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The diversity of chemical compounds of bilih fish body (*Mystacoleucus padangensis*) originating from Lake Toba and Lake Singkarak, Sumatra, Indonesia

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Abstract. *Razak A. 2018. The diversity of chemical compounds of bilih fish body (*Mystacoleucus padangensis *Bleeker) originating from Lake Toba and Lake Singkarak, Sumatra, Indonesia. Biodiversitas 19: 1552-1557.* Bilih fish (*Mystacoleucus padangensis*) is an endemic fish in Lake Singkarak, West Sumatra. Bilih fish in Lake Singkarak experiencing pressure due to human activities that destroy the habitat of this fish in Lake Singkarak. The improvement of bilih fish habitat conducted by the government by introducing bilih fish to Lake Toba for bilih fish preservation. The purpose of this study is to describe the diversity of chemical compounds and their relation to several ecological factors that influence bilih fish in Lake Toba and Lake Singkarak. The research method is survey method. Bilih fish taken at three to four points on both Lakes. The distance between sample points is 8000 m. The result of this research is to find the morphology of bilih fish from Lake Toba bigger than bilih Lake Singkarak fish. The bilih fish Fins of Lake Toba have a 52.08% CaO compound (per 100 ppm sample), the fins of Lake Singkarak have a 53% CaO compound higher than Lake Toba, 51%. The content of Bilih Lake Toba fish muscle has P_2O_5 compounds 34,48% higher than Lake Singkarak with P_2O_5 34.58% higher, Bilih Danau Toba fish bone has CaO 57.66%, from Lake Singkarak 60,83%. Bilih Lake Toba has 97.32% Fluoride compound, higher than Lake Singkarak 98.43%. The ecological conditions in Lake Toba are relatively similar to the condition of the waters in Lake Singkarak.

Keywords: Bilih fish, chemical compounds, diversity, ecological conditions

INTRODUCTION

Bilih fish (*Mystacoleucus padangensis* Bleeker) is an endemic freshwater fish from Lake Singkarak, West Sumatra, Indonesia. Fish is an important food source for humans. Fish as a source of nutrition is very important for the human brain. The importance of fish as a food because of high quality, balanced, easily absorbed by human intestine that absorbs protein. The fish body has a very good vitamin, polyunsaturated fatty acid (Ravichaadran et al. 2011). Fish like energy depots from the fat source of the fish. Consumption of fish and fish products is recommended to prevent cardiovascular disease and other diseases. In addition, fish also play an important role in defending the human body from pathogenic attacks such as microorganisms (Ravichandran et al. 2011). The composition of fish chemical compounds as contained in the body of bilih fish, need to know and important to be processed as food quality. Food quality is important for many stakeholders such as local communities, governments, PLN and Non-Governmental Organizations (NGOs) who consume these fish. The fish are mostly consumed by the people of West and North Sumatra, Indonesia. Fish composition is important to know. Until now, Minang people love bilih fish because of its delicious protein and rich in Calcium. Furthermore, the fish bone affects significantly the composition or chemical content of the compound. The different lipid content of three species such as Cod (Gadus morhua), Mackerel (*Scomber scombrus*) were 23 g/kg and 509 g/kg respectively. Bones of fatty fish species are generally higher in fat levels compared with nonfat fish. (Poppe et al. 2007).

Since 2001, bilih fish was introduced to its new habitat, Lake Toba, North Sumatra (Kartamihardja and Sarnita 2008). Currently, bilih fish needs our attention to its life. In both lakes, bilih fish threatened by human activity, especially overfishing by fishermen who are around Lake Toba and Lake Singkarak. Bilih fish now includes endangered species. Much information exists on the ecology, growth, and reproduction of bilih fish (Syandri 1996; Syandri 1997; Syandri 2011; Nofrita et al. 2013; Nofrita et al. 2015). However, until now, there is no information about the composition of chemicals compound of body bilih fish. The purpose of this study was to explore the diversity of chemical compounds and their relation to the ecological factors that influence bilih fish from Lake Toba and Lake Singkarak.

MATERIALS AND METHODS

Area study

The research was conducted in Lake Singkarak, West Sumatra, Indonesia and Lake Toba, North Sumatra, Indonesia (Figure 1). The samples of bilih fish from Lake Singkarak was taken on June 2, 2016; while the samples of bilih fish from Lake Toba was taken on July 2-3, 2016. Water quality samples were taken in July-September 2015.

Lake Toba lies on 2°21'32"-2°56'28" N dan 98°26'35"-99°15'40" E, while Lake Singkarak lies on 0°36'00" S and 100°15'00" E.

The bilih fish samples of Lake Singkarak were taken from Guguak Malano Village, Sumpur Village, and Simawang Village in Tanah Datar District; and X Koto Singkarak Village in Solok District. The distance between the sites was 8000 m. For Lake Toba, the fish samples were only taken from three sites, namely Kampung Silalahi (Silalahi I, II, III) (Dairi District), Haranggaol (Simalungun District) and Pangururan (Samosir District), because at 4th site bilih fish was not found, possibly fish larvae were eaten by predators. Bilih samples collected from Lake Toba were 75 fish samples, where 25 fish samples from Kampung Silalahi, 25 samples fish from Pangururan Village and 25 fish from Haranggaol Village. The samples of bilih fish collected from Lake Singkarak were 100 fish sample where 25 fish samples from each of Guguak Malalo, Sumpur, Simawang, and X Koto Singkarak. The fish sample was handled by using special sample container for airtight fish samples and containing ice cubes (box Marina Cooler 6 L), then put in freezer.

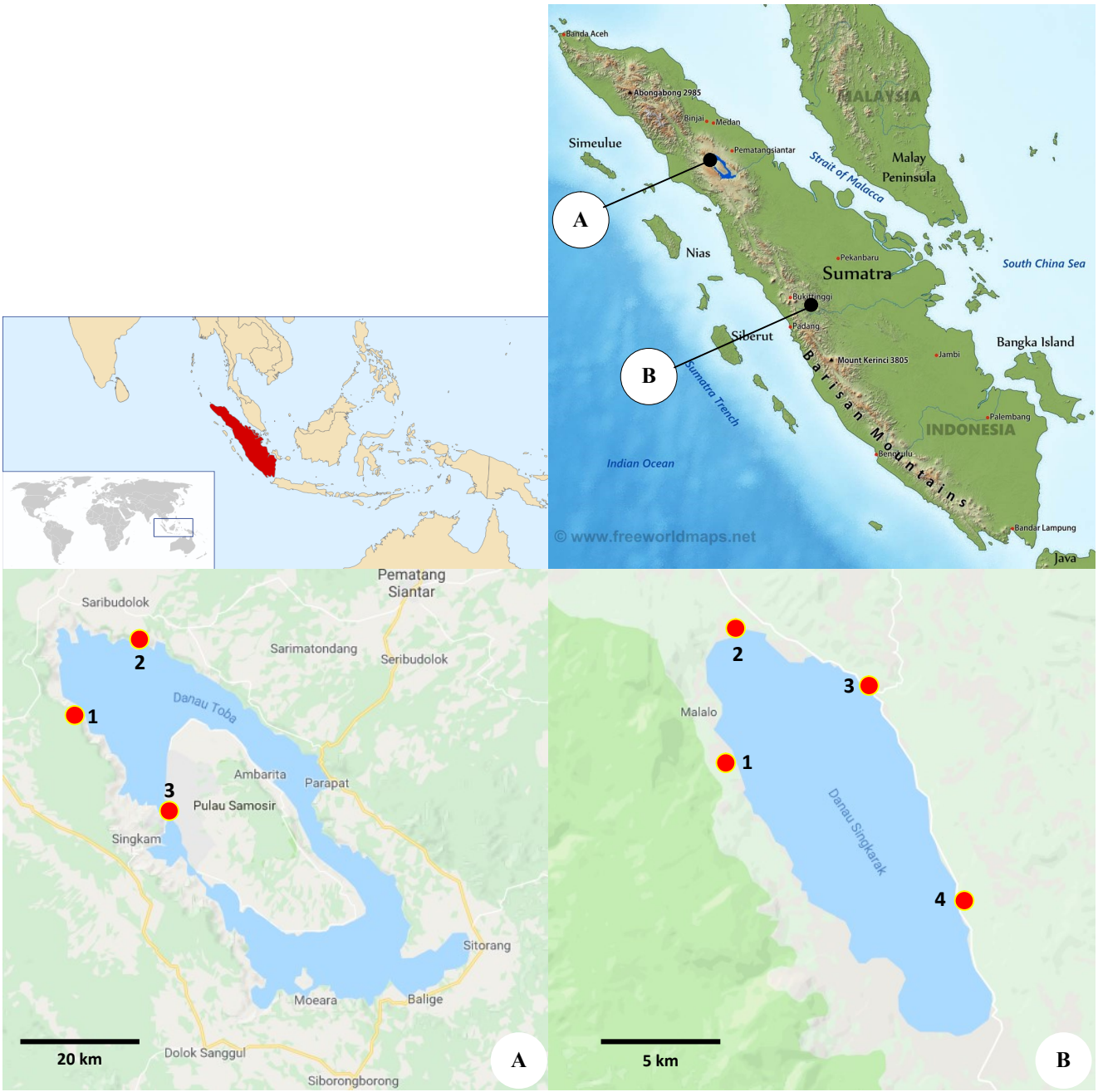

Figure 1. Study sites of samples of bilih fish in Sumatra, Indonesia. A. Lake Toba: 1. Kampung Silalahi, 2. Haranggaol, 3. Pangururan; B. Lake Singkarak: 1. Guguak Malalo, 2. Sumpur, 3. Simawang, 4. X Koto Singkarak

Samples analysis

The muscles of meat, bones and fins of the fish were analyzed for the chemical compounds. As much as 10 g of the meat muscle, Bone, and fin of bilih fish were taken and then crushed using white porcelain and given 96% alcohol solvent. Then, the samples were inserted in cuvet XRF sample as much as 5 ml. The sample analysis method follows the trace element guide of XRF Pan Analytical. Chemical compounds from 10 fish samples were measured using XRF Pan Analytical and FITR spectrophotometer to check the content of organic chemical compounds.

RESULTS AND DISCUSSION

The bones of bilih fish from Lake Toba had similar amount of phosphate (P_2O_5) (29%) compared from Lake Singkarak (27%). Bilih fish from Lake Singkarak had calcium oxide (CaO) content (62%) was relatively the same from bilih fish from Lake Toba (59%). Other compounds tended to be small. That is, fish bones of Lake Toba have higher phosphate compounds but low CaO compounds. Bilih fish from Lake Singkarak and Lake Toba had higher CaO (calcium compound) than content of phosphate compound. This is consistent with the results of a Logesh et al. (2012) study that found 32.73% Calcium and 17.2% of phosphorus in Sardine fish bone in Parangipettai, Southeast Coast of India. Figure 3illustrates the high calcium and phosphate content of fish bones compared to the other compounds. The t-test analysis showed that chemical contents of bilih fish bone content were not significantly differenced between Lake Toba and Lake Singkarak (Table 1). Calcium is a major component of fish bone (Malde et al. 2010). Calcium content in fish bones is high and goo for human growth in adolescence. Calcium is needed for blood clotting, nerve transmission, muscle stimulation, acid stability (pH) of blood, and maintaining water balance.

Data in Table 1, water quality data of Lake Toba and Lake Singkarak, water temperature and water pH are still in accordance with government regulation (PP No. 82, year 2001)on Water management and water pollution control. Temperature is an important factor in the lake water environment. The optimal temperature range for fish life according to Dan-Kishiya et al. (2010) 18-38 °C and influenced extensively by geographical location (latitude, longitude, and altitude). The temperature and pH of the lakes are the indicators of the presence of chemical compounds. Based on the water quality analysis (Table 1), the water of both Lakes was still quite natural. However, the low DO and BODindicate the lake water experienced mild contamination. Water alkalinity and clarity were not taken into water quality measurement. If the pH is in the range of 8.1 then the alkalinity or $CaCO_3$ content is about 120 mg L^{-1} and under normal conditions (PP No.82 year 2001).

According to the graph of Figure 4, the flesh of bilih fish from Lake Toba had phosphate (P_2O_5) (38%) tend to be similar to Lake Singkarak bilih fish (36%), The Calcium oxide (CaO) of bilih fish from Lake Toba (19%) was also higher than bilih fish from Lake Singkarak (6%), Lake Singkarak fish meat has Sulfite (SO_3) compounds (27%) higher than bilih fish Lake Toba (22%). Lake Singkarak bilih fish flesh had higher potassium (K_2O) (17%) than bilih fish of Lake Toba (6%). The other compounds were relatively low.

Table 2 shows the results of t-test analysis. All of the chemical compounds in Lake Toba and Lake Singkarak were not significantly different. Similar results are reported by Mubarok (2013).

The flesh of bilih fish from Lake Toba had higher phosphate sulfites and calcium than other chemical compounds. The muscle or meat of bilih fish from Lake Singkarak had higher phosphate, sulfite, and potassium than other chemical compounds. Chandrasekar (1993) reports the similar study that 100 g of fish flesh has 4.7-51.4 mg Ca, 116-312 mg P, 29-54.3 mg Mg. As a comparison, the highest macro mineral content of milkfish in brackish water is potassium (K) reaching 318,725 mg 100 g^{-1} of material. l. The similar results are reported by Wilfrido et al. (2007) that milkfish has mineral content of 4.8% calcium; phosphorus 16.9%, increasing the selling value of milkfish (*Chanos chanos*). Ramlah et al. (2016) also report similar results about the chemical content of Lake fish in South Sulawesi, where the calcium of fish from Lake Mawang (4.782 mg) higher than fish from Lake Unhas (3.027 mg); the phosphorus content of fish from Lake Mawang (360 mg) is lower compared to the origin of Lake Unhas (610 mg); and the iron content of fish from Lake Mawang (2.756 mg) is lower than the fish from Lake Unhas (0.835 mg). Furthermore, Chandrasekar and Deosthale (1993) stated that fish flesh content per 100 g was 4.7-51.4 mg Ca, 116-312 mg P, 29-54.3 mg Mg.

The results of chemical content analysis of bilih fish flesh originating from Lake Toba and Lake Singkarak are shown in Figure 4. The analysis of chemical compound content of each sample measured and tested on the compound content is shown in Table 3. Table 3 explains that the content of each compound which was tested on 10ak samples showed no significant difference because t calculated was smaller than t table.

Table 1. Water quality of Lake Toba and Lake Singkarak

Habitat	Temp. (°C)	pH	DO (mg/L)	Alkali-nity	BOD	Clarity (meter)
Lake Toba	25	8.10	1.65	33.00	0.50	320
Lake Singkarak	25	8.50	2.14	26.50	0.50	330

Table 2. The t-test of bone chemical compounds of bilih fish between Lake Toba and Lake Singkarak

Chemical compounds	t-count	t-table	Significantly
MgO	0.000006	2.262	Not significant
Al_2O_3	0.00000007		Not significant
SiO	0.00002		Not significant
P_2O_5	0.00000005		Not significant
SO_3	0.000003		Not significant
K_2O	0.0000007		Not significant
CaO	0.0000001		Not significant

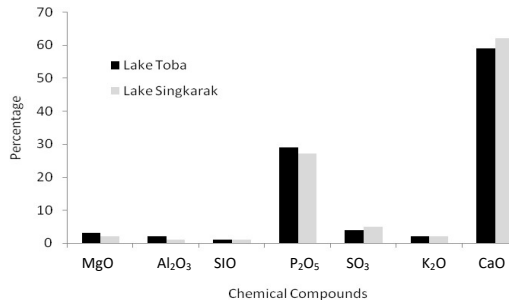

Figure 3. Bone compounds of bilih fish from Lake Toba and Lake Singkarak, Sumatra, Indonesia

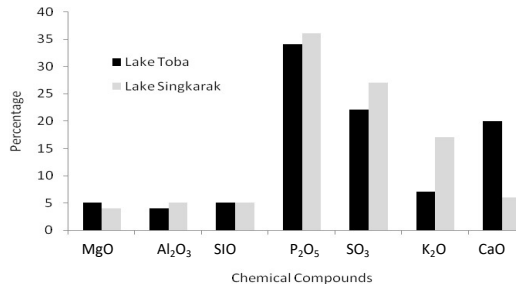

Figure 4. Chemical compounds of fish flesh of bilih fish from Lake Toba and bilih fish Lake Singkarak, Sumatra, Indonesia

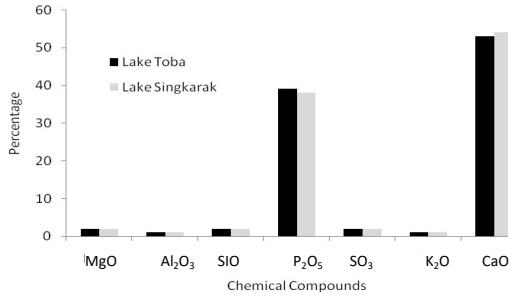

Figure 5. Chemical compounds of fins of bilih fish from Lake Toba and Lake Singkarak

Bilih fish fins from Lake Toba and Lake Singkarak are higher in Phosphate compounds and Calcium compounds as shown in Fig. 5. Fins of fish are flexible, contain more minerals than bone cells as well as in skeletal bone (Flammang et al. 2013). Figure 5 shows that the main content of fin compound of bilih fish from Lake Toba and Lake Singkarak were phosphate and calcium. The other chemical compounds were small amounts such as MgO, SiO_2, and SiO_3. These results are lower than chemical compounds of the shark fin, where the content of phosphorus and calcium are 146 mg and 194 mg respectively (FAO 2018). To t-test of bilih fish fins on Lake Toba and Lake Singkarak show similar result with bones and flesh of bilih fish, not significant, as seen in Table 3. The study of chemical content of freshwater fish such as bilih fish is important for life. Fawole et al. (2007) state that the chemical content of essential elements relates to the biologically-impacted metabolic processes.

Table 3. T-test chemicals compounds of bilih fish

Chemical compounds	t-count	t table	Significantly
MgO	0.0015	2.262	Not significant
Al_2O_3	0.00001		Not significant
SiO	0.0000007		Not significant
P_2O_5	0.0000003		Not significant
SO_3	0.0000007		Not significant
K_2O	0.000009		Not significant
CaO	0.0000002		Not significant

Table 4. T-test chemical compounds of fins bilih fish

Chemical compounds	t-count	t-table	Significantly
MgO	0.000070	2.262	Not Significant
Al_2O_3	0.000010		Not Significant
SiO	0.0000070		Not Significant
P_2O_5	0.0000003		Not Significant
SO_3	0.0000070		Not Significant
K_2O	0.0000100		Not Significant
CaO	0.0000003		Not Significant

Figure 6 provides information on the organic compound of the eye lenses of bilih fish from Lake Toba (SBT) and Lake Singkarak (SBS). The arrows in Figure 6 show the difference of organic compound of bilih fish lens from Lake Toba and Lake Singkarak. Organic compounds with a range of 3,300 was, alkana compounds and ring aromatic compounds. The arrow with range 1900-1800 indicated alkuna compound and aromatic ring. The arrow with 1600-600 denotes a strong and aromatic alkena compound (Skoog et al. 1998). The function of the hydrocarbon compound is the basis of glucose formation which is an important energy for vision. Byron et al (2013) state that hydrocarbons are the starting or base source of the formation of amino acids and protein lenses.

Fish muscles, fish fins, and eye lens are different metal elements and organic compounds. That means there was a diversity of species related to ecology and the environment, especially the water factor in the two lakes (Lake Toba and Lake Singkarak). Bilih fish Lake Toba whose body was larger than Lake Bilih Singkarak. This is due to the sharpness of the eye lens bilih fish Toba more powerful. This fact indicates bilih fish from Lake Toba may eat more food than bilih fish from Lake Singkarak. The significant environmental factor related to growth of bilih fish Lake Toba more support which include compound chemical lens related to water temperature, air temperature, pH, and hardness (Razak 2017, Nofrita et al. 2013). However, in this study, there was no significant difference between the chemical compounds of bilih fish from Lake Toba and Lake Singkarak. For the organic material, the FITR lens is shown to function different chemical compounds according to the infrared frequency range (Skoog et al. 1998)

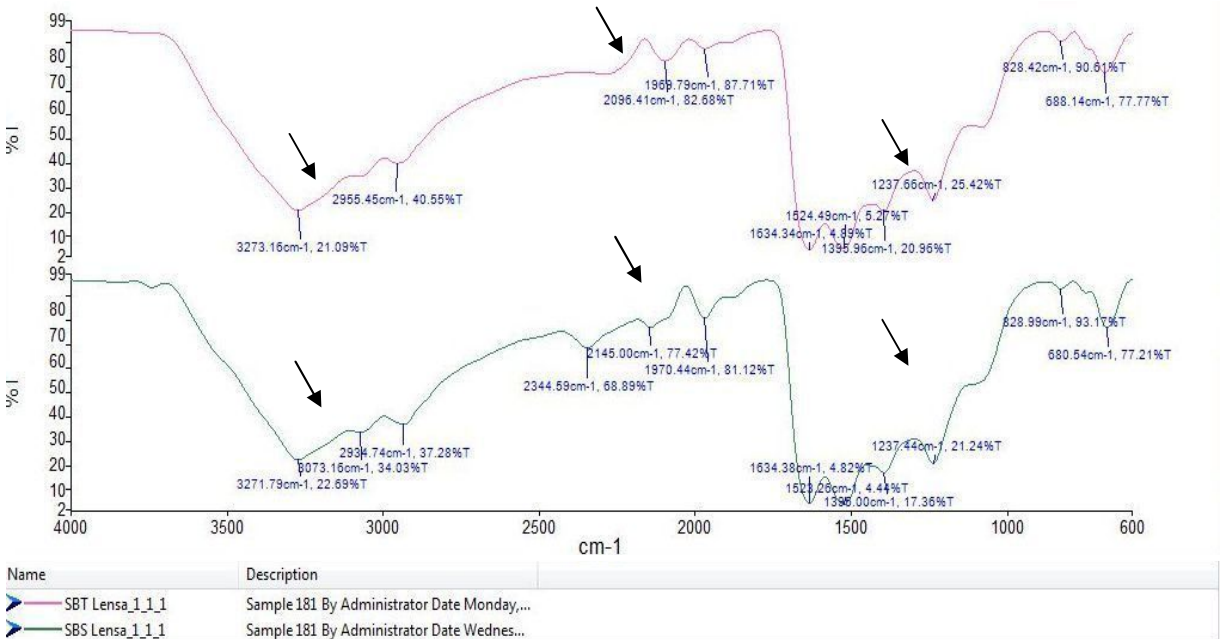

Figure 6. Differences of organic fish lenses composition of bilih fish lake Toba (Samples of Bilih Toba, SBT) and from Lake Singkarak (Samples of Bilih Lake Singkarak, SBS)

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