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Omega-3 Fatty Acids Composition and Lipid Content from Liver and Muscle Tissues of *Scomberomorus commerson* (Lacepede, 1800) in the Persian Gulf

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Abstract Studies indicate that omega-3 fatty acids have positive effects on reducing heart diseases several such as myocardial infarction, cardiac arrhythmia, atherosclerosis thrombosis and hypertension. The omega-3 PUFA EPA and DHA are important throughout life and are a dietary necessity found predominantly in fish and fish-oil supplements. In this research, the liver and muscle tissues of *Scomberomorus commerson* from the Iranian Port of Bandar Abbas in March 2015 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, were Palmitic acid, Oleic acid, Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA). The result of this study show that the muscle and liver tissues of *Scomberomorus commerson* are rich sources of omega-3 fatty acids EPA (18.12-21.63%) and DHA (17.37-19.12- %).

Keywords: *omega-3, lipid content, liver, muscle, Scomberomorus commerson, Persian Gulf*

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1. Introduction

The narrow-barred Spanish mackerel (*Scomberomorus commerson*) found in the Indo-West Pacific from the Red Sea and South Africa to Southeast Asia, north to China and Japan and south to southeast Australia, and to Fiji [8]. It is a pelagic and top level predator species. This fish is a member of the family scomberidae [9,25]. This species is of major commercial fish in the Persian Gulf, locally known as Shir-Mahi.

This fish feeds on small fish anchovies, clupeids, carangids, also squids and penaeoid shrimps. The species is easily distinguished from its confamilial species from the evi-dent dip of the lateral line under the middle of the second dorsal fin and from the presence of approximately 40 dark vertical and wavy bars on the trunk which sometimes break off into spots ventrally. Sides of body are silvery white with several rows of round dark brownish spots [15] (Figure 1).

Figure 1. Scomberomorus commerson

Marine lipids have a high content of polyunsaturated fatty acids (PUFA), in particular eicosapentaenoic (EPA) and docosahexaenoic acids (DHA). There is strong evidence that consumption of fish containing high levels of these fatty acids (FAs) is favorable for human health [15,17]. Omega-3 fatty acids include docosahexaenoic acid (DHA), eicoapentaenoic acid (EPA) and alpha-linolenic acid (ALA). They are necessary for human health but the body can't make themand must be obtained through diet or supplementation [1,12]. Two crucial ones EPA and DHA are primarily found in certain fish such as salmon, mackerel, tuna, and lake trout, halibut, herring. ALA (alpha-linolenic acid), another omega-3 fatty acid, is found in plant sources such as nuts and seeds [35]. Some researchers have found that people that eat foods with high levels of omega-3s have lower levels of heart disease, depression, inflammation, diabetes, depression, cancer, lupus and Alzheimer's disease [7,11,13,24,31,37]. Omega-3 fatty acids also are used to treat hyperlipidemia, hypertension, and rheumatoid arthritis [5,14,34,41]. The aim of this study was to identify of the lipid content especially Omega-3 fatty acids of liver and muscle tissues of *Scomberomorus commerson* in the Persian Gulf.

2. Material and Methods

In this research, 30 *Scomberomorus commerson* samples were obtained of Bandar Abbas region in the

Persian Gulf (Figure 2). Fish samples were collected during weekly dives off the Southeast coast of Bandar Abbas in Mar 2015. The samples were taken for lipid extraction and fatty acids analyses. Initially the liver and muscle tissues were weighed separately and mixed into a soft uniform mixture.

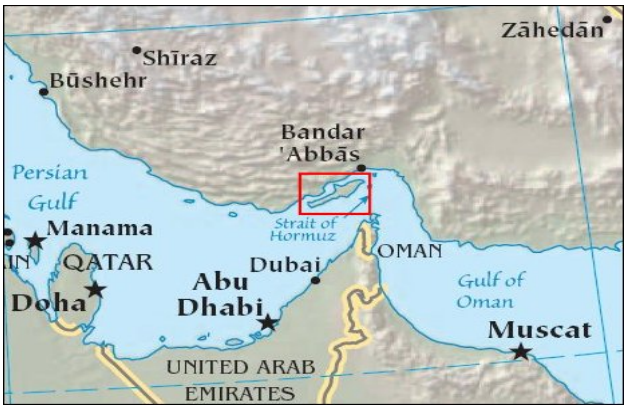

Figure 2. Map of study area and location of sampling station in the Persian Gulf

Mixtures of chloroform and methanol were added as the lipid extract [3]. 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

The present study indicates that compounds identified are common between liver and muscle tissue (Table 1 and Table 2) such as saturated fatty acid Palmitic acid (34.90% in liver and muscle 33.13%), Monounsaturated fatty acid Oleic acid (26.84% in liver and muscle 21.80%), polyunsaturated fatty acids Eicosapentaenoic acid (18.12% in liver and muscle 21.63%) and Docosahexaenoic acid (17.37% in liver and muscle 19.12%), two esters of fatty acid consist Palmitic acid–methylester (0.73% in liver and muscle 1.69%) and Stearic acid - methylester (0.95% in liver and muscle 1.68%) and Alkane including Heptadecane (0.54% in liver and muscle 0.47%) and Octadecane (1.55% in liver and muscle 0.48%). The amounts of alkanes are identified in liver and muscle tissues that they are environmental pollution.

The components identified by GC-MS analysis of the chloroform phase of liver samples are shown below (Table 1).

Table 1. The compound identified in the chloroform phase of liver tissue of *Scomberomorus commerson* from the Persian Gulf

Compound	MF	KI	% of total
Fatty acid			
Saturated fatty acid			
Palmitic acid (Hexadecanoic acid)	$C_{16}H_{32}O_2$	1541	34.90
Mono-unsaturated fatty acid			
Oleic acid (9Z Octadecenoic acid)	$C_{18}H_{34}O_2$	1645	26.84
Poly-unsaturated fatty acid			
Docosahexaenoic acid (DHA)	$C_{20}H_{30}O_2$	1812	17.37
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1801	18.12
Ester			
Palmitic acid – methylester (Hexadecanoic acid, methyl ester)	$C_{17}H_{34}O_2$	1546	0.73
Stearic acid-methylester (Octadecanoicaci, methyl ester)	$C_{19}H_{38}O_2$	1619	0.95
Alkane			
Heptadecane	$C_{17}H_{36}$	1823	0.54
Octadecane	$C_{18}H_{38}$	1631	1.55

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 *Scomberomorus commerson* from the Persian Gulf

Compound	MF	KI	% of total
Fatty acid			
Saturated fatty acid			
Palmitic acid (Hexadecanoic Acid)	$C_{16}H_{32}O_2$	1536	33.13
Mono-unsaturated fatty acid			
Oleic acid (9Z Octadecenoic Acid)	$C_{18}H_{34}O_2$	1645	21.80
Poly-unsaturated fatty acid			
Docosahexaenoic Acid (DHA)	$C_{20}H_{30}O_2$	1812	19.12
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1801	21.63
Ester			
Palmitic acid –methylester (Hexadecanoic Acid, methyl ester)	$C_{17}H_{34}O_2$	1618	1.69
Stearic acid-methylester (Octadecanoic acid, methyl ester)	$C_{19}H_{38}O_2$	1619	1.68
Alkane			
Heptadecane	$C_{17}H_{36}$	1813	0.47
Octadecane	$C_{18}H_{38}$	1621	0.48

4. Discussion

In the present research, the results indicate that the dominant fatty acids in liver and muscle tissues of *Scomberomorus commerson* are Palmitic acid (33.13-34.90%) and Oleic acid (21.80-26.84%). Palmitic acid is a saturated fatty acid commonly found in both animals and plants. Palmitic acid is useful in bio manufacturing and Tissue engineering. The omega-9 family of fatty acids, including oleic acid, can be synthesized by animal cells from the saturated precursors palmitic and stearic acids. Oleic acid reduces blood pressure, increases fat burning to help with weight loss, protects cells from free radical damage, may prevent type 2 diabetes, prevents ulcerative colitis and generates brain myelin [2,21,40]. In this research, the dominant omega-3 fatty acid was Eicosapentaenoic acid (18.12-21.63%). EPA is used for preventing of high blood pressure in high-risk pregnancies (eclampsia), age-related macular degeneration (AMD), heart disease, schizophrenia, personality disorder, cystic fibrosis, Alzheimer's disease, depression, and diabetes [6,26,42]. In the present study, the next dominant omega-3 fatty acid was Docosahexaenoic acid (17.37-19.12%). DHA is essential for the growth and functional development of the brain in infants. It is also required for maintenance of normal brain function in adults [33,38]. DHA omega-3 is naturally found throughout the body and is most abundant in the brain (cerebral cortex), eyes (retina), skin, sperm, testicles and heart [22,23,26,36]. The DHA omega-3 also reduces proinflammatory mediators such as prostaglandin E2, thromboxanes, and leukotrienes, and increases the production of anti-inflammatory compounds such as lipoxins and resolvin along with substances that protect brain cells called neuroprotectins [4,10]. DHA was found to inhibit growth of human colon carcinoma cells, more than other omega-3 PUFAs [26]. The cytotoxic effect of DHA was not caused by increased lipid peroxidation or any other oxidative damage [4,22,23,26] but rather a decrease in cell growth regulators [32,36]. EPA and DHA are essential for proper fetal development and healthy aging. EPA and DHA are also used in combination for migraine headache prevention in adolescents, skin infections, Behçet's syndrome, high cholesterol, high blood pressure, psoriasis, Raynaud's syndrome, rheumatoid arthritis, inflammatory, disease depression, cancer, lupus, diabetes and blood clots [16,18,19,20,28,34,39,40]. Several studies suggest omega-3 fatty acids may help protect humanheart from coronary heart disease, sudden cardiac death and non fatal heart attacks [27,29,30,43] This research showed that the muscle and liver tissues of *Scomberomorus commerson* from the Iranian Port of Bandar Abbas in the Persian Gulf wererich sources of omega-3 fatty acids EPA and DHA and eating this fish seems to help people who already have heart disease. It also can lower the risk for developing heart disease.

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