Identification of fatty acids composition and lipid content from liver and muscle tissues of *Tenualosa ilisha* in the Persian Gulf coasts (Bandar Khorramshahr)

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Abstract: In the present study, the liver and muscle tissues of *Tenualosa ilisha* from the coastal waters of Bandar Khorramshahr, Iran in Mar 2013 were separately extracted for their fatty acids composition and lipid content 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 (PUFA) Eicosapentaenoic acid (EPA), two methyl esters of fatty acids including Octadecanoic acid, methyl ester and Hexadecanoic acid, methyl ester ,Cholesterol and Alkane including, Heptadecane and Octadecane.The results showed that the dominant fatty acids in liver and muscle tissues were Omega-3 fatty acids Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA).

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1. Introduction

Tenualosa is a genus of fishes in the family Clupeidae. *Tenualosa ilisha*, is a tropical fish. It is the national fish of Bangladesh and extremely popular in parts of India, Vietnam, regions of southern Pakistan and Persian Gulf coasts eastward to Myanmar (Rainer & Pauly, 2005). The Color of the body is silver shot with gold and purple (Figure1).

Figure1. *Tenualosa ilisha*

In biochemistry, a fatty acid is a carboxylic acid with a long aliphatic tail, which is either saturated or unsaturated. Most naturally occurring fatty acids have a chain of an even number of carbon atoms, from 4 to 28. Omega-3 fatty acids are polyunsaturated fatty acids with a double bond starting after the third carbon atom from the end of the carbon chain (Allen & Harris, 2001). Omega-3 fatty acids are fats commonly found in marine and plant oils. Some of the potential health benefits of omega-3 fatty acids supplementation are controversial. They are considered essential fatty acids, meaning that they cannot be synthesized by the human body but are vital for normal metabolism. Though mammals cannot synthesize omega−3 fatty acids, they have a limited ability to form the long-chain omega−3 fatty acids including eicosapentaenoic acid (EPA, 20 carbons and 5 double bonds), docosahexaenoic acid (DHA, 22 carbons and 6 double bonds) and α-linolenic acid (ALA, 18 carbons and 3 double bonds). Fish, plant and nut oils are the primary dietary source of omega-3 fatty acids (Simopoulos, 2002). Omega-3 is used to regulate blood clotting, build cell membranes and support cell health. It's polyunsaturated**,** which is the relatively heart-healthy kind of fats that help reduce blood triglycerides and low-density lipoprotein **(**LDL**),** the so-called bad cholesterol (Chattipakorn et al., 2009). Omega-3 also curbs inflammation (David, *et al.*, 2005). While inflammation is a normal part of the body's immune response (Harbige & Fischer, 2001; Gil, 2002; Grimm et al., 2002), research indicates that it also underlies a host of serious illnesses, including cardiovascular diseases (Allen & Harris, 2001; Reiffel & McDonald, 2006), cancers and autoimmune diseases (Hardman, 2002; Simon et al., 2009). The objective of this study was to identify of the lipid content especially fatty acids of liver and muscle tissues of *Tenualosa ilisha* from the coastal waters of Persian Gulf (Bandar Khorramshahr).

2. Material and Methods

In this research, 30 *Tenualosa ilisha* samples were obtained from the coastal waters of Bandar

Khorramshahr in the south of Iran (Figure 2). Initially the liver and muscle tissues were weighed separately and mixed into a soft uniform mixture.

Figure2. Map of sampling station in the coastal waters of Bandar Khorramshahr in the south 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 *Tenualosa ilisha.*

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 *Tenualosa ilisha* from the coastal waters of Persian Gulf (Bandar Khorramshahr)

Compound	MF	KI	% of total
Fatty acid Saturated fatty acid Palmitic acid (Hexadecanoic acid)	$C_{16}H_{32}O_2$	1628	11.23
Stearic acid	$C_{18}H_{36}O_2$	1876	17.36
Monounsaturated fatty acid Oleic acid (9Z Octaecenoic acid)	$C_{18}H_{34}O_2$	1736	7.94
Poly-unsaturated fatty acid Docosahexaenoic acid (DHA)	$C_{20}H_{30}O_2$	1823	21.24
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1810	19.31
Ester Palmitic acid–methylester (Hexadecanoic acid, methyl ester)	$C_{17}H_{34}O_2$	1604	3.15
Stearic acid-methylester (Octadecanoic acid, methyl ester)	$C_{19}H_{38}O_2$	1863	4.27
Esterol Cholesterol(Cholesta-5en-3-ol(3.β)	$C_{27}H_{46}O_2$	1983	13.63
Alkane Octadecane	$C_{18}H_{38}$	708	1.87

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 *Tenualosa ilisha* from the coastal waters of Persian Gulf (Bandar Khorramshahr)

Compound	MF	KI	% of total
Fatty acid Saturated fatty acid Palmitic acid (Hexadecanoic acid)	$C_{16}H_{32}O_2$	1628	10.58
Stearic acid	$C_{18}H_{36}O_2$	1876	16.25
Monounsaturated fatty acid Oleic acid (9Z Octaecenoic acid)	$C_{18}H_{34}O_2$	1736	5.87
Poly- unsaturated fatty acid Docosahexaenoic acid (DHA)	$C_{20}H_{30}O_2$	1823	22.64
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1810	20.41
Ester Palmitic acid –methylester (Hexadecanoic acid, methyl ester)	$C_{17}H_{34}O_2$	1604	3.68
Stearic acid-methylester (Octadecanoic acid, methyl ester)	$C_{19}H_{38}O_2$	1863	4.59
Esterol Cholesterol(Cholesta-5en-3-ol(3.β)	$C_{27}H_{46}O_2$	1983	13.73
Alkane Heptadecane	$C_{17}H_{36}$	1691	1.15
Octadecane	$C_{18}H_{38}$	708	1.11

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 (11.23% in liver and muscle 10.58%) and Stearic acid (17.36% in liver and muscle 16.25%), Monounsaturated fatty acid Oleic acid (7.94% in liver and muscle 5.87%), polyunsaturated fatty acids Docosahexaenoic acid (21.24 % in liver and muscle 22.64%) and Eicosapentaenoic acid (19.31% in liver and muscle 20.41%) and two esters of fatty acid consist Palmitic acid–methylester (3.15% in liver and muscle 3.68 %) and Stearic acid-methylester (4.27% in liver and muscle 4.59%), Cholesterol (13.63% in liver and muscle 13.73%) and Alkane including Heptadecane (2.15% in muscle) and Octadecane (1.87% in liver and muscle 1.11%). Amounts of alkanes are identified in the liver and muscle tissues which are regarded as environmental pollution.

4. Discussions

In the present research, the results indicate that the dominant fatty acids in liver and muscle tissues of Tenualosa ilisha are omega-3 fatty acids Docosahexaenoic acid (21.24-22.64%) and Eicosapentaenoic acid (19.31-20.41%). Docosahexaenoic acid (DHA) is a primary structural component of the human brain, cerebral cortex, skin, sperm, testicles and retina. It can be synthesized from alpha-linolenic acid or obtained directly from fish and fish oil or maternal milk. Dietary DHA may reduce the risk of heart disease (Stampfer, et al., 2000; Reiffel & Mc Donald, 2006) by reducing the level of blood triglycerides (Hardman, 2002; Kato et al., 2002; Bousquet et al., 2008) and lower blood pressure (Frenoux et al., 2001; Calo et al., 2005; Teres et al., 2008;) in humans. DHA plays a crucial role in the growth and development of the central nervous system and visual abilities during the first 6 months of life. DHA is benefit for Alzheimer's disease (Guesnet & Alessandri, 2011). Eicosapentaenoic acid (EPA) is a polyunsaturated fatty acid (PUFA) that acts as a precursor for prostaglandin-3 (which inhibits platelet aggregation), thromboxane-3, and leukotriene-5 groups (all eicosanoids). Studies have suggested that EPA may be efficacious in treating depression (Kris-Etherton, et al., 2001; Song & Zhao, 2007; Bousquet et al., 2008), suicidal behavior and Schizophrenia (Rees et al., 2006; Schonberg et al., 2006; Bousquet et al., 2008; Cunnane et al., 2009; Simon et al., 2009). Research also suggests that EPA can improve patients' response to chemotherapy (Bousquet et al., 2008). EPA can also reduce the probability of developing particular kinds of cancer and autoimmune disease (Aronson et al., 2001; Kato et al., 2002; Schonberg et al., 2006).

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