Global Scientific JOURNALS

GSJ: Volume 9, Issue 5, May 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

ARTICLE REVIEW : CHARACTERISTICS OF FISH PROTEIN CONCENTRATES OF FRESHWATER FISH

Junianto[1] , Alvina Triana Putri[2] , Muqsithia Verentika Rahayu[2] , Deni Rizki Rustiawan[2]

[1] Lecture, Faculty of Fisheries and Marine Science, Padjadjaran University, Sumedang Regency, West Java, Indonesia
[2] Student, Faculty of Fisheries and Marine Science, Padjadjaran University, Sumedang Regency, West Java, Indonesia;
Corresponding Author: alvina18002@mail.unpad.ac.id

KeyWords
Fish Protein Concentrates, Freshwater Fish, Proximate Characteristics, Protein, Fat, Nutrient Content, Extarction

ABSTRACT

The purpose of this review article is to study the different types of aquatic fish that can be processed into protein concentrates, methods of making protein concentrates and characteristics of freshwater fish protein concentrates. Based on the results of various articles and other libraries can be concluded that the types of freshwater fish that can be processed into fish protein concentrates are siamese catfish, tilapia, snakehead fish, and catfish. The method of making fish protein concentrate in general uses ethanol solvent and isopropyl alcohol. The value of proximate (chemical) and physical characteristics of freshwater fish protein concentrates from various research results that have been done varies greatly depending on the type of fish and its extraction method.

INTRODUCTION

Fisheries is an activity that aims to cultivate and utilize the potential of fish such as fish processing, fishing and fish breeding. One of the fishery sectors that has enough potential in meeting the nutritional needs of the community is freshwater fish. In freshwater fish farming activities itself has been done a lot. Although there are many advantages of freshwater fish but in its own consumption level is more supplied by sea fish. To support people like to consume freshwater fish, not only in the cultivation sector but the need for development in processed fishery products such as fish protein concentrates (KKP, 2019).

Fish protein concentrate is a dry solid product produced by extracting liquid and some or all of the fat contained in the body of fish (Nur Anisa, 2017). Fish protein concentrate can be used as a fortification ingredient in a protein-poor food product. Thus, food will be obtained with high nutrition. The purpose of this review article is to study the different types of aquatic fish that can be processed into protein concentrates, methods of making protein concentrates and characteristics of freshwater fish protein concentrates.

TYPES OF FRESHWATER FISH IN INDONESIA THAT ARE PROCESSES INTO PROTEIN CONCENTRATES

Indonesian fish is one of the countries that have a wealth of freshwater fish species are very much. An estimated 8500 species of fish live in Indonesian waters or about 45% of the world's species. A total of 1300 species of this number occupy freshwater waters (Kottelat and Whitten, 1996). Indonesia has 440 species of freshwater fish endemic to the 4th position after Brazil (1716 species), China (888 species) and the United States (593 species), as well as more than 140 endemic species of marine fish (KKP, 2015). Generally freshwater fish that are processed into protein concentrate fish is a fish that is often cultivated. Here is a freshwater fish that is managed into fish protein concentrate:

SIAMESE CATFISH

Catfish is a fish native to Indonesian waters that has been domesticated. Catfish itself has various types such as *Pangasius pangasius* or *Pangasius jambal*, *Pangasius polyuranodon*, *Pangasius humelaris*, *Pangasius lithostoma*, *Pangasius nasutus*, *Pangasius niewenhuisii*, *Pangasius sutchi*, *Pangasius hypophtalmus* (Andrian, 2019). Based on Marine and Fisheries Ministry (KKP) in Indonesia statistics, the number of catfish production every year increases. Catfish production from 2015 to 2019 increased by an average of 10.40%. In 2015 reached 339,069 tons, in 2016 reached 392,918 tons, in 2017 reached 319,548 tons, in 2018 reached 373,245 tons and in 2019 reached 476,208 tons (KKP, 2019).

Siamese catfish is one of the fish known as a commodity that has a bright prospect and has a fairly high selling price. This fish is known as the flagship fish because the meat of catfish is savory, contains a lot of fat and not much thorns and the selling value of this fish is good enough so that the farmers are quite a lot because it promises profit.

Classification of catfish according to Saanin (1984) is as follows:

Kingdom : Animalia
Phylum : Chordata
Class : Pisces
Order : Ostariophysi
Family : Pangasidae
Genus : Pangasius
Species : *Pangasius hypophthalamus*

Siamese catfish or Pangasius hypophthalamus has an elongated body shape, silver white with a slightly bluish back, the head of this fish is relatively small with the mouth at the end of the head down (Susanto, 2002). This fish is classified as a catfish that has a characteristic not scaly, with a body length of up to 120 cm. has 2 pairs of mustaches used for touch. At the bottom of the back there are fat scales with a small size with a forked tail fin that are symmetrical (Faisal, 2016).

Catfish are known as nocturnal fish because they are active at night. Catfish usually hide in burrows by the river can also estuaries of rivers and lakes. In the activities of self-cultivation catfish does not require complicated care. Because catfish are generally classified as fish that are able to survive in an ugly aquatic environment. Apart from catfish that like to be in bad waters, catfish prefer good water conditions (Kordi, 2005).

The nutritional content of catfish has a lower fat content than other types of fish, such as dha essential fatty acids around 4.74% and EPA is about 0.31 (Pangestika, 2020). Catfish is very beneficial for health if consumed. Total unsaturated fat content (USFA 50%) excellent for preventing the risk of cardiovascular disease (Pangestika, 2020).

DUMBO CATFISH

Dumbo catfish (*Clarias gariepinus*) is native to Mozambique (Africa). This fish entered Indonesia in 1985. Some also say that this catfish is the result of a local catfish crossing from Africa with Taiwanese catfish (Khairuman and Khairul, 2002). At first catfish became ornamental fish but along with the development of catfish into fish consumption is often cultivated. Dumbo catfish production in Indonesia has increased from year to year, based on data from the Directorate General of Aquaculture Ministry of Marine Affairs and Fisheries catfish production in 2017 reached 1.8 million tons and will continue to increase.

Catfish is a freshwater consumption fish that has a long body and slippery skin. Dumbo catfish is a clarias genus that has the characteristic of an elongated and scaly slippery body, dorsal fins fused with tail fin and anal fin, hard scalp with small eyes and a wide mouth located at the end of the muzzle equipped with four pairs of murmurs or whiskers (Santoso 1994).

Classification of Dumbo Catfish (*Clarias gariepinus*) according to Saanin (1986) is as follows:

Phylum : Chordata
Sub Phylum : Vertebrate
Class : Pisces
SubClass : Teleostei
Order : Ostariophysi
Family : Clariidae
Genus : Clarias
Species : *Clarias gariepinus*

Dumbo catfish habitat is all fresh water. Catfish themselves love the unsettled waters of puddles (Ratnasari, 2011). In this river of fish is found in the waters that are not rapid flow. Where the ideal condition of dumbo catfish is water that has a pH of 6.5-9 and a temperature of 27-30℃. catfish is an all-eating fish or commonly called omnivore but in the wild catfish will eat the bodies of zooplankton and phytoplankton (Ratnasari, 2011). Dumbo catfish is a nocturnal fish that is more active at night, therefore dumbo catfish prefers a protected and dark place (Ratnasari, 2011).

Catfish have a high nutritional value. According to Utama (2008) states that, the chemical composition of fish meat is protein 16-17%, fat 0.5-5%, carbohydrates 1-3%, water 75-79% and organic materials by 0.8-2%.

NILE TILAPIA

Nile tilapia is well known by the freshwater fish enthusiast community, both in developing countries and in developed countries. In Southeast Asia, nile tilapia is widely cultivated, especially the Philippines, Malaysia, Thailand and Indonesia. In Indonesia, this fish has spread almost all over the country (Amri and Khairuman 2003). Nile tilapia is a type of freshwater fish that has a high consumption value (Alfinta *et al*, 2016). The nile tilapia comes from the Nile and the surrounding lakes. Now the fish has spread to countries across five tropical and subtropical continents. According to data from the Ministry of Fish and Fisheries (KKP), the national number of nile tilapia production is satisfactory as it continues to increase. In 2018 the number of nile tilapia production reached

1,125,149 tons and in 2019 reached 1,474,742 tons (OSH, 2019).

According to Saanin (1984), nile tilapia (*Oreochromis niloticus*) has the following classifications:

Kingdom : Animalia
Filum : Chordata
Subfilum : Vertebrate
Class : Osteichtyes
Subclass : Acanthopterygii
Order : Percomorphi
Suborder : Percoidea
Family : Cichlidae
Genus : Oreochromis
Species : *Oreochromis niloticus*

According to Saanin (1968) Morphology of nile tilapia (*Oreochromis niloticus*) has characteristics of flat round shape, higher back, on the body and caundal fin found straight line (vertical). On the dorsal fins are found an elongated straight line. Nile tilapia can live in fresh water and they use tails to move, abdominal fins, pectoral fins and hard gill covers to support their bodies. Tilapia has five fins, namely dorsal fin, pectoral fin, ventral fin, anal fin, and caudal fin. There is also a pair of pectoral fins and small abdominal fins and anal fins that are only one rather long shape. Meanwhile, the number of tail fins is only one fruit with a round shape.

Nile tilapia is a fish that has a high tolerance to its environment. Nile tilapia can live in fresh water until brackish water. The habitat of tilapia is diverse, namely rivers, reservoirs, lakes, swamps, rice fields, ponds and ponds. The normal temperature of nile tilapia is 14-38℃ and the optimum development ranges from 25-30℃ (Khairuman and Amir, 2003). Tilapia is an all-eating or omnivore fish where this fish is very easy to cultivate. When the fish is still seed stage, fish will prefer zooplankton such as Rotifer sp, Moina sp, or Daphnia sp.

Nile tilapia has a nutritional content that is not inferior to the nutritional content of other freshwater fish. tilapia protein content of 43.76%, fat 7.01%, ash content of 6.80% per 100 grams of fish weight (Leksono and Syahrul, 2001).

SNAKEHEAD FISH

Snakhed fish has a not so attractive appearance and has a fishy smell so that this fish is less in the interest of the public. This fish is not sukit to be found in the market because it is always present in modern markets as well as traditional markets. Snakhed fish is a native fish in Indonesian waters (Mustard, 2013). This fish is not difficult to find in the market because it is always present in modern markets and traditional markets. Snakhed fish is a native fish in Indonesian waters (Mustard, 2013).

Classification of snakehead fish according to Rahayu (1992) in Alfarisy (2014) as follows:

Kingdom : Animalia
Phylum : Chordata
Class : Agtinopterigii
Order : Perciformes
Family : Chanidae
Genus : Channa
Species : *Channa striata*

Snakehead fish generally have a blackish-brown body, with a whitish abdomen. This fish also has a color according to its environment. Gufron and Kordi (2010) stated, that there are two types of common snakehead fish, namely fish that grow fast and slow to grow. Snakehead fish that have light gray scales and on the chest are white corks that have rapid growth.

Snakehad fish can live in public waters such as rivers, swamps, lakes, and reservoirs. The shape of this fish looks strange with a fishy smell. Fishy smell itself is due to snakehead fish meat has albumin content that is the advantage of this fish. In the field of albumin medicine can accelerate the healing of wounds on the body.

Snakehead fish is a carnivorous fish whose main food is meat. Snakhed fish has a good nutritional content for health. According to Nugro (2013) states that Snakhed fish has a high protein content of about 25% and albumin content of 6.22% compared to freshwater fish. Cork fish meat is usually used as flour in mixing fish feed, but in its development fishmeal began to be developed for subsite raw materials in the manufacture of processed food products (Fatmawati, 2014).

METHOD OF MAKING FISH PROTEIN CONCENTRATE

Here is an image of the flow of making Fish Protein Concentrate:

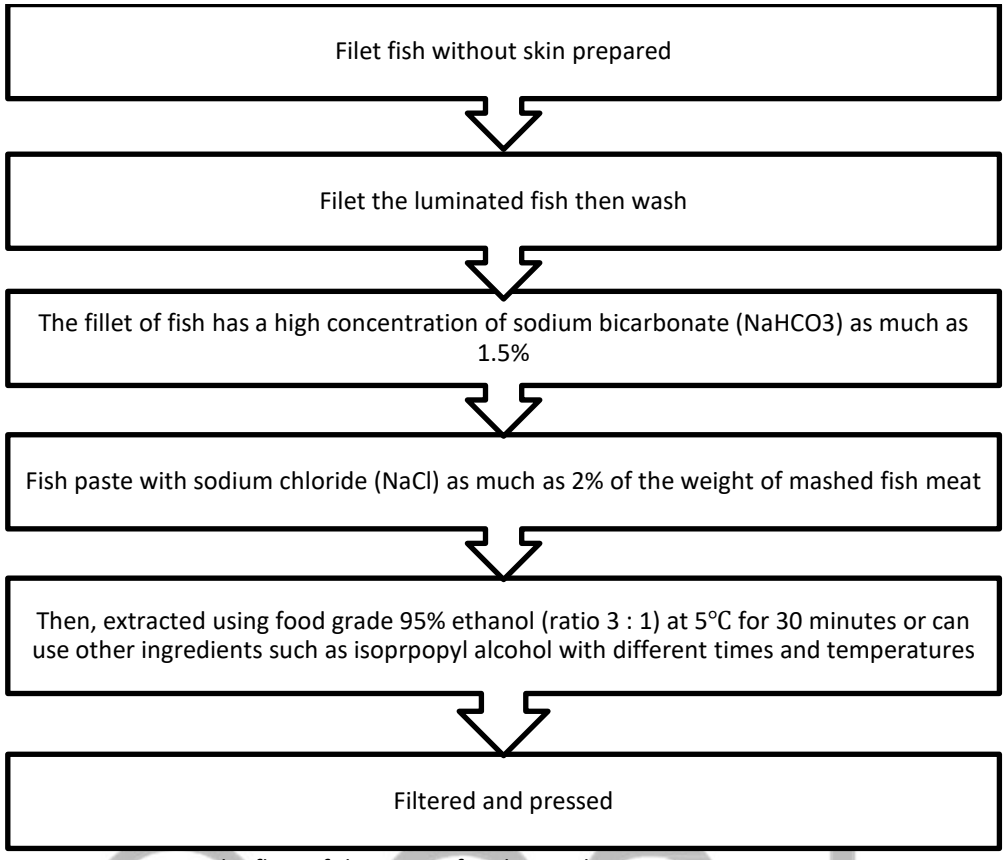

Figure 1. The flow of the steps of making Fish Protein Concentrate

In the manufacture of fish protein concentrate, it goes through several processes and the most important process in making fish protein concentrate is the extraction process, because the extraction process greatly affects the final result of the fish protein concentrate. There are several methods for extracting fish protein concentrate and the most commonly used are ethanol and isopropyl alcohol (Asriani *et al*, 2018). In another study, Koesoemawardani and Nurainy (2008) stated, that to extract fish protein using organic solvents including iso-propanol, methanol, ethanol or 1,2 dichloroethane with variations in time and temperature to remove fat and water in order to obtain high protein content. Although it is often used in the extraction of fish protein concentrates from ethanol and isopropyl alcohol, it has a weakness, namely that it still leaves a solvent aroma in the resulting fish protein concentrate.

Asriani *et al.* (2018) stated that many studies of making Fish Protein Concentrates using ethanol and isopropyl alcohol, namely Astawan (1990) extracted winghead shark protein using ethanol solvents, Sumaryanto *et al*. (1996) used ethanol to extract red tilapia protein; Rieuwpassa (2005) extracted anchovy protein using ethanol solvent; Koesoemawardani and Nurainy (2008) used ethanol solvent to extract trash fish protein; Tirtajaya *et al*. (2008) extracted protein from catfish (*Pangasius pangasius*) using ethanol and isopropyl alcohol; Widiyawati (2011) extracted catfish (*Clarias gariepenus*) protein using ethanol solvent; Chalamaiah *et al*. (2011) used isopropyl alcohol to extract *Cirrhinus mrigala* fish protein; Wiharja *et al*. (2013) used ethanol to extract protein from tuna and red snapper eggs; while Rao (2014) uses isopropyl alcohol to extract egg protein gold (*Cyprinus carpio*) and *Epinephelus tauvina* and Siahaan *et al*. (2015) used isopropyl alcohol to extract protein from snakehead fish (Channa striatus).

One of the procedures for making fish protein concentrate that uses ethanol at the time of extraction is the manufacturing procedure according to Suzuki (1981). As for the procedure for making fish protein concentrate according to Suzuki (1981) with a slight modification from Afriani *et al*. (2016) using ingredients such as fresh tilapia, 95% food grade ethanol, sodium bicarbonate (NaHCO3), and sodium chloride (NaCl) by means of manufacture as following:

a. skinless nile tilapia fillets then the meat is crushed using a meat grinder. The meat grind is washed with clean water so that the quality of the fish protein concentrate is maintained well. The water used in this washing stage is 3 1 and the washing is done once, to avoid the loss of sarcoplasm/albumin protein during the washing process with cold water.
b. The filtered mashed meat is made into a paste by adding 1.5% sodium bicarbonate (NaHCO3), the purpose of this addition is to change the actomyosin in fish meat into sol form. The pH level of the meat is adjusted to the range 7.4-7.8, then 2% sodium chloride (NaCl) is added from the weight of mashed fish meat, this functions to reduce the amount of water.

c. The paste that has been mixed with NaHCO3 and NaCl is then extracted using food grade 95% ethanol, until the water content and water activity are low. The paste that has been formed is then ground again so that the mixing is more evenly distributed.
d. The extraction process was carried out at 5℃ for 30 minutes to remove fat from the fish paste. The ratio of ethanol with extracted fish paste is 3 : 1. The extraction vessel is covered with ice to keep the temperature during the extraction process cool.
e. After the extraction process, filtration and compression were performed using calico cloth to separate ethanol from fish paste, then milled using a food processor. The extraction process in cold ethanol was performed for three times, but the second and third extractions were performed without the addition of NaHCO3 and NaCl.
f. The drying process in the oven is carried out at a temperature of 45℃ for 12 hours
g. The final stage of the fish protein concentrate manufacturing process is to reduce the size of the powder using a sieve.

PROXIMATE CHARACTERISTICS OF FRESHWATER FISH PROTEIN CONCENTRATE

The proximate characteristics commonly applied to fish protein concentrate products are moisture, protein, fat, carbohydrate, and ash. Proximate characteristics are needed to become one of the quality parameters of a product.

One of the results of the analysis of the proximate characteristics of catfish protein concentrate (*Pangasius hypopthalmus*) was the result of research by Dewita *et al*. (2011). The extraction method uses isopropyl alcohol. Its proximate characteristics are shown in table 1.

Table 1. Proximate characteristics of the extraction method using isopropyl alcohol

Composition	Amount(%)
Water	6,39
Protein	75,31
Fat	2,79
Ash	2,14
Yield	12

The proximate characteristics of the analysis by Dewita *et al*. (2011) differs from the proximate characteristics of fish protein concentrates made by Anugrahati *et al*. (2012) with the same type of fish, namely catfish, but the manufacturing procedure uses 95% ethanol. The results of the analysis can be seen in table 2.

Table 2. Results of the Prosimatic Characteristics Analysis Using 95% Ethanol

Characteristics	Catfish protein concentrate
White degree (%)	81,88
Water content (%)	4,68
Protein content (%)	92,93
Fat content (%)	1,57
Protein digestibility in vitro (%)	94,33
Aroma score	3,17

The water content of catfish protein concentration (4.68%) meets the maximum water content set by FAO as referred to in Murueta *et al*. (2007), a maximum of 10%. The protein content of catfish protein concentrate (92.93%) fulfills the fish protein concentrate type A, at least 67%, but the fat content of catfish KPI (1.57%) is classified as type B fish protein concentrate, which is less than 3% but not less than 0.75% so based on this, the catfish fish protein concentrate can be classified into type B fish protein concentrate. The resulting catfish protein concentrate has a higher protein content than fish protein concentrate derived from marine fish.

The results of the next proximate analysis are the results of research by Rieuwpassa *et al*. (2020) in a research article entitled "Physical Chemical Analysis of Tilapia Protein Concentrate (*Oreochromis niloticus*) Extracted Using Ethanol Solvent". The preparation of extracted fish protein concentrate using ethanol is the same as the research of Anugrahati *et al*. (2012) but the treatment is different, namely by soaking the fish for 24 hours with every 4 hours of soaking stirring. This research produces proximate characteristics which can be seen in table 3.

Table 3.Proximate Analysis Results Using Ethanol by Immersion for 24 Hours

Parameter	Amount
Chemistry	
Protein	61,13%
Fat	7,11%
Water	8,26%
Physics	
White degree	74,77%
Water absorption	2,47 g/ml
Oil absorption Density	1,12 g/g
Kamba density	0,47 m/g
Odor value	2 (strong fish smell)

The results showed that tilapia protein concentrate has a white degree of 74.77%, while the smell value has a score of 2 (strong fish smell). The degree of whiteness and the value of the smell are closely related to the amount of fat in the protein concentrate of the fish, if the fat content is high, then the smell value and the white degree will be low. Fat will be oxidized, causing a distinctive odor and resulting in a yellowish-white fish protein concentrate. Rieuwpassa *et al*. (2013) Rawdkuen *et al*. (2009) explained that fats contain carotenoid pigments so that the protein extraction process is not only intended to remove fat but also to eliminate other components such as pigments, blood, and other components that affect odor and color.

CONCLUSION

Based on the results of various articles and other libraries can be concluded that the types of freshwater fish that can be processed into protein concentrates fish are siamese catfish, tilapia, snakehead fish, and catfish. The method of making fish protein concentrate in general uses ethanol solvent and isopropyl alcohol. The value of proximate (chemical) and physical characteristics of freshwater fish protein concentrates from various research results that have been conducted varies greatly depending on the type of fish and its extraction method.

References

[1] Afriani. R R., Kurniawati, N., Rostini, I. 2016. Penambahan Konsentrat Protein Ikan Nila Terhadap Karakteristik Kimia Dan Organoleptik Biskuit. *Jurnal Perikanan Kelautan* Vol. 7 No. 1. Hlm 6-13.

[2] Alfarisy, M. U.2014. *Pengaruh Jenis Kelamin dan Ukuran Terhadap Kadar Albumin pada Ikan Gabus (Channa striata).* Surabaya: Sekolah Pascasarjana. Institut Teknologi Sepuluh November.

[3] Amri, K. dan Khairuman. 2003. *Budidaya Ikan Nila Secara Intensif*. Jakarta: Agromedia Pustaka.

[4] Anugrahati, N.A., Santoso, J., Pratama, I. 2012. Pemanfaatan Konsentrat Protein Ikan (KPI) Patin Dalam Pembuatan Biskuit. *Jurnal Pengolahan Hasil Perikanan Indonesia*, Volume 15 Nomor 1. Hlm 45-51

[5] Asriani., Santoso, J., Listyarini, S. 2018. *Jurnal Kelautan dan Perikanan Terapan*. Vol. 1 No 2. Hlm 77-86.

[6] Dewita., Syahrul., Isnaini. 2011. Pemanfaatan Konsentrat Protein Ikan Patin (*Pangasius hypopthalmus*) untuk Pembuatan Biskuit dan Snack. *Jurnal Pengolahan Hasil Perikanan Indonesia.* Volume 14 Nomor 1. Hlm 30-34.

[7] Dewita dan Syahrul. 2012. Pola Penerimaan anak Sekolah Terhadap Produk Makanan Jajanan Berbahan Baku Konsentrat Protein Ikan Baung (*Hemibagrus nemurus*) di Kabupaten Kampar, Riau. *Jurnal Pengolahan Hasil Perikanan Indonesia.* 15(3): 216 – 222.

[8] Faisal, A. F. 2015. *Optimasi Formula Stirred Yogurt Menggunakan Desain Campuran (Mixture Design).* Skripsi. Departemen Ilmu dan Teknologi Pangan. Fakultas Teknologi Pertanian. Institut Pertanian Bogor.

[9] Faldt, P. dan B. Bergenstahl. 1995. Fat Encapsulation in Spray Dried Powdwrs. *J. Am. Oil Chem. Soc* 72: 171-176.

[10] Fatmawati dan Mardiana, 2014. *Tepung Ikan Gabus sebagai Sumber Protein (Food Supplement)*. Jurnal Bionature. 15(1):54-60.

[11] Irianto, H dan Soesilo, I. 2007. *Dukungan Tekhnologi Penyediaan Produk Perikanan*. Badan riset kelautan dan perikanan.

[12] KKP. 2015. *Petunjuk Teknis Pemetaan Sebaran Jenis Agen Hayati yang Dilindungi, Dilarang dan Invasif di Indonesia.*

[13] KKP. 2019. *Laporan Kinerja Tahun 2019 Ditjen Perikanan Budidaya.*

[14] Kordi, M. G. H. 2005. *Budidaya Ikan Patin : Biologi, Pembenihan dan Pembesaran*. Yayasan Pustaka Nusatama, Yogyakarta.

[15] Lasena., A. Nasriani, Mahmudy.,I. 2016. *Pengaruh Dosis Pakan yang Dicampurkan Probiotik Terhadap Pertumbuhan dan Kelangsungan Hidup Benih Ikan Nila (Oreochromis niloticus).* Universitas Muhammadiyah : Gorontalo.
[16] Mahyuddin, K. 2010. *Panduan Lengkap Agribisnis Patin.* Jakarta: Penebar Swadaya.
[17] Mustar. 2013. *Studi Pembuatan Abon Ikan Gabus (Ophiocephalus striatus) Sebagai Makanan Suplemen (Food Suplement).* Fakultas Pertanian. Universitas Hasanuddin. Makasar.
[18] Nugroho. 2013. *Uji Biologi Ekstrak Kasar dan Isolat Albumin Ikan Gabus (Ophiocephalus striatus) terhadap Berat Badan dan Kadar Serum Albumin Tikus Mencit*. Jurnal Saintek Perikanan Vol.9 No.1 pp: 49-54.
[19] Ratnasari, Dewi. 2011. *Kelangsungan Hidup Ikan Lele Dumbo (Clarias sp) pada Daun Singkong yang Berbeda dalam Perlakuan.* Skripsi Program Sarjana Universitas Negeri Jakarta. Tidak diterbitkan.
[20] Rawdkuen S, Samart SU, Khamsorn S, Chaijan M, Benjakul S. 2009. *Biochemical and Gelling Properties of Tilapia Surimi and Protein Recovered using an Acid-alkaline Process.* Food Chemistry. 112: 112–119
[21] Rieuwpassa FJ, Karimela EJ, Lasaru DC. 2018. Karakterisasi Sifat Fungsional Konsentrat Protein Ikan Sunglir (Elagatis bipinnulatus). *Jurnal Teknologi Perikanan dan Kelautan.* 9(2): 177-183.
[22] Rieuwpassa, F.J., Karimela, E J., Karaeng, M C. 2020. Analisis Fisiko Kimia Konsentrat Protein Ikan Nila (*Oreochromis niloticus*) yang Diekstrak Menggunakan Pelarut Etanol. *Jurnal Teknologi Perikanan dan Kelautan* Vol. 11 No. 1. hlm 45-52.
[23] Saanin, H. 1968. *Taksonomi dan Kunci Identifikasi Ikan Jilid 1.* Bandung: Bina Cipta.
[24] Saanin. 1986. *Taksonomi dan Identifikasi ikan bagian I*. Bina Cipta. Bogor. 255hal.
[25] Saanin, H. 1984. *Taksonomi dan Kunci Identifikasi Ikan Jilid 2*. Bandung: Bina Cipta.
[26] Suzuki T. 1981. Fish and Krill *Protein: Processing Technology. London: Applied Science Publishing Ltd.*