ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ
«ХАЛЫҚ» ЖҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

NEWS

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF
KAZAKHSTAN
«Halyk» Private Foundation

SERIES CHEMISTRY AND TECHNOLOGY

2 (459)

APRIL – JUNE 2024

PUBLISHED SINCE JANUARY 1947

PUBLISHED 4 TIMES A YEAR

ALMATY, NAS RK

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

«ҚР ҰҒА Хабарлары. Химия және технология сериясы»
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ66VPY00025419** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *органикалық химия, бейорганикалық химия, катализ, электрохимия және коррозия, фармацевтикалық химия және технологиялар.*

Мерзімділігі: жылына 4 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19

http://chemistry-technology.kz/index.php/en/arhiv

Редакцияның мекенжайы: 050100, Алматы қ., Қонаев к-сі, 142, «Д.В. Сокольский атындағы отын, катализ және электрохимия институты» АҚ, каб. 310, тел. 291-62-80, факс 291-57-22, e-mail:orgcat@nursat.kz

«Известия НАН РК. Серия химии и технологий».
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ66VPY00025419,** выданное 29.07.2020 г.

Тематическая направленность: *органическая химия, неорганическая химия, катализ, электрохимия и коррозия, фармацевтическая химия и технологии.*

Периодичность: 4 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19

http://chemistry-technology.kz/index.php/en/arhiv

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News of the National Academy of Sciences of the Republic of Kazakhstan. Series of chemistry and technology.
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)
Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).
The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ66VPY00025419,** issued 29.07.2020.
Thematic scope: *organic chemistry, inorganic chemistry, catalysis, electrochemistry and corrosion, pharmaceutical chemistry and technology.*
Periodicity: 4 times a year.
Circulation: 300 copies.
Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19
http://chemistry-technology.kz/index.php/en/arhiv

Editorial address: JSC «D.V. Sokolsky institute of fuel, catalysis and electrochemistry», 142, Kunayev str., of. 310, Almaty, 050100, tel. 291-62-80, fax 291-57-22, e-mail: orgcat@nursat.kz

NEWS OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES CHEMISTRY AND TECHNOLOGY
ISSN 2224–5286
Volume 2. Number 459 (2024), 177–190
https://doi.org/10.32014/2024.2518-1491.231

UDC 54.064, 599.745.31

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RESEARCH ON THE CHEMICAL COMPOSITION OF SEAL OIL

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Abstract. The study presents the fundamental technique involved in obtaining seal oil. An in-depth investigation into the chemical composition of artisanal seal oil and pharmaceutical fish oil has been conducted. The research involved a robust method of extracting subcutaneous fat from seals to obtain seal oil. Organic compounds were analyzed using a gas chromatograph, while heavy metal content was assessed using an inductively coupled plasma emission spectrometer (ICP-OES) and a mercury analyzer. Lipids were separated using the Bligh-Dyer method with a binary solvent of chloroform and ethanol in a 2:1 ratio to determine markers for oxidative deterioration, fractional composition, and fatty acids. The content of polyunsaturated fatty acids in seal oil varied with the type of seal, gender, fishing season, and extraction regime. A comparative analysis revealed that the lack of heating temperature control during the handcraft extraction of oil results in the loss of beneficial characteristics of numerous compounds. It was also found that uncontrolled processes result in increased concentrations of heavy metals such as cadmium, lead, arsenic, and others.

Keywords: Caspian seal, seal oil, fish oil, handicraft industry, chemical analysis, polyunsaturated fatty acids, heavy metals

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ИТБАЛЫҚ МАЙЫНЫҢ ХИМИЯЛЫҚ ҚҰРАМЫН ЗЕРТТЕУ

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Аннотация. Зерттеу барысында тығыздағыш майын алудың негізгі әдістемесі ұсынылған. Қолдан жасалған итбалық майы мен фармацевтикалық балық майының химиялық құрамына терең зерттеу жүргізілді. Зерттеуге итбалық майын алу үшін итбалықтардың тері астындағы майды алудың сенімді әдісі қолданылды. Органикалық қосылыстар газ хроматографының көмегімен талданды, ал ауыр металдардың құрамы индуктивті байланысқан плазмалық оптикалық эмиссия спектрометрі мен сынап анализаторының көмегімен бағаланды. Липидтер тотығу деградациясының, фракциялық құрамының және май қышқылдарының маркерлерін анықтау үшін хлороформ мен этанолдың екілік еріткішімен 2:1 қатынасында Bligh-Dyer әдісімен бөлінді. Итбалық майындағы полиқанықпаған май қышқылдарының мөлшері итбалық түріне, жынысына, балық аулау маусымына және экстракция режиміне байланысты өзгерді. Салыстырмалы талдау көрсеткендей, майды қолмен алу кезінде қыздыру температурасын бақылаудың болмауы көптеген қосылыстардың пайдалы қасиеттерін жоғалтуға әкеледі. Сондай-ақ, бақыланбайтын процестер кадмий, қорғасын, күшән және басқалары сияқты ауыр металдардың концентрациясының жоғарылауына әкелетіні анықталды.

Түйін сөздер: Каспий итбалығы, итбалық майы, балық майы, қолөнер өнеркәсібі, химиялық талдау, полиқанықпаған май қышқылдары, ауыр металдар

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ИССЛЕДОВАНИЕ ХИМИЧЕСКОГО СОСТАВА ЖИРА ТЮЛЕНЯ

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Аннотация. Исследование представляет основную методику получения тюленьего жира. Было проведено глубокое изучение химического состава ручного тюленьего жира и фармацевтического рыбьего жира. В рамках исследования использовался надежный метод извлечения подкожного жира тюленей для получения тюленьего жира. Органические соединения анализировались с использованием газового хроматографа, а содержание тяжелых металлов определялось с помощью индуктивно связанного плазменного оптико-эмиссионного спектрометра (ИСП-ОЭС) и анализатора ртути. Липиды были разделены методом Блай-Дайера с использованием бинарного растворителя хлороформа и этанола в соотношении 2:1 для определения маркеров окислительного распада, фракционного состава и жирных кислот. Содержание полиненасыщенных жирных кислот в тюленьем жире варьировалось в зависимости от типа тюлени, пола, сезона ловли и режима извлечения. Сравнительный анализ показал, что отсутствие контроля температуры нагрева во время ручного извлечения масла приводит к потере полезных характеристик множества соединений. Также было установлено, что неуправляемые процессы приводят к увеличению концентрации тяжелых металлов, таких как кадмий, свинец, мышьяк и другие.

Ключевые слова: каспийский тюлень, жир тюленя, рыбий жир, кустарная промышленность, химический анализ, полиненасыщенные жирные кислоты, тяжелые металлы

Introduction

In recent years, the problem of by-catch in the global illicit fishing industry has been more acute than ever before. In Kazakhstan, special attention is being paid to a drainless water body, such as the Caspian Sea. Today, sturgeon poaching and by-catch of seals, as well as deliberate poaching of seals, are among the most significant threats to the Caspian seal population. Traditionally marine mammals are considered to be sources for fur, industrial oil, feed meal, and biologically active food additives. Today, on the black market in the cities, such as Atyrau and Aktau, handicraft seal oil is sold all year, presumably from Caspian seal lard in 0.5 liters, 0.25 liters, and 5-liter plastic containers. Typically, there are no specifics regarding the production time or the methods of obtaining the product. There are no labels or manufacturer's addresses to be found. The lack of such critical information raises concerns about the authenticity of sea oil. Furthermore, the use of artisanal products could be hazardous to one's health, as the majority of the oils are obtained at home through melting, pressing, or extraction without regard for sanitary regulations.

Research in the field of the physicochemical composition of fat-containing raw materials of marine mammals and their production technology has been extensively conducted scientific community (Shahidi and et al., 2002; Privezentsev, 2008; Khlebnyy, 2019; Boeva, 2017; Grahl-Nielsen, 2005; Bonilla-Méndez, 2018; Dannenberger, 2020; Watanabe, 2020). Numerous studies have found that the oils of marine animals (fish, marine mammals, and invertebrates) are high in polyunsaturated fatty acids and antioxidants.

In this article, we present a robust method of extracting the subcutaneous fat of a seal. The chemical composition of a handcraft Caspian seal's oil has been thoroughly investigated. We have also considered pharmaceutical fish oils as a comparison.

Seal Oil Extraction Technique. Seal oil could be extracted in several ways, such as evaporation, cold pressing, and using organic solvents (Beaudoin, 1999; Mukatova, 2008). Before receiving the product, the oil obtaining material was subjected to special processing (washing, cleaning, grinding, crushing, drying, separation, filtration, etc.). As a raw material, subcutaneous fat obtained from a seal carcass was utilized. The fat was then subjected to separation to remove impurities, water, and protein substances in fat separators. Before separation, the fat was heated to a temperature of 85 °C. The heated fat was mixed with hot freshwater with a temperature of up to 90 °C in the separator. For enhanced cleaning, a 2–3-fold separation could be used. After separation, the fat was cooled to 0 °C and a part of triglycerides was crystallized, which was then separated during filtration. The fat was filtered to produce a homogeneous liquid product, with the solid portion being used for technical purposes.

The oil was then placed in a container with a stirrer and heated to a temperature of 30–40 °C. After continuous stirring, it was irrigated through a spray device with a solution of a mixture of sodium bicarbonate and sodium chloride with a concentration of 2% in a ratio of 1:1, heated to 50–60 °C, respectively, in an amount of 5–10 % by weight of oil (depending on the content of free fatty acids in oil) for 20–45 minutes, gently stirred, after which the mixer was turned off. The mixture was precipitated for 1–2 hours and stirred occasionally. The lower layer was drained after the oil was precipitated, and the oil was washed 2–3 times with a hot saline solution of up to 2 % concentration at a temperature of 50–60 °C, and then at least three times with fresh hot water at a temperature of 70 °C until the traces of sodium bicarbonate salts disappeared. The oil was precipitated for 20–25 minutes after each washing. The washed oil was heated to 80 °C and then filtered through a fat separator.

In addition, the oil was brightened with bleaching clay. It was combined with clay in a 1:0.1–1:0.5 ratio, thoroughly mixed, then precipitated for 1 hour before centrifugation. The oil was then poured into a clean container. Subsequently, in a ratio of 1:0.2–1:0.5, deodorization with activated carbon is carried out. The oil is mixed, then precipitated before being centrifuged. The oil was placed into a clean container. Alternatively, the process of molecular distillation was utilized for deodorization and purification from organochlorine pesticides, which required the oil to flow over the evaporation surface in a thin layer while being vigorously stirred and heated under vacuum. Molecular distillation was carried out in “triturated film” devices, in which specific trituration devices ensured a high efficiency of mixing the oil on the evaporator. The oil had to be transparent, with an acceptable moisture level of up to 0.3 %. Clean bins were used to collect clear oil, which was then shipped to be encapsulated and packaged in containers. Figure 1 shows a diagram of the technique for extracting seal oil.

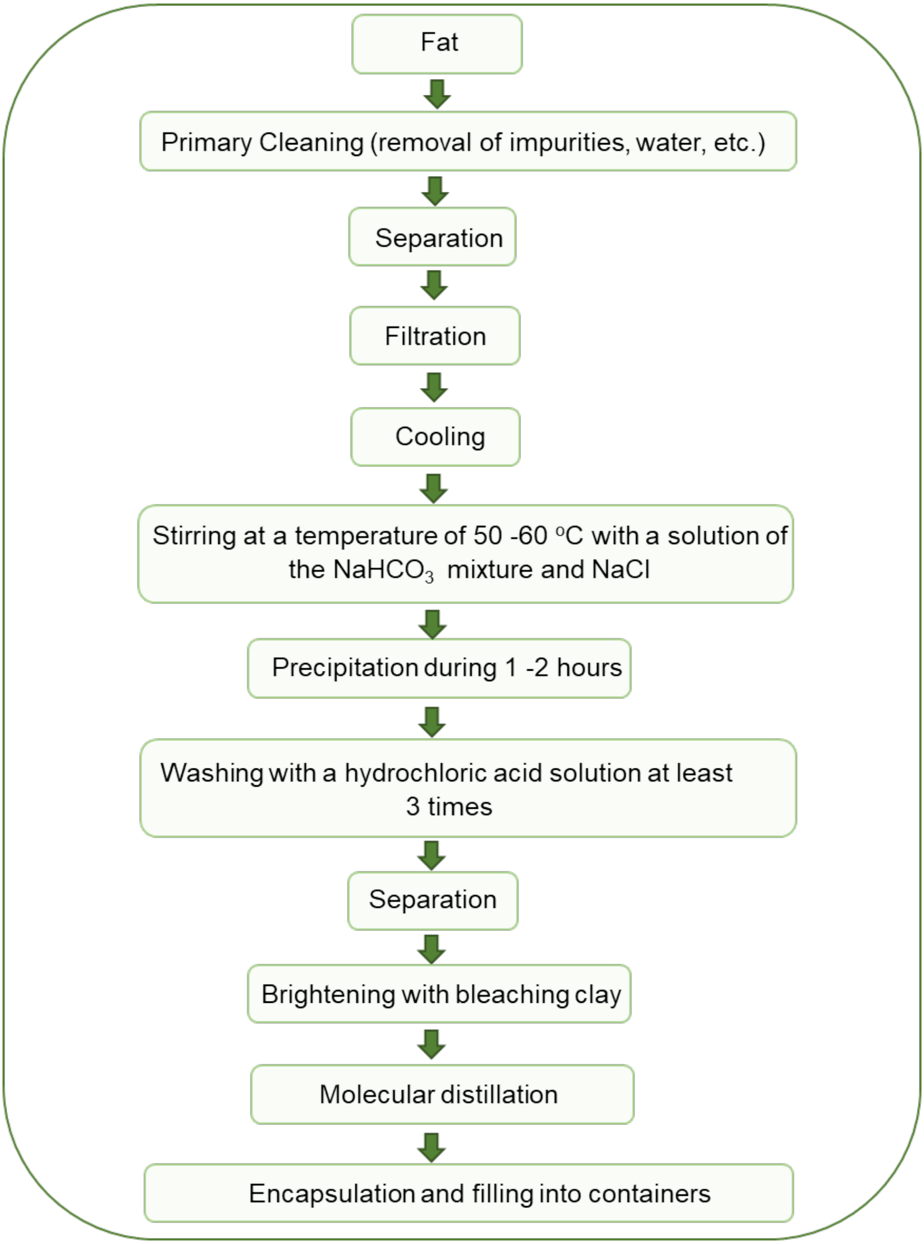

Figure 1. Diagram of the procedure for extracting seal oil

Materials and methods

Figure 2 shows the three types of oils utilized in the study: fish oil (pharmacy), seal oil-1 (melted), and seal oil-2 (melted). Seal oil was obtained by the artisanal method and purchased in the market of Aktau city.

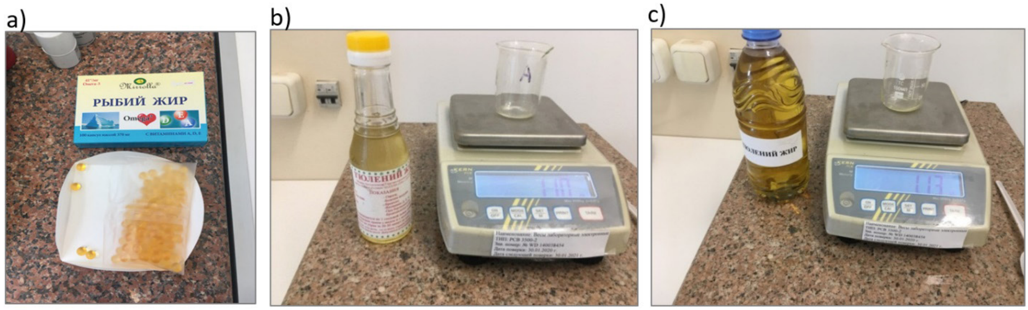

Figure 2. a) Fish oil in capsules. b) Artisanal seal oil-1 and c) Artisanal seal oil-2

For the analysis a gas chromatograph (7890B, Agilent) with a 5977A MSD, an HP-5MS column was used. The following parameters were utilized: GC, evaporator temperature of 230 °C, split mode - *Splitless*, column flow of 1.2 ml/min, initial oven temperature of 50 °C, a heating rate of 10 °C/min, final oven temperature of 240 the °C, retention time of 3 min.

The content of metals such as Ba, Ca, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Sn, V, Zn in oil was determined on an inductively coupled plasma optical emission spectrometer (8300, Optima). Mercury was determined on a mercury analyzer (MAS-50). GOST 26929 “Mineralization for the determination of the content of toxic elements” was followed when preparing samples for toxic element testing. GOST 30178 “Method for determination of toxic element” was used to determine the concentration of toxic elements, such as lead and cadmium. Arsenic was analyzed according to GOST 26930 on an atomic absorption spectrophotometer (240Z, Agilent). Meanwhile, GOST 7636 was used to create indicators of hydrolytic and oxidative deterioration of lipids from fish and seal fat lipid samples. GOST 26593 was used to recalculate peroxide levels per mmol of active oxygen/kg.

The lipids were separated using the Bligh-Dyer method using a binary solvent chloroform ethanol in a 2:1 ratio to determine oxidative deterioration, fractional, and fatty acid composition markers. The fatty acid composition of lipids was determined on an Agilent chromatograph on a capillary column with an inner diameter of 0.25 mm, a length of 25 m, and a deposited FFAP phase with preliminary lipid methylation.

Results and discussions

Blubber of seals comprises (%): 75,0–98,0 oil, 3,0–9,0 moisture, protein 1,5–3,0. The chemical composition of the blubber varies depending on the gender, age, condition of the seal flesh, and the hunting season [4]. The majority of the fat in a seal is concentrated in the cover fat, which varies in thickness depending on the fatness of the seal. Following the birth of offspring, there is intensive use of reserve fats, the animal is depleted and the layer of cover fat can be as thin as 3.0 cm in the spring. In autumn, the thickness of cover fat increases to 8.0 cm; the animal’s fatness is highest in November.

The oil from high-quality seal blubber is translucent and has a light-yellow color, a nice taste, and a very weak particular odor that abruptly develops as fat oxidation progresses (Kizevetter, 1976; Petrova, 2009). The study provides physicochemical indications of fat, fractional composition of lipids in seal cover fat, and percent of total fractions. Tables 1–4 show the results of the analysis of seal and fish oil by gas chromatography with mass selective detection (GC MSD). Table 1 lists the chemical components discovered in all samples. Table 2 lists the results for fish oil and seal oil-1, and Table 3 lists the results for fish oil and seal oil-2. Meanwhile, the results of seal oil-1 and seal oil-2 samples are shown in Table 4. It should be noted the highest concentration of organic compounds was found in fish oil (see Table 5).

Table 1. Chemical composition analysis of all samples (fish oil, seal oil-1 and seal oil-2).

№	The title of the substance, (formula)	Formula	Percentage of the total mass (%)		
			Fish oil (pharmacy)	Seal oil-1	Seal oil-2
1	2-Decenal, (E)-	$C_{10}H_{18}O$	0,08	0,86	1,71
2	2,4-Decadienal, (E,E)-	$C_{10}H_{16}O$	1,08	30,74	33,40
3	Adrenalone	$C_9H_{11}NO_3$	0,13	0,30	1,31
4	Pentadecane	$C_{15}H_{32}$	1,02	1,94	4,59
5	1,8(2H,5H)-Naphthalenedione, hexahydro-8a-methyl-, cis-	$C_{11}H_{16}O_2$	0,28	0,37	2,18
6	dl-Phenylephrine	$C_9H_{13}NO_2$	0,02	0,30	0,28
7	2H-Azepin-2-one, hexahydro-1-methyl-	$C_7H_{13}NO$	0,08	0,27	0,79
8	Methyl 4,7,10,13-hexadecatetraenoate	$C_{17}H_{26}O_2$	0,07	0,31	0,91
9	Heptadecane	$C_{17}H_{36}$	4,13	1,14	6,31
10	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	0,48	0,63	3,99

Table 2. Chemical composition analysis of oil fish oil and seal oil-1

№	The title of the substance, (formula)	Formula	Percentage of the total mass (%)		
			Fish oil (pharmacy)	Seal oil -1	Seal oil -2
1	Butylated Hydroxytoluene	$C_{15}H_{24}O$	26,97	16,13	0
2	Pentadecane, 2,6,10,14-tetramethyl-	$C_{19}H_{40}$	6,58	31,02	0
3	Methyl 6,9,12,15,18-heneicosapentaenoate	$C_{22}H_{34}O_2$	0,41	1,24	0
4	Kaur-16-ene	$C_{20}H_{32}$	0,64	5,04	0

Table 3. Chemical composition analysis of oil fish oil and seal oil-2

№	The title of the substance, (formula)	Formula	Percentage of the total mass (%)		
			Fish oil (pharmacy)	Seal oil-1	Seal oil -2
1	7-Methylene-9-oxabicyclo[6.1.0]non-2-ene	$C_9H_{12}O$	0,35	0	4,55
2	Methyl 10,12-octadecadiynoate	$C_{19}H_{30}O_2$	0,03	0	0,76
3	1,8(2H,5H)-Naphthalenedione, hexahydro-8a-methyl-, cis-	$C_{11}H_{16}O_2$	0,10	0	1,45
4	Methyl 6,9,12,15-hexadecatetraenoate	$C_{17}H_{26}O_2$	0,02	0	0,75
5	3-Heptadecene	$C_{17}H_{34}$)	0,45	0	3,49
6	Octadecanoic acid	$C_{18}H_{36}O_2$	0,09	0	0,91
7	Hexadecanal	$C_{16}H_{32}O$	0,18	0	2,03
8	Imidazole, 2-amino-5-[(2-carboxy)vinyl]	$C_6H_7N_3O_2$	0,04	0	0,63

Table 4. Chemical composition analysis of seal oil-1 and seal oil- 2

№	The title of the substance, (formula)	Formula	Percentage of the total mass (%)		
			Fish oil (pharmacy)	Seal oil-1	Seal oil - 2
1	2-Pentadecyn-1-ol	$C_{15}H_{28}O$	0	0,48	2,32
2	2H-Azepin-2-one, hexahydro-1-methyl-	$C_7H_{13}NO$	0	0,42	1,40
3	Octadecane, 6-methyl-	$C_{19}H_{40}$	0	0,27	0,48
4	N-dl-Alanylglycine	$C_5H_{10}N_2O_3$	0	0,20	0,41

Table 5. Chemical composition analysis of fish oil and seal oil- 2

№	The title of the substance, (formula)	Formula	Percentage of the total mass (%)		
			Fish oil (pharmacy)	Seal oil-1	Seal oil-2
1	1-(5-Bicyclo[2.2.1]heptyl)ethylamine	$C_9H_{17}N$	0	0	0,31
2	2-(Prop-2-enoyloxy)pentadecane	$C_{18}H_{34}O_2$	0	0	1,01
3	1,2,3-Propanetriol, diacetate	$C_7H_{12}O_5$	0,36	0	0
4	Z,Z-2,5-Pentadecadien-1-ol	$C_{15}H_{28}O$	0	0	2,25
5	Falcarinol	$C_{17}H_{24}O$	0,08	0	0
6	Methylparaben	$C_8H_8O_3$	36,15	0	0

№	The title of the substance, (formula)	Formula	Percentage of the total mass (%)		
			Fish oil (pharmacy)	Seal oil-1	Seal oil-2
7	Dimethoxyamphetamine, 2,5-	$C_{11}H_{17}NO_2$	0,08	0	0
8	Phenol, 3-methyl-5-(1-methylethyl)- methylcarbamate	$C_{12}H_{17}NO_2$	0,00	0,40	0
9	3-tert-Butyl-4-hydroxyanisole	$C_{11}H_{16}O_2$	0,67	0	0
10	dl-Phenylephrine	$C_9H_{13}NO_2$	0	0	0,29
11	1,4-Benzenediol, 2-(1,1-dimethylethyl)-	$C_{10}H_{14}O_2$	0,23	0	0
12	Nonadecane	$C_{19}H_{40}$	0,12	0	0
13	E,Z-2,13-Octadecadien-1-ol	$C_{18}H_{34}O$	0,39	0	0
14	E,E-1,9,17-Docasatriene	$C_{22}H_{40}$	0,00	0	0,35
15	8-Heptadecene	$C_{17}H_{34}$	0,32	0	0
16	E-14-Hexadecenal	$C_{16}H_{30}O$	1,46	0	0
17	Eicosane, 10-methyl-	$C_{21}H_{44}$	0,19	0	0
18	Tetradecanoic acid, ethyl ester	$C_{16}H_{32}O_2$	0,25	0	0
19	2-Pentadecanone, 6,10,14-trimethyl-	$C_{18}H_{36}O$	0,00	1,01	0
20	E,E-1,9,17-Docasatriene	$C_{22}H_{40}$	0,12	0	0
21	9-Nonadecene	$C_{19}H_{38}$	0,29	0	0
22	n-Propyl tetradecanoate	$C_{17}H_{34}O_2$	0,32	0	0
23	Androstane-11,17-dione, 3-[(trimethylsilyl)oxy]-, 17-[O-(phenylmethyl)oxime], (3α,5α)-	$C_{29}H_{43}NO_3Si$	0,00	0,43	0
24	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	0,10	0	0
25	9-Hexadecenoic acid	$C_{16}H_{30}O_2$	0	0	16,13
26	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	1,21	0	0
27	Ethyl 9-hexadecenoate	$C_{18}H_{34}O_2$	0,27	0	0
28	1,3,6,10-Cyclotetradecatetraene, 3,7,11-trimethyl-14-(1-methylethyl)-, [S-(E,Z,E,E)]-	$C_{20}H_{32}$	0,30	0	0
29	Hexadecanoic acid, ethyl ester, ($C_{18}H_{36}O_2$)	$C_{18}H_{36}O_2$	0,40	0	0
30	Z-(13,14-Epoxy)tetradec-11-en-1-ol acetate	$C_{16}H_{28}O_3$	0,13	0	0
31	i-Propyl hexadecanoate, ($C_{19}H_{38}O_2$)	$C_{19}H_{38}O_2$	1,18	0	0
32	9,10-Secocholesta-5,7,10(19)-triene-3,24,25-triol, (3β,5Z,7E)-	$C_{27}H_{44}O_3$	0,08	0	0

№	The title of the substance, (formula)	Formula	Percentage of the total mass (%)		
			Fish oil (pharmacy)	Seal oil-1	Seal oil-2
33	9,12,15-Octadecatrienoic acid, 2-[(trimethylsilyl)oxy]-1-[[(trimethylsilyl)oxy]methyl]ethyl ester, (Z,Z,Z)-	$C_{27}H_{52}O_4Si_2$	0,09	0	0
34	n-Propyl hexadecanoate	$C_{19}H_{38}O_2$	0,38	0	0
35	Vitamin A palmitate	$C_{36}H_{60}O_2$	0,20	0	0
36	Oleic Acid	$C_{18}H_{34}O_2$	5,33	0	0
37	Ethyl Oleate	$C_{20}H_{38}O_2$	0,48	0	0
38	1-Monolinoleoylglycerol trimethylsilyl ether	$C_{27}H_{54}O_4Si_2$	0	0,55	0
39	i-Propyl 9-octadecenoate	$C_{21}H_{40}O_2$	0,36	0	0
40	Androstane-11,17-dione, 3-[(trimethylsilyl)oxy]-, 17-[O-(phenylmethyl)oxime], (3α,5α)-	$C_{29}H_{43}NO_3Si$	0	0,96	0
41	Ergosta-5,22-dien-3-ol, acetate, (3β,22E)-	$C_{30}H_{48}O_2$	0,09	0	0
42	9,12,15-Octadecatrienoic acid, 2-[(trimethylsilyl)oxy]-1-[[(trimethylsilyl)oxy]methyl]ethyl ester, (Z,Z,Z)-	$C_{27}H_{52}O_4Si_2$	0,14	0	0

By looking at the data in Table 1, we can see that although composition and quantitative chemical content of oils are different, 2-decenal, (E)-($C_{10}H_{18}O$), 2,4-decadienal, (E, E)-($C_{10}H_{16}O$), adrenalone ($C_9H_{11}NO_3$), pentadecane ($C_{15}H_{32}$), 1,8 (2H, 5H)-naphthalenedione, hexahydro-8a-methyl-, cis- ($C_{11}H_{16}O_2$), dl-phenylephrine ($C_9H_{13}NO_2$), 2h-azepin-2-one, hexahydro-1-methyl- ($C_7H_{13}NO$), methyl 4,7,10,13-hexadecatetraenoate ($C_{17}H_{26}O_2$), heptadecane ($C_{17}H_{36}$), 3,7,11,15-tetramethyl-2-hexadecen-1-ol ($C_{20}H_{40}O$) were found in all samples.

7-methylene-9-oxabicyclo [6.1.0] non-2-ene ($C_9H_{12}O$), methyl 10,12-octadecadiynoate ($C_{19}H_{30}O_2$), 1,8 (2H, 5H) n, hexahydro-8a-methyl-, cis- ($C_{11}H_{16}O_2$), methyl 6,9,12,15-hexadecatetraenoate ($C_{17}H_{26}O_2$), 3-heptadecene, (Z)-($C_{17}H_{34}$), octadecanoic acid ($C_{18}H_{36}O_2$), hexadecanal ($C_{16}H_{32}O$), imidazole, 2-amino-5-[(2-carboxy) vinyl] - ($C_6H_7N_3O_2$) present in large quantities in fish oil and seal oil-2 (Table 3).

The results of analyzes of samples of fish and seal oil-2 show with except methyl 10,12-octadecadiynoate ($C_{19}H_{30}O_2$), the concentration of other substances in fish oil is 2 or more times higher than in seal oil 2, 7-methylene-9-oxabicyclo [6.1.0] non-2-ene ($C_9H_{12}O$), 1,8 (2H, 5H) -naphthalenedione, hexahydro-8a-methyl-, cis-($C_{11}H_{16}O_2$), methyl 6,9,12,15-hexadecatetraenoate ($C_{17}H_{26}O_2$), 3-Heptadecene, (Z)-($C_{17}H_{34}$), octadecanoic acid ($C_{18}H_{36}O_2$), hexadecanal ($C_{16}H_{32}O$), imidazole, 2-amino-5-[(2-carboxy) vinyl] - ($C_6H_7N_3O_2$). The above substances were not found in the seal oil-1.

The following substances were not found in fish oil table 4: 2-pentadecyn-1-ol ($C_{15}H_{28}O$, 2H-azepin-2-one, hexahydro-1-methyl-($C_7H_{13}NO$), octadecane, 6-methyl-($C_{19}H_{40}$), n-dl-alanylglycine ($C_5H_{10}N_2O_3$).

According to Table 5 the following substances were found only in fish oil: 1,2,3-propanetriol, diacetate ($C_7H_{12}O_5$), falcarinol ($C_{17}H_{24}O$), methylparaben ($C_8H_8O_3$), dimethoxyamphetamine, 2,5- ($C_{11}H_{17}NO_2$), 3-tert-butyl-4-hydroxyanisole ($C_{11}H_{16}O_2$), 1,4-benzenediol, 2-(1,1-dimethylethyl)-($C_{10}H_{14}O_2$), nonadecane ($C_{19}H_{40}$), E, Z-2,13-octadecadien-1-ol ($C_{18}H_{34}O$), 8-heptadecene ($C_{17}H_{34}$), e-14-hexadecenal (C16H30O), eicosane, 10-methyl- ($C_{21}H_{44}$), tetradecanoic acid, ethyl ester ($C_{16}H_{32}O_2$), E, E-1,9,17-docasatriene ($C_{22}H_{40}$), 9-nonadecene ($C_{19}H_{38}$), n -propyl tetradecanoate ($C_{17}H_{34}O_2$), hexadecanoic acid, methyl ester ($C_{17}H_{34}O_2$), n-hexadecanoic acid ($C_{16}H_{32}O_2$), ethyl 9-hexadecenoate ($C_{18}H_{34}O_2$), 1,3,6,10-cyclotetradecatetraene, 3,7,11-trimethyl-14-(1-methylethyl)-, [S- (E, Z, E, E)]-($C_{20}H_{32}$), hexadecanoic acid, ethyl ester (C18H36O2), Z-(13,14-epoxy) tetradec-11-en -1-ol acetate ($C_{16}H_{28}O_3$), i-propyl hexadecanoate ($C_{19}H_{38}O_2$), 9,10-secocholesta-5,7,10 (19)-triene-3,24,25-triol, (3β, 5Z, 7E)-($C_{27}H_{44}O_3$), 9,12,15-octadecatrienoic acid, 2-[(trimethylsilyl) oxy]-1-[[(trime thylsilyl) oxy] methyl] ethyl ester, (Z, Z, Z)-($C_{27}H_{52}O_4Si_2$), n-propyl hexadecanoate ($C_{19}H_{38}O_2$), vitamin A palmitate ($C_{36}H_{60}O_2$), oleic acid ($C_{18}H_{34}O_2$), ethyl Oleate ($C_{20}H_{38}O_2$), i-propyl 9-octadecenoate ($C_{21}H_{40}O_2$), ergosta-5,22-dien-3-ol, acetate, (3β, 22E)-($C_{30}H_{48}O_2$), 9,12,15-octadecatrienoic acid, 2-[(trimethylsilyl) oxy]-1-[[(trimethylsilyl) oxy] methyl] ethyl ester, (Z, Z, Z)-($C_{27}H_{52}O_4Si_2$). In the samples of seal oils those substances were absent.

The following substances were found in the seal oil-1: phenol, 3-methyl-5-(1-methylethyl)-methylcarbamate ($C_{12}H_{17}NO_2$), 2-pentadecanone, 6,10,14-trimethyl-($C_{18}H_{36}O$), 1-monolinoleoylglycerol trimethylsilyl ether ($C_{27}H_{54}O_4Si_2$), and rostane-11,17-dione, 3- [(trimethylsilyl) oxy]-, 17-[O-(phenylmethyl) oxime], (3α, 5α)-($C_{29}H_{43}NO_3Si$). Those substances were absent in fish oil and seal oil-2.

The following substances were found only in a sample of seal oil-2: 1-(5-bicyclo [2.2.1] heptyl) ethylamine ($C_9H_{17}N$), 2- (prop-2-enoyloxy) pentadecane ($C_{18}H_{34}O_2$), Z, Z-2,5- pentadecadien-1-ol ($C_{15}H_{28}O$), dl-phenylephrine ($C_9H_{13}NO_2$), E, E-1,9,17-docasatriene ($C_{22}H_{40}$), 9-hexadecenoic acid ($C_{16}H_{30}O_2$).

The indicators of hydrolytic and oxidative reactions are presented in Table 6. As we see, the lipids of all samples meet the requirements for edible fats from mammals, however, the acid number of samples of seal oil-1 and seal oil-2 is at the MPC level.

Table 6. Indicators of hydrolytic oxidative and long-term lipid spoilage of fish and seal oil samples

Name of the indicator	MPC, no more	Actual Lipid from Cover Fat		
		Fish oil	Seal oil-1	Seal oil-2
Peroxide number, mmol of active oxygen/kg	10	1,3	8,5	9,2
Acid number, mg KOH / g	4	0,8	3,9	4,0

The analysis of the obtained data indicates that in the fish oil sample the peroxide and acid numbers do not exceed the MPC, however, the acid number in the samples of seal oil-1 is 3.9, and in the sample of seal oil-2 is at the MPC level. The results of analyzes for the content of metals are shown in Table 7. It should be noted that the content of metals in the oil samples did not exceed the MPC level.

Table 7. Content of the metals in the oil, mg/kg

Elements	MPC	Fish oil	Seal oil-1	Seal oil-2
Cd	0,2	Not detected	0,10	0,11
Pb	1,0	0,0726	0,15	0,30
Hg	0,3	Not detected	Not detected	Not detected
As	1,0	Not detected	0,50	0,47
Ba		Not detected	Not detected	Not detected
Ca		0,084	0,054	0,077
Co		0,0096	Not detected	Not detected
Cr	0,5	Not detected	Not detected	Not detected
Cu	10	0,029	0,0037	0,0077
Fe	5	0,0033	Not detected	0,00080
Mg		0,0277	0,0631	0,00840
Mn		0,00178	Not detected	Not detected
Mo		Not detected	Not detected	Not detected
Ni		0,193	0,00396	Not detected
Sn		Not detected	Not detected	Not detected
V		Not detected	Not detected	Not detected
Zn	40	0,00131	Not detected	Not detected

When extracting seal oil by handicraft, some factors are not taken into account, such as the initial preparation of the material, such as washing, drying, grinding, and so on. Even if some of the foregoing steps are carried out, the question remains as to under what circumstances all of this occurs? During the extraction by handicraft, the heating temperature is often not controlled, resulting in the loss of many compounds' beneficial characteristics during the process. An uncontrolled process also leads to increased concentrations of heavy metals such as cadmium, lead, and arsenic.

Conclusion

As can be seen from the results of laboratory studies, handicraft seal oil does not have all the medicinal properties. Therefore, its use for medicinal purposes is not recommended.

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http://chemistry-technology.kz/index.php/en/arhiv
ISSN 2518-1491 (Online), ISSN 2224-5286 (Print)

Подписано в печать 15.06.2024.
Формат 60х88 1/8. Бумага офсетная. Печать – ризограф.
13,0 п.л. Тираж 300. Заказ 2.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-19