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Optimising the Quality of Sago Bamboo through Fortification of Cork Fish Flour (Ophiocephalus striatus) with Various Processing Methods

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A B S T R A C T

This research was examining several methods of processing snakehead fish with several treatment methods before drying, namely (1) making surimi, (2) making mashed fish, and (3) cooking using an autoclave. Data analysis used a Completely Randomized Design (CRD). The study's results showed that protein levels during the study for all treatments did not significantly affect the protein content of snakehead fish meals. The average protein content was 71.17 ± 1.28 to 88.05 ± 1.28. The highest protein content was obtained in the treatment method for making snakehead fish meals, starting with the manufacture of freshly dried surimi. The Fat ranged from 0.77 ± 0.58 to 1.88 ± 0.58. The lowest fat content was obtained in the treatment of the Making Snakehead Fish Meal processing method by making surimi, then drying at 65° C ± 12 hours. The water content of snakehead fish meal for all treatments was 3.91 ± 1.33 to 6.51 ± 1.31. Carbohydrates for all treatments were, on average, 1.38 ± 0.7 to 2.73 ± 0.7. Protein digestibility is an average of 88 ± 1.7 to 91 ± 1.7. Total Microbes, namely 18,733 ± 1.7 to 8,133 ± 1.7. As for the Organoleptic Test, the treatment that was given the number 9 from the parameters of Appearance, Color, Taste, Aroma, Texture, and Acceptance was the research treatment, namely the production of snakehead fish meal using the method of making surimi first before drying

INTRODUCTION

Cork fish is a type of fish that lives in swamps or rivers, with a high albumin content. In addition to albumin content, fat is also present in high amounts in cork fish meat. The fat content, especially saturated fat, is easily oxidised by oxygen which causes a rancid smell in the fish. This constraint requires a study to find the right processing method, so that the methodology produces fishmeal that can be stored for a long time and the nutritional quality can be maintained.

Fresh cork fish protein can reach 25.2%, albumin 6.224 g/100 g of cork fish meat. Utilisation of cork fish into preparations such as fishmeal, needs to be done with the right processing method, so that more nutrient loss can be avoided. Muchtadi (1989) suggested that poorly controlled processing of protein foods can reduce the nutritional value of the protein. Protein is a reactive compound, where the active side of some amino acids in protein can react with other components.

Cork fish flour that can be stored for a long time, will be very useful in fortifying food ingredients that have very little nutritional value. One of the foods from sago is bamboo sago which is often consumed by inland Papuan people in addition to papeda and sago plates (sago porno = Poiwai District, Papua). The method of making it by placing it in bamboo and then burning it. This type of preparation is used as a storage food, which is later removed when other foods, such as wet sago or rice, are not available. The material used in making bamboo sago is 100% sago, and does not use other ingredients to enrich its nutritional value. Sago bamboo is consumed not only by adults, but also by young children. One of the unmet nutritional needs of bamboo sago is the protein component.

Proper processing methods in producing long-lasting fishmeal will not affect the quality and shelf life of bamboo sago. This condition needs to be assessed so that the methodology of making fishmeal, in producing fishmeal can be determined.

This study aims to study several fishmeal processing methods to obtain long-lasting fishmeal; and to obtain the right fishmeal processing method with low nutritional loss value, not easily rancid with the taste and smell of fish that is no longer there.

LITERATURE REVIEW

Channa striata, 'haruan' or 'gabus' in Indonesian, is a cork fish or gabus fish belonging to the family Channidae. It is native to many tropical and subtropical countries including Indonesia, especially Papua. It is a freshwater, air-breathing, carnivorous fish that is a valuable source of protein throughout the Asia Pacific region. The high protein content of this fish makes it potential to prevent stunting. However, as each species of fish is different and highly dependent on the region, we thought that the profile of this fish would also be different from that of cork fish in other regions.

Cork fish or gabus fish from other regions and countries have been studied for their chemical composition and effect on wound healing.1 reported the biochemical composition of three species of Channa spp. in Malaysia, namely Channa lucius, Channa micropeltes, and C. striatus. The chemical composition of Ophiocephalus striatus from Bandung, Indonesia, Channa striata from East Kalimantan, Indonesia, C. striata, C. micropeltes, Channa pleuropthalmus, Channa maculata, and C. lucius from Central Kalimantan, Indonesia were also reported. Ama-Abasi and Ogar (2013) described the proximate analysis of cork fish, Parachanna obscura from Cross River, Nigeria. In Papua, especially in Merauke, C. striata is a consumed fish that has a high selling value and high commercial demand, so it has great potential in terms of food security. Cork fish is widely utilized by the local community traditionally as salted fish. People utilize cork fish in the form of salted fish, boiled or steamed fish meat, filtrate and oil from steaming and boiling, but there is no report on the chemical composition of cork fish from the Merauke area. Such information is needed to strengthen the study of this species from Merauke as the main source of protein and other nutritional needs for healthy growth. Therefore, this study describes the proximate profile, amino acids, and fatty acids of cork fish meat, cork fish filtrate from steaming and pressure boiling processes, and cork fish oil from steaming and pressure boiling processes.

Sago is one of the staple foods for people in eastern Indonesia, especially in Papua and Maluku. This food is obtained from processing the trunk of a tropical palm tree or Metroxylon sago. Apart from being the main food, sago can also be used as an ingredient to make various delicious snacks. Sago flour, for example, can be processed into balls, pasta, or pancakes. In addition, sago can also be processed with other ingredients to form pudding cakes.

Sago is one of the staple foods of the people in Indonesia, and has good nutrition for the body. This is because the nutritional content in sago is relatively complete. In sago, there is a considerable amount of carbohydrates. In addition, this ingredient also has protein, vitamins, and minerals, although the amount is not much. In 100 grams of dried sago, there are 94 grams of carbohydrates, 0.2 grams of protein, 0.5 grams of fiber, 10 mg of calcium, and 1.2 mg of iron. The calories produced by 100 grams of sago is as much as 355 calories. Although it contains fat, carotene, and ascorbic acid, the amount is so small that it is often overlooked.

RESEARCH METHODS

1. Research Design

This study examined the physico-chemical quality of cork fish flour with the application of several processing methods. The experimental design used in the study was a completely randomised design (CRD) with three replications. The research was conducted in the Fishery Product Processing Technology laboratory, Chemistry laboratory and Microbiology laboratory at the Department of Fishery Product Processing Technology, Pangkep State Agricultural Polytechnic.

2. Materials and Tools

The materials used in this study are cork fish (Ophiocephalus striatus), dry sago, dry bamboo, charcoal. The materials used in the analysis are perchloric acid 6%, NaOH 20%, HCl 0.02 N, H3BO4 3%, Na2B4O7 0.02 N, phenolphthalein indicator, methyl red indicator, chloroform, catalyst tablets, potassium sulfate,

$CuSO_4$ / $CuSO_4 . 5H_2O$, concentrated sulfuric acid, 30% hydrogen peroxide, 4% boric acid, distilled water, 50% NaOH, sodium thiosulfate, 0.2 N standard HCl solution, MM indicator, 0.1 N HCl containing 1.5 mg pepsin enzyme, 0.5 N NaOH, 0.2 M phosphate buffer solution containing 0.05 M sodium azide, pancreatin enzyme, and PCA medium.

The tools used for the manufacture of fishmeal are knives, steamer, press, flouring tools, oven, 60 mesh sieve and stove. The tools used in the analysis are blender, beaker glass, erlenmeyer, measuring flask, funnel, filter paper, burret, steam distillation equipment, cup, oven, spatula, analytical balance, desiccator, tongs, furnace, electric heater, buffer, condenser as well as soxhlet extractor, fat flask, fat sleeve, filter paper, rotary evaporator, kheldahl deconstruction apparatus, 250 ml erlenmeyer, deconstruction flask, statip, 25 ml volumetric pipette, 50 ml measuring cup, and dropper pipette.

RESULTS AND DISCUSSION

1) Univariate Analysis Results

a. Protein Content

All treatments did not significantly affect the protein content of cork fish meal. The average protein content of cork fish meal during the study ranged from 71.17 + 1.28 to 88.05 + 1.28 (Figure 1). The highest protein content was obtained in the treatment method of making surimi then dried at 65 ^{o}C.

Steaming treatment carried out on Cork Fish as an initial treatment before drying, causes fish protein to denature, resulting in the breakage of peptide bonds and followed by coagulation and precipitation of protein. The effect of high temperature treatment causes changes in the weakening of proteinase enzymes and protein digestibility values (Nielsen et al., 1988; Deshpande and Damodaran, (1989). Heat treatment of proteins will result in irreversible structural changes, as seen by the increase in water-insoluble proteins. Such treatment is likely to cause a decrease in the amount of protein in Cork fishmeal with repeated heat treatment when compared to the fishmeal processing method with one-time heat treatment.

Proteins are generally very reticent to the influence of temperature, so the application of the right temperature is very necessary in the process to produce good quality fish extracts. Because heating will affect the permeability of the cell wall so that the process of removing plasma from the tissue can be faster.

The treatment of processing methods by making surimi and pulverised fish then dried at 65 °C for 12 hours gave a greater crude protein value than the steaming treatment with autoclaving. This is in accordance with the application of temperature carried out by de Man, 1977, namely the process temperature between 70-80 ^{o}C gives good results. Heating at 90 ^{o}C for 10 minutes has coagulated most of the plasma proteins, so they cannot be extracted.

b. Fat Content

All research treatments gave a significant effect on the value of fat content in cork fishmeal. The average fat content of cork fish meal during the study ranged from 0.77 + 0.58 to 1.88 + 0.58 (Figure 2).

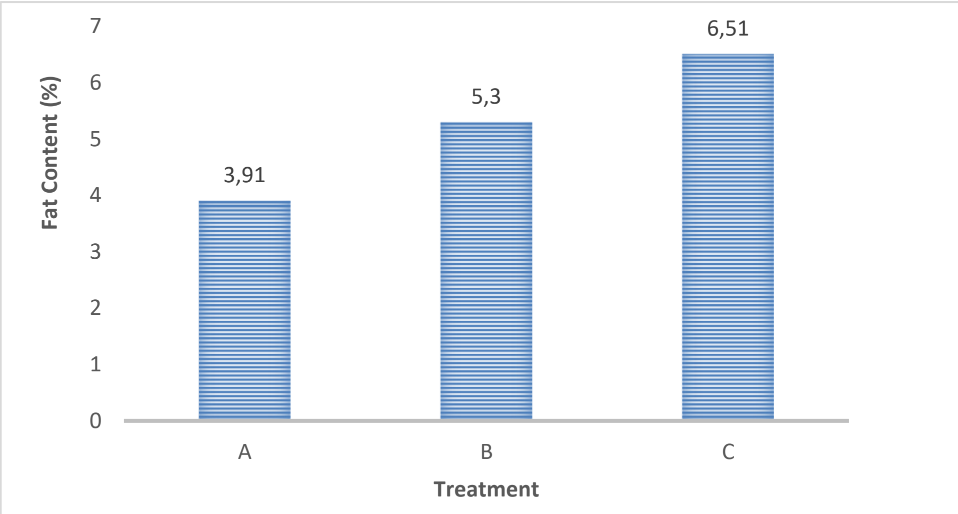

Figure 1. Fat Content of Cork Fish Meal From Different Processing Method Treatments

The treatment of processing methods in making fishmeal gives different fat content in the resulting cork fishmeal. Making surimi before the cork fish meat is dried, the lowest fat content is 3.91%. The low fat content is likely from the treatment process, namely washing carried out in the process of making surimi, where washing fish meat is carried out to separate dirt, fat, blood, mucus, water soluble protein and flavour components. This treatment removes the fat content in the fish meat. The extent of fat deterioration can also occur with the application of heat. Damage varies greatly depending on the temperature used and the length of time of the processing process. The higher the temperature used, the more intense the fat destruction.

In extreme roasting, linoleic acid and possibly other fatty acids are converted to unstable hydroperoxides by the activity of the enzyme lipoxygenase. These changes will affect the nutritional value of the fat and vitamins (oxidation of fat-soluble vitamins). of the product.

Steaming treatment is one of the recommended cooking methods for fish processing, especially those with high fat content because steaming does not increase the fat content of food ingredients so it is safe for consumption. To improve the quality of local fishmeal, the technology needed is to increase protein content and decrease fat content. The decrease in fat leads to better durability and shelf life.

c. Water Content

All treatments gave no significant effect on the moisture content value of fishmeal. The average moisture content of cork fish meal during the study ranged from 3.91 + 1.33 to 6.51 + 1.33 (Figure 3).

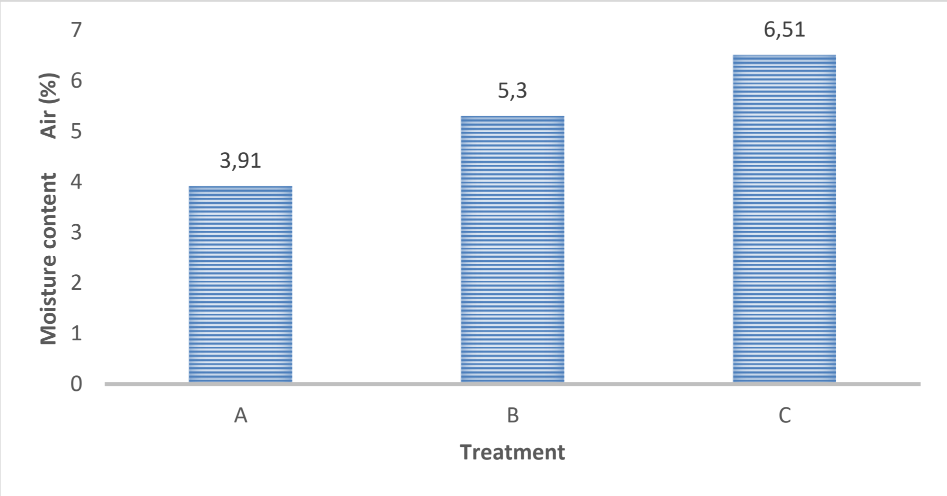

Figure 2. Moisture content (%) of Cork Fish Meal From Different Processing Methods

Research treatment A is the process of making cork fish flour which begins with making surimi with an average water content of 3.91%. The low amount of water content in this research treatment is thought to be influenced by the process of making surimi which involves washing the fish with cold water at 5^{o}C, and each stage of washing is filtered to remove the water content contained in the fish meat. After the last washing, hydraulic pressing is carried out, to remove some of the water contained in the fish meat. The oven drying process causes the fish meat to dry quickly, because the volume or surface area of the meat is very smooth.

Meanwhile, research treatment C, namely making fishmeal by cooking in an autoclav, has a higher water content than the other treatments. It is suspected that at the time of cooking the medi water absorbs in the fish meat. So that the 12-hour time for drying at 65^{o}C is not as fast as drying fishmeal from other treatments. Research by Jacoeb et al. (2008) found that there was a decrease in the moisture content of fish meat from 73% to 6.51% in cork fish flour due to boiling which caused the protein to coagulate and the water in the meat came out. This is due to the steaming process with increasingly high temperatures causing bonds between food components to break such as carbohydrates, fats and proteins. So that water will bind to these materials and cause the water content to increase. While the lowest water content is at a steaming temperature of 60 ^{o}C, this is because the higher the steaming temperature used, the more mature the fish meat will be and the shredding process will be easier and more perfect so that the resulting texture can be softer so that in the frying process the water content in the material can evaporate perfectly.

d. Ash Content

All treatments gave a significant effect on the ash content of cork fishmeal. The average ash content of fish meal during the study ranged from 1.8 + 1.1 to 3.53 + 1.1 (Figure 4).

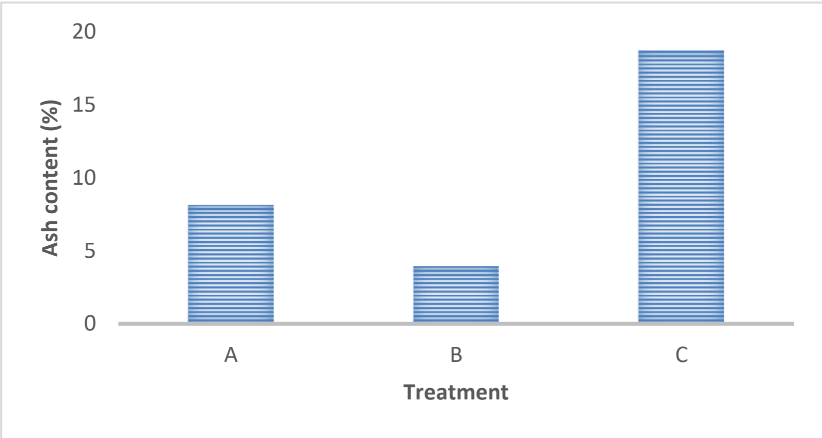

Figure 3. Ash content (%) of Cork Fishmeal From Different Processing Methods

e. Carbohydrate Content

All treatments gave a significant effect on the value of carbohydrate content of cork fish flour. The average carbohydrate content during the study ranged from 1.38 + 0.7 to 2.73 + 0.7 (Figure 5).

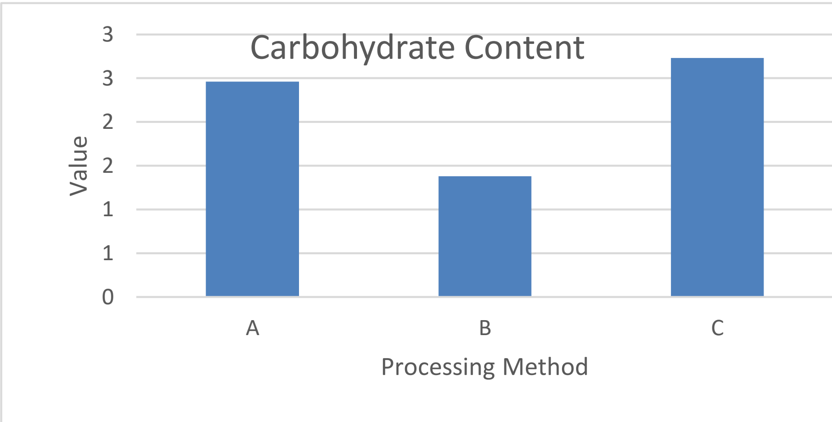

Figure 4. Carbohydrate Content (%) of Cork Fish Flour From Different Processing Methods

Carbohydrate content in cork fish flour from the treatment of several processing methods obtained the highest results (2.73%) with the treatment of cooking in autoclav compared to the preparation of crushed fish meat and surimi. Here it can be seen that the effect of processing methods into cork fish flour can increase carbohydrate levels. Carbohydrates in the form of starch are stored in fish tissue and fish liver. (possibly through the process of) cooking before drying into fishmeal will cause some of the hydrolysed starch to be broken down into simple sugar parts.

f. Protein Digestibility of Cork Fish Flour

All treatments gave no significant effect on protein digestibility of cork fish meal. The average protein digestibility value of cork fish meal during the study ranged from 88 + 1.7 to 91 + 1.7 (Figure 6).

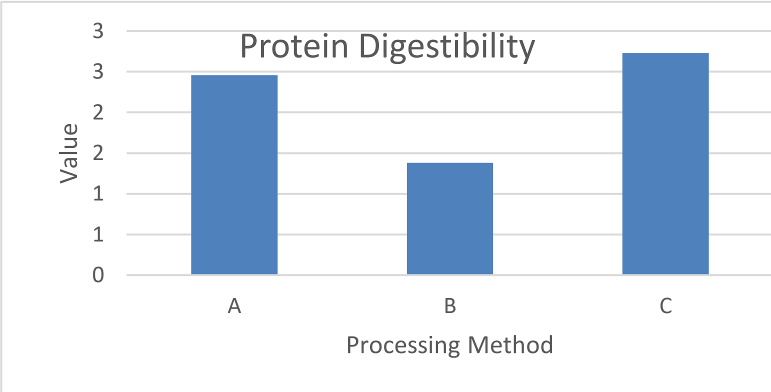

Figure 5. Protein Digestibility Values (%) of Cork Fish Meal From Different Processing Method Treatments

Easily digestible protein indicates a high amount of amino acids that can be absorbed by the body and vice versa. Some factors that can affect the digestibility of protein in the body are the physical and chemical conditions of the ingredients. Processing with steaming, boiling and drying can cause protein denaturation. So it affects the lack of levels and changes in protein digestibility. The decrease in levels and changes in protein digestibility varies depending on the treatment received.

Total Microbes

Based on statistical tests all treatments gave no significant effect on Total Plate Count (TPC) according to microbiological tests. The average Log TPC during the study ranged from 18,733 + 1.7 to 8,133 + 1.7 (Figure 7).

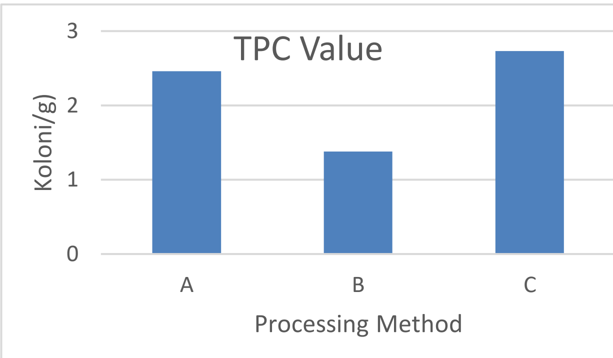

Figure 6. Total Plate Count (TPC) Value (Colonies/G) of Cork Fish Flour From Various Processing Methods

g. Organoleptic Test

Hedonic quality criteria tested based on organoleptic tests, namely appearance, colour, fragrance, taste, texture and acceptance.

Appearance

The Appearance Value of Cork Fish Flour ranges from 6 to 9 with an average of 7.4 + 0.62 which lies between 6 (slightly like) to 9 (very slightly like) (Figure 8).

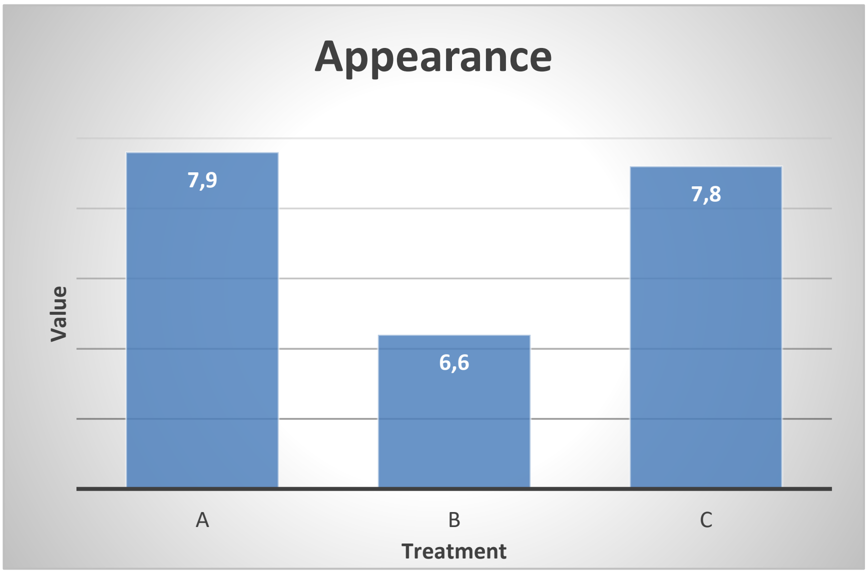

Figure 7. Appearance Value of Cork Fish Meal From Various Processing Method Treatments

Colour

The colour value of Cork Fishmeal ranged from 5 to 9 with an average of 7.2 + 0.49 (Figure 9).

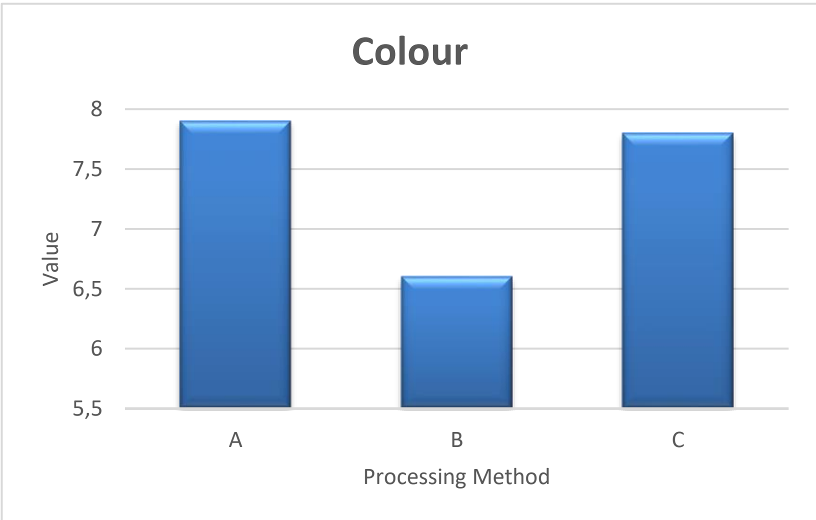

Figure 8. Colour Value of Cork Fish Meal From Various Processing Methods

Fragrance

Cork Fish Flour Fragrance values ranged from 5 to 9 with an average of 7.1 + 0.70 (Figure 10).

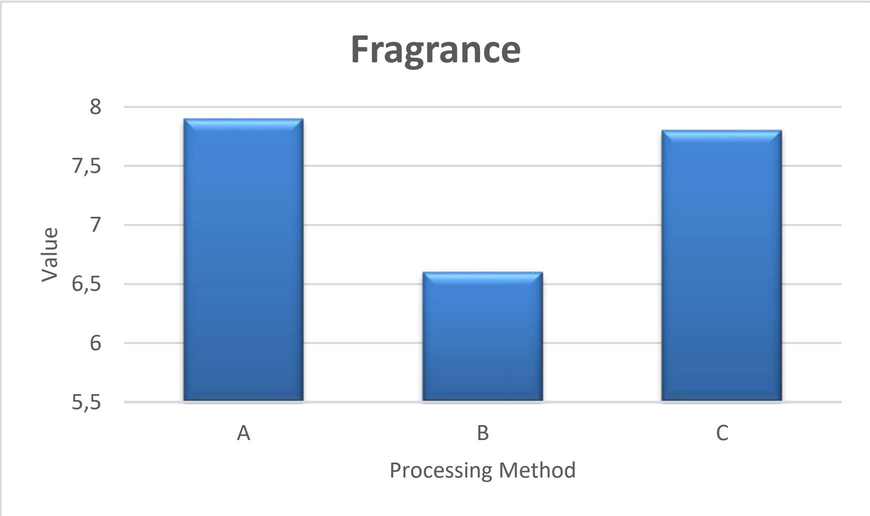

Figure 9. Fragrance Value of Cork Fish Flour From Various Processing Method Treatments

Flavour

Cork Fishmeal Flavour values ranged from 5 to 9 with an average of 7.3 + 0.60 (Figure 11).

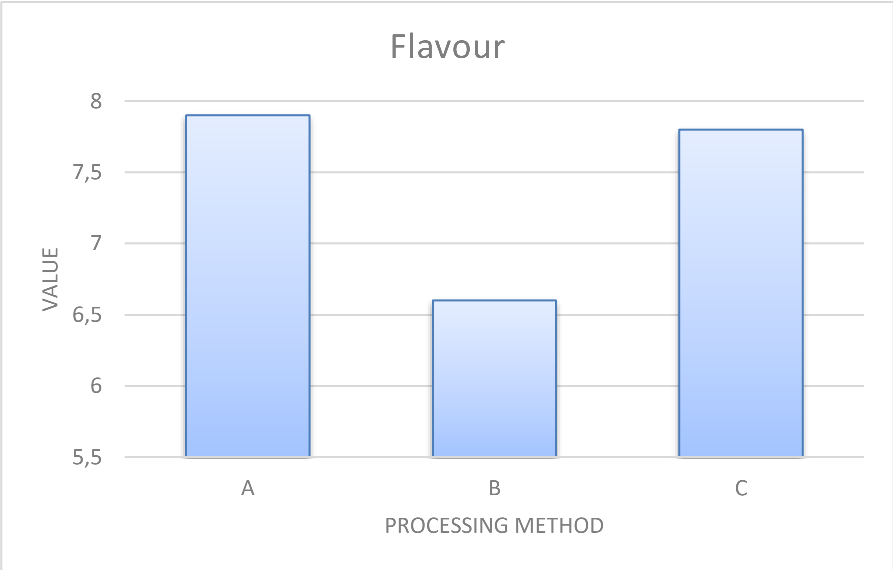

Figure 10. Flavour Value of Cork Fish Meal From Different Processing Method Treatments

Texture

Cork Fish Meal texture values ranged from 7 to 9 with an average of 7.5 + 0.05 (Figure 12).

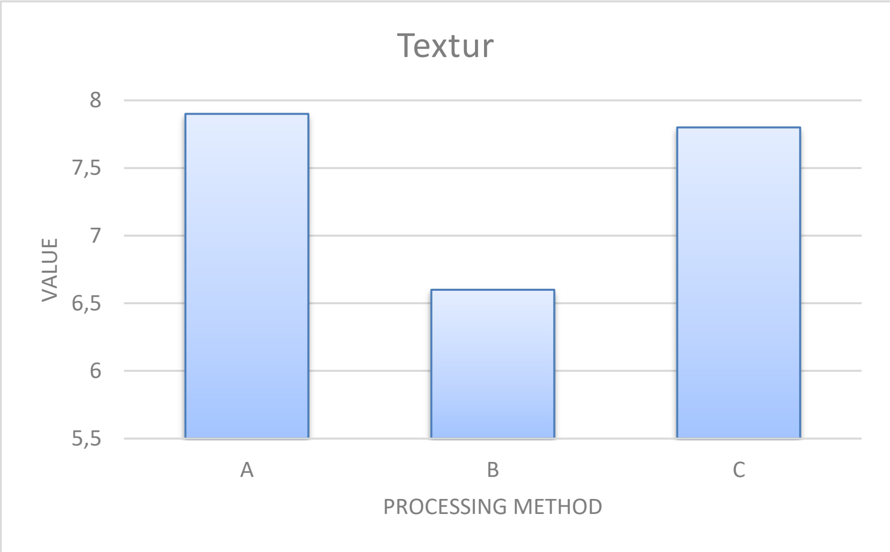

Figure 11. Texture Value of Cork Fish Flour From Different Processing Methods

Acceptance

The acceptance value of Cork Fishmeal ranged from 5 to 9 with an average of 7.4 + 0.72 (Figure 13).

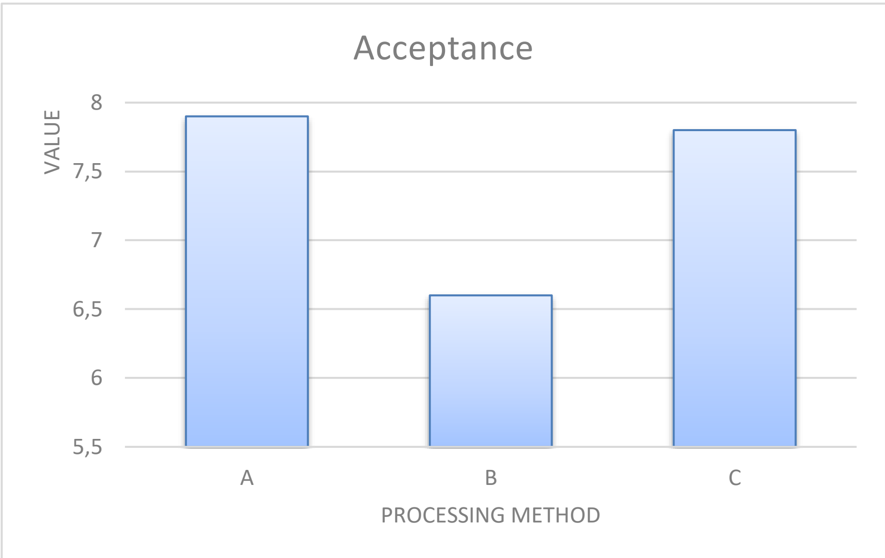

Figure 12. Acceptance Value of Cork Fish Meal From Different Processing Method Treatments

2) Bivariate Analysis Results

The following are the results of bivariate analysis on various processing methods of cork fish flour:

Table 1. Results of Bivariate Analysis of Differences Between Methods

Test Type	P-value	Description
Protein content	0,907	Non-significant
Fat content	0,000	Significant
Water Content	0,265	Non-significant
Ash Content	0,009	Significant
Carbohydrate Value	0,190	Non-significant
Protein Digestibility Value	0,903	Non-significant
Total Plate Count (TPC) Value	0,318	Non-significant
Organoleptic Value:		
Appearance	0,048	Significant
Colour	0,097	Non-significant
Aroma	0,042	Significant
Taste	0,060	Non-significant
Texture	0,054	Significant
Reception	0,051	Significant

The results of statistical tests in Table 1 show that the treatment of processing methods provided significant differences in fat content, ash content, visual value, texture and acceptance of cork fish flour. Meanwhile, all treatments given did not provide significant differences in protein content, moisture content, carbohydrate value, Protein Digestibility Value, Total Plate Count (TPC) value, colour value, and taste value of cork fish flour.

CONCLUSION

Of the 3 cork fishmeal processing methods used, the cork fishmeal processing method, which begins with making Surimi (Treatment A), obtained the lowest fat content of 1.02%, water 3.91%, the highest protein 81.13%, protein digestibility 88% and total microbes 8,133 colonies/g. The physico-chemical parameters obtained support long-term storage and are not easily oxidised fats that can cause rancidity. The manufacture of cork fishmeal with the process of making surimi before ranking from Hedonic quality is better, namely Rupa, colour, taste, aroma, texture and level of acceptance with an average of 8 and 9. Further research is still needed by completing testing parameters such as types of amino acids to determine the sensitivity to the processing methods applied.

REFERENCES

Ama-Abasi D, Ogar A. Proximate analysis of snakehead fish. Parachana obscura, (Gunther 1861) of the cross river, Nigeria. J Fish Aquat Sci 2013;8:295–8, doi:10.3923.

Ansar, 2010." *Processing and Utilisation of Cork Fish*". Ministry of National Education Directorate General of Nonformal and Informal Education Directorate of Equivalency Education. Jakarta : ISBN.

Bustaman, S., dan Susanto, A.N., 2007. Prospects and Strategies for Sago Development to Support Local Food Security in Maluku Province. Jurnal Ekonomi dan Pembangunan (JEP) Vol XV (2). ISBN 0854-526X

Fadli, 2010. "*Bagusnya Ikan Gabus*". Warta Pasarikan Edisi No.86, hal.4-5
Gayton." *Handbook of Medical Physiology*". Edisi 11.Jakarta : EGC.2008. page 896.

Homisah. 1997. Study on the Preparation of Red Bean (Phaseolus vulgaris L.) Cider Powder. [Thesis]. Department of Community Nutrition and Family Resources, Faculty of Agriculture, Institut Pertanian Bogor. Bogor.

Mardiyanti M. 2005. Substitution of Fish Meal with Soybean Meal in Rations Containing Tea Dregs (Camelia sinensis) on the Performance of Male Local Sheep. [thesis]. Bogor: Animal Nutrition and Diet. Faculty of Animal Science. Institut Pertanian Bogor.

Muchtadi, D., Nurheni Sri Palupi, dan Made Astawan. 1992. Biochemical and biological chemistry methods in evaluating the nutritional value of processed foods. Hal.: 5-28, 82-92, dan 119-121.

Muchtadi, D. 1989a. Petunjuk Laboratorium Evaluasi Nilai Gizi Pangan. Departemen Pendidikan dan Kebudayaan, Direktorat Jendral Pendidikan Tinggi, Pusat Antar Universitas Pangan dan Gizi, Institut Pertanian Bogor. Bogor.

Rachman, Handewi P.S. dan Mewa Ariani. 2008. "Food Consumption Diversification in Indonesia: Issues and Implications for Policies and Programmes". Agricultural Policy Analysis. Volume 6 No. 2 bulan Juni 2008. Hal 140 – 154.

Swaminathan. M. 1974. Effect of cooking and heat processing on the nutritive value of food.Di dalam Essentials of food and nutrion.Ganesh and Company Madras. India. Vol 1. P. 384-387.

Suwandi, R. 1990. Effect of Frying and Steaming Process on the Physico-Chemical Properties of Carp Protein (*Cyprinus carpio* L.). [Thesis]. Graduate Faculty, Institut Pertanian Bogor. Bogor.