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Original article

Effect of steaming and pressurized boiling process to the nutrient profile of Papuan cork fish *Channa striata* as potential protein-rich food to prevent stunting☆

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ABSTRACT

Objective: This study was to analyze the chemical composition of cork fish (*Channa striata*) of Papua Indonesia.

Method: Cork fish meat was steamed and pressure boiled to get filtrate and oil. Raw fish meat, steaming process, and pressurized boiling sample were analyzed for proximate, amino acid, and fatty acid.

Result: Proximate analysis revealed that protein content and fat content of dry raw fish meat were 58.68% and 0.65%, respectively. The total amino acid of raw fish meat, steaming process filtrate, and pressure boiled filtrate were 67.49%, 3.38%, and 1.54%, respectively. The total fatty acid of raw fish meat, steaming process oil, and pressure boiled oil were 67.28%, 72.75%, and 85.14%, successively.

Conclusion: Cork fish (*Channa striata*) from Merauke Region of Papua, Indonesia shows the high protein content and interesting profile of amino acid and fatty acid that makes it potential to prevent stunting. *C. striata* fish is a good source of amino acid, and fatty acid can be served by steaming or pressurized boiling process.

Introduction

Channa striata, 'haruan' or 'gabus' in Indonesia, are snakehead or cork fish belonging to the Channidae family. It is indigenous to many tropical and subtropical countries including Indonesia, especially Papua. It is freshwater, air-breathing, and carnivorous fish, which is a valuable source of protein throughout the Asia Pacific region.[1] High protein in this fish makes it potential to prevent stunting. However, as each species of fish is different and highly dependent on the area, we thought that the profile of this fish will also different from snakehead fish in other areas.

Cork fish or snakehead fish from other regions and countries has been studied for its chemical composition and its effect on wound healing.[1] reported the biochemical composition of three Malaysian *Channa* spp. fish *Channa lucius, Channa micropeltes,* and *C.striatus.* Chemical composition of *Ophiocephalus striatus* from Bandung, Indonesia, *Channa striata* from East Kalimantan, Indonesia, *C. striata*, *C. micropeltes*, *Channa pleuropthalmus*, *Channa maculata*, and *C. lucius* from Central Kalimantan, Indonesia were also reported.[2,3] Ama-Abasi and Ogar (2013) explained the proximate analysis of Snakehead fish, *Parachanna obscura* of the Cross River, Nigeria.[4]

In Papua, especially in Merauke, *C. striata* is a highly valued food fish with high commercial demand, hence it has great potential for food security. Cork fish is widely used by local people traditionally as salted fish. People use cork fish in the form of salted fish, fish meat that is boiled or steamed, filtrate and oil resulting from steaming and boiling, but no report on the chemical composition of the cork from Merauke region. Such information is needed to strengthen the study for this species from Merauke as a major source of protein and other nutritional requirements for healthy growth. Therefore, this study describes proximate, amino acid, and fatty acid profile of cork fish meat, cork fish filtrate of steaming process and pressure boiling process, and cork fish oil of steaming process and pressure boiled process. By describing the nutrient profile, we can further determine the potential of this fish to prevent stunting.

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Material and methods

Fish preparation

Cork fish *Channa striata* were purchased from a traditional market in Merauke Town, Papua, Indonesia. Cork fish were cleaned with water and stored in the freezer before further preparation. In low-temperature conditions, cork fish mucus was removed and drained. Furthermore, the fish meat was fillet to obtain it without the bone and the skin. The fillet meat was then weighed and prepared for the extraction process.

Steaming process

2 kg of cork fish meat that had been cleaned was cut to about 1 cm in size. After that, the extraction process was carried out for 2 h by steaming the fish meat at a temperature of 90 ± 2.5 °C. The produced filtrate was then separated from the fish meat, and filtered to get the cork fish extract. The cork fish extract was stored at 4 °C until the analysis.

Pressurized boiling process

Boiling was done using a stainless steel pressure cooker at a temperature of ± 100 °C for 2 h. 2 kg of fish meat that had been cleaned was then put into a stainless steel pressure cooker by adding water, with the ratio of cork fish: water = 1:4, then cooked it for 30 min. Every 30 min, the pressure cooker was added with water so that the volume of water that remained as before was obtained, then continued with cooking it for the next 30 min. This process was repeated in the same way until 2 h of cooking. Next, the meat and filtrate were separated, and the filtrate was filtered and stored at 4 °C to be analyzed.

Proximate analysis, amino acid, and fatty acid analysis

Proximate analysis is about water content, ash content, fat content, protein content, and crude fiber were analyzed by Unit Laboratorium Jasa Pengujian, Kalibrasi dan Sertifikasi, Institut Pertanian Bogor. The amino acid and fatty acid analyses were carried out in the same place.

Result and discussion

Proximate composition

Proximate composition of this cork fish *C. striata* is 35.94% w/w water content, 0.65% w/w fat content, 58.68% protein content w/w, 3.61% ash content w/w, crude fiber 0.55% w/w, and total carbohydrate 0.96% w/w. Cork fish contains a very high protein level, so it is good to be used as a source of protein. The quality of nutrition of *C. striata* as a source of protein and fatty acid was investigated. The protein content of this *C. striata* is higher than crude protein from local Malaysian cork fish *Channa* spp. fish, *C. striatus, C. micropeltes*, and *C. Lucius*, 23.0 ± 0.7%, 22.1 ± 0.6, and 19.9 ± 1.3, successively[1]; some fish of Channidae from Central Kalimantan *C. micropeltes, C. pleuropthalmus, C. maculate, C. Lucius, C. striata,* 19.69%, 19.5%, 17.22%, 17.98%, and 20.83%, successively.[2] Beside that, the protein content of this cork fish is higher than protein content of Channidae family from the Cross River Nigeria *Salmo gairdneri, Sarotherodon melanotheron, C. striatus, Synodontis clarias, Snakehead murrel, Parachanna obscura*, about 19.0%, 29.3%, 23.0%, 22.0%, 18.6%, and 21.5%, respectively.[4] The high protein content of this *Channa striata* makes it a value fish for food and should be explored to increase protein sources for the local community of Papuan beside chicken and other meat.

Table 1
Amino acid composition of raw fish meat, steaming process filtrate (SF), and the pressurized boiling filtrate (PF) of *C. striata.* Values are in % w/w, nd expresses not detected.

Amino acid	Meat	SF	PF
Aspartic acid	10.55	0.29	0.13
Threonine	2.63	0.11	0.05
Serine	2.27	0.10	0.05
Glutamate	11.97	0.57	0.23
Proline	1.75	0.18	0.12
Glysine	3.47	0.55	0.32
Alanine	4.30	0.32	0.15
Cystine	0.56	nd	nd
Valine	3.30	0.10	0.04
Methionine	2.30	0.05	0.02
Isoleusine	3.08	0.08	0.03
Leusine	5.82	0.22	0.09
Tyrosine	1.96	0.03	0.01
Phenylalanin	2.68	0.11	0.06
Histidine	1.43	0.07	0.06
Lysine	6.87	0.30	0.14
Arginine	2.55	0.30	0.04
Total amino acid	67.49	3.38	1.54

Amino acid profile

Amino acid composition of dry raw fish meat, filtrate from the steaming process, and filtrate from the pressurized boiling process are presented in Table 1.

A total amino acid in fish meat after a steaming process and pressurized boiling process does not decrease much because only a few amino acids are dissolved both in the filtrate from the steaming process and which are dissolved in the filtrate from the pressurized boiling process. The amino acid content in raw fish meat, in steaming process filtrate, in the pressurized boiling filtrate are 67.49%, 3.38%, and 1.54%, respectively and percentage of amino acid solubility in steaming filtrate and pressurized boiling filtrate are 5.01% and 2.28%, respectively. It shows that cork fish meat after steaming or boiling still contains high amino acids so that both methods can be used to consume cork fish.

Cork fish (*C. striata*) possesses 5 types of the highest amino acid, two of the essential one, leucine and lysine, three of the non-essential one, aspartic acid, glutamate, and alanine. Leucine is one of the components absolutely needed as a brain preventing muscular degradation for children growth and in nitrogen equilibrium regulation for adults, and play a role in the wound healing process.[2,5] Jezova et al. (2005) showed that treatment with a mixture of amino acid lysine and arginine resulted in higher neuroendocrine activation in response to psychosocial stress in subjects with high trait anxiety.[6]

Fatty acid profile

The filtrate of a steaming process and pressurized boiling process contain a little amount of oil. Fatty acid composition of dry raw fish meat, steaming process oil, and pressurized boiling process oil is presented in Table 2.

Table 2 shows that major fatty acid in the fish meat, steaming process oil, and pressurized boiling oil are palmitic acid, oleic acid, stearic acid, and linoleic acid. Saturated fatty acid in fish meat, steaming process oil, and pressurized boiling process oil are 34.63%, 35%, and 32.16%, successively, while unsaturated fatty acid in fish meat, steaming process oil, and pressurized boiling oil is 33.84%,

Table 2
The fatty acid composition of raw fish meat, steaming process oil (SO), and pressurized boiling oil (PO) of *C. striata*. Values are in % w/w.

Fatty acid	Fish meat	SO	PO
Lauric acid, C12:0	0.09	0.18	0.20
Tridecanoic acid, C13:0	0.03	0.06	0.07
Myristic acid, C14:10	0.93	1.70	1.87
Myristoleic acid, C14:1	0.11	0.05	0.05
Pentadecanoic acid, C15:0	0.49	0.57	0.64
Cis-10-pentadecanoic acid, C15:1	nd	0.03	nd
Palmitic acid, C16:0	20.39	20.36	21.55
Palmitoleic acid, C16:1	3.16	0.57	6.39
Heptadecanoic acid, C17:0	0.79	0.28	0.66
Cis-10-heptadecanoic acid, C17:1	0.38	0.12	0.46
Stearic acid, C18:0	9.79	7.35	8.14
Elaidic acid, C18:1n9t	0.35	0.35	0.32
Oleic acid, C18:1n9c	19.23	26.24	28.57
Linolelaidic acid, C18:2n9t	0.30	0.03	nd
Linoleic acid, C18:2n6c	4.79	7.37	8.39
Arachidic acid, C20:0	0.39	0.33	0.39
γ-linolenic acid, C18:3n6	0.25	0.52	0.62
Cis-11-eicosenoic acid, C20:1	0.49	0.51	0.58
Linolenic acid, C18:3n3	1.02	1.74	1.93
Heneicosanoic acid, C21:0	0.07	0.05	0.06
Cis-11,14-eicosedienoic acid, C20:2	0.33	0.41	0.42
Behenic acid, C22:0	0.22	0.14	0.17
Cis-8,11,14-eicosetrienoic acid, C20:3n6	0.51	0.66	0.78
Erucic acid methyl ester, C22:1n9	nd	0.05	nd
Cis-11,14,17-eicosantrienoic acid methyl ester, C20:3n3	0.24	0.30	0.34
Arachidonic acid, C20:4n6	1.45	1.07	1.24
Tricosanoic acid, C23:0	0.09	0.04	0.05
Cis-13,16-docosadienoic acid, C22:2	0.04	0.03	0.05
Lignoceric acid, C24:0	0.16	0.09	0.16
Cis-5,8,11,14,17-eicosapentaenoic acid, C20:5n3	0.11	0.10	0.06
Nervonic acid, C24:1	0.05	0.09	0.08
Cis-4,7,10,13,16,19-docosahexaenoic acid, C22:6n3	1.03	0.82	0.90
Total fatty acid	67.28	72.75	85.14

51.18%, and 41.60%, respectively. It means that the oil contains more unsaturated fatty acids than saturated fatty acids.

Omega-6 polyunsaturated fatty acid (PUFA) in this cork include linoleic acid (LA), γ-linolenic acid, dihomo-γ-linolenic acid (cis-8,11,14-eicosetrienoic acid), and arachidonic acid. Linoleic acid (LA) is the principal polyunsaturated fatty acid (PUFA) and considered to be essential because it cannot be synthesized in a higher animal including humans.[7] Arachidonic acid is an essential PUFA that participates in the modulation of the function of various organs and systems, such as the digestive, reproductive, renal, and immune system. Moreover, arachidonic acid is a precursor for prostaglandin and thromboxane biosynthesis.[8]

Both amino acid and fatty acids are important components for healing processes. Any deficiency in disturb the recovery process. Glycine, together with other essential amino acids such as proline, alanine, arginine, serine, isoleucine, and phenylalanine form polypeptide that will support regrowth and tissue healing.[1,9]

Conclusion

In conclusion, based on our findings, cork fish *C. striata* from Merauke Region of Papua, Indonesia shows the high protein content and interesting profile of amino acid and fatty acid. *C. striata* fish is a good source of amino acid and fatty acid. This fish can be served by steaming or pressurized boiling process. Cork fish may provide an alternative source of protein and fat for the local community. The high nutrient contained in *C. striata* makes this fish potential as nutrient-rich food to prevent stunting.

Conflict of interest

The authors declare no conflict of interest.

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