atoms) makes the resulting comestibles muddier.

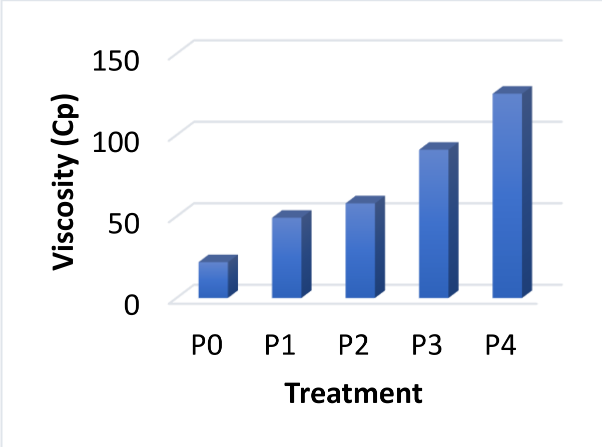

Figure 4. Viscosity of Petis

Taste Organoleptic in Shrimp Paste

Figure 5 shows that P3 treatment (6 g cornstarch) has the highest taste score from the panelists. This is because P3 can produce a balanced taste, so that the typical taste of starch is not noticeable. The organoleptic properties of taste were carried out using the hedonic quality method. To be noted, this method strongly depends on the preferences of the panelists. One of the factors that determine the quality of food is the content of flavor compounds. Taste compounds are compounds that cause taste sensations (sweet, bitter, sour, salty) and aroma after consuming these compounds. Taste compounds are compounds or mixtures of chemical compounds that can affect the body's senses, for example the tongue as a sense of taste. Basically, the tongue is only able to taste four types of flavors, namely bitter, sour, salty and sweet (Tarwendah, 2017). The right proportion of thickener (cornstarch) of P3 in making petis; the carbohydrate content in which there is glucose adds sweet taste which when combined with the salty and slightly acidic taste obtained from shrimp broth and salt will cause a "very tasty" taste. On the other hand, the addition of less (P0 - P2) or too much (P4) cornstarch will not produce the savory flavor blend (umami) that the panelists like.

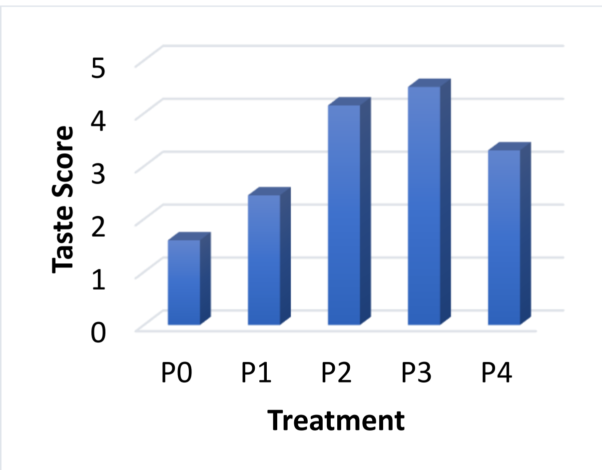

Figure 5. Organoleptic – Taste of Petis

Organoleptic Color in Shrimp Taste

Figure 6 shows that the color organoleptic in comestibles is a parameter that focuses on appearance. In the cooking process, there will be several flavor processes and color changes due to the Maillard and browning reactions. Maillard reactions occur because of the reaction between reducing sugars and amine groups of proteins or amino acids. The assessment was carried out using the eye senses, the aim was to assess the color homogeneity of the shrimp paste. Treatment P4 has the highest color score with 4.70 / Very Dark.

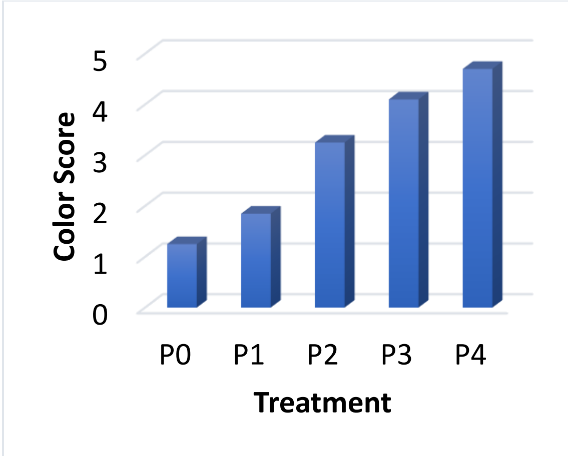

Figure 6. Organoleptic – Color of Petis

Organoleptic Aroma of Shrimp Paste

Figure 7 shows that treatment P3 had the highest score. Aroma is the smell of food products, odor itself is a response when volatile compounds from a food enter the nasal cavity and are felt by the olfactory system (Tarwendah, 2017). Aromatic compounds are volatile, so they easily reach the olfactory system at the top of the nose, and need sufficient concentration to interact with one or more olfactory receptors. Aromatic compounds can be found in food, wine, spices, perfumes, perfumes and essential oils. Besides that, aroma compounds play an important role in the production of flavorings, which are used in the food service industry, to enhance taste and generally increase the attractiveness of these food products (Antara et al., 2014).

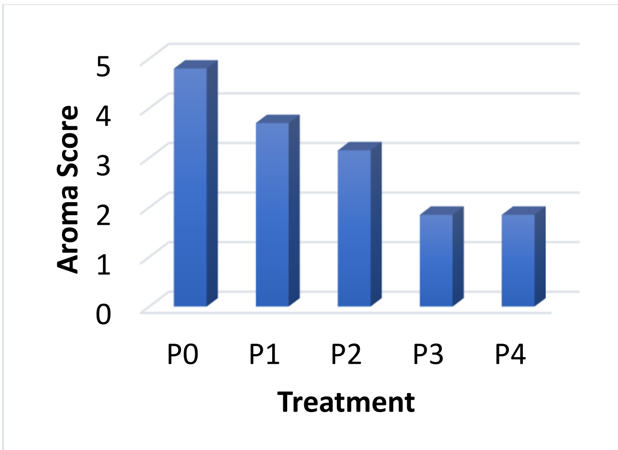

Figure 7. Organoleptic – Aroma of Petis

According to Pratiwi et al., (2015), food ingredients that give aroma are generally volatile materials such as alcohol, aldehyde, ketones and lactone esters. Brown sugar has a distinctive aroma because it contains benzyl alcohol which is a volatile aromatic compound. The aroma of processed products usually has a constant change that is reduced during handling, processing and storage. During cooking, various reactions will occur between the filler and the broth. The distinctive aroma of the ingredients will be reduced (Kuncoro, et al., 2019).

Organoleptic Texture of Shrimp Paste

Figure 8 shows that P4 had the highest score. The organoleptic properties of texture are properties obtained through the impression that is felt on the tongue. In petis, the organoleptic properties of texture are determined by the starch content. The high texture score at P4 is thought to be caused by amylopectin which has bind too much water so that it is no longer able to bind water. As is known as a food ingredient, starch functions as a structure-forming agent. Starch is used in the food industry primarily as a texture modifier, viscosity, adhesion, moisture retention, gel and film formation (Waterschoot et al., 2015). Starch granules swell and increase several times in size, breaking down the molecules and consequently the amylose leaching forms a three-dimensional network and increasing the viscosity of the paste (Sarker et al., 2013). According to Pahruzi et al., (2016), the more flour concentrations are used, the higher the amylose and amylopectin fractions, so that in the heating process of the material, the starch will swell and eventually break and absorb the higher water. The heating process in addition to swelling of the starch granules is also followed by an increase in viscosity.

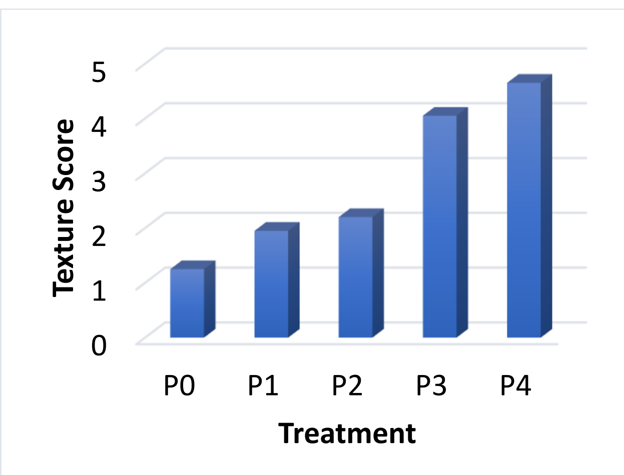

Figure 8. Organoleptic – Texture of Petis

Analysis of Best Treatment Results

In Indonesia, a good food product must meet the quality requirements listed in the Indonesian National Standard (SNI). SNI for shrimp paste itself has been regulated in SNI No. 2718.1 of 2013 which includes chemical properties and organoleptic properties. In this study, the chemical properties (moisture content, ash content and protein content), physical properties (viscosity), and organoleptic properties (taste, color, aroma, and texture) were observed. In detail, the scoring system in Table 1 is that the greater the score the more the sample in the treatment is closer to the SNI and has good physical and organoleptic characteristics. P3 (6% cornstarch) produced good shrimp paste, the analysis of the best treatment decisions is shown in Figure 1-Figure 8.

Based on the data, the P3 treatment was chosen as the best treatment because it was the variable closest to SNI and had good physical and organoleptic properties. P3 (6% cornstarch) produces good shrimp paste, with a concentration of 100 g of shrimp stock and 6 g of cornstarch. P3 treatment for moisture content parameters resulted in 48.2919% based on SNI requirements 20% -50%, ash content 1.1025% based on SNI max 1% requirements, 20.9529% protein content based on SNI requirements min 15%, viscosity 91.01Cp, and test organoleptic taste 4.50 (very savory), color 4.10 (dark), aroma 1.85 (a little fishy), and texture 4.05 (thick).

Conclusion

The various concentrations of flour cornstarch has a real effect ($p < 0.05$) on chemical properties (moisture content, ash content, protein content), physical properties (viscosity) and organoleptic (taste, color, aroma, and texture) in shrimp paste. P3 treatment with the concentration of cornstarch (6% cornstarch) produces shrimp paste as the best treatment because it is close to the quality requirements of shrimp paste according to SNI (Indonesian National Standard) with characteristics of water content of 48.29%, ash content of 1.10%, protein content of 20.95%, viscosity of 91.01 Cp, and organoleptic score for taste 4.50 (slightly savory), color 4.10 (dark), aroma 1.85 (somewhat fishy), and texture 4.05 (thick).

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