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Omega-3 fatty acids composition and lipid content from liver and muscle tissues of *Katsuwonus pelamis* in the Chabahar Port in the south west of Iran

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Abstract: In this investigation, the liver and muscle tissues of *Katsuwonus pelamis* from the Iranian Port of Chabahar in Mar 2013 were separately extracted for their lipid content especially omega-3 fatty acids composition using the method of Blight & Dyer. The compounds were determined by Gas Chromatography-Mass Spectrometry (GC- MS). The components detected in the liver and muscle tissues, include saturated fatty acids Palmitic acid and Stearic acid, monounsaturated fatty acid Oleic acid, polyunsaturated fatty acids Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA), two methyl esters of fatty acids including Octadecanoic acid, methyl ester and Hexadecanoic acid, methyl ester. The results showed that docosahexaenoic and eicosapentaenoic acids were the dominant Omega-3 polyunsaturated fatty acids in the species.

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1. Introduction

Fish has traditionally been a popular part of diets in many parts of the world. The skipjack tuna, *Katsuwonus pelamis* (skipjack, balaya), is a medium-sized perciform fish in the tuna family, Scombridae. It grows up to 1 m in length. It is a cosmopolitan pelagic fish found in tropical and warm-temperate waters. It is a very important species for fisheries (Karunarathna & Attygalle, 2010) Countries recording large amounts of skipjack catches include the Maldives, France, Spain, Malaysia, Sri Lanka, and Indonesia (Miyake et al., 2004). It is an important commercial and game fish, usually caught using purse seine nets, and is sold fresh, frozen, canned, dried, salted, and smoked (FAO, 2011). The back of this fish is dark purplish blue, lower sides and belly silvery, with 4 to six very conspicuous longitudinal dark bands which in live specimens may appear as continuous lines of dark blotches (Figure 1).

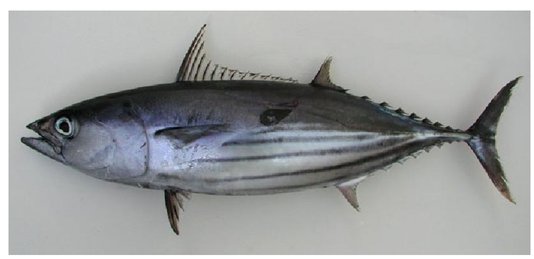

Figure1. *Katsuwonus pelamis*

Omega-3 fatty acids are polyunsaturated fats found naturally in oily fish, nuts, seeds, and leafy green vegetables. Omega-3 fatty acids are thought to protect against heart disease (Allen & Harris, 2001; Reiffel & McDonald, 2006), inflammation (David, *et al*., 2005), types of cancer (Hardman, 2002; Simon et al., 2009), diabetes (Stirban et al., 2010), Alzheimer’s disease (Cunnane *et al*., 2009), and macular degeneration (a leading cause of vision loss).

Omega-3 fatty acids are critical for proper brain development and neurological function in developing babies, too (Bousquet et al., 2008). Omega-3 fatty acids are often classed as "essential fatty acids," meaning that they are necessary for our health and that our bodies are unable to produce them. In fact, the body is unable to manufacture *one* kind of omega-3 fatty acid known as alpha linolenic acid (LNA or ALA), but it can make the other types, eicosapentaeonic acid (EPA) and docoshexaeonic acid (DHA), by converting LNA, though only a small percentage of LNA is able to be converted (Simopoulos, 2002; David & Michael, 2005).

The objective of this study was to identify of the lipid content especially omega-3 fatty acids composition of liver and muscle tissues of *Katsuwonus pelamis* in the south of Iran (Chabahar Port).

2. Material and Methods

In this research, 30 *Katsuwonus pelamis* samples were obtained from the Chabahar Port in the south of Iran (Figure 2). Initially the liver and muscle tissues were weighed separately and mixed into a soft uniform mixture.

Figure 2. Map of sampling station in the Chabahar Port in the south west of Iran

Mixtures of chloroform and methanol were added as the lipid extract (Blight & Dyer, 1959).This solvent system allows for extraction of both polar and non polar compounds. The lower chloroform layer includes the lipids and the top methanol-water layer generally contains the polar components. The lipid in the chloroform layer is removed using a rotary evaporator under vacuum, at temperature of 40 ° C. The weight of the lipid was determined.

The lipid extract obtained was injected into chromatograph equipment with a mass spectra detector (GC-MS).Components were identified by comparison of the retention time and mass spectra of the unknowns with those of authentic samples and also comparative analysis of kovats index & using references of Eight peak.

3. Results

This study investigated on the fatty acid composition and lipid content in the liver and muscle tissues of *Katsuwonus pelamis.*

The results are shown in Tables 1 and 2. Chloroform phase is discussed in this research because the fat content of the muscle tissue is extracted with chloroform (Blight & Dyer, 1959). The components identified by GC-MS analysis of the chloroform phase of liver samples is shown the below table.

Table 1. The compound identified in the chloroform phase of liver tissue of *Katsuwonus pelamis* from the Iranian Port of Chabahar

Compound	MF	KI	% of total
Fatty acid			
Saturated fatty Acid			
Palmitic acid (Hexadecanoic Acid)	$C_{16}H_{32}O_2$	1619	49.27
Stearic acid	$C_{18}H_{36}O_2$	1632	7.60
Mono-unsaturated fatty Acid			
Oleic acid (9Z Octaecenoic Acid)	$C_{18}H_{34}O_2$	1679	12.19
Poly-unsaturated fatty acid			
Docosahexaenoic Acid (DHA)	$C_{20}H_{30}O_2$	1821	14.53
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1808	12.44
Ester			
Palmitic acid –methylester (Hexadecanoic Acid, methyl ester)	$C_{17}H_{34}O_2$	1545	2.44
Stearic Acid-methylester (Octadecanoic acid, methyl ester)	$C_{19}H_{38}O_2$	1621	1.57

MF: Molecular Formula KI: Kovats Index

Table 2 shows the components identified by GC-MS analysis of the muscle samples from species.

Table 2. The compound identified in the chloroform phase of muscle tissue of *Katsuwonus pelamis* from the Iranian Port of Chabahar

Compound	MF	KI	% of total
Fatty acid			
Saturated fatty Acid			
Palmitic acid (Hexadecanoic Acid)	$C_{16}H_{32}O_2$	1619	43.27
Stearic acid	$C_{18}H_{36}O_2$	1632	11.70
Mono-unsaturated fatty Acid			
Oleic acid (9Z Octaecenoic Acid)	$C_{18}H_{34}O_2$	1676	11.90
Poly-unsaturated fatty acid			
Docosahexaenoic Acid (DHA)	$C_{20}H_{30}O_2$	1821	15.11
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1808	13.09
Ester			
Palmitic acid – methylester (Hexadecanoic Acid, methyl ester)	$C_{17}H_{34}O_2$	1545	2.50
Stearic Acid-methylester (Octadecanoic acid, methyl ester)	$C_{19}H_{38}O_2$	1621	2.52

MF: Molecular Formula; KI: Kovats Index

The present study indicates that compounds identified are common between liver and muscle tissue such as saturated fatty acids Palmitic acid (49.27% in liver and muscle 43.27%) and Stearic acid (7.60% in liver and muscle 11.70%), Monounsaturated fatty acid Oleic acid (12.19% in liver and muscle 11.90%), polyunsaturated fatty acids Docosahexaenoic acid (14.53% in liver and muscle 15.12%) and Eicosapentaenoic acid (12.44% in liver and muscle 13.08%) and two esters of fatty acid consist Palmitic acid –methyl ester (2.44% in liver and muscle 2.50 %) and Stearic acid-methyl ester (1.57 % in liver and muscle 2.52%).

4. Discussions

In the present research, the results indicate that the dominant Omega-3 polyunsaturated fatty acids in liver and muscle tissues of *Katsuwonus pelamis* are Docosahexaenoic acid (14.53-15.12%) and Eicosapentaenoic acid (12.44-13.08%). Some studies have shown that Omega-3 fatty acids found in fish oil help lower triglycerides (Hardman, 2002; Kato et al., 2002; Bousquet et al., 2008), lower blood pressure (Calo et al., 2005; Teres et al., 2008), reduce the risk of blood clots(Frenoux et al.,2001), improve the health of arteries (Grimm et al., 2002; Gil, 2002) and reduce the amount of arterial plaque, which narrows arteries and causes heart disease (Stampfer, *et al.,* 2000; Kris-Etherton et al., 2001; Reiffel & McDonald, 2006; Chattipakorn et al., 2009).

Docosahexaenoic acid (DHA) is essential for the growth and functional development of the brain in infants (Harbige & Fischer, 2001; Bousquet et al., 2008). DHA is also required for maintenance of normal brain function in adults (Guesnet & Alessandri, 2011). DHA has a positive effect on diseases such as hypertension, arthritis, atherosclerosis, adult-onset diabetes mellitus, myocardial infarction, thrombosis and some cancers (Aronson et al., 2001; Kato et al., 2002; Hardman, 2002). Some studies have shown that fish oil reduces symptoms of depression (Rees et al., 2006; Song& Zhao, 2007; Bousquet et al., 2008). Other studies suggest it may be EPA (and not DHA) that has the positive effect on depression (Calo et al., 2005). Omega-3 fatty acids, including EPA, may also have positive effects on lung and kidney diseases, type 2 diabetes (Stirban et al., 2010**)**, obesity, ulcerative colitis, Crohn's disease, anorexia nervosa, burns, osteoarthritis, osteoporosis, and early stages of colorectal cancer (Schonberg et al., 2006). The results of Omega-3 polyunsaturated fatty acids DHA and EPA obtained in this study are similar to that reported in the Journal of Food Science Technology by Nimish et al (2010) and in the Vidvodaya journal of science by Karunarathna & Attygalle (2010). The results showed that the fish species has high quantity ω-3 fatty acids DHA and EPA.

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References

1. Allen K. G. and M. A. Harris. 2001. The role of n-3 fatty acids in gestation and parturition. Exp. Biol. Med. (Maywood) 226(6): 498-506.
2. Blight, E.G., and Dyer, W.J. (1959) A rapid method of total lipid extraction and purification. Can. J. Biochem. Physiol. 37, 911-917.
3. Bousquet, M., Saint-Pierre, M., Julien, C., Salem, N., Cicchetti, F and Calon. F, 2008). Beneficial effects of dietary omega-3 polyunsaturated fatty acid on toxin-induced neuronal degeneration in an animal model of Parkinson's disease*. The FASEB Journal.* 2008; 22: 1213-1225.
4. Calo L, Bianconi L, Colivicchi F, et al .N-3 fatty acids for the prevention of atrial fibrilliation after coronary artery bypass surgery. JAM Coll Cardio. 2005; 45:1723-8.
5. Chattipakorn N,Settakorn J et al. Cardiac mortality is associated with low levels of Omega-3 and Omega-6 fatty acids in the heart of cadavers with a history of coronary heart disease. Nutr Res. 2009; 29 (10); 696-704.
6. Cunnane, S.C., Plourde, M., Pifferi, F., Bégin, M., Féart, C. and Barberger-Gateau P. 2009. Fish, docosahexaenoic acid and Alzheimer's disease. Progress in Lipid Research 48(5): 239-25.
7. David, L. Nelson, and Michael M. Cox, 2005. Principles of Biochemistry. (W. H. Freeman), New York.
8. FAO (Food and Agriculture Organization of the United Nations) (2011). *Yearbook of fishery and aquaculture statistics* 2009. *Capture production*. Rome: Food and Agriculture Organization of the United Nations. p. 27.
9. Frenoux, J. R., Pros, E. D., Bellelle, J. L. and Prost, J. L. 2001. A polyunsaturated fatty acid diet lowers blood pressure and improves antioxidant status in spontaneously hypertensive rate. Journal of Nutrition 131: 39-45
10. Gil A., 2002. Polyunsaturated fatty acids and inflammatory disease. Biomed. Pharmacother., 56: 388-396.
11. Grimm H., K. Mayer, P. Mayser, and E. Eigenbrodt. 2002. Regulatory potential of n-3 fatty acids in immunological and inflammatory processes. Br. J. Nutr. 87 Suppl 1:S59:67.
12. Guesnet P, Alessandri JM (2011). "Docosahexaenoic acid (DHA) and the developing central nervous system (CNS)- Implications for dietary recommendations". *Biochimie* 93 (1): 7–12.
13. Harbige L. S. and Fischer B. A., 2001. Dietary fatty acid modulation of mucosally-induced tolerogenic immune responses. Proc. Nutr. Soc. 60(4): 449-456.

14. Hardman W. E. 2002. Omega-3 fatty acids to augment cancer therapy. J. Nutr. 132 (11 Suppl): 3508S-3512S).
15. Karunarathna K.A.A. U and Attygalle M V.E .Nutritional evaluation in five species of tuna. 2010. Vidvodaya journal of science vol 15. Na1.8.2 pp 7-16.
16. Kato T, Hancock RL, Mohammadpour H, McGregor B, Manalo P, Khaiboullina S, Hall MR, Pardini L, Pardini RS (2002). "Influence of omega-3 fatty acids on the growth of human colon carcinoma in nude mice". *Cancer Lett.* 187 (1–2): 169–77.
17. Kris-Etherton, P., R. H. Eckel, B.V. Howard, St. Jeor S, and T. L. Bazzare, 2001. AHA: Science Advisory Lyon Diet Heart Study. Benefits of a Mediterranean-style, National Cholesterol Education Program/ American Heart Association Step I Dietary Pattern on Cardiovascular Disease.
18. Nimish Mol S. Jeya Shakila R. Jeyasekaran G. Sukumar D. Effect of different types of heat processing on chemical changes in tuna. J Food Sci Technol (March–April 2010) 47(2):174181.
19. Reiffel, JA., McDonald ,A (August 2006). "Antiarrhythmic effects of omega-3 fatty acids". *The American Journal of Cardiology* 98 (4A): 50i–60i. doi: 10. 1016 / j. amjcard. 2005. 12. 027. PMID 16919517.
20. Rees, D., Miles, EA., Banerjee, T., Wells, SJ., Roynette, CE, et al., 2006., Dose-related effects of eicosapentaenoic acid on innate immune function in healthy humans: a comparision of young and older men. AM J Clin Nutr, 83:331-42, 2006.
21. Schonberg SA, Lundemo AG, Fladvad T, Holmgren K, Bremseth H, Nilsen A, Gederaas O, Tvedt KE, Egeberg KW, Krokan HE (2006). "Closely related colon cancer cell lines display different sensitivity to polyunsaturated fatty acids, accumulate different lipid classes and downregulate sterol regulatory element-binding protein 1". *Cancer Lett.* 273 (12): 2749 –65.
22. Simopoulos A. P. 2002. The importance of the ratio of omega-6/omega-3 essential fatty acids. Biomed Pharmacother. 56(8):365-79.
23. Song C, Zhao S (Oct 2007). "Omega-3 fatty acid eicosapentaenoic acid. A new treatment for psychiatric and neurodegenerative diseases: a review of clinical investigations". *Expert Opin Investig Drugs* 16 (10): 1627–38.
24. Stampfer M. J., F.B. Hu, J.E. Manson, E.B. Rimm, and W.C. Willett, 2000. Primary prevention of coronary heart disease in women through diet and lifestyle. N. Engl. J. Med., 343:1:16-22.
25. Stirban A, Nandrean S, Götting C, Tamler R, Pop A, Negrean M, Gawlowski T, Stratmann B. Effects of n–3 fatty acids on macro- and microvascular function in subjects with type 2 diabetes mellitus. AM J Clin Nutr January 2010. 2874.
26. Teres S, Barcelo-Coblijn G, Benet M, Alvarez R, Bressani R et al., 2008. Oleic acid content is responsible for the reduction in blood pressure induced by olive oil. PNAS. 2008, 105(37); 13811-6.

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