

UDC 615.262.1

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E-mail: kdrakhimov@inbox.ru, zhanar90kz@mail.ru, aknurik_88@mail.ru**PROSPECTS FOR THE USE OF SAFFLOWER
(*CARTHAMUS TINCTORIUS* L) IN OPHTHALMOLOGY**

Abstract. Plant materials and preparations based on it continue to play an important role in the pharmacotherapy of many chronic and sluggish human diseases. Over the past two decades, there has been a very high consumer demand for medicines and preventive products obtained from natural plant sources. This is due to the complex effect of biologically active substances, vitamins, antioxidants of plant origin on the human body and the practical absence of side effects. An analysis of the development of phytopharmacology shows that the most promising direction in the field of the development of phytopreparations is the scientifically based use of the experience of traditional and modern medicine.

One of the promising types of raw material - medicinal plant safflower (*Carthamus tinctorius* L). It contains vitamins A, E, unsaturated fatty acids and other biologically active substances in large quantities, that determine antimicrobial, antifungal, anti-inflammatory, antioxidant properties. Thanks to these pharmacological effects, the content of vitamins is promising for the development and introduction of a drug used in the field of ophthalmology.

To this end we have searched and analysed scientific publications about safflower – *Carthamus tinctorius*. All studies used in this review have been found using «Google Scholar» scientific search engine and were selected from publications indexed in Web of science, PubMed, Medline, E-library, and Cyberleninka databases.

Key words: safflower, eye diseases, ophthalmopharmacology, phytopreparation.

Currently, medicinal plants are becoming increasingly popular in the world, including in our country, used for the prevention and treatment of various diseases. In this regard, in the field of pharmacy and medicine, pharmaceutical development and production of domestic innovative herbal remedies. These initiative scientific directions include the collection and study of medicinal plant materials, pharmacognostic studies, pharmaceutical development of herbal remedies and other scientific studies, after which they can be recommended and used as medicines for the treatment of various diseases.

More than 7,000 different drugs are registered in the State Register of the Republic of Kazakhstan [19]. According to marketing analysis, the majority of these drugs come from abroad, and domestic drugs make up an insignificant amount.

In the structure of the general morbidity of the population of the Republic of Kazakhstan, ophthalmopathology takes fifth place after diseases of the respiratory, cardiovascular, digestive and genitourinary systems [1]. Around the world, about 285 million people suffer from visual impairment, of which 19 million are children and 39 million are blind [2]. In Kazakhstan, according to official figures, more than 1 million people turn to ophthalmologists every year. Among the main causes are injuries, inflammatory diseases, myopia, cataracts, glaucoma and age-related macular degeneration [1].

Anti-inflammatory and Analgesic Properties Although a number of steroidal or non-steroidal anti-inflammatory drugs have been developed, researchers are changing their focus to natural products to develop new anti-inflammatory agents due to the side-effects of chemical drugs. As a result, the search for other alternatives seems necessary and beneficial. *C. tinctorius* are an open door for new and effective compounds [18, 20].

Carthamus tinctorius L. is commonly known as Safflower. *C. tinctorius* extracts and oil are important in drug development with numerous pharmacological activities in the world. This plant is cultivated mainly for its seed, which is used as edible oil [18].

Safflower (*Carthamus tinctorius L.*) ranks eighth among the major oilseeds crop grown worldwide. The leaves, flowers and seeds have medicinal and industrial significance. *Carthamus tinctorius L.* is commonly known as Safflower. *C. tinctorius* extracts and oil are important in drug development with numerous pharmacological activities in the world. This plant is cultivated mainly for its seeds, which are used as edible oil. Safflower (*Carthamus tinctorius L.*) belongs to the Compositae family. It is a herbaceous plant with pronounced external signs of the inhabitant of arid regions. Safflower has the following characteristic morphological indications: a solid, upright, bare and branchy stem depending on the variety and growing conditions over 100 cm. The leaves are leathery, oblong-lanceolate or elliptical, at the edges have teeth, usually end in thorns as a rule, but it should be noted that there are forms without thorns. The color of the safflower leaf is observed from light green to dark green. The flowers are small, tubular, yellow or orange. The corolla is five-partite, the stigma is rounded and the anthers firmly and tightly fit to the style. Safflower is characterized by an oval-shaped ovary and a long style. It is noted that the color of the corolla is in the range from white to red. The inflorescences of safflower are many-flowered, multi-seeded baskets in shape are conical, dome-shaped or flat. The flower basket is from 1.5 to 4 cm in diameter, and the number of baskets per individual varies and depends both on the variety and cultivation conditions (from 14 to 60, and an average of 18). The number of seeds in the basket is from 25 to 60. The basket wrap is double, the outer scales of the wrapper are of leaf-shaped. Depending on the variety, there are thorns on the edges, there are also forms without thorns. The nature of the covering films belongs to the inner scales of the wrapper, and with the help of a tight closure of the inner leaflets, no shedding of seeds occurs. The fruit of the safflower is the seed. Seeds are white, bare, obovoid, glossy, tetrahedral, elongated, with weakly protruding ribs. The seeds of safflower dye are all armored. It should be noted that the shell layer is very deep in the tissues of the shell. By mass, 1000 seeds correspond to 400 g. 50-60 % of the mass of the whole seed is the seed-coat. The root system of safflower is well developed and of taproot. According to P.I. Podgorny safflower roots structure is small-cell. The main root is located at a depth of 15-20 cm and is quite well branched, thinning far to 1.5-2 m deep in the soil. Lateral branches run horizontally from the main root, almost at an angle of 90° to the main taproot. They begin quite close to the soil surface (3-5 cm).

Safflower tinctorial is a cross-pollinated plant. Pollination occurs with the help of insects (bees). First of all, the central baskets of safflower bloom, then the lateral once, flowering of different types of baskets in one plant lasts about one month. The vegetation period (the number of days from full germination to full maturity) is divided into varieties and is in the following limits 93-152 days. According to authors such as N.V. Yakushkin and P.I. Podgorny, botanical characteristic is controversial. This is due to the difference in climatic zones and the dependence of the formation of different morphological characters on the variety of the plant. And this indicates that the study of safflower cultivated in the territory of the South Kazakhstan oblast is especially important and necessary.

Edge flowers of the flower basket and fatty oil from the seeds of safflower tinctorial are used for therapeutic purposes. Safflower flowers are used as components of flower teas. According to published data, it is known that substances containing in safflower play a large role in improving blood circulation, when blood stagnates, in improving the blood composition, in anemia, at high blood pressure, and in the consequences of brain hemorrhage.

According to observations at the Kazakh Research Institute of Plant Protection and Quarantine, it has been found that individuals after two weeks of taking safflower tea showed a decrease in blood viscosity to normal, hypertensive pressure reduced, and low pressure returned to normal, so we can say that safflower tea affects blood pressure. At the same time, it was noted that this drug doesn't have a negative effect for those who do not suffer from hypertension [18].

In Chinese traditional medicine, safflower tea is used by patients with heart failure, suffering from anemia, numbness of the upper and lower extremities. After taking tea for 4-6 months, full recovery occurs. Safflower tea is one of the flower teas produced by the Chinese. In Europe, safflower is known mainly because of the fact that vegetable oil, which has found its wide application in the food industry is made from safflower. Many people don't even suspect that this plant is able to cure numerous pathologies. This fact was the impetus for a close study of this tea. It made directly from the petals of this plant flowers. This tea is used, in most cases, as a

mean, which tends to facilitate the general well-being of patients in the presence of these or other diseases of the gastrointestinal tract [18].

There is evidence that safflower flowers help to improve blood circulation, reduce inflammation, and also can reduce brain damage in connection with impaired blood flow, as well as preventing the occurrence of stroke. In addition, safflower petals help to block cell proliferation. While influencing the human body, safflower tea helps to relieve inflammation, prevents cell proliferation, and also improves blood circulation. Very often it is prescribed as a means of preventing psoriasis and malignant tumors. The composition of safflower flowers contains a fairly large number of useful substances used in the fight against numerous pathologies. Very often safflower is used in the treatment of pneumonia, jaundice, and also gastritis. In the case of gynecological diseases such as metritis and amenorrhea, the use of this plant is also shown. Quite often, this plant is also used as a choleric and laxative agent. Safflower has some other useful properties. So, for example, it also has diuretic, stimulating, emetic, antiseptic and astringent effects.

A decoction of the flowers of this plant treats peptic ulcer, gastritis, jaundice, and enterocolitis. The seeds of this plant provide with a blood-purifying and laxative effect. It is believed that the greatest benefits of this tea are cleansing the liver and kidneys, increasing sweating and healing of damage to the intestinal walls. Safflower tea is also an intestinal antiseptic. It should be taken for quite a long time, until the skin is completely cleansed, and then periodically carry out cycles of its reception, which helps the proper bowel movement. It should be taken for quite a long time, until the skin is completely cleansed, and then periodically carry out cycles of its reception, which helps the proper bowel movement [18].

Fatty oil from the seeds of safflower can be used in medicine as well as sunflower, its use is known externally for rheumatism. Use of safflower oil helps to low cholesterol. Safflower tinctural is actively used in cosmetics: safflower oil has a high moisture retention and moisture regulating ability and is well absorbed by any skin type as an emollient and moisturizing agent; it is used in shampoos and balms for dry hair, in night creams for dry skin, in sunscreens. As a result of scientific research, it was found that the chemical composition of safflower oil contains a record amount of gamma-tocotrienol compared to other types of vegetable oils, i.e. vitamin E. However, on the other hand, in the composition of safflower oil is completely absent no less important compound – squalene. In order to preserve all the benefits of safflower oil it is produced by cold pressing. However, in the food industry there is safflower oil, made by pressing or extraction. Safflower oil is actively used for medical as well as dietary purposes [18].

For example, with obesity or overweight, safflower oil helps to normalize the metabolic and digestive processes occurring in the human body. It reduces the amount of abdominal fat, while increasing muscle tissue. Linoleic acid contained in the safflower oil has a positive effect on the human body as a whole, and also contributes to the prevention and treatment of diseases of the cardiovascular system. Safflower oil is used not only as a food or medicine. This type of vegetable oil is actively used in the production of cosmetics for skin care and hair. It is not unreasonably believed that safflower oil can help in the treatment of some serious dermatological diseases. Safflower oil is able to penetrate into the deeper layers of the skin and saturate the cells with the necessary beneficial compounds of natural origin. For this reason, it is safflower oil that is the main component of expensive anti-aging cosmetics. The seed oil of safflower can be used to obtain provitamin A. According to the literature, the highest beta-carotene content in safflower oil is described, namely 12.68 mg / l [18].

The fatty oil obtained from seed kernels is close in taste to sunflower oil, and it is also used in the food industry. The oil extracted from whole seeds is bitter in taste, and therefore it is used for the production of varnish, white paint, enamel, soap, linoleum. Safflower seeds are good food for poultry. Oilcake in small quantities is fed to animals: in 100 kg it contains 55 feed units.

Data generalized indicate a significant variety of applications of plants of the *Carthamus* in popular and traditional medicine; screening experimental studies of scientific medicine have shown a wide range of biological activity of this species. Thus, *Carthamus tinctorius L.* is of great interest for the introduction into medical practice by the prevalence of the plant, the cultivation potential, the degree of knowledge of the chemical composition and pharmacological properties.

As of safflower production, Kazakhstan has been among the top five world leaders since 2000, and in 2010, with a harvest of 122.24 thousand tons, it became the second after India. In addition to these countries, safflower is actively grown in China, Uzbekistan, Ukraine, Australia, USA, Mexico, Argentina, Ethiopia, Tanzania.

There are several studies using of Safflower in ophthalmology practice.

The neuroprotective properties of Honghua was examined, an extract of safflower used as an herbal medicine in China, in several experimental models of retinal ischemia [4].

The possibility that previously demonstrated reductions in photoreceptor sensitivity to light in n-3 fatty-acid-deficient rats that can be explained by alterations in rhodopsin content, and/or function was investigated in rat retina [5].

The nature and reversibility of biochemical and functional changes in the retina encountered over a single generation of dietary n-3 polyunsaturated fatty acid deficiency in guinea pigs [6].

The molecular species composition of ethanolamine glycerophospholipids (EGP) in the primate retina and to examine the effects of different dietary fats, the authors fed rhesus monkeys diets containing widely ranging amounts of n-3 fatty acids was characterized.

Diets of differing n-3 fatty acid content had profound qualitative and quantitative effects on the molecular species of retinal phospholipids, and the replacement of 22:6(n-3) by 22:5(n-6) in the retinas of n-3 deficient monkeys was asymmetric and functionally incomplete [7].

A phytochemical study of the aerial organs of the safflower tinctorial was carried out. A technique has been developed for quantitative analysis of the amount of flavonoids in the safflower flowers. When using the results of phytochemical studies, it can be argued that safflower is not only a promising oilseed crop, but also a potential domestic medicinal raw material. Thus, the safflower tinctorial cultivated in the territory of the Samara region is promising for further justification of its use in medicine and pharmacy [8].

Recycling of docosahexaenoic acid in rat retinas during n-3 fatty acid deficiency was investigated. Analysis of plasma, liver, and the contralateral (non-injected) eye showed that the specific activity of 22:6 (n-3) was less than 1 % of the 22:6 (n-3) in the injected eye. These results suggest that, during n-3 deficiency, the retina conserves 22:6 (n-3) by recycling this fatty acid within the eyes [9].

Fat-1 mice can convert n-6 to n-3 fatty acids endogenously, resulting in the accumulation of n-3 fatty acids in major tissues. Highly enriched DHA and n-3 VLCFA in the retina lead to supernormal scotopic and photopic ERGs and increases in Müller cell reactivity and oxidative stress in photoreceptors. The regulation of n-3 fatty acids levels and of the n-6/n-3 fatty acid ratio are essential in preserving retinal integrity [12].

Docosahexaenoic acid can protect against hereditary retinal degenerations in transgenic mice expressing the V20G, P23H, and P27L (VPP) rhodopsin mutations was determined [13].

Polyunsaturated fatty acids (PUFA), especially docosahexaenoic acid (DHA, 22:6n-3), are enriched in phospholipids of vertebrate rod outer segments (ROS). Retinal ROS can incorporate 22 carbon (C-22) PUFA from the plasma pool where C-20 PUFA are predominant. In this study, we analyzed the fatty acid composition of retinal pigment epithelium (RPE) and ROS from rats fed different fatty acid supplements to determine whether this enrichment is at the photoreceptor-RPE boundary or the RPE-choriocapillaris boundary [14].

The effects of n-3 and n-6 polyunsaturated fatty acids (n-3 and n-6 PUFAs) in a murine model of herpetic chorioretinitis was examined. Results showed that mice fed on Menhaden oil (n-3 PUFAs) presented an early development of contralateral chorioretinitis by day 6 post-AC HSV-1 inoculation and also a significant increase in RNA HSV-1 expression compared with animals fed on Safflower and Corn oils. This increase of HSV-1 could be associated with the higher development of chorioretinitis. [15].

For a long time *C. tinctorius* has been used in traditional medicines as a purgative, analgesic, antipyretic and an antidote to poisoning [18].

The objective of this review has been to show the recent advances in the exploration of *C. tinctorius* as phytotherapy and to illustrate its potential as a therapeutic agent. With the current information, it is evident that *C. tinctorius* has pharmacological functions including antioxidant, anti-inflammation, analgesic, antidiabetic, hepatoprotective and antihyperlipidemic activities, among others [17]. As the current information shows, it is also possible that furanocoumarins might be useful in the development of new drugs to treat various diseases.

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САФЛОРАНЫ (*CARTHAMUS TINCTORIUS L*) (МАҚСАРЫ) ОФТАЛЬМОЛОГИЯДА ҚОЛДАНУДЫҢ КЕЛЕШЕГІ

Аннотация. Дәрілік өсімдік шикізаты және оның негізінде жасалынған фитопрепараттар адамды емдеу фармакотерапиясында маңызды рөл атқарады. Соңғы жиырма жылда емдеу және профилактикалық дәрілік заттар ретінде өсімдік шикізаты негізінде жасалған дәрілерге сұраныс дүние жүзінде күн санап артып келеді. Бұл дәрілік өсімдіктегі биологиялық белсенді заттың, дәрумендердің, антиоксиданттардың, микроэлементтердің және т.б. кешенді түрде адам ағзасына әсер етуі жоғары және жанама әсерінің төмен болуымен түсіндіріледі. Қазақстан Республикасында тіркелген дәрілік заттардың ішінде офтальмологияда қолданылатын дәрілер жалпы дәрілер санының 3 %-ын құрайды. Бұл дәрілік заттардың барлығы да – синтетикалық дәрілер. Фитофармакологияның дамуы фитопрепараттарды жасауда ерекше рөл атқарады, сонымен қатар халық және дәстүрлі медицинаның ғылыми негізде кенінен қолдануға мүмкіндік береді.

Солардың бірі – мақсары (сафлора – *Carthamus tinctorius L*) өсімдігі. Мақсары (*Carthamus tinctorius L*) күрделігүлділер тұқымдасына (*Compositae*) жатады. Құрамында А, Е дәрумендері, көп мөлшерде поликанықпаған май қышқылдары, линол қышқылы (70 %) және аз мөлшерде стеарин қышқылы бар моноқанықпаған олеин қышқылы (10 %) бар. Медицина саласында микробқа, бактерияға, зенге қарсы, қабынуға қарсы, антиоксидантты қасиетке ие. Құрамында дәрумендердің болуы, аталған фармакологиялық әсерлеріне байланысты, осы дәрілік өсімдіктен офтальмология саласында қолданатын препарат жасап, оны практикаға енгізудің болашағы зор. Сондықтан біз алғаш рет Қазақстанның оңтүстік аймағында өсірілетін мақсары дәнінің сығындысынан көзге арналған тамшының оптималды құрамын дайындадық.

Осы мақсатта мақсары (сафлора – *Carthamus tinctorius L*) өсімдігі бойынша ғылыми мақалаларға талдау жасадық. Әдебиеттік шолуға алынған мақалаларды «Google Scholar» ғылыми іздеу жүйелерімен және Web of science, PubMed, Medline, E-library и Cyberleninka индекстелетін деректер қорынан алдық.

Халық медицинасында мақсары шайын қан аздығымен ауыратын, аяқ-қолы ұйып қалатын ауруларда қолданады. *C. Tinctorius* су сығындысы халық медицинасында жүрек-тамыр ауруларын клиникалық емдеу үшін кеңінен қолданылатын көктамыр ішіне инъекция ретінде әзірленген. Қазақстандық өсімдіктер карантині және қорғауды бақылау ғылыми зерттеу институты мәліметтері бойынша, мақсары шайын екі апта бойы қабылдаған адамдардың қан тұтқырлығының нормаға түсетіні, гипертониктердің қысымы төмендегені, төмен қысым қалпына келетіні, сондықтан мақсары шайы артериялық қысымға әсер ететіні анықталған. *C. Tinctorius* – жүрек-тамыр, цереброваскулярлық және гинекологиялық ауруларда қолданылатын рецептілер үшін маңызды дәрілік зат. Мақсары гүлдері қан айналымын жақсартып, қабынуды азайтады және қан ағымының дұрыс болмауына байланысты миды зақымданудан сақтайды, сонымен қатар insultтың пайда болуына жол бермейтіні туралы мәліметтер бар. Одан басқа, мақсары жапырақтары жасушаның бөлінуіне тосқауыл болуға көмектеседі. Мақсары шайы адамның ағзасына әсер ете отырып, қабыну процестерін тоқтатуға көмектеседі, жасушалардың бөлінуінің алдын алады, сонымен бірге қан айналымын жақсартады. Оны өте жиі қатерлі ісіктердің және псориаздың алдын алу үшін дәрі ретінде қолданады. Пневмонияны, сары ауруды, гастритті емдегенде өсімдікті өте жиі қолданады. Метрит және аменорея сияқты гинекологиялық ауруларда осы өсімдіктің қолданылуы көрсетілген. Сондай-ақ бұл өсімдікті өт айдайтын және іш жүргізетін дәрі ретінде өте жиі пайдаланады. Мақсарыға басқа да бірнеше пайдалы қасиеттер тән. Мысалы, ол несеп жүргізетін, ынталандыратын, құстыртатын, антисептикалық қасиеттерімен белгілі.

Жинақталған мәліметтер *Carthamus* тұқымды өсімдіктің алуан түрлілігін дәстүрлі медицинада көрсетеді; скринингтік эксперименталды ғылыми медицинаның зерттеулері бұл түрдің кең түрдегі биологиялық белсенді спектрін көрсетеді.

Біздің ғылыми жұмысымыз сафлора негізінде жасалған көз тамшысын фундаменталды және қолданбалы офтальмологияда зерттеумен байланысты.

Тірек сөздер: мақсары, көз аурулары, офтальмофармакология, фитопрепараттар

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ПЕРСПЕКТИВЫ ПРИМЕНЕНИЯ САФЛОРА (*CARTHAMUS TINCTORIUS L*) В ОФТАЛЬМОЛОГИИ

Аннотация. Лекарственное растительное сырье и препараты на его основе продолжают играть важную роль в фармакотерапии многих хронических и вялотекущих заболеваний человека. За два последних десятилетия во

всем мире возник очень высокий спрос потребителей на лекарственные и профилактические средства, полученные из природных растительных источников. Это объясняется комплексным воздействием биологически активных веществ, витаминов, антиоксидантов, микроэлементов и др. растительного происхождения на организм человека и практическое отсутствие у них побочных эффектов. Маркетинговый анализ зарегистрированных лекарственных средств, применяемых в офтальмологии в Республике Казахстан, составляет – 3 % от общего количество. Все лекарственные препараты синтетического происхождения часто вызывают побочные эффекты, такие как раздражение и различные аллергические реакции. Анализ развития фитотерапии показывает, что наиболее перспективным направлением в области разработки фитопрепаратов является научно обоснованное использование опыта народной и традиционной медицины.

Один из перспективных видов сырья – лекарственное растение сафлор (*Carthamus tinctorius* L.). Принадлежит к семейству сложноцветных (*Compositae*). Содержит витамины А, Е, большое количество полиненасыщенных жирных кислот, линолевой кислоты (70 %) и мононенасыщенной олеиновой кислоты (10 %) с небольшим количеством стеариновой кислоты и другие биологически активные вещества в значительных количествах, которые обуславливают противовоспалительные, антимикробные, антиоксидантные свойства. Благодаря этим фармакологическим эффектам и содержанию витаминов является перспективным для разработки и внедрения лекарственного средства, используемого в области офтальмологии. Поэтому мы впервые сделали оптимальный состав глазных капель на основе экстракта семян сафлора, выращиваемых на огромной территории в южных регионах Казахстана.

С этой целью нами были проведен анализ научных публикаций по сафлору – *Carthamus tinctorius* L. Все принятые к формированию обзора статьи были найдены при помощи научной поисковой системы «Google Scholar» и были индексированы в базах данных Web of science, PubMed, Medline, E-library и Cyberleninka.

В народной медицине сафлорный чай применяют больные с сердечной недостаточностью, страдающие малокровием, онемением верхних и нижних конечностей. По наблюдениям в КазНИИ защиты и карантина растений выявлено, что у лиц после двухнедельного приема сафлорного чая наблюдалось снижение вязкости крови до нормы, у гипертоников снижается давление, а низкое давление нормализуется, поэтому можно сказать, что сафлорный чай оказывает влияние на артериальное давление. Есть данные о том, что цветки сафлора способствуют улучшению кровообращения, уменьшают воспаление, а также способны уменьшать повреждения мозга в связи с нарушением притока крови, а также предотвращая возникновение инсульта. Воздействуя на организм человека, чай из сафлора помогает снять воспалительные процессы, предупреждает пролиферацию клеток, а также улучшает циркуляцию крови. Очень часто его назначают в качестве средства профилактики псориаза и злокачественных новообразований. Сафлор используют в лечении пневмонии, желтухи, а также гастрита. В случае таких гинекологических заболеваний, как метрит и аменорея также показано применение этого растения. Данное растение используют также в качестве желчегонного и слабительного средства. Присущи сафлору и некоторые другие полезные свойства. Так, к примеру, он обладает еще мочегонным, стимулирующим, рвотным, антисептическим и вяжущим действиями.

Обобщенные данные указывают на значительное многообразие применения растений рода *Carthamus* в народной и традиционной медицине; скрининговые экспериментальные исследования научной медицины показали широкий спектр биологической активности данного вида.

Наша научная работа сосредоточена на исследовании глазных капель на основе сафлора в фундаментальной и прикладной офтальмологии.

Ключевые слова: сафлора, глазные болезни, офтальмофармакология, фитопрепараты.

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REFERENCES

- [1] Statistical compilation "Health of the population of the Republic of Kazakhstan and the activities of healthcare organizations in 2013" // Astana. 2014 (in Russ).
- [2] Newsletter No. 282 of August 14, 2014. (in Russ).
- [3] Statistical compilation "Health of the population of the Republic of Kazakhstan and the activities of health organizations in 2017". // Astana. – 2018. (in Russ).
- [4] Carmelo Romano, Madelon Price, Hui Ying Bai, FX and John W. Olney. Neuroprotectants in Honghua: Glucose Attenuates Retinal Ischemic Damage. Invest Ophthalmol Vis Sci. 1993;34:72-80 (in Engl).

- [5] Ronald A. Bush, Armand Malnoe, Charlotte E. Reme and Theodore P. Williams. Dietary Deficiency of N-3 Fatty Acids Alters Rhodopsin Content and Function in the Rat Retina. *Invest Ophthalmol Vis Sci.* 1994; 35:91-100 (in Engl).
- [6] Harrison Scott Weisinger, Algis Jonas Vingrys, Bang Viet Bui, and Andrew James Sinclair. Effects of Dietary n-3 Fatty Acid Deficiency and Repletion in the Guinea Pig Retina. *Invest Ophthalmol Vis Sci.* 1999;40: 327-338 (in Engl).
- [7] Don S. Lin, Gregory J. Anderson, William E. Connor, and Martha Neuringer. Effect of Dietary N-3 Fatty Acids Upon the Phospholipid Molecular Species of the Monkey Retina. *Invest Ophthalmol Vis Sci.* 1994;35:794-803. (in Engl).
- [8] Harisova A.V. Prospects for the use of safflower dyeing in medicine and pharmacy. *Basic research* No. 10, 2013. 154-157 p.
- [9] Ann M. Stinson, Rex D. Wiegand, and Robert E. Anderson. Recycling of docosahexaenoic acid in rat retinas during n-3 fatty acid deficiency. *J Lipid Res.* 1991. 32: 2009-2017. (in Engl).
- [10] Rex E. Martin, Isabelle Ranchon-Cole, Richard S. Brush, Clint R. Williamson, Steven A. Hopkins, Feng Li, Robert E. Anderson. P23H and S334TER opsin mutations: increasing photoreceptor outer segment n-3 fatty acid content does not affect the course of retinal degeneration. *Molecular Vision* 2004; 10:199-207 <http://www.molvis.org/molvis/v10/a25> (in Engl).
- [11] Miyoung Suh, Yves Sauve, Krystal J. Merrells, Jing X. Kang, and David W. L. Ma. Supranormal electroretinogram in fat-1 mice with retinas enriched in docosahexaenoic acid and n-3 very long chain fatty acids (c24–c36). *Invest Ophthalmol Vis Sci.* 2009;50:4394–4401 DOI:10.1167/iovs.08-2565 (in Engl).
- [12] Feng Li, Lea D. Marchette, Richard S. Brush, Michael H. Elliott, Kimberly R. Davis, Ashley G. Anderson, and Robert E. Anderson. High levels of retinal docosahexaenoic acid do not protect photoreceptor degeneration in VPP transgenic mice. *Mol Vis.* 2010; 16: 1669–1679. (in Engl).
- [13] Nan Wang, Robert E. Anderson. Enrichment of polyunsaturated fatty acids from rat retinal pigment epithelium to rod outer segments. *Current Eye Research* Volume 11, 1992 - Issue 8 (in Engl).
- [14] Berra, A, Tau, J, Zapata, G, Chiaradia, P. Effects of pufas in a mouse model of hsv-1 chorioretinitis. *Ocular immunology and inflammation.* 844-854 DOI: 10.1080/09273948.2016.1184287
- [15] CN1274324C. Preparation method of Chinese medicinal eye drops for treating myopia / Tao G., Wang G., Li Y; publish. 22.03.2013, Bull. №32. – P. 1-3. (in Engl).
- [16] Li Junfu, Yin Rongli, Wei Juan, Li Xiaoyi, Luo Yan. Research advance of safflower on chemical composition and pharmacologic action. <http://www.paper.edu.cn> (in Engl).
- [17] Jinous Asgarpanah, Nastaran Kazemivash. Phytochemistry, Pharmacology and Medicinal Properties of *Carthamus tinctorius* L. *Chin J Integr Med* 2013 Feb;19(2):153-159 (in Engl).
- [18] Rakhimov K.D., Turgumbayev A.A., Ustenova G.O., Abuova Zh.B. *Phytodrugs from safflower (Carthamus tinctorius L.)* – Almaty: SD. Asfendiyarov NMU, 2019. – 610 p. ISSN 978-601-246-673-7 (in Engl).
- [19] Registers of medicines of the Republic of Kazakhstan “Electronic Resource” www.ndda.kz/category/reestr_podamyh_na_ekspertizu_ls (in Russ).
- [20] Rakhimov K.D., Abuova Zh. B., Balmukhanova A.V. *Ophthalmopharmacology.* Almaty, 2020. P.408. ISSN 978-601-246-682-9 [in Kaz].