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Proximate, Fatty Acid Profile and Heavy Metal Content of Selected By-Catch Fish Species from Muara Angke, Indonesia

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Abstract: Proximate content, fatty acid and heavy metal content were determined for the ten by-catch fish species from Muara Angke, Indonesia. The proximate composition was found to be 15.00-17.70% protein, 0.44-2.78% fat, 69.01-76.61% water, 2.69-5.94% ash and 1.32-6.68% carbohydrate, whereas the fatty acid compositions consist of 14.55-36.83% saturated fatty acids (SFA), 4.92-21.1% monounsaturated fatty acid (MUFA) and 10.9-23.06% polyunsaturated fatty acids (PUFAs). Among them, those occurring in the highest proportions were myristic acid (C14:0, 0.12-7.59%), palmitic acid (C16:0, 0.02-20.5%), stearic acid (C18:0, 0.42-49.19), oleic acid (C18:1, 0.29-50.09%), linoleic acid (C18:2, 0.23- 44.91%), eicosapentaenoic acid (EPA, C20:5n3, 0.41- 4.61%) docosahexaenoic acid (DHA, C22:6n3, 0.28-3.44%). The rest of the heavy metal content, Pb, Cd, Ni, Hg and As were all present in amounts below toxic levels.

Key words: By-catch fish, proximate, fatty acid, heavy metal

INTRODUCTION

Utilization of fish which have low economic value especially for by-catch have not optimized, because its few in number and scattered in several location. The main problem in the fishery industry is a large number of by-catch which are not well utilized because they think that by-catch are useless, so it is almost thrown back into the sea (Pauly and Neal, 1985). Letelay and Malawat (1995) stated that the fish which are thrown back into the sea could achieve 65.56% of the total by-catch fish every year and the numbers of by-catch fish brought to ashore was only 34.44%. Numbers of fish thrown back into the sea could reach 300,000 tons per year and based on the data collected from 338 shrimp trawl fleet catching fish in the Arafura Sea, the by-catch produced was estimated at 332,186.40 tons per year (Djazuli *et al*., 2009; Purbayanto *et al*., 2004).

Data Statistics Directorate General of Capture Fisheries in 2002-2006 showed that the catch of shrimp by trawlers is amount of 26837.4 tons per year. By using the ratio of 1:12, the HTS number is expected to reach an average of 322 048 ton per year. Production of low economical fish such as *tetengkek*, *terubuk*, *fish tongue* and *kurisi* increase consecutively 11.40, 10.03, 8.57 and 8.07% per year. Production *golok* fish and flying fish decrease for average by 3.08 and 3.01% per year (Indonesian Ministry of Marine and Fisheries Affairs, 2012).

Resultantly by-catch tend untapped. One reason is the absence of any management policy catching shrimp trawl industry that is the target of a shrimp fishing operations is that interventions should be prioritized. Therefore, there needs to be an effort to utilize fish production in Indonesia and in such efforts need to consider biological factors (type and size of fish) and economic value (value added) as well as the obstacles to its development. One of the technologies and alternative fish processing of by-catch is the manufacture of fish oil from fish low economic value. By-catch species in trawlers are generally classified into 8 types namely; Bambangan fish (*Lutjanus* sp), *gulamah* fish (*Argyrosomus amoyensis*), Kurisi (*Nemiptherus nematophorus*), Beloso (*Saurida tumbil*), lencam (*Lethrinus* sp), jackfruit seeds (*Openeus* sp.), bananas (*Caesio crysozonus*) and swanggi (Holocentridae sp). One use of by-catch is the content of omega-3 which added to food and used as health supplement.

Fishes of low economic value have a high protein (47.9-58.8%) and micronutrients as a source of food (Kabahenda *et al*., 2011). Freshwater fish as the by-catch *Diaphus watasei* contains 28-36.7% MUFA, PUFA and SFA 33.3 and 25.5% omega-3 PUFAs approximately 70% of total PUFA (Sebastine *et al*., 2011). Unsaturated fatty acids (PUFA) is a substance that is essential to maintain health and human growth and development (Chow, 2000). By-catch holds the potential for processed meat products such as creamed (33.5 to 55.9%), fish meal (23-33%) and fat content and fatty acids are high (Eid *et al*., 1992).

Fatty acids are long-chain hydrocarbon components that compose lipids. Fatty acids have very important functions for the human body, especially the poly

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unsaturated fatty acid (PUFA) of which is linoleic acid (omega-6) and linolenic acid (omega-3). It is used to maintain the structural parts of the membrane cells and plays an important role in brain development. The benefits of omega-3 fatty acids are to prevent atherosclerosis, cancer, diabetes and to strengthens the immune system (Imre and Sahgk, 1997). Linolenic fatty acid derivatives have EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid). The EPA and DHA is needed by the human body because it has several benefits, among others, can effect the intelligence, helping infancy and lower triglyceride levels (Leblanc *et al*., 2008). The high number of by-catch will effect for utilization of fatty acid, but it has not been used for fish oil as source of omega-3. This study aimed to determined chemical composition of by-catch, to determined amount of heavy metal of by-catch and to determined fatty acid composition of by-catch which obtained from Muara Angke Water, Indonesia.

MATERIALS AND METHODS

Materials that used in this study consisted of 10 species of by-catch of fishes (*Hemirhampus* spp, *Trichiurus savala*, *Saurida tumbil*, *Stolephorus* sp., *Carangoides* spp, *Leiognathus lineolatus*, *Formio niger*, *Rastrelliger kanagurta*, *Selaroides leptolepis*, *Sardinella* sp.) from TPI Muara Angke, Jakarta, Indonesia. Samples were kept frozen at -20°C until analyzed.

Chemical analysis (proximate analysis): Moisture content was determined by drying samples in an air circulation oven for 1 h at 105°C. Samples for ash determination were heated in a furnace at 600°C for 1 h to constant weight as described in the AOAC manual (AOAC, 2005). Crude protein was determined on the edible portions of fish from Kjeldahl nitrogen using a 6.25 conversion factor (AOAC, 2005). Lipids were extracted by using chloroform/methanol (2:1, v/v) and were gravimetrically determined as described previously (Bligh and Dyer, 1959).

Fatty acid analysis: Preparation of fatty acids methyl ester was carried out according to the method of AOAC (2005). Crude oil extract (20 µL) from samples were trans-esterified in a pyrex tube by using 200 µL of boron trifluoride methanol (20% BF3) reagent and heating at 100°C for 30 min. After cooling, 200 µL of n-hexane and 800 µL of distilled water were added to the mixture, which was then agitated manually for 1 min and centrifuged for 2 min. Approximately 100 µL of the upper n-hexane layer was transferred to a 150 µL glass insert for 2 mL vials after diluting the extracted hexane to obtain a suitable chromatographic response. Fatty acids were identified by comparing the retention times of FAME mixture with the standard myristic acid palmitic acid, stearic acid, oleic acid, linoleic acid, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA). Two replicate GC analyses were performed and the results were expressed in GC area% as mean values±standard deviation. The fatty acid composition of deep-sea fish oil triacyglyserol was directly analyzed using Gas Chromatography (GC) after methyl esterification. One µL of each fatty acid methyl ester (FAME) sample was injected (split ratio 15:1) into a GC 17 A-SHIMADZU Gas Chromatography (Shimadzu Scientific Inc., USA) with flame ionization detector (GC-FID). A BPX 70 (SGE, Australia) column consisting of a 30 m x 0.32 mm fused silica capillary coated with 70% cyanopropyl polysilphenylene-siloxane of 0.25 µm film thickness was used, with Hydrogen as the carrier gas at constant linear velocity (28 cm/s). The injector temperature was 250°C and the detector temperature 280°C. The oven was programmed as follows: 80°C for 2 min, 5°C/min to 200°C for 10 min and 10°C/min to 230°C for a further 10 min. Total analysis time was 49 min and the last major fatty acid (24:1 n-9) was eluted at approximately 30 min. Chromatographic peaks were identified by comparing retention times with the PUFA standard.

Analysis of heavy metals Cd, Pb, Hg, Ni and As: Analysis of heavy metal were conducted using BSN (2009). Analysis was performed using 1 g sample was put into destruction flask 100 mL, add 15 and 5 mL of concentrated HNO_3 $HClO_4$, then allowed to stand 24 h. Samples then were destructed until clear, cooled and added 10-20 mL of deionized water, heated±10 min, removed and chill. The solution was transferred into a 100 mL flask pint (destruction flask rinsed with deionized water and put into a pumpkin drinks). Solution was added water to the extent of calibration marks. Then shaken and filtered with Whatman filter paper No. 4. Samples were prepared and analyzed in accordance with the testing of heavy metals (Cd, Pb, Hg, Ni, As) in water analysis (APHA 3110 for the metals Cd, Pb and Ni; method 3114 for As and method 3112 for Hg). The filtrate was analyzed using Atomic Absorption Spectrophotometer (AAS).

RESULTS AND DISCUSSION

Proximate composition of the fish muscle: The moisture, protein, fat and ash content in the muscle of by- fishes examined are shown in Table 1.

The moisture content was between 69.01 and 76.62%, protein content was between 15.00 and 17.70%, fat content ranged from 0.44 to 2.78%, ash content ranged from 2.69 to 5.94% and carbohydrate ranged from 1.32 to 6.68%. The protein content of *Rastreliger kanagurta* was the highest of all by-catch fishes examined. The protein contents of by catch fishes examined were similar to commercially important fishes species from the South coast of India reported by Kumar *et al*. (2014). The average of protein content from all by catch fishes

Table 1: Proximate composition of edible portion of selected by catch fishes species

Fish species	Water (%)	Ash (%)	Fat (%)	Protein (%)
Hemirhampus spp	74.57±0.66	4.34±0.61	0.52±0.38	16.41±0.17
Trichiurus savala	73.79±0.27	2.74±0.09	2.58±0.49	16.04±0.15
Saurida tumbil	73.81±0.23	4.27±0.05	1.40±0.08	16.05±0.40
Stolephorus spp	76.61±0.02	3.15±0.28	0.63±0.40	16.89±0.04
Carangoides spp	69.01±0.05	5.85±0.47	2.78±0.10	16.90±0.03
Leiognathus lineolatus	75.57±1.32	5.18±0.13	1.26±0.03	16.67±0.23
Formio niger	76.02±0.01	2.69±0.29	1.44±0.34	15.00±0.37
Rastrelliger kanagurta	72.97±0.08	3.62±0.40	1.46±0.01	17.70±0.13
Selaroides leptolepis	71.18±0.04	5.94±0.20	2.00±0.55	15.91±0.45
Sardinella spp	71.87±0.08	3.91±0.52	0.44±0.16	17.11±0.32

Table 2: Heavy metal content of selected by catch fish species

	Heavy Metal (µg/g)				
Fish species	Pb	Cd	Ni	Hg	As
Hemirhampus spp	0.26±0.09	0.05±0.00	0.02±0.00	0.01±0.00	n.d
Trichiurus savala	0.39±0.11	0.04±0.00	0.03±0.00	0.03±0.00	n.d
Saurida tumbil	0.16±0.10	0.02±0.00	0.04±0.00	0.18±0.00	n.d
Stolephorus spp	0.27±0.02	0.02±0.00	0.01±0.00	0.02±0.00	n.d
Carangoides spp	0.53±0.17	0.10±0.00	n.d	0.01±0.00	n.d
Leiognathus lineolatus	0.64±0.13	0.05±0.00	n.d	0.25±0.00	n.d
Formio niger	0.39±0.09	0.31±0.00	0.02±0.00	0.03±0.00	n.d
Rastrelliger kanagurta	0.57±0.12	0.05±0.00	n.d	0.01±0.00	n.d
Selaroides leptolepis	0.71±0.07	0.09±0.00	n.d	0.28±0.00	n.d
Sardinella spp	0.67±0.07	0.03±0.00	0.01±0.00	0.24±0.00	n.d

examined was high in protein content. The difference of protein content from different fish species is caused by age, feed, habitat and season.

In terms of the lipid content, by catch fishes examined can be considered to be in the lean and low fat category. Fish can be grouped into four categories according to their fat contents: lean fish (<2%), low fat (2-4%), medium fat (4-8%) and high fat (>8%)

(Ackman, 1989). The species of lean fish were *Hemirhampus* spp, *Saurida tumbil*, *Stolephorus* sp, *Leiognathus lineolatus*, *Formio niger*, *Rastrelliger kanagurta* and *Sardinella* sp. The species of low fat category were *Trichiurus savala*, *Carangoides* spp and *Selaroides leptolepis*. The fat content in the species *Sardinella* sp. examined was lower than reported previously by Kumar *et al*. (2014). Lipid levels and fatty acid composition will vary depend on species, age, sex, season, salinity, water temperature and food availability (Stansby, 1981).

Heavy metals: The average concentration of heavy metals in muscle tissues of by catch fishes from Muara Angke Jakarta, Indonesia are presented in Table 2.

Heavy metals which analyzed in this study were Pb, Cd, Ni, Hg and As. Pb concentration of by catch fishes examined ranged from 0,16 to 0,67 µg/g. The observed concentration of Pb in muscle tissues was highest in *Sardinella* sp. (0,67 µg/g). Ni concentration of by catch fishes examined ranged from 0 to 0,04 µg/g. Arsenic was not detected in all of observed fishes. This was showed that there was no arsenic in the muscle tissues of all of the species.

Cadmium values in this study ranged from 0.02 to 0009 µg/g. The observed values were similar to study from east Medinpur district of West Bengal and the northern end of the Bay of Bengal, India (Mukherjee and Bupander, 2011). This study similar to study from Gresik coastal waters of Indonesia (Agoes and Hamami, 2007). Cadmium is one of the type of heavy metals which has high potential for bio-concentration in fish and it is accumulated in multiple organs (Mukherjee and Bupander, 2011). Cadmium may accumulate in humans from food chain magnification and may induce kidney dysfunction, skeletal damage and reproductive deficiencies (Commission of the European Communities, 2001).

The concentration of mercury (Hg) in muscle tissues of different by catch species examined varied from 0.01 to 0.28 µg/g. The lowest mercury concentration was found in *Rastrelliger kanagurta* and the highest mercury concentration was found in *Selaroides leptolepis*. The mercury concentration in by catch species from Muara Angke waters of Indonesia were comparable with mercury in muscle tissue of marine fishes from east Medinpur district of West Bengal and the northern end of the Bay of Bengal, India (Mukherjee and Bupander 2011). The mercury concentration of this study was lower than those reported in fishes observed by Mukherjee and Bupander (2011). The toxicokinetics of mercury is associated with its chemical form: elemental, inorganic and organic. The organic form, usually methyl mercury (MeHg) is more hazardous than both other forms. The liver and kidneys of stock animals, fish and shellfish tend to concentrate environmental mercury. Marine organisms possess a remarkable capacity to turn inorganic mercury into organic compounds (MeHg), thus rendering mercury more easily transferable throughout the aquatic food chain (Dudka and Miller 1999).

Table 3: Fatty acid compotition

Parameter	*Hemiramphus* spp.	*Trichiurus savala*	*Saurida tumbil*	*Stolephorus* spp	*Carangoides* spp.	*Leiognathus* lineoatus	*Formio* niger	*Rastrelliger* kanagurta	*Selaroides* leptolepis	*Sardinella* spp
Fatty acid*										
C12:0	0.03±0.02	0.05±0.00	0.04±0.01	0.08±0.01	0.1±0.00	0.08±0.00	n.d	0.07±0.00	0.02±0.00	0.10±0.00
C13:0	0.01±0.01	0.02±0.00	0.02±0.01	0.04±0.01	0.07±0.00	0.04±0.01	0.02±0.00	0.04±0.00	0.02±0.00	n.d
C14:0	1.28±0.00	2.96±0.02	2.15±0.00	3.57±0.01	3.35±0.01	3.23±0.00	1.01±0.01	2.60±0.02	1.46±0.01	2.64±0.00
C15:0	0.40±0.00	0.51±0.03	15.64±0.03	16.16±0.00	0.85±0.02	0.57±0.01	1.22±0.01	0.61±0.03	0.40±0.00	0.72±0.00
C16:0	12.37±0.00	24.4±0.02	3.36±0.00	2.86±0.00	16.97±0.04	24.19±0.02	16.2±0.02	14.14±0.02	7.91±0.03	15.43±0.03
C17:0	0.71±0.02	0.65±0.01	5.84±0.01	5.99±0.02	1.24±0.01	0.77±0.00	2.03±0.00	0.96±0.00	0.59±0.01	1.06±0.02
C18:0	9.00±0.02	7.15±0.01	0.09±0.02	0.08±0.01	7.29±0.00	6.71±0.00	9.26±0.01	7.61±0.00	3.57±0.00	6.92±0.01
C20:0	0.32±0.01	0.32±0.00	0.05±0.00	0.09±0.00	0.41±0.00	0.44±0.01	0.5±0.00	0.41±0.01	0.21±0.01	0.52±0.00
C21:0	0.06±0.01	0.07±0.00	0.12±0.01	0.15±0.00	0.13±0.00	0.11±0.00	0.15±0.00	0.11±0.00	0.07±0.02	0.12±0.02
C22:0	0.34±0.00	0.25±0.00	0.09±0.04	0.09±0.00	0.35±0.02	0.35±0.01	0.3±0.00	0.33±0.00	0.15±0.00	0.42±0.00
C24:0	0.42±0.02	0.33±0.00	0.34±0.05	0.36±0.00	0.31±0.02	0.34±0.01	0.18±0.00	0.44±0.01	0.15±0.01	0.41±0.00
Total SFA	24.56	36.71	27.74	29.47	31.07	36.83	30.87	27.32	14.55	28.34
C14:1	n.d	0.03±0.01	0.57±0.01	6.74±0.01	n.d	0.03±0.00	n.d	0.01±0.00	-	-
C16:1	1.82±0.00	4.14±0.02	0.81±0.00	1.01±0.01	3.45±0.01	5.33±0.01	1.74±0.02	3.12±0.00	1.38±0.02	2.59±0.02
C18:1n9t	0.06±0.00	0.11±0.00	5.82±0.03	5.24±0.01	0.12±0.00	6.10±0.01	0.18±0.02	0.11±0.00	0.05±0.01	0.09±0.01
C18:1n9c	5.86±0.03	12.61±0.03	n.d	0.03±0.02	6.26±0.00	8.89±0.02	6.05±0.01	6.0±0.02	3.14±0.02	4.1±0.00
C20:1	0.07±0.02	0.20±0.00	0.13±0.00	0.41±0.02	0.24±0.00	0.40±0.03	0.42±0.01	0.17±0.03	0.11±0.02	0.12±0.00
C22:1n9	0.02±0.00	0.03±0.00	0.04±0.04	0.07±0.01	0.05±0.00	0.04±0.04	0.18±0.01	0.04±0.00	0.02±0.00	0.05±0.01
C24:1	0.25±0.01	0.32±0.01	0.33±0.02	0.47±0.01	0.34±0.00	0.31±0.01	0.23±0.01	0.36±0.00	0.22±0.00	0.38±0.00
Total MUFA	8.08	17.44	7.70	13.97	10.46	21.11	8.80	9.81	4.92	7.33
C18:2n9t	0.02±0.00	0.02±0.00	0.47±0.00	0.77±0.01	0.02±0.00	0.04±0.01	n.d	6.02±0.00	0.01±0.01	0.03±0.03
C18:2n6c	0.59±0.00	0.48±0.01	0.35±0.00	0.36±0.00	0.88±0.01	0.62±0.02	0.54±0.00	0.60±0.01	0.41±0.01	0.77±0.02
C18:3n6	0.04±0.01	0.04±0.01	0.26±0.01	0.24±0.02	0.09±0.01	0.06±0.01	0.04±0.00	0.07±0.03	0.03±0.01	0.09±0.03
C18:3n3	0.22±0.02	0.36±0.01	0.09±0.01	0.10±0.00	0.52±0.01	0.61±0.01	0.19±0.00	0.21±0.02	0.18±0.02	0.44±0.03
C20:2	0.09±0.02	0.14±0.01	0.33±0.00	0.32±0.01	0.20±0.01	0.12±0.01	0.18±0.02	0.10±0.02	0.07±0.00	0.12±0.00
C20:3n6	0.09±0.02	0.11±0.00	0.07±0.02	0.04±0.00	0.15±0.01	0.08±0.02	0.14±0.03	0.09±0.00	0.05±0.00	0.10±0.00
C20:3n3	0.04±0.03	0.08±0.00	1.68±0.00	1.35±0.00	0.09±0.01	0.08±0.01	0.08±0.01	0.07±0.00	0.04±0.00	0.05±0.00
C20:4n6	1.03±0.03	1.30±0.02	n.d	0.02±0.01	0.07±0.01	n.d	3.42±0.02	1.74±0.00	0.72±0.00	1.64±0.00
C22:2	-	-	-	-	-	-	0.05±0.02	0.02±0.00	-	-
C20:5n3	0.97±0.00	2.49±0.00	2.30±0.00	3.08±0.02	3.3±0.02	2.65±0.01	3.22±0.03	3.10±0.00	1.63±0.02	3.07±0.02
C22:6n3	10.67±0.01	9.0±0.01	6.37±0.00	11.63±0.03	12.02±0.01	11.39±0.03	3.59±0.02	11.04±0.01	7.76±0.03	13.77±0.03
Total PUFA	13.76	14.62	11.92	17.91	17.34	15.65	11.45	23.06	10.90	20.08

*percent w/w in fat n.d = not detected

Fatty acid composition: Fatty acid analysis was performed using a *gas chromatograph* (GC) to determine the fatty acid composition all samples muscle. Fatty acid composition of samples can be seen in Table 3.

Results of fatty acid profile analysis showed that SFA, MUFA and PUFA content of all samples observed ranged from 14.55-36.83, 4.92-21.11 and 10.90-23.06%, respectively. Highest content of SFA was found in muscle of *Leiognathus lineoatus*, while the lowest value can be found in muscle of *Selaroides leptolepis*. Dominant fatty acid in saturated fatty acids detected was palmitic acid (C16:0), which the palmitic acid content in muscle of *Leiognathus lineoatus* was 24.19%. MUFA content of all samples was dominated by oleic acid (C18:1nc). Having a highest MUFA content, muscle of *Leiognathus lineoatus* contained 8.89±0.02% oleic acid. Highest content of PUFA was found in muscle of *Rastrelliger kanagurta*, while the lowest value can be found in muscle of *Selaroides leptolepis*. Dominant fatty acid in polyunsaturated fatty acids detected was EPA (C20:5) and DHA (C22:6). Highest EPA and DHA content can be found in muscle of *Carangoides* sp., there were 3.30±0.02% for EPA and 12.02±0.01% for DHA. All samples were categorized to pelagic fish. The study of Edirisinghe *et al.* (1998) showed that some pelagic fish species from Sri Lanka waters such as yellow stripped scad, Indian mackerel and herring have dominant SFA content and then followed by PUFA content. Eicosapentaenoic acid/EPA (C20:5n3) and docosahexaenoic acid/DHA (C22:6n3) are dominant omega-3 fatty acids in marine fish. The n-6/n-3 ratio of marine fish is higher than freshwater fish. The n-6/n-3 ration in marine fish is about 5 to 10. All samples observed are potential to be developed as a source of omega-3 and can be a raw material for fish oil production.

Ozogul and Ozogul (2005) analyzed fat content and fatty acid composition from eight commercial fishes which originating from Turkey waters area. Eight samples observed had SFA content ranged from 25.5-38.7%, MUFA content ranged from 13.2-27.0% and PUFA content ranged from 24.8-46.4%. Kind of fatty acids which dominated the SFA content were meristic acid (C14:0, 1.70-10.9%), palmitic acid (C16:0, 15.5-20.5%), palmitoleic acid (C16:1, 2.86-17.0%), stearic acid (C18:0, 3.32-8.18%), oleic acid (C18:1n9 cis, 6.11-20.8%), linoleic acid (C18:2n6, 0.93-4.03%), octadecatetraenoic acid (C18:4n3, 0.02-4.55%), cis-5,8,11,14,17-eicosapentaenoic acid (EPA, C20:5n3, 4.74-11.7%) and cis-4,7,10,13,16,19-docosahexanoic acid (DHA, C22:6n3, 7.69-36.2%). Proportion of omega-3 polyunsaturated fatty acids (21.7-43.7%) was higher than omega-6 polyunsaturated fatty acids (1.24-4.34%). The n-6 to n-3 ratio of eight samples observed by Ozogul and Ozogul (2005) were 0.04-0.12, while the n-6 to n-3 ratio of samples observed in this study were ranged from 0.04-0.58. Ratios of n6/n3 found in this study were lower than the value (4.0 at maximum) recommended by UK Department of Health (HMSO, 1994). Values higher than the maximum value are harmful to health and may promote cardiovascular diseases (Moreira *et al.*, 2001) Some studies showed that fatty acid composition will vary depend on climate influence, diet, age, gonad maturity, environment condition and species. Water temperature can influence the fatty acid composition in fish lipid. Unsaturated fatty acid proportion in phospholipid and neutral lipid will increase along with the decrease of water temperature (Farkas *et al.*, 1980). Fish from tropical area tend to have a lower total lipid than fish from subtropic area (Ackman, 1967).

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