Chemical composition of Sentani gudgeon (Oxyeleotris heterodon)

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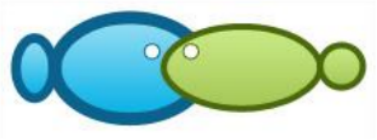
Submission date: 22-Dec-2022 02:37AM (UTC-0800)
Submission ID: 1985824621
File name: 2020.3155-3162_Chemical_composition_of_Sentani_gudgeon.pdf (391.29K)
Word count: 3569
Character count: 18959



Chemical composition of Sentani gudgeon (*Oxyeleotris heterodon*)

Mohammad Sayuti, Kadarusman, Intanurfemi B. Hismayasari, Achmad Suhermanto, Achmad Sofian, Agung S. Abadi, Ernawati, Saidin

Sorong Polytechnic of Marine and Fisheries, St. Kapitan Pattimura, Suprau, Tanjungkasuari, Sorong, West Papua, Indonesia. Corresponding author: M. Sayuti, mohsayut@gmail.com

Abstract. The aim of this study was to identify proximate, amino acid and fatty acid content of gabus Sentani or Sentani gudgeon (*Oxyeleotris heterodon*). The samples were taken from Lake Sentani, Jayapura, Indonesia. AOAC, LC-MS and GC-MAS were the standards used to test proximate, amino acid and fatty acid content, respectively. Findings showed that *O. heterodon* contained 11.7% of water, 21.83% of ashes, 59.59% of protein, 1.20% of fat, 12.0% of carbohydrate, and 17.85% of crude fiber. Concerning the essential amino acids the species contained 3.40% L-Lycine, 1.27% L-Leucine, 1.27% L-Arginine, and 1.02% L-Valine, while non-essential amino acids were 3.07% L-Glutamic Acid, 1.75% L-Aspartic acid, and 1.24% L-Alanine. Fatty acids of *O. heterodon* were C15:1 (cis-10) Fatty acid (55.93%), C18:0 Methyl ester (16.25%), C17:1 (cis-10) Methyl ester (8.5%) and C16:0 Methyl ester (7.75%). Based on the findings, it is suggested that *O. heterodon* has a high protein content and thus, may serve as alternative source of protein for human consumption.

Key Words: proximate, amino acid, fatty acid, *Oxyeleotris heterodon*, nutrients.

Introduction. Lake Sentani comprises of 30 species of freshwater fish; four of which are endemic to the lake. The endemic species are gabus Sentani or Sentani Gudgeon (*Oxyeleotris heterodon*), Sentani rainbowfish (*Chilatherina sentaniensis*), red rainbowfish (*Glossolepis incisus*), and saw shark (*Pristis pristis*). Furthermore, Lake Sentani is a popular tourist attraction in the city. Visitors come to the lake to swim, row, dive, go fishing, and go waterskiing as well as for culinary attractions. Among the four endemic species of Lake Sentani, *O. heterodon* is the species of which population is declining rapidly. It happened because Asia Gudgeon (*Channa striata*), and cichlid red devil (*Amphilophus labiatus*), are invasive species which ate *O. heterodon* eggs (Budi et al 1994; Ohee 2013; Wargasasmita 2017; Kanath & Budiyanti 2018).

O. heterodon is a pivotal source of protein for locals who live around Lake Sentani. The freshwater fish can adapt to lacustrine and riverine habitat. *O. heterodon* can be found in Sentani Lake (Indonesia), and Sepik and Ramu Rivers (Papua New Guinea). *O. heterodon* measures 40 cm in length and male individuals are biger (longer) than females. Its staple food is smaller fish (*Giuris margaritacea*) and small prawn (*Macrobrachium* spp.) (Coates 1992; Abinawanto et al 2018).

Gudgeon is rich in nutrition, particularly protein. Protein has a particular, irreplacable function that is to develop and maintain tissue cells (Almatsier 2004). It is needed for growth, regulating metabolism, and energy supply. Human should get a sufficient level of protein intake (Astawan 2007). Beside high protein content, Mustafa et al (2013) revealed that gudgeon contains Cu, Fe, Ca dan Zn. *C. striata*, one of the gudgeon fish species, is rich in albumin, a vital protein for human body. As an addition, gudgeon fish helps increase albumine level and boost immune system, and accelerate healing process of both internal and external wounds (Ulandari et al 2011). In line with the advance of science and technology, gudgeon has been developed as a functional type of food. There are a lot of studies on nutrient and albumine content of gudgeon fish and its application in food and cosmetics, for example using gudgeon (*Ophiocephalus striatus*)

flesh residue for making fish crackers with albumin (Wahyu et al 2013), using (*C. striata*) gudgeon fish flour as susbstitute to enhance proximate content and tensile strength of noodle (Anggarini 2015) and using gudgeon fish (*C. striata*) albumin extract as main ingredient for wound care creams (Fitriyani & Deviarni 2013). Until recently, there is not any research focusing on nutrient content of *O. heterodon* even though the fish has become a source of protein for the locals.

Figure 1. Gabus Sentani or Sentani Gudgeon (*Oxyeleotris heterodon*, Weber 1908) (Source: Kadarusman et al 2018).

Material and Method

Sample treatment. Samples of *O. heterodon* were obtained from Lake Sentani, Jayapura, Indonesia, packed and shipped to Sorong Polytechnic of Marine and Fisheries. The samples were cleaned and stored in freezer for testing.

Proximate analysis. Proximate analysis was conducted in Integrated Research and Testing Laboratory, Gadjah Mada University, Indonesia. Chemical analysis was performed to describe the percentages of protein, water, ashes, fat, carbohydrates, and crude oil using AOAC (AOAC 1999). The analysis was repeated three times.

Saturated and non-saturated fatty acid analysis
Hydrolysis: We took 1-5 mL of sample and 5 mL of concentrated HCl, the sample was placed in waterbath of which temperature was 80°C for 3 hours, then the sample was cooled down, extracted the sample with 15 mL and diethyl ether and petroleum ether (1:1). The vortex was then placed aside and precipitated. The top layer of oil was taken and evaporated the oil in waterbath with N_2.
Methylation: 1.5 mL of methanolic natrium solution was poured to the sample. Covered and heated the sample at the temperature of 60°C for 5-10 minutes while shaking, cooled down the sample, added 2 mL of Boron trifluoride methanoate, heated at the temperature of 60°C for 5-10 minutes, cooled down, extracted with 1 mL of Heptane and 1 mL of concentrated NaCl, took the top layer and put the sample in Eppendorf, injected it to GC. 1µL of the sample was injected to GC Shimadzu 2010.
GC condition: Detector: FID, temperature: 260°C, method: Methylester 37 New 3032017 Kal, gcm, column: HP-88, Length: 100 m.

Amino acid analysis with LC MS
Sample preparation: ±2.5 g of the sample were taken and placed it into 50 mL testing tube with caps, poured 20 mL of HCl 6N, hydrolysis in autoclave at the temperature of 110°C for 12 hours, neutralized the sample with NaOH 6N, added up to 50 mL, filtered with 0.22 µM filter, diluted for 10 times, injected into 2 µL LCMSMS.
Mobile Phase:
A: 0.1% Pentadecafluorooctanoic Acid (PDFOA) 99.5% : 0.5% Water/CH3CN with 0.1% Formic acid
B: 0.1% PDFOA, 10% : 90% Water/CH3CN with 0.1% Formic acid
Flow: 0.6 mL min^{-1}

Results and Discussion. Table 1 shows the proximate content of *O. heterodon* examined. *O. heterodon* has higher protein content compared to *C. striata* (17.83-19.85%) (Asikin & Kusumaningrum 2018; Chasanah et al 2015). It is reported that myofibril protein hydrolysate of snakehead fish (*C. striata*) had antihypertensive properties (Ghassem et al 2011). Snakehead fish is freshwater fish species well-known for its high protein content, mainly albumin. Studies showed that snakehead fish extract accelerated wound healing (Baie & Sheikh 2000), and had antinociceptive (Zakaria et al 2007) and anti-inflammatory properties (Abedi et al 2012).

Table 1

Oxyeleotris heterodon proximate analysis

No	*Parameter*	*O. heterodon*	*C. striata (Asikin & Kusumaningrum 2018)*	*C. striata (Chasanah et al 2015)*
1	Water content (%)	75.78±0.02	77.17	78.88±0.29
2	Ash content (%)	1.44±0.04	1.79	1.23±0.09
3	Total fat (%)	0.43±0.02	2.43	0.44±0.19
4	Protein (%)	21.51±0.02	17.83	19.85±0.59
5	Carbohydrate (%)	0.78±0.01	0.74	NT
6	Crude fiber (%)	2.58±0.02	NT	NT

The values are mean ± standard deviation of triplicate determination expressed in dry wet basis; NT - Not tested.

Table 2 revealed that *O. heterodon* had 18 types of amino acids in which L-Lycine, L-Leucine, L-Arginine and L-Valine are the ones with the highest concentrations. On the other hand, in *O. striatus*, Sari et al (2014) reported 1.67% of lysine, 1.34% of arginine, and 1.13% of leucine. Rosa & Nunes (2004) stated that arginine, lysine, and leucine are essential amino acids that we can obtain from aquatic animals making them considered as highly protein food. Furthermore, Erkan et al (2010) explained that arginine and histidine are essential amino acid for children. Arginine is integral for production of growth hormone (Adeyeye & Kenni 2008).

Table 2

Oxyeleotris heterodon amino acid profile

No	*Testing parameter*	*O. heterodon (%)*	*O. striatus (%) (Sari et al 2014)*
1	L-Arginine	1.27	1.34
2	L-Hisidine	0.46	0.40
3	L- Lysine	3.40	1.67
4	L-Phenylalanine	0.87	0.84
5	L-Isoleucine	0.97	0.85
6	L-Leucine	1.66	1.13
7	L- Tyrosine	0.63	0.67
8	L-Methionine	0.62	0.62
9	L-Valine	1.02	0.85
10	L-Proline	0.80	0.00
11	L-Glutamic Acid	3.07	2.94
12	L-Aspartic acid	1.75	1.9
13	L-Cysteine	0.14	0.00
14	L-Threonine	0.83	0.79
15	L-Serine	0.74	0.78
16	L-Alanine	1.24	1.32
17	L-Glycine	0.87	1.06
18	L-Tryptophan	0.05	0.00

Lysine functions as the basic material for blood antibodies, strengthens the circulatory system, maintains normal cell growth, together with proline and vitamin C will form

collagen and reduce excessive blood triglyceride levels. Daily intake of lysine per day was between 1 and 1.5 grams (Baker 2007). The highest non-essential amino acid *O. heterodon* were L-Glutamic Acid (3.07%), L-Aspartic acid (1.75%), and L-Alanine (1.24%). Glutamic and aspartic acid has role in developing food taste and aroma (Afolabi et al 1984).

Figure 2 shows result of fatty acid chromatogram of *O. heterodon* subjected to analysis.

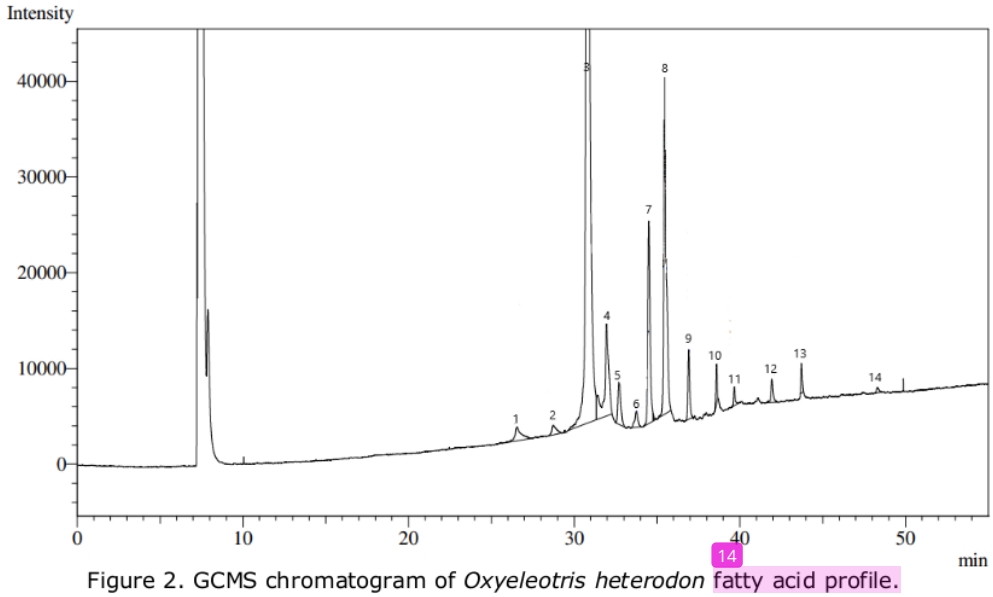


Figure 2. GCMS chromatogram of *Oxyeleotris heterodon* fatty acid profile.

Table 3 shows the fatty acid composition of *O. heterodon*. The four highest types of fatty acids *O. heterodon* contained are C15:1 (cis-10) Fatty acid (Cis 10-Pentadecenoic Acid Methyl Ester) (55.93%), C18:0 Methyl ester (Methyl Octadecanoate) (16.25%), C17:1 (cis-10) Methyl ester (Cis 10-Heptadecenoic acid Methyl Ester) (8.5%) and Methyl Palmitate (C16:0 Methyl ester) (7.75%). Cis 10-Pentadecenoic Acid Methyl Ester and Cis 10-Heptadecenoic acid Methyl Ester is Monounsaturated Fatty Acids (MUFA). MUFA works more effectively in reducing blood cholesterol levels than Poly Unsaturated Fatty Acid (PUFA) (de Roos et al 2001). MUFA works more effectively in reducing K-LDL and increasing K-HDL than Omega-3 and Omega-6 (Wood et al 1993). It is reported that PUFA reduces K-LDL, however MUFA reduces both total cholesterol and K-LDL and increase K-HDL more effectively than PUFA. Decreasing K-LDL/K-HDL ratio prevented atherosclerosis (Müller et al 2003).

Methyl Octadecanoate and Methyl Palmitate are categorized as Saturated Fatty Acids (SFA). SFA is a type of fatty acid that does not have double bond on atomic carbon. It means unlike unsaturated fatty acid saturated fatty acid is not sensitive to oxidation and free radical formation. Dominant effect of SFA is to increase total cholesterol and K-LDL (LDL cholesterol) (Müller et al 2003). The maximum recommended daily consumption of total fat is 30% of total energy, which comprises 10% SFA, 10% MUFA, and 10% PUFA (Lichtenstein et al 2006). Epidemiological studies showed that high fat diet is strongly associated to colon and breast cancer. Low fat and high fiber intake in vegetarian diet can reduce number of cancer patients (Yu-Poth et al 2000).

Table 3

Oxyeleotris heterodon fatty acid composition

Peak	*Ret. time*	*Compound*	*Molecular formula*	*Area*	*Height*	*Concentration (% relative area)*
1	26.555	C13:0 Methyl Ester	$C_{14}H_{28}O_2$	39502	1449	1.691
2	28.731	C14:1 (cis-9) Methyl ester	$C_{15}H_{28}O_2$	19288	1021	0.826
3	30.791	C15:1 (cis-10) Fatty acid	$C_{16}H_{30}O_2$	1306456	74214	55.934
4	31.954	C16:0 Methyl ester	$C_{17}H_{34}O_2$	181068	9632	7.752
5	32.715	C16:1 (cis-9) Methyl ester	$C_{17}H_{32}O_2$	55365	4455	2.370
6	33.752	C17:0 Methyl ester	$C_{18}H_{36}O_2$	22474	1683	0.962
7	34.508	C17:1 (cis-10) Methyl ester	$C_{18}H_{34}O_2$	198637	21118	8.504
8	35.458	C18:0 Methyl ester	$C_{19}H_{38}O_2$	379481	35130	16.247
9	36.916	C18:2 (all trans-9,12) Methyl ester	$C_{19}H_{34}O_2$	53615	7248	2.295
10	38.590	C20:0 Methyl ester	$C_{21}H_{42}O_2$	22358	4208	0.957
11	39.663	C20:1	$C_{21}H_{40}O_2$	14222	2011	0.609
12	41.935	C22:0 Methyl ester	$C_{23}H_{46}O_2$	20168	2437	0.863
13	43.725	C20:4 (all cis-5,8,11,14) Methyl ester	$C_{21}H_{34}O_2$	17423	3112	0.746
14	48.306	C22:6 (all cis-4,7,10,13,16,19) Methyl ester	$C_{23}H_{34}O_2$	5655	575	0.242
		Total		2335712	168293	100

Conclusions. *O. heterodon* contains 21.51% (w/b) of protein. The amino acid profile showed 18 types of amino acids, and most of them are essential amino acids. The main content of fatty acids in *O. heterodon* was represented by C15:1 (cis-10) fatty acid and C17:1 (cis-10) methyl ester which are of MUFA group. In general, *O. heterodon* is a nutrient reach species as it revealed high protein, amino acid and fatty acid content.

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Received: 21 September 2020. Accepted: 23 October 2020. Published online: 30 October 2020.
Authors:
Mohammad Sayuti, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, 98411 Sorong, West Papua, Indonesia, e-mail: mohsayut@gmail.com
Kadarusman, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, 98411 Sorong, West Papua, Indonesia, e-mail: kadarusman@kkp.go.id
Intanurfemi Bacandra Hismayasari, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, 98411 Sorong, West Papua, Indonesia, e-mail: ib.hismayasari@gmail.com
Achmad Suhermanto, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, 98411 Sorong, West Papua, Indonesia, e-mail: achmadsuhermanto@kkp.go.id
Achmad Sofian, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, 98411 Sorong, West Papua, Indonesia, e-mail: achmad.sofian@kkp.go.id
Agung Setia Abadi, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, 98411 Sorong, West Papua, Indonesia, e-mail: agungsb.asa@gmail.com
Ernawati, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, 98411 Sorong, West Papua, Indonesia, e-mail: ernawati190@gmail.com
Saidin, Sorong Polytechnic of Marine and Fisheries, Kapitan Pattimura St., Suprau, Tanjungkasuari, Sorong, West Papua, Indonesia, e-mail: saidin31081975@gmail.com

How to cite this article:
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