ARTICLE

FATTY ACIDS PROFILE OF SOME COMMERCIALLY FISH ROE

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Abstract: *The demand for natural food sources and food ingredients is increasing, and fish roes are known to present high levels of ω-3 fatty acids (FA). In this work, we used gas-chromatography and UV spectroscopy (GC-DAD) to characterize the FA profile of six different commercial fish roes. The increase of concentration of ω-3 FA is tarama < hering < pike < cod < salmon < lumpfish. Altogether, the fish roes are an important source of unsaturated fatty acids (minimum 26.62% for pike roe) and present a modest source of saturated fatty acids (less than 46.45% for pike roe). Overall, this study provides a preliminary screening of FA profiles between several commercial fish roes.*

Keywords: fish roe, fatty acids, gas chromatography, mass spectrometry.

Introduction

The beneficial effects of fish and fish oil consumption on human health are widely documented in the scientific literature (Abdelhamid et al., 2020; Abdelhamid et al., 2018; Alagawany et al., 2019; Cretton et al.). There have been many studies that have verified a reduction in the incidence of a variety of diseases, including cardiovascular disease (de la Guia-galipienso et al., 2021), cancer (de Castro et al., 2022; Franchi et al., 2022; Hsieh et al., 2022; Jiang et al., 2021; Laumann et al., 2022; Stasiewicz et al., 2022; Wang et al., 2022; Zhang et al., 2022), inflammatory (Dawczynski et al., 2018) and autoimmune disorders (AlAmmar et al., 2021; Lofvenborg et al., 2014), as well as psychiatric and mental ailments (Berger et al., 2017; Hansen et al., 2020; Sikka et al., 2021; Yonezawa et al., 2020). Fish liver oil, mushrooms, and other sources of vitamins are the best sources of vitamin D, besides exposure to the sun, for the average person. 1,25-dihydroxyvitamin D is primarily responsible for maintaining calcium and phosphorus balance in the body (de la Guia-galipienso et al., 2021). Many extra-skeletal effects of vitamin D, including those on the immune and cardiovascular (CV) systems, can be detected in human cells and tissues that contain vitamin D receptors. Blood pressure is regulated by vitamin D's effect on endothelium and smooth muscle cells. This vitamin deficiency has been linked to an increased risk of cardiovascular disease (CVD) death and incidence (de la Guia-galipienso et al., 2021).

Health advantages of a diet containing fish products are attributed to polyunsaturated fatty acids (PUFA), mainly omega-3 fatty acids; e.g., eicosapentaenoic acid: EPA and docosahexaenoic acid: DHA.

The fatty acids (FA) present in four lipid fractions [polar lipids (PL), diacylglycerols (DAG), free fatty acids (FFA), and triacylglycerols (TAG)] of common carp were investigated by Chvalova, D. and J. Spicka in (Chvalova and Spicka, 2016). There were differences across the examined tissues in terms of the amounts of lipid fractions and fatty acids that were classified as: saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), and furan fatty acids (F-acids). Forty-nine compounds were identified in this research, from which eight F-acids were discovered in the tissues under investigation. In carp muscle, MUFA predominated because it accounted for nearly half of the total fatty acids: 51.8% in TAG, followed by SFA: 29.3% and PUFA: 19.0%. PUFA represented the majority of the PL 54.8%, followed by SFA: 26.6% and

MUFA: 18.5%, similar to that reported in [25]. Carp muscle tissue contained only negligible amounts of F-acids, less than 0.05%. The composition of PL in male and female gonad tissues was found to be comparable to that of muscle PL (a high amount of PUFA, followed by SFA and MUFA), which was previously observed.

It was discovered that the triacylglycerol fraction of male gonad tissue contained the highest concentration of F-acids. F-acids were found in polar lipids and diacylglycerols in female gonad tissue, albeit at a significantly lower concentration than in male gonad tissue (Chvalova and Spicka, 2016).

This study aimed to develop a method for determining the fatty acids in fish roe and screening the FA profile of some common commercial fish roe.

MATERIALS AND METHODS

All the solvents (*n*-hexane, *n*-heptane, methanol, sulphuric acid) were of analytical grade and chromatographic purity (acetonitrile), respectively, acquired from Merck KGaA, Darmstadt, Germany.

Commercial fish roes (tamara, cod, herring, lumpfish, salmon, and pike) from the supermarket were bought and used in 2018. The lipid phase was extracted with *n*-hexane, and the supernatant was derivatized according to the method published by Copolovici et al., 2017, to obtain the corresponding fatty acid methyl esters (Copolovici et al., 2017). These esters were identified by using GC-MS (Shimadzu 2010, Tokyo, Japan), mass spectrometry data from commercial libraries (NIST and Wiley) as presented in (Copolovici et al., 2017), and overlapping chromatograms are depicted in Figure 1.

RESULTS AND DISCUSSIONS

Prior studies have shown high amounts of PUFA in fish roe, with some articles reporting levels as high as 50% of total FA (Al-Sayed Mahmoud et al., 2008; Intarasirisawat et al., 2011). Docosahexaenoic acid (C22:6 n-3) was found to be the most abundant fatty acid (20.53–26.19%) in crude lipids extracted from tuna roes (51.22–54.90% of total lipids) (Al-Sayed Mahmoud et al., 2008). In our study, the values of PUFA are found to be from 26.61% in pike roe to 45.52% in cod roe (Table 1.)

In the present study, we found out that in the analyzed fish roes, the concentration of fatty acids varies depending on the species, so the myristic acid was found in a proportion of 3.55% in lumpfish roe and is increasing to up to 13.78% in pike roe. Elaidic acid was found in the samples analyzed, from 17.45% in pike roe to 26.26% in salmon roe (Figure 1).

As is revealed in Table 1, the fish roes analyzed present a good source of unsaturated fatty acids (UFA), with the following concentration for total ω-3 FA: tarama < herring < pike < cod < salmon < lumpfish, while ω-6 FA (linoleic acid) is found in a proportion of 6.46% in lumpfish roe and increase to 33.89% in tarama roe.

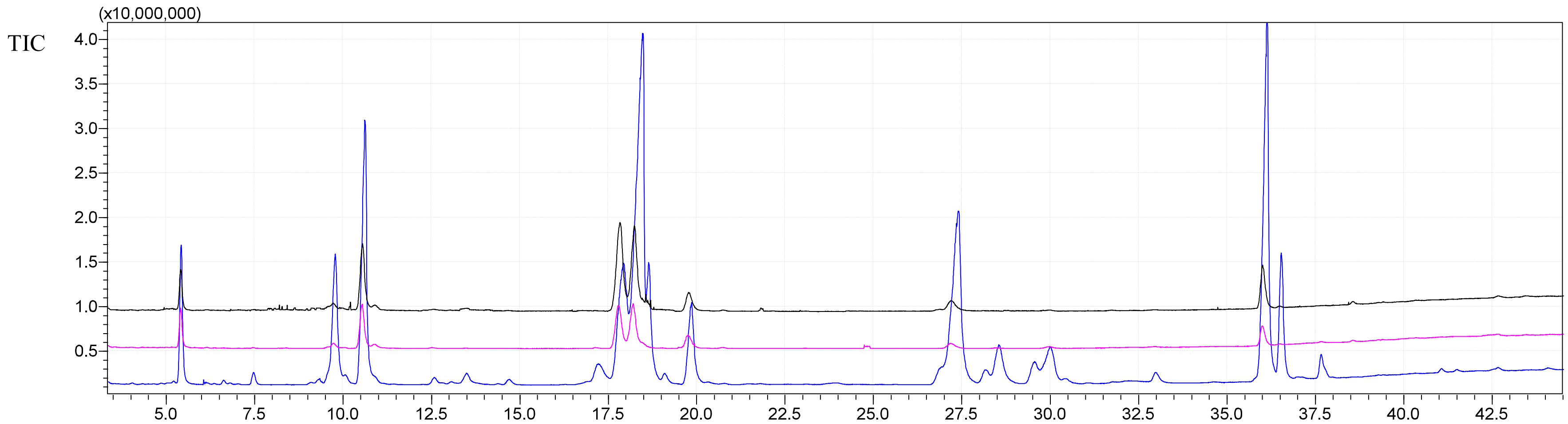

Figure 1. Overlapping chromatograms of salmon roe (blue), herring roe (pink), cod roe (black).

Table 1. Fatty acids identified in fish roe samples: the values are area expressed in % (R_t: retention time).

Fatty acid	Molecular formula	Molecular weight (Da)	R_t (min)	Tarama roe	Cod roe	Hering roe	Lumpfish roe	Salmon roe	Pike roe
Myristic acid (C14:0)	$C_{14}H_{28}O_2$	228.371	5,407	5.70±0.04	5.85±0.03	10.48±0.14	3.58±0.11	3.67±0.31	13.78±0.28
Palmitoleic acid (C16:1, ω-7)	$C_{16}H_{30}O_2$	254.408	9,726	0.95±0.03	1.35±0.17	1.58±0.15	4.64±0.15	6.36±0.16	5.30±0.21
Palmitic acid (C16:0)	$C_{16}H_{32}O_2$	256.424	10,552	16.48±0.17	16.30±0.42	19.65±0.21	13.62±0.02	11.45±0.14	22.50±0.35
Linoleic acid (C18:2, ω-6)	$C_{18}H_{32}O_2$	280.445	17,844	33.89±0.12	31.89±0.12	26.84±0.08	6.46±0.15	9.42±0.13	14.16±0.21
Elaidic acid(C18:1, ω-9)	$C_{18}H_{34}O_2$	282.461	18,251	23.34±0.48	20.73±0.04	19.73±0.04	24.34±0.18	26.26±0.20	17.45±0.21
Oleic acid (C18:1, ω-7)	$C_{18}H_{34}O_2$	282.461	18,49	1.52±0.02	2.95±0.02	1.95±0.02	5.19±0.16	4.73±0.37	3.23±0.14
Stearic acid (C18:0)	$C_{18}H_{36}O_2$	284.477	19,821	9.58±0.11	6.39±0.16	7.24±0.06	4.84±0.24	4.84±0.26	10.17±0.09
Eicosapentanoic acid (C20:5, ω-3)	$C_{20}H_{30}O_2$	302.451	27,182	2.57±0.27	2.57±0.25	2.57±0.27	15.82±0.62	14.23±0.32	1.89±0.16
Docosahexaenoic acid (C22:6, ω-3)	$C_{22}H_{32}O_2$	328.488	36,002	5.75±0.21	11.06±0.06	9.42±0.11	20.93±0.05	18.45±0.14	10.56±0.31
Σ SFA				31.76	28.54	37.37	22.00	19.96	46.45
Σ MUFA				25.81	25.02	23.245	34.16	37.34	25.98
Σ PUFA				42.20	45.52	38.83	43.20	42.09	26.61
Σ MUFA+ Σ PUFA				68.01	70.54	62.08	77.36	79.43	52.59
Σ SFA/ Σ UFA				0.47	0.40	0.60	0.28	0.25	0.88
Σ PUFA/ Σ MUFA				1.64	1.82	1.67	1.26	1.13	1.02

CONCLUSIONS

Saturated fatty acids include palmitic acid (C16: 0) as the predominant FA in the analyzed samples, with a maximum of 22.5% in pike roe. The concentration of monounsaturated ω-7 fatty acids (palmitoleic acid and oleic acid) varied between 2.47% (tarama roe) and 11.08% (salmon roe), while for ω-9 fatty acid varied from 17.45% (pike roe) to 26.26% (salmon roe). Polyunsaturated fatty acids are smaller than 45.52%, while the concentration of ω-3 fatty acids varied from 8.32% in tarama roe to 36.74% in lumpfish roe. The PUFA / MUFA ratio varies between 1.02% for pike roe and 1.82% for cod roe. Further studies are required to quantify the fatty acids from commercial fish roes and determine their correlation between chemical composition and biological activities.

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