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Characteristic of Protein Hydrolyzate Starch of Snakehead Fish (*Channa Striata*) Head

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ABSTRACT

The making of protein hydrolyzate of snakehead fish head by using spray drying method and it is encapsulated with maltodextrin in which a final product in the form of starch is expected to ease the process of storage and extend the shelf-life of the product. This research was aimed to determine the quality of protein hydrolyzate starch of snakehead fish head with inlet temperature treatment of spray drying 120^{0}C and outlet temperature of 80^{0}C and the addition of maltodextrin. The design used is independent t-test. It was conducted to compare the average value of sample composition. Experimental data were processed using Statistical Package for Social Science (SPSS) 21.0 for Windows. The best treatment from the research is a comparison of snakehead fish starch and maltodextrin 95%:5%. The characteristic of physicochemical of snakehead fish starch as produced in the form of white starch with a yield of 21.35%, white degree L 97.73, water content 4.52%, ash 7.92%, protein 75.25%, fat 0.60%. Based on this, the protein hydrolyzate of snakehead fish head has the potential to be applied as a flavoring or flavor enhancer and it can be developed as a source of essential amino acids in food products because they contain almost complete essential amino acids.

Keywords : Amino Acids, Snakehead Fish Head, Maltodextrin, Spray Drying

I. INTRODUCTION

Generally, fish protein hydrolyzate is liquid with a short shelf-life so it must be stored in cold conditions. Storage at low temperatures is a method that has been commonly used to extend the shelf-life of food products that contain high water content (Belitz *et al.* 2009).Therefore, the second stage of the research is the making of protein hydrolyzate of snakehead fish head by using *spray drying* method and encapsulated with maltodextrin as the final product in the form of starch is expected to ease the process of storage and extend the shelf-life of the product. Berk (2009) explains the products produced by using *spray drying* method in the form of brightly-colored powder. Starch-food products contain low water content have several advantages including ease of transportation, storage and wider use. According to Cuq *et al.* (2011) that food is often made in the form of starch for a variety of reasons, including having a longer shelf-life, ease of transportation, and convenience for consumers. Starch-food products also do not require low temperatures to maintain quality so that it will reduce costs for equipment supply.

Previously, the study about protein hydrolyzate starch of fish has been conducted by Meiyani *et al*, 2014. By using shrimp head cooking water as a powdery flavor with the addition of 2.5% maltodextrin gave the highest glutamic acid by 36.85%. Suharso (2006) made flavor powder of tiger shrimp head (*Penaeus monodon*) enzymatically as an instant seasoning with 5% (w/v) maltodextrin filler. A research on protein hydrolyzate starch has been reviewed by Salamah *et al*, 2012 using catfish (*Clariasgariepinus*) as raw material and the supernatant was dried using a spray dryer with an inlet temperature of 120^{0}C and an outlet temperature of 80^{0}C. Djaafar *et al*, 2017 clarifying good quality pollen can be produced through the process of *spray drying* at an inlet temperature of 80^{0}C. Liu. *et al*, 2015 with CN 104719993 A as a patent invention, the invention of the processing of liquid squid hydrolyzate by an enzymatic method that is added ginger, garlic, and it is concentrated by spray drying for a delicious flavored food seasoning.

It is expected that the study of protein hydrolyzate starch of snakehead fish head by using spray drying method and encapsulation with maltodextrin can ease the process of storage and extend the shelf-life.

II. METHODS AND MATERIALS

A. Research Site

The research was conducted from 2018 to 2019, the making of protein hydrolyzate of snakehead fish head is conducted at the Laboratory of Biochemical and Miniplant, Agroindustrial Program, Department of Fisheries Product Processing Technology of Pangkep State Polytechnic of Agricultural; and for the processing of protein hydrolyzates starch of snakehead fish head by using spray-dryer method was conducted at the Agricultural Central Plant of Plantation Products of Makassar.

B. Materials and Tools

The materials used are snakehead fish head weighing 3 fish per kg obtained from Tempe Lake, Wajo district, South Sulawesi, and bromelin enzymes obtained at Delta Malang laboratory as manufactured by Xian Lyphar Biotech Activity of Enzyme 400.000 u/g min, maltodextrin, aquades obtained at Intrako Store of Makassar and analysis material.

The tools used in the processing procedure are analytical scales (Sartorius TE 64), ovens (Memmert), shellab vacuum ovens, Kjeldahl apparatus desiccators, waterbath shakers (Wise bath shakers WSB-18), centrifuges (HIMAC CR 21G), and chomameters (Monolta Camera CR-300), filter paper Wadmant 41, cool boxes, knives, electric meat grinders/blenders, fermentation jars, basins, and bottle packaging and caps and tools for chemical analysis uses analytical scales Mettler AE 100, erlenmeyer, funnel, pH meter (Thermo scientific-USA), Kjeldhal flask, reaction tube, condenser, oven, distillation flask, exicator, porcelain cup burette, digital scale.

C. Sample Preparation

Procedure for making protein hydrolyzate of snakehead fish head (Modified by Nurhayati *et al*. 2007) as follows: snakehead fish is weeded by removing the gills, and washed. After weeding, the head of snakehead fish is separated to be used as raw material for hydrolyzate.

D. Method

Protein hydrolyzates of snakehead fish head as obtained from the first stage of the research will be made into protein hydrolyzates of snakehead fish head in the form of starch which are expected to last longer during the storage process. In the second stage of the research, we conduct a comparison of the ratio of snakehead fish head hydrolyzate and the addition of maltodextrin (Snakehead Fish Head HPI:

Maltodextrin) 100% was HPKIG:M_1 = 97.5:2.5 (b/b) and HPIM_2 = 95:5 (b/b). After adding maltodextrin filler, it is dried with a spray dryer with an inlet temperature of 120^{0}C and an outlet temperature of 80^{0}C. Characteristics of protein hydrolyzate starch of snakehead fish head in physicochemical analysis are water content, ash, protein, fat, and yield and brightness level.

Water Content with Oven Method (AOAC 2005)

Determination of water content is based on differences in material weight before and after drying. Initially, the empty cup was dried in oven for 30 minutes at a temperature of 105^{0}C and then cooled in an exicator for 15 minutes, then weighed 3 - 5 grams of protein hydrolyzate of snakehead fish head and put in a cup then dried in an oven 105^{0}C for 6 hours. The cup was cooled in an exicator for 30 minutes and then weighed. Water content is calculated by using a formula:

$$\text{Water Content (\%)} = \frac{B-C}{B-A} x100\%$$

Protein Content (AOAC, 2005)

Protein solution is taken 10 ml and dilute it to 100 ml with distilled water in a flask, then put into Kjeldahl flask 500 ml and 10 ml H_2SO_4 (93% - 98% free-N) add 5 grams of mixture H_2BO_3, Na_2SO_4-HgO for catalyst. Rub thoroughly and continue for 30 minutes. After cooling, wash it in Kjeldahl flask with distilled water then boil again for 30 minutes.

After cooling, adding 140 ml of distilled water, and 35 ml of NaOH-$Na_2S_2O_3$ and a few grains of zinc. Then distilled, 100 ml of distillate was stored in Erlenmeyer containing 25 ml of saturated solution of boric acid and a few drops of PP indicator. The solution is obtained with 0.02 NHCl.

Ash Content with Gravimetric Method (AOAC, 2005)

As many as 3-5 gr samples is weighed and put in a cup, then burned until there is no smoke. After being put into the furnace, it is burned to gray. Ash is done in two stages, first at 400^{0}C and second at 550^{0}C. After the weight of cup is constant, the cup is then cooled in a desiccator and weighed. The ash content is determined by using a formula:

$$\text{Ash Content (\%)} = \frac{A}{B} x100\%$$

Fat Content (AOAC, 2005)

A sample of 2 grams is put in filter paper and in the sleeve. The fat flask that has been weighed then connected with the fat sleeve. Samples and fat solvents (*diethyl ether*) are put into fat sleeve. The series of fat flask and sleeves are mounted on the Soxhlet extractor which is connected to a recirculation chiller 4^{0}C. Fat samples were extracted at 60^{0}C for 7 - 8 hours. The mixture of fat and solvents contained in fat flask is distilled until drying. Fat flask is put in the oven at 105^{0}C for 2 hours. The flask is cooled in a desiccator until the weight is constant. Fat content is calculated by using a formula:

$$\text{Fat Content (\%)} = \frac{W3-W1}{W2} x100\%$$

Color (Hutching JB. 1999)

Color measurement was made using a colorimeter. The color reading included lightness (L), redness (a) and yellowness (b). The equipment was standardized with a white color standard.

E. Data Analysis

The design used is independent t-test. It was conducted to compare the average value of sample composition. Experimental data were processed by using *Statistical Package for Social Science* (SPSS) software 21.0 for Windows (Steel & Torrie 1993).

III. RESULTS AND DISCUSSION

The second stage of the research as the best results from the research of hydrolyzate products of snakehead fish head and it will make into protein hydrolyzate starch with the addition of maltodextrin as a coating material using a drying method using a spray dryer with an inlet temperature of 120^{0}C and an outlet temperature of 80^{0}C. According to Cuq *et al*. (2011), that food is often made in the form of starch for a variety of reasons, including having a longer shelf-life, ease of transportation, and convenience for consumers. Starch-food products also do not require low temperatures to maintain quality so that it will reduce costs for equipment supply. The physicochemical characteristics of the effect of the percentage of protein hydrolyzate of snakehead fish head and Maltodextrin on protein hydrolyzate starch products of snakehead fish head can be seen in Table 1.

Table 1. Effect of percentage treatment of protein hydrolyzate of snakehead fish head and Maltodextrin of protein hydrolyzate starch product of snakehead fish head

Composition (%)	HPI Snakehead Fish Head 97.5 %: Maltodextrin 2.5%	HPI Snakehead Fish Head 95 %: Maltodextrin 5 %
Yield	19.19 ± 0.04	21.35 ± 0.24
Brightness	86.0 ± 0.00	97.73 ± 0.12
Water	5.23 ± 0.20	4.52 ± 0.13
Ash	7.42 ± 0.04	7.92 ± 0.24
Protein	55.56 ± 0.09	70.25 ± 2.26
Fat	0.86 ± 0.07	0.60 ± 0.07

Source: Primary data processed, 2019

A.Content Level of Cork Head Hydrolsat Flour Yield

Yield content is one of the important parameters in the processing of fishery products which aims to estimate the number of parts of raw materials that can be utilized. According to Anwar and Rosmawati (2013), the percentage of the amount of hydrolyzate product produced to the volume of raw material before hydrolysis is called the yield of hydrolyzate product. Yield value can describe the economic value of a material. The higher of yield value, the higher of economic value because the higher of amount that can be utilized from the material.

Based on Table 1, yield value of protein hydrolyzate starch of snakehead fish head showed protein hydrolyzate of snakehead fish head 95%: maltodextrin 5% had a higher yield of 21.35% compared to protein hydrolyzate of snakehead fish head 97.5%: maltodextrin 2.5% had a yield of 19.10% . The study of protein hydrolyzate of snakehead fish head by using liquid protein

hydrolyzate treatment of snakehead fish head using maltodextrin by spray dryer method with an inlet temperature of 120^{0}C and an outlet temperature of 80^{0}C seen that the yield obtained was very low, this was caused by liquid hydrolyzate of snakehead fish head with high water content and adding maltodextrin will produce yield according to the amount of maltodextrine used and the working power of spray dryer which still separates the product attaches to the tube. The yield content of protein hydrolyzate starch of snakehead fish head can be seen in Figure 1.

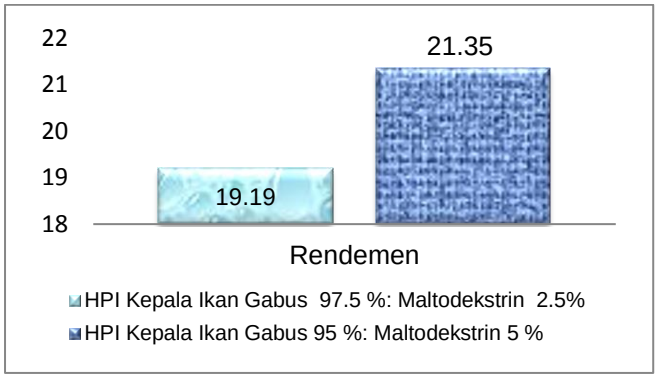

Figure 1. Yield content of protein hydrolyzate starch of snakehead fish head

Based on the results of significance analysis of independent t-test on the yield content of protein hydrolyzate starch of snakehead fish head with the comparison of protein hydrolyzate of snakehead fish head with maltodextrin were difference significantly ($p < 0.05$).Widadi (2011) showed that the yield value of protein hydrolyzate of catfish was 21.16%, it shows a small yield. According to Cucikodana, *et al.* (2012), the low yield is thought to be due to the effect of drying, where drying is the process of removing or disposing liquid material from a material that includes drying, roasting, evaporation, and others. The end result of drying is material that is free of water (liquid) or contains low amounts of water.

B. **Degree of White Cork Head Fish Flour Hydrolsat**

Table 1 protein hydrolyzate starch of snakehead fish head by using a comparison treatment of protein hydrolyzate of snakehead fish head and maltodextrine 97.5%:2.5%, a value of L 86.0 while hydrolyzate of snakehead fish head and maltodextrine 95%:5%, a value of L 97.73. The white degree of protein hydrolyzate starch of snakehead fish head can be seen in Figure 2.

White degree indicates the degree of color or brightness of a material, a scale from 0 to 100; the greater of L-value, the brighter of sample color. The results of observations of L (*lightness*), *a* (*redness*), and *b* (*yellowness*) and white degrees were conducted
by using Chromameter.

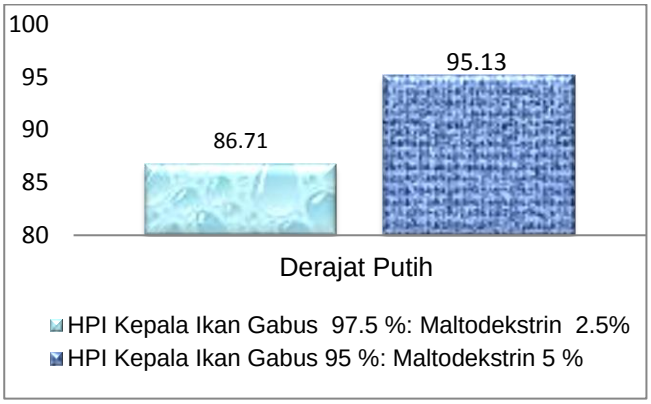

Figure 2. White degree of protein hydrolyzate starch of snakehead fish head

The results of *independent t-test* on the white degree of protein hydrolyzate starch of snakehead fish head with a comparison of protein hydrolyzate of snakehead fish head with maltofrtrin shows a significant difference ($p < 0.05$). White degree of protein hydrolyzate starch of snakehead fish head as obtained has index value (> 50) it indicate a bright color. Pilar and Reyes (2007) explain that the value of yellowness is usually caused by lipids, while

redness is influenced by protein precipitation. Denaturation or oxidation can also cause high brownish-yellow values in the product. According to Riansyah, *et al*. (2013), the ability of material to release water from its surface will be greater with increasing air temperature of drier used and the longer of drying process so that the resulting water content is lower. Salamah *et al*. (2011) states that water content resulting from the drying process by spray drying method is influenced by the temperature of the inlet and outlet, if the temperature used is too high then the risk of protein damage due to heat will also be even greater. The products produced from the spray drying method are brightly colored and porous (Berk 2009).

C. Proximate Analysis Results of Gabaus Fish Head Hydrolyzate Flour

Table 1 water content of protein hydrolyzate starch of snakehead fish head as dried with a spray dryer and uses inlet and outlet temperatures 120^{0}C and 80^{0}C, respectively shows the best treatment, namely the ratio of protein hydrolyzate of snakehead fish head and maltodextrine 95%:5% has a lower water content i.e 4.52% compared to protein hydrolyzate of snakehead fish head and maltodextrine 97.5%: 2.5% has a moisture content of 5.23%. The results of proximate analysis of the water content of the treatment ratio between protein hydrolyzate of snakehead fish head and maltodextrin as shown in Figure 4 that low water hydrolyzate protein content can be attributed to the high temperature used during the spray drying evaporation process. According to Sanapi (2013), the water content resulting from the drying process by the spray drying method is influenced by the inlet and outlet temperatures. A study of protein hydrolyzate starch of snakehead fish head as obtained from the two treatment comparisons between protein hydrolyzate of snakehead fish head and maltodextrin with spray drying method, obtained lower water content from research conducted by Widadi (2011) and Cholifah (2014) that showed that the value of water content of protein hydrolyzate of catfish was 5.46% by using spray drying method.

According to Sanapi (2013) states that water content resulting from the drying process by using spray drying method is influenced by the inlet and outlet temperatures. A research by Roslan, *et al*. (2014) showed that the value of water content of protein hydrolyzate of tilapia was 6.48% with the addition of 2.5% alkalase enzyme concentration. The results of *independent t-test* on the water content of protein hydrolyzate starch of snakehead fish head with a comparison of protein hydrolyzate of snakehead fish head with maltodextrnie were differences significantly ($p < 0.05$).

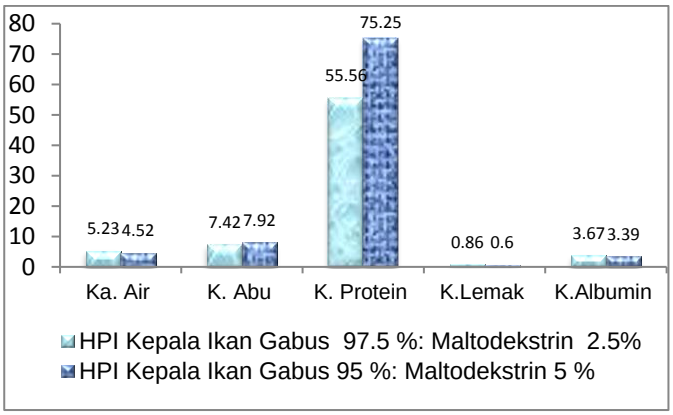

Figure 3. Proximate analysis result for comparison treatment of protein hydrolyzate of snakehead fish head and maltodextrin to protein hydrolyzate starch of snakehead fish head

Most foodstuff consists of 96% organic matter and water, the rest is mineral elements. The burning process of food to a temperature of 600^{0}C will cause organic matter to burn, but the inorganic material does not burn, namely in the form of ash consisting

of various mineral elements such as Ca, Mg, Na, P, K, Fe, Mn and Cu. Ash content indicates mineral content in foodstuffs (Winarno, 2008). Table 1 the ash content of protein hydrolyzate starch of snakehead fish head dried with spray dryer and inlet and outlet temperature 120^{0}C and 80^{0}C, respectively where the comparison of protein hydrolyzate of snakehead fish head and maltodextrine 97.5:2.5 had higher ash content was 7.42% and protein hydrolyzate of snakehead fish head and maltodextrine 95:5 has an ash content of 7.92%. Some researchers reported that the ash content of protein hydrolyzate of sardinella *by-product* had ash content ranging from 12.10 to 25.23% (Souissi *et al*. 2007). The results of proximate analysis of ash content for comparison treatment between the protein hydrolyzate of snakehead fish head and maltodextrin to protein hydrolyzate starch of snakehead fish head can be seen in Figure 3. The result of independence t-test analysis on the ash content of protein hydrolyzate of snakehead fish head with the comparison of protein hydrolyzate of snakehead fish head and maltofrtrin have significant differences ($p < 0.05$).

Protein is an essential molecule in the preparation of structure and functional processes of the living things. Proteins consist of amino acid chains that are connected by peptide bonds to form a variety of complex structures (Vaclavik and Christian, 2008). Table 1 the highest protein levels of protein hydrolyzate starch of snakehead fish head is a comparison of protein hydrolyzate of snakehead fish head and maltodextrine 95%:5% has 75.25% compared to protein hydrolyzate of snakehead fish head and maltodextrine 97.5%:2.5% has 50.56%, the high or low protein value can be influenced by the amount of water content lost (dehydration) from the material. The protein value as measured will be even greater if the amount of water lost is greater. The results of proximate analysis of protein content for comparison treatment between protein hydrolyzate of snakehead fish head and maltodextrin to protein hydrolyzate starch of snakehead fish head can be seen in Figure 3. Studies conducted by several researchers reported that protein content of protein hydrolyzate of catfish 35.6% (Amiza *et al*. 2013) is lower than the study of protein hydrolyzate for snakehead fish head. Protein hydrolyzate of snakehead fish head and maltodextrine 95%:5% with protein content 75.25% almost close to commercial fish protein hydrolyzate value that is 73-75% (International Quality Ingredients, 2011) and according to the Food and Agricultural Organization (2011) that protein hydrolyzate of snakehead fish head has a protein content of less than 80% included in type B protein content that meets the requirements as type B hydrolyzate. Nurhayati *et.al* (2007) states that protein content as measured in protein hydrolyzate of fish as a dissolved protein molecule. According to Bahalwan (2011), the increase in protein content is caused by the decrease in water content in the sample. Reducing the water content of foodstuff will increase compounds such as protein and minerals, but vitamins and dyes in general will be reduced. The result of independent t-test for protein content of protein hydrolyzate starch of snakehead fish head with a comparison of protein hydrolyzate of snakehead fish head with maltodextrin shows significant difference ($p < 0.05$).

Fat molecules consist of fatty acids and glycerol. Fats are contained in each type of foodstuff, but at different levels. Fat is also deposited in the tissues of several types of animals and organs of several types of plants. Fats are included in a group of compounds called *lipids*, and generally have insoluble properties in water (Belitz *et al*. 2009). Based on Table 1 it can be seen that the highest fat content of protein hydrolyzate of snakehead fish head is the comparison

of protein hydrolyzate and maltodextrin 95 %:5% is 0.60% compared to protein hydrolyzate of snakehead fish head and maltodextrin 97.5%:2.5% is 0.86%. The results of proximate analysis of fat content for comparison treatment between protein hydrolyzate of snakehead fish head and maltodextrin to protein hydrolyzate starch of snakehead fish head can be seen in Figure 4. Studies of protein hydrolyzate starch of snakehead fish head meet the standards of commercial fish protein hydrolyzate (Sanapi, 2013), namely less than 19-22%. This is due to the working process of bromelin enzyme which separates fat after being hydrolyzed. According to Nurhayati, *et al*. (2014), shows that fat content in hydrolyzate products is influenced by the characteristics of hydrolysis material used and the process of fat separation after hydrolysis. The process of separating fat after hydrolysis is done by filtering method using filter paper. According to Purbasari (2008), a decrease in fat content in fish protein hydrolyzate products is caused by the enzymatic hydrolysis process which changes the structure of fish tissue very quickly, where myofibril protein is greatly reduced during hydrolysis process, whereas the muscular cell membrane system looks relatively resistant to damage. During the hydrolysis process, these membranes tend to gather and form insoluble bubbles, resulting in loss of lipid membrane. Fat content of protein hydrolyzate starch of snakehead fish head is lower than fat content of commercial protein hydrolyzate namely 19-22% (International Quality Ingredients, 2011). The treatment of protein hydrolyzate of snakehead fish head and 95%:5% is 0.60% meets the requirements for type A hydrolysates because it has a fat content of less than 0.75% (FAO, 2011). Nilsang *et al*. (2005) states that protein hydrolyzate products which have low fat content are more stable against fat oxidation reactions during storage compared to fish protein hydrolyzate with high fat content. Fat molecules consist of fatty acids and glycerol. The results of independent t-test analysis on the fat content of protein hydrolyzate starch of snakehead fish head with a comparison of protein hydrolyzate with maltofrtrin were difference significantly ($p < 0.05$).

Conclusion

The best treatment from the research is a comparison of snakehead fish starch and maltodextrin 95%:5%. The characteristic of physicochemical of snakehead fish starch as produced in the form of white starch with a yield of 21.35%, white degree L 97.73, water content 4.52%, ash 7.92%, protein 75.25%, fat 0.60%. Based on this, the protein hydrolyzate of snakehead fish head has the potential to be applied as a flavoring or flavor enhancer and it can be developed as a source of essential amino acids in food products because they contain almost complete essential amino acids.

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