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ASSESSMENT OF OMEGA-3 FATTY ACIDS COMPOSITION AND LIPID CONTENT FROM LIVER, MUSCLE AND CAVIAR OF *ACIPENSER PERCICUS*

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ABSTRACT

Sturgeons are commercially the most important fish species in the world. Marine animals such as fish provide Omega-3 fatty acid EPA and DHA, which are mostly promoted for their protective effects on our heart. In the present study, the liver, muscle and Caviar of Caspian Sea *Acipenser percicus* from Astara region in Mar 2017 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, muscle and caviar include saturated fatty acid Palmitic acid and Myristic acid, monounsaturated fatty acid Oleic acid, polyunsaturated fatty acids DHA and EPA, two methyl esters of fatty acids including Octadecanoic acid, methyl ester and Hexadecanoic acid, methyl ester. The results show that the muscle, liver and caviar of Caspian Sea *Acipenser percicus* are rich sources of omega-3 fatty acids were Eicosapentaenoic acid (12.56-14.18-15.12%) and Docosahexaenoic acid (12.14-13.47-14.23%).

KEYWORDS: Omega-3, liver, muscle, Caviar, *Acipenser percicus.*

INTRODUCTION

The *Persian sturgeon* (Acipenser persicus) is one of the most important species for caviar production. It is a species of fish in the family Acipenseridae. This type of sturgeon is endemic to the Caspian and Black Sea basins, but primarily resides in the Caspian Sea.[1] The Persian sturgeon has an elongated, bulky body with a bluish tint. These Sturgeons are ancient and commercial fishes which possess primitive characteristics and due to their great inflections are able to live in both freshwater and marine environments.[15] The Persian sturgeon has 8-18 dorsal scutes, 24-50 lateral scutes, 6-12 ventral scutes, 31-50 dorsal fin rays and 16-30 fin rays. Coloration is dark blue-black on the back, with white-cream bony platelets on the ventral side. The four barbes are located closer to the end of the snout than the mouth. The Persian sturgeon can reach 2.3 meter in length and a weigh of 70 kg (Figure1).

Fig. 1: ***Acipenser percicus.***

Omega-3 long-chain PUFA, including EPA and DHA, are essential nutrients with an array of health benefits.[24] They have a structural role in the process of creating organs for example in the cell membrane (muscle cells, brain and retina). They are the precursors of physiologically active molecules such as eicosanoids. They are important for a number of bodily functions, including muscle activity; blood clotting, digestion, fertility and cell division and growth. Omega-3 fatty acid EPA and DHA have been studied for preventing or treating a variety of other conditions such as allergies[2], asthma, prostate cancer[25], Crohn's disease[27], cardiac death, sudden death, cardiovascular disease[19,22] schizophrenia and Alzheimer's diseases[13,14], cystic fibrosis, diabetes, kidney disease[12], lupus, menstrual cramps, obesity, osteoporosis, ulcerative colitis, depressed mood[4], inflammatory[16], thrombotic, arrhythmic and vasodilatory.

Omega-3 fatty acids (EPA and DHA) are used to treat hyperlipidemia, hypertension and rheumatoid arthritis.[6] Oleic acid benefits heart health, brain and overall well-being when consumed and produced in moderation. The aim of this study was to identify the lipid content especially Omega-3 fatty acids of liver, muscle tissues and caviar of *Acipenser percicus* from Caspian Sea.

MATERIAL AND METHODS

In this research, 15 *Acipenser percicus* samples were collected from Astara region along the Iranian coast in the south Caspian Sea (Figure 2).

Fig 2- Map of study area and location of sampling station in the south of Iran.

Initially the liver and muscle tissues were weighed separately and mixed into a soft uniform mixture.

Mixtures of chloroform and methanol were added as the lipid extract.[5] 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.

RESULTS

This study investigated on the fatty acid composition and lipid content in the liver, muscle and caviar of *Acipenser percicus*.

The results are shown in Tables 1, 2 and 3. Chloroform phase is discussed in this research because the fat content of the liver, muscle and caviar is extracted with chloroform.[5] The components identified by GC-MS analysis of the chloroform phase of liver samples is shown the below table (Table 1).

Table 1: The compounds identified in the chloroform phase of liver tissue of *Acipenser percicus* from the South of Caspian Sea.

Compound	MF	KI	% of total
Fatty acid			
Saturated fatty acid	$C_{16}H_{32}O_2$	1517	32.14
Palmitic acid			
Stearic acid	$C_{18}H_{36}O_2$	1568	8.23
Mono-unsaturated fatty acid	$C_{18}H_{34}O_2$	1599	28.84
Oleic acid			
Poly-unsaturated fatty acid	$C_{20}H_{30}O_2$	1769	13.47
Docosahexaenoic acid (DHA)			
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1789	14.18
Ester	$C_{17}H_{34}O_2$	1506	1.61
Palmitic acid – methylester			
Stearic acid-methylester	$C_{19}H_{38}O_2$	1521	1.53

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 compounds identified in the chloroform phase of muscle tissue of *Acipenser percicus* from the South of Caspian Sea.

Compound	MF	KI	% of total
Fatty acid			
Saturated fatty acid	$C_{16}H_{32}O_2$	1517	32.91
Palmitic acid			
Stearic acid	$C_{18}H_{36}O2$	1568	8.12
Mono-unsaturated fatty acid			
Oleic acid	$C_{18}H_{34}O_2$	1649	31.56
Poly-unsaturated fatty acid	$C_{20}H_{30}O_2$	1769	12.14
Docosahexaenoic Acid (DHA)			
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1789	12.56
Ester	$C_{17}H_{34}O_2$	1506	1.44
Palmitic acid – methylester			
Stearic acid-methylester	$C_{19}H_{38}O_2$	1521	1.27

MF: Molecular Formula KI: Kovats Index

Table 3 Shows the components identified by GC-MS analysis of the caviar samples from species.

Table 3: The compounds identified in the chloroform phase of caviar of *Acipenser percicus* from the South of Caspian Sea.

Compound	MF	KI	% of total
Fatty acid			
Saturated fatty acid	$C_{16}H_{32}O_2$	1517	33.15
Palmitic acid			
Stearic acid	$C_{18}H_{36}O_2$	1568	8.41
Mono-unsaturated fatty acid	$C_{18}H_{34}O_2$	1599	25.74
Oleic acid			
Poly-unsaturated fatty acid	$C_{20}H_{30}O_2$	1769	14.23
Docosahexaenoic acid (DHA)			
Eicosapentaenoic acid (EPA)	$C_{22}H_{32}O_2$	1789	15.12
Ester	$C_{17}H_{34}O_2$	1506	1.72
Palmitic acid – methylester			
Stearic acid-methylester	$C_{19}H_{38}O_2$	1521	1.63

MF: Molecular Formula KI: Kovats Index.

The present study indicates that compounds identified are common between liver and muscle tissue such as saturated fatty acid Palmitic acid (32.14% in liver, 32.91% in muscle and 33.15% in caviar) and Stearic acid (8.23% in liver, 8.12% in muscle and 8.41% in caviar), Monounsaturated fatty acid Oleic acid (28.84% in liver, 31.56% in muscle and 25.74 in caviar), polyunsaturated fatty acids Docosahexaenoic acid (13.47% in liver, 12.14% in muscle and 14.23 in caviar) and Eicosapentaenoic acid (14.18% in liver, 12.56% in muscle and 15.12 in caviar), two esters of fatty acid consist Palmitic acid–methylester (1.61% in liver, 1.44% in muscle and 1.72 in caviar) and Stearic acid-methylester (1.53% in liver, 1.27% in muscle and 1.63 in caviar).

DISCUSSION

In the present research, the results indicate that the dominant Omega-3 fatty acids in liver, muscle and caviar of *Acipenser percicus* from the South of Caspian Sea are Palmitic acid (32.14-32.91-33.15%), Oleic acid (28.84-31.56-25.74%). Eicosapentaenoic acid (14.18-12.56-15.12%) and Docosahexaenoic acid (13.47-12.14-14.23%). Palmitic acid is the most common saturated fatty acid found in animals, plants and microorganisms. Palmitic acid has many functions in cosmetics, from detergent cleansing agent to emollient.[3] Oleic acid is an omega-9 fatty acid. Research has shown that omega-9 fatty acids can help reduce the risk of cardiovascular disease and stroke. Omega-9 benefits heart health because omega-9s have been shown to increase HDL cholesterol and decrease LDL cholesterol.[26,28] In this investigation, the dominant omega-3 fatty acids were EPA and DHA. They are essential for proper fetal development and healthy aging. DHA is a key component of all cell membranes and is found in abundance in the brain and retina. EPA and DHA are also the precursors of several metabolites that are potent lipid mediators, considered by many investigators to be beneficial in the prevention or treatment of several diseases.[20] They are important throughout life and are a dietary necessity found predominantly in fish and fish-oil supplements. Many clinical and epidemiologic studies have shown positive roles for n-3 fatty acids DHA and EPA in infant development; cancer; cardiovascular diseases; and more recently, in various mental illnesses, including depression, attention-deficit hyperactivity disorder and dementia.[7,17,18,23] EPA is used for 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.[7,8,12,16,21] Studies from animal models and cell cultures have shown that omega-3 fatty acids EPA and DHA are neuroprotective during development and aging. Studies have shown that the use of omega-3 polyunsaturated fatty acids EPA and DHA have positive effective in schizophrenia, Alzheimer's and allergic diseases.[2,13,14] The studies in 2010 showed the polyunsaturated fatty acids EPA and DHA are effective on depressed mood continues.[4] A research in 2012 suggests that Omega 3 fatty acids EPA and DHA are safe in Crohn's disease.[27] Omega-3 fatty acids have been linked to healthy aging throughout life.[9,10]

This research showed that the liver, muscle and caviar of *Acipenser percicus* from Astara region along the Iranian coast in the south Caspian Sea were rich sources of omega-3 fatty acids EPA and DHA.

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