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ω -Fatty acids from Malaysian giant snakehead (*Channa micropeltes)* fish oil

MUHAMMAD NOR OMAR, NUR SHAHIDATUL AHLAM Md. YUSOFF, NUR AZIYAH ZAINUDDIN and KAMARUZZAMAN YUNUS

Kulliyyah of Science, International Islamic University Malaysia (IIUM), Bandar Indera Mahkota, 25200 Kuantan Pahang (Malaysia).

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ABSTRACT

ω-Fatty acids of *Channa micropeltes* fish oil was analysed. The lipid from the fish flesh was extracted using Folch method and the fatty acid composition was analysed using GC and GC-MS. It was found that the major constituents of *C. micropeltes* lipid were palmitic acid (C16:0) (14.1%), docosahexaenoic acid (DHA, C22:6 ω-3) (13.9%) and arachidonic acid (AA, C20:4 ω-6) (11.4%). In addition, the total ω-3 and ω-6 contents were 19.8 % and 16.6% respectively and the ratio of ω-3: ω-6 was 1: 0.9

Key words: *Channa micropeltes*, fish oil, ω-fatty acids.

INTRODUCTION

The Giant snakehead (*Channa micropeltes*) belongs to Channidae family. It is a freshwater fish providing a valuable source of protein throughout the South-East Asian region, including Malaysia, Indonesia, Vietnam and Thailand[1]. It has been documented that, *Channa spp*., particularly *C. striatus* possesses anti-inflammatory properties and regulates prostaglandin synthesis since it contains polyunsaturated fatty acids (PUFA) categorized as ω-fatty acids including arachidonic acid (AA, C20:4 ω-6), eicosapentaenoic acid (EPA, C20:5 ω-3) and docosahexaenoic acid (DHA, C22:6 ω-3) [2,3].

It has also been reported that the ratio of ω-3 to ω-6 is used as an indicator in order to compare the nutritive significance of fish oils. It is suggested that a ω-3: ω-6 ratio of 1:1-1.5 would constitute a healthy human diet [4]. However, previous studies on Malaysian freshwater fish found that most of them had an ω-3: ω-6 ratio of less than 1 [5].

ω-Fatty acids have a vital role in our daily health. Their benefits include lowering of triglyceride/ lipid levels by lowering very low-density lipoprotein levels (VLDL, or bad cholesterol), lowering of blood pressure and anti-atherogenic activity [4]. ω-fatty acids that are important to human nutrition are α-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA), which are categorized under polyunsaturated fatty acids. The human body cannot synthesize ω-fatty acids *de novo*, but it can form 20- and 22-carbon unsaturated ω-fatty acids from the eighteen-carbon ω-fatty acid, α-linolenic acid. Both the ω-3 α-linolenic acid and ω-6 linoleic acid are essential nutrients which must be obtained from food. Previous studies show that fish oils contain polyunsaturated fatty acids (PUFA) of up to 20% of the total lipid composition. The fatty acid contents of other freshwater fish were not reported.

Meanwhile, Osman and co-workers have studied the fatty acid profiles of marine fin fish near Langkawi Island and found the ω-fatty acid contents to be more than 50% of the total polyunsaturated fatty acid (PUFA) [6]. Most of the ω-fatty acid content in freshwater fish depends on their feeding diet.

The main aim of the present study is to look into the composition of the giant snakehead fish lipid which might be useful to human health by looking into the ration of ω- fatty acids present in *C. micropeltes* oil.

EXPERIMENTAL

Sample preparation

The Giant snakehead fish was collected from Tasik Kenyir, Malaysia in February 2009. The fish flesh was homogenized using a homogenizer (DIAX 900, Heidolph Elektro GmbH, Kelheim, Germany) and dried to release excess moisture by using an Alpha 1-4 freeze dryer (Christ GmbH, Osterode, Germany).

Fat extraction

The freeze-dried homogenate of fish flesh was weighed and subjected to fat extraction using a modified Folch method[7] utilizing chloroform: methanol in the ratio of 2:1 according to method previously reported[8]. In brief, 200 g of sample was transferred into a flask containing 300 ml of solvent system of chloroform:methanol (2:1) and the flask was shaken for 5 days at room temperature using a Unimax 2010 platform shaker (Heidolph Elektro GmbH, Kelheim, Germany). The solvent extract was concentrated *in vacuo* until dry using a rotary evaporator (Rotavapor R-200, *Buchi* Labortechnik AG, Switzerland).

Analysis of fish oil

The fish oil was methylated using a boron trifluoride methanolic sodium hydroxide solution according to the method previously reported[9]. The oil was then analysed via on-column GC technique using Agilent 6890N gas chromatograph (Agilent, Avondale, USA) equipped with a flame ionization detector (FID). An HP-5 non-polar capillary column (50m × 0.12 × 0.5 mm, SGE, Australia) was used and the temperature was initially kept at 50°C for 2 min. and then programmed at 5°C min^{-1} to 250°C. The injector and detector temperatures were 220° and 250°C respectively and He gas was used as carrier gas with a flow rate of 1.2 ml min^{-1}. For identification of fatty acids in fish oil, the GC-MS technique using Agilent 6890N gas chromatograph coupled with an Agilent 5973N mass selective detector (Agilent, Avondale, USA) was used. The column and temperature conditions are similar with GC analysis. The fatty acid constituents were recognized by comparing the MS spectrum with standard library (Wiley Registry of Mass spectral data).

RESULTS AND DISCUSSION

% Fat recovery

The oil recovery from fresh fish was 5.8 ± 2.2% (% DW) of total body weight (1.4kg). The recovery was slightly lower compared to the result obtained by Zuraini *et al*. [8]. This might be due to the size of the fish used. The present study used smaller fish while previous data were obtained from larger sources (2.0-2.3 kg).

Fatty acid composition

Fatty acid profile of the Giant snakehead fish oil was analysed after methylation with a BF_3-methoxide solution according to reported methods[9]. Table 1 shows the result of the GC analysis on non-polar capillary column. It was found that the major chemical constituents of *C. micropeltes* oil were palmitic acid (C16:0) (14.1%), docosahexaenoic acid (C22:6) (13.9%) and arachidonic acid (C20:4) (11.4%). The palmitic acid content was slightly lower compared to previously reported results (26.2%)[8] and the total saturated fatty acid (SFA) was also found to be less (30.7%). The low SFA content makes this fish good for human consumption in order to promote a healthy diet. The ratio of the total saturated and polyunsaturated acids was 1:1.2 and it is considered that the Giant snakehead fish oil is good for human consumption according to Zuraini *et al.* [8] who found that the ration of TSA:USA was around 1:0.8-1.1.

Meanwhile, the level of arachidonic acid (C20:4 ω-6) was high (11.4%) compared to the results of the previous study (4.71%) [8]. Since arachidonic acid is a precursor for prostaglandin and thromboxan biosynthesis[2], it may interfere with the

Table 1: Fatty acid profile of Malaysian giant snakehead fish oil

Fatty acid (series)	Mean ± S.D
C12:0	2.5 ± 1.1
C14:0	1.1 ± 0.2
C15:0	1.3 ± 0.4
C16:0	14.1 ± 1.2
C17:0	0.7 ± 0.3
C18:0	10.6 ± 1.4
C20:0	0.4 ± 0.2
Total Saturated (SFA)	30.7
C16:1 ω7	2.6 ± 1.3
C18:1 ω9	9.2 ± 2.5
C18:1 ω7	2.6 ± 1.5
Total monounsaturated	14.4
C18:2 ω6	3.8 ± 1.6
C18:3 ω6	0.8 ± 0.3
C20:2 ω6	0.6 ± 0.2
C20:3 ω6	0.8 ± 0.2
C20:4 ω6	11.4 ± 2.3
C20:5 ω3	5.1 ± 1.1
C22:6 ω3	13.9 ± 3.5
Total polyunsaturated	36.4
Total unsaturates (USFA)	50.8
Total ω3 fatty acids	19.8
Total ω6 fatty acids	16.6
Ratio ω3/ω6	1:0.9
PUFA: SFA (P/S) ratio	1.2:1
USFA: SFA ratio	1.7:1

blood clotting process during wound healing[5,10]. Besides AA, eicosapentaenoic acid (EPA ω-6) as well as docosahexaenoic acid (DHA, ω-3) contents showed slight variations from previous results. The distribution of ω-3 and ω-6 fatty acids in the present research differed from results obtained by other researchers. In this study the total ω-3 and ω-6 were 19.8 and 16.6 % respectively compared to other results, which ranged from 10.1 to 26.31 %. The variations in the ω-fatty acid content in *C. micropeltes* might be due to the difference in locations and feeding habitats. This is because *C. micropeltes* is classified as a carnivorous fish and depends on other fish for its diet. In addition, Tasik Kenyir is the largest natural lake in Malaysia covering the borders of the states of Kelantan, Perak, Pahang and Terengganu, and contains a variety of freshwater fish that may become the feeding prey for *C. micropeltes*.

In terms of ω-fatty acid ratio, the ω-3: ω-6 ratio in *C. micropeltes* was *ca*. 1: 0.9. This is in accordance to the suggested ratio from previous reports which state that most freshwater fish have an ω-3: ω-6 of less than 1 [5].

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