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Potential of endemic and native fish from Maninjau Lake, West Sumatra, Indonesia as a nutritional source

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ABSTRACT

Lake Maninjau, West Sumatra, Indonesia is one of the 15 nationally priority lakes and has an economic and ecological function i.e., a habitat of biodiversity such as several native fish species. However, the lake's status is hypertrophic, that is influence to the biodiversity of the lake. Some of the native fish species in the lake that used by the surrounding community as nutritional resources and economical value. That are Asang (*Osteochilus vittatus*), Bada (*Rasbora maninjau*), Rinuak (*Gobiopterus brachypterus*), and Supareh (*Barbodes binotatus*). A study to determine the nutritional content and amino acids of these fish has been conducted in July 2018 and June 2019. Proximate and amino acid analysis were carried out at Bogor Agricultural University (IPB) Laboratory. The results showed that the protein content of Asang, Bada, Rinuak, and Supareh were 50.23; 60.13; 62.38; and 54.23 % dry weight and the fat content of each fish were 21.08; 14.03; 8.44; and 10.01% dry weight respectively, while the number of amino acids in a row is 15.85; 13.50; 14.18% and 15.17 % w/w. The Total Essential Amino Acid (TEAA) were 6.67; 5.72; 8.46 and 6.40% w/w which is equivalent to 42.08; 42.37; 59.66 and 42.19% of the total amino acids examined. Total Non-Essential Amino Acid (TNEAA) were 9.18; 7.78; 5.72 and 8.77%w/w which is equivalent to 57.92; 57.63; 40.34 and 57.81% of the total amino acids. These results indicate that all of the fish have a high nutritional value. The existence of these fish are essential in meeting the dietary needs of the community and helping the economy. Therefore, its presence in its natural habitat (Lake Maninjau) needs to be maintained.

Key words: *Lake Maninjau, Native fish, Nutrient content, and Amino acid content*

Introduction

Lake Maninjau is one of fifteen lakes which, Nationally priority. It is a sizeable tecto-vulcanic lake located in Agam Regency, West Sumatra, Indonesia. The lake of 99.5 km^2 with maximum water depth 165 meters and water volume 10,400 m^3 (MERI, 2014). It has many economic functions, including as a power plant that generates 205 GWh of annual energy, source of irrigation water, floating cages and capture fisheries, also as a national and international tourist destination. Ecological functions include controlling groundwater balance and microclimate, and habitat for biodiversity (Fakhruddin *et al*., 2012; MERI, 2014) such as fishes, and the other biota. Fish play an essential role in human life (Nelson *et al*., 2016) such as for human diet because it has excellent nutritional quality (Pal *et al*., 2018). There other function of fish, besides providing economical, but giving incalculable recreational and psychological value for human life, also subject to international and domestic agreements (Nelson *et al*., 2016). Therefore, the existence of fish must be maintained particularly in their habitat. Various aspects of research on fish species can be carried out, such as ecological aspects, biological, ecology, interaction, physiology, and genetic, including nutritional content of fish.

Lake Maninjau has about 34 species, of which 20 species are declared extinct, and 14 species remain (http://lipi.go.id/lipimedia/lipi:-20-spesies-ikan-danau-maninjau-punah/18337). Lake Maninjau native fish that have been known as protein sources for the community and play a role in the economic circulation of the surrounding community. Examples are Bada fish and Rinuak fish. Bada fish has a high economic value as a source of protein and also has the potential as an ornamental fish, thus becoming the main target of capture. According to information from the local market that the price of smoked dried Bada fish currently is Rp.250,000–300,000/kg and was higher on certain days, such as during Muslim holidays. So do to fried Rinuak that at certain periods the price of Rp.200,000/ kg. Some times is difficult to find these fishes because depends to the condition of the lake as their habitat. The last report stated that Lake Maninjau has a hypereutrophic status (MERI, 2014). Concerning the phytoplankton community dynamic, Sulastri *et al.* (2018) reported a temporal variation in the tropical status of the lake, from mesotrophic, mesoeutrophic, eutrophic, and up to hypereutrophic. Based on the potential of the fishery and its trophic status conditions, therefore Lake Maninjau needs to recovery.

Aims of this study are to determinate the nutritional content and amino acids of the endemic and native fish species of Lake Maninjau, that are commonly found in the economic cycle of the surrounding community of the lake. There are Asang fish (*Osteochilus vittatus*), Bada (*Rasbora maninjau*), Rinuak (*Gobiopterus brachypterus*), and Supareh (*Barbodes binotatus*). The results of this study to confirm the importance of fish resources in Lake Maninjau as a source of community nutritional. Moreover, these fish species need to be maintained by taking into account the condition of Lake Maninjau as their habitat.

The research about the nutritional content of endemic or native species of Lake Maninjau is rarely done, but inquiry about the topic often conducted on fish farming commodities such as Tilapia, Carp, Gouramy, Catfish, or Patin. However, Tanjung (2015) has examined the nutritional content of Lake Maninjau's Mollusca biotas such as valuable aquatic resources high economic already traded in markets around Lake Maninjau ie. pensi shells (*Corbicula moltkiana* and *Corbicula javanica*) and langkitang (*Brotiasumatrensis* and *Melanoides tuberculata*). They have a high protein content, ranging from 5.2% to 9.5% of wet weight. Lipid content is quite low (1.3 to 2.7) % of wet weight.

Materials and Methods

This study was conducted on 4 species fishes of Lake Maninjau. Asang fish (*O. hasselti*), now namely *Osteochilus vittatus* is a native species of the lake, but not the primary target catching fish. The fish usually use as a source of nutrient for the locals. Sold in the form of fresh fish and it is found out at the local market. Bada (*R. maninjau*) is one species of *Rasbora* spp in Lake Maninjau that local common name as Bada. Several species of Rasbora are endemic or native to Lake Maninjau, such as *Rasbora argyrotaenia, R. sumatrana, R. lateristriata, R. Spilotaenia.* The *R. maninjau* is an endemic species of Lake Maninjau (Lumbantobing, 2014). Bada fish circulates in the community in the form of cooked foods such as fried bada fish or preserved fish through the fogging process. Sales target in addition to the surrounding community and tourists.

Rinuak fish (*G. brachypterus*) is an endemic fish of Lake Maninjau, has small size and transparent and very famous. Circulation in the community in the form of cooked food such as 'rempeyek,' 'palai (pepes),' 'pergedel,' jerky or also in the type of preserved fish through the process of dryed or smoked. Like the Bada fish, sales target of Rinuak are the local community and tourist. Supareh fish (*P. binotatus*), now namely *Barbodes binotatus* is a native fish of Lake Maninjau which acts as a source of nutrient for the community although it is not a significant commodity for catching. Circulation in the city in the form of fresh fish and find out at the local market

A sampling of Ikan Asang, Ikan Bada, and Ikan Supareh were conducted on July, 2018, while the Rinuak species on June 2019 by local fisherman. All of the fish were brought to the laboratory with a chilled condition. The proximate analysis consists of the content of moisture, ash, protein, lipid, and crude fiber. The method for proximate referred to AOAC (2005). It was conducted at Research Center for Biological and Biotechnology Laboratory, LPPM, Bogor Agricultural University. Every sample was done in duplicate. While fifteen of amino acid content analysis of there fish by high-performance liquid chromatography (HPLC) method followed ICI (1988) and were carried out at Integrated Labora-

tory Bogor Agriculture University.

Results and Discussion

The main components of proximate analysis are moisture, ash, lipids, protein, and carbohydrate content which are expressed as the content percentage. Ash which shows mineral content and Nitrogen Free Extract, is analogous to Carbohydrate content. According to Pat *et al*. (2018) that the composition is usually used also for the analysis of food or feed content. The Nutrient composition of the 4 species fish (Asang, Bada, Rinuak, and Supareh fish) of Lake Maninjau shown at Table 1.

In percentage dry weight, the lowest ash content was obtained in Rinuak fish by 10.73%, Asang Fish by 14.33%, Supareh fish by 15.72% and the highest in Bada fish by 16.08%. The ash content of the native fish of Lake Maninjau is higher then to the Tilapia (from a IMTA rearing system) ash content by 5,423% dry weight (Said *et al*., 2019). The Rinuak ash content was slightly smaller than the catfish surimi of 3.19 ± 0.10% wet weight (Widjayanti *et al*., 2014). The ash content of the fish in this study varied between species. Ash content is related to mineral content. Fish that contains the highest ash content has the most top mineral content. Common minerals found in the fish meat are iron, calcium, zinc (from marine fish), phosphorus, selenium fluorine, iodine (Pat *et al*., 2018). Minerals in these fish were high ash content. Thus that fish from Lake Maninjau is suitable as a source of minerals.

Carbohydrate levels are described by the amount of Nitrogen Free Extract (NFE). Bada fish contains the lowest NFE at 6.67%, followed by Asang fish at 12.05%; Rinuak fish is 18.45%, and highest in Supareh fish is 20.04%. It shows that Bada fish is a fish that is low in carbohydrates. However, Supareh fish has the most moderate moisture content of 72.74%, followed by Asang fish by 73.50%; Bada fish is 74.05%, and highest in Rinuak fish is 80.62% (Table 1). Water is a significant component in fish meat. Water content that is often detected in fish flesh is around 80% of the weight of a fresh meat fish. However, in principle, the water content in fish meat between 66-71% (Pat *et al*., 2018).

Fish lipids are known to provide a high content of essential components of the human diet. The lipid content in research fish shows that the lowest in Rinuak fish is 8.44%, followed by Supareh fish as much as 10.01%; bada fish at 14.03% and highest in Asang fish at 21.08% dry weight (Table 1). The lipid content of fish in the range of 0.2–25%, which depends on the type of fish species and the season at which the study was conducted (Pat *et al*., 2018). It also depends on the age, size of the sample fish. Fish is a source of high-quality protein that is very important for growth, body defense, or for repairing damaged body tissue (Pat *et al*., 2018).

The lowest protein content was found in Asang fish by 50.23%, followed by Supareh fish by 54.23%; Bada fish was 60.13%, and the highest protein content was on Rinuak fish was 62.38% dry weight. Native fish have high protein content and are low in lipids. It shows the real fish, although small in size, but perfect for consumption. When compared with aquaculture commodities, the protein content of these native fish is much higher and lower in fat than cultured fish. Tilapia fish in a IMTA system has a protein content of 42.17 - 50.99 and fat (4.42 - 11.79% dry weight (Said *et al*., 2019), catfish surimi protein as much as 13.68 ± 0.38% wet weight and fat 4.77 ± 0.08%. (Widjayanti *et al*., 2014) The results of Tazbosan *et al*. (2013) research on five species of Tilapia get the highest nutrient content of Tilapia rendalli fish compared to others. Other research results from Ramlah *et al.* (2016) on two Tilapia origin from different living places have different nutrient content.

Table 1. Proximate Content of Native Fishes of Lake Maninjau

	Percentage in wet weight					Percentage in dry weight				
	Moisture	Ash	Lipid	Protein	Crude fiber	Ash	Lipid	Protein	Crude fiber	Nitrogen free extract
Asang (*O. vittatus*)	73.50	3.80	5.58	13.31	0.62	14.33	21.08	50.23	2.32	12.05
Bada (*R. maninjau*)	74.05	4.18	3.64	15.61	0.80	16.08	14.03	60.13	3.08	6.67
Rinuak (*G. brachypterus*)	80.62	2.08	1.64	12.09	8.00	10.73	8.44	62.38	0.00	18.45
Supareh (*B. binotatus*)	72.74	4.29	2.73	14.79	0.00	15.72	10.01	54.23	0.00	20.04

From the phenomena , it can be concluded that the nutrient content of fish depends on the species, habitat environment, place of maintenance, including the type of feed, the growth phase of fish. Referring to Pat *et al*. (2018) that protein content of fish muscle depends on species, nutritional condition, and type of muscle. When calculating in% wet weight, the protein content of the sample fish is between 12.09 - 15.01%. According to Pat *et al*. (2018) that the amount of protein in the fish muscle of fish is usually between 16 and 21%, but values lower than 16% or as high as 28% are occasionally found in some species. The protein content is very high (50.23-62.38)% dry weight and low fat (8.44-21.08)% dry weight (Table 1). The protein content was 4–8 times the fat content. It shows that the original Lake Maninjau fish is healthy for consumption because it has a low fat which is thought to have a low cholesterol content as well.

Mazumder *et al*., (2008) *in* Pat *et al*., 2018 analyzed the proximate composition of some small indigenous fish species in Bangladesh and found that the protein content varied from species to species. Proximate composition of almost all the food fishes was various based on their environment, biological status of the life cycle, fish size, stage of maturity. The nutritional quality depends on their feeding habits, season, adaptation temperature, age, sex, and availability of feed-in spawning period, etc. (Pat *et al*., 2018). The levels of food nutrients determine their quality. And more important is the factors that cannot use as nutrients by the human body (Muchtadi, 1989). Fish is one of the most essential foods in human food because of its high nutritional quality (Pat *et al*., 2018). The native fish species has a reasonably good dietary content as a source of protein, and minerals (ash), as well as relativelly low fat. The four species of this study are an excellent source of nutrition. And it is very potential to be developed as a primary source of food and can improve the economy of the community.

Fish protein has a high biological value because it contains essential Amino Acids (AA). In this research about 15 AA (Table 2), there are eight of Essential Amino Acids (EAA) which are Methionine, Threonine, Histidine, I-leucine, Leucine, Lysine, Valine, and Phenylalanine. There are seven of Non-Essential Amino Acids (NEAA): Aspartic acid, Glutamic acid, Serine, Glycine, Arginine, Alanine, Tyrosine. The AA content was the same as Gurami (Pratama *et al*., 2018) and Tilapia (Said *et al*., 2019). The type of EAA contained in these fish species is

Table 2. The Amino Acid Content of Native fish species of Lake Maninjau (g/100g)

Amino Acid Category	Components	Asang (*O. vittatus*)	Bada (*R. maninjau*)	Rinuak (*G. brachypterus*)	Supareh (*B. binotatus*)
EAA	Methionine	0.45	0.38	1.35	0.43
	Threonine	0.68	0.58	1.02	0.64
	Histidine	0.39	0.37	2.63	0.4
	I-leucine	0.76	0.66	0.39	0.74
	Leucine	1.29	1.12	0.77	1.23
	Lysine	1.53	1.25	0.16	1.44
	Valine	0.85	0.74	0.51	0.83
	Phenylalanine	0.72	0.62	0.73	0.69
Total EAA		6.67	5.72	8.46	6.4
NEAA	Aspartic acid	1.75	1.38	1.59	1.61
	Glutamic acid	2.68	2.15	0.68	2.45
	Serine	0.71	0.65	0.65	0.73
	Glycine	1.23	1.13	0.85	1.27
	Arginine	1.13	0.95	0.77	1.06
	Alanine	1.13	1.06	0.44	1.13
	Tyrosine	0.55	0.46	0.74	0.52
Total NEAA		9.18	7.78	5.72	8.77
Total Amino Acid		15.85	13.5	14.18	15.17
Ratio (%) of Total EAA : NEAA		42.058:57.92	42.37:57.63	59.66:40.34	42.19:57.81

almost complete.

The EAA of Rinuak fish is very high, (59.66%) of the total amino acids contained in it. While the other three species have almost the same EAA values between 42.08–42.37% (Tabel 2). It can be concluded that Rinuak fish is a good source of EAA. Essential Amino Acids are AA that cannot be synthesized in the human body, so they must be met through food intake, while NEAA are categories of AA that can be synthesized by the body itself (Tarbozan *et al*., 2013). All AA have each function in the human body (Mohanty *et al*., 2014), so the lack of AA can cause various diseases such as low blood pressure, digestive disorders, brain function disorders, edema, growth disturbance, and regeneration of muscle tissue which is obstructed. Fish is one type of food containing high EAA. According to Mohanty *et al*. (2014), fish is an important dietary source of protein and AA that plays a vital role in human nutrition.

Table 2 shows the AA components of 4 fish species in this research. Total AA among species varied (13.5–15.85), the lowest in Bada fish and the highest in Asang fish. The total amount of EAA varies for each fish species, that is 5.72– 8.46; lowest in bada fish and highest in Rinuak fish. Whereas the NEAA varies in the range 5.72– 9.18; lowest in Rinuak fish and highest in Asang fish (Table 2). The total amount of these AA is lower than AA of Tilapia fish in a IMTA system (19.945). According to Torbuzan's (2013), AA levels were found higher in cultivated fishes compared to wild fishes.

NEAA content such as Glutamic Acid has a relatively high content compared to other AA in the NEAA group, except for Rinuak fish. Glutamic acid plays a vital role in amino acid metabolism (Mohanty *et al*., 2014) whereas in fish meat, Glutamic Acid causes the taste of fish flesh to be savory (Suryaningrum *et al*., 2010). Refer to Table 2 that Native Fish is a good source of amino acids. The amino acid profile found at the 4 species fish especially EAA is an EAA that is needed for the balance of the human diet (Pal *et al*., 2018, Mohanty *et al*., 2014). The nutritional content of fish from Lake Maninjau is excellent because it contains high protein, high ash (mineral), low fat, and low carbohydrate. Fish and fish products play a significant role in the nutritional picture because they are rich sources of nutrients and provide a right balance of protein, vitamins and minerals, and relatively low caloric content (Pat *et al*., 2008).

Conclusion

The protein content of endemic fish and native Lake Maninjau fish (asang fish, bada fish, rinuak fish, and supareh fish) is higher than that of cultured fish. The lipid and carbohydrate content of these fishes is also lower so that it is perfect for meeting people's nutritional needs. Lake Maninjau native fish is also a source of amino acids. Essential amino acid content is almost complete, and the highest is in Rinuak Fish, compared to the others. The fish is beneficial to meet the nutritional needs and economic turnaround of the communities around Lake Maninjau. The existence of native fish in their natural habitat needs to be maintained and developed. Therefore, the management of Lake Maninjau as a natural habitat of native fish needs to be done thoroughly.

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