ХАБАРЛЫРЫ

ИЗВЕСТИЯ НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК РЕСПУБЛИКИ КАЗАХСТАН АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского»

NEWS OF THE ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN JSC «D.V. Sokolsky institute of fuel, catalysis and electrochemistry»

SERIES CHEMISTRY AND TECHNOLOGY

6 (438)

NOVEMBER – DECEMBER 2019

PUBLISHED SINCE JANUARY 1947

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK
NAS RK is pleased to announce that News of NAS RK. Series of chemistry and technologies scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of chemistry and technologies in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of chemical sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Химия және технология сериясы" ғылыми журналының Web of Science-тің жаңа нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарайды. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент теңдісі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Химия және технология сериясы Emerging Sources Citation Index-ке енүі біздің қоғамдастық үшін ең взекті және беделді химиялық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия химии и технологий» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по химическим наукам для нашего сообщества.
Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» Республикалық қоғамдық бірлестігі (Алматы к.)
Қазақстан республикасының Мәдениет пен акпарат министрлігінің Акпарат және мұрағат комітетінде 30.04.2010 ж. берілген №1089-Ж мерзімдік басылық тіркеуіне койылу турали туралы құқірлік

Редакцияның мекенжайы: 050010, Алматы к., Шевченко кош., 28, 219 бд., 220, тел.: 272-13-19, 272-13-18,

©Қазақстан Республикасының Ұлттық ғылым академиясы, 2019

Типографияның мекенжайы: «Аруна» ЖК, Алматы к., Муратбаева кош., 75.
Г л а в н ы й р е д а к т о р
д.х.н., проф., академик НАН РК М. Ж. Журинов

Редакционная коллегия:

Агабеков В.Е. проф., академик (Беларусь)
Волков С.В. проф., академик (Украина)
Воротынцев М.А. проф., академик (Россия)
Газалиев А.М. проф., академик (Казахстан)
Ерножин Е.Е. проф., академик (Казахстан)
Жармагамбетова А.К. проф. (Казахстан), зам. гл. ред.
Жоробекова Ш.Ж. проф., академик (Кыргызстан)
Иткулова Ш.С. проф. (Казахстан)
Манташян А.А. проф., академик (Армения)
Пралиев К.Д. проф., академик (Казахстан)
Баешов А.Б. проф., академик (Казахстан)
Буркитбаев М.М. проф., академик (Казахстан)
Джусипбеков У.Ж. проф. чл.-корр. (Казахстан)
Мулдахметов М.З. проф., академик (Казахстан)
Мансуров З.А. проф. (Казахстан)
Наурызыбаев М.К. проф. (Казахстан)
Рудик В. проф., академик (Молдова)
Рахимов К.Д. проф. академик (Казахстан)
Стрельцов Е. проф. (Беларусь)
Ташимов Л.Т. проф., академик (Казахстан)
Тодераш И. проф., академик (Молдова)
Халиков Д.Х. проф., академик (Таджикистан)
Фарзалиев В. проф., академик (Азербайджан)

«Известия НАН РК. Серия химии и технологии».
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 и архивов Министерства культуры и информации Республики Казахстан №10893-Ж, выданное 30.04.2010 г.
Периодичность: 6 раз в год
Тираж: 300 экземпляров

© Национальная академия наук Республики Казахстан, 2019
COMPARATIVE ANALYSIS OF CERTAIN MICRONUTRIENTS OF PLANTS OF THE SUAEDA GENUS

Abstract. The article presents a comparative analysis of the content of some biologically active micronutrients, namely ascorbic acid, retinol and tocopherol in 6 six representatives of the genus Suaeda of the Amaranthaceae family.

In this paper, we study the micronutrients of the aerial parts of plants of the genus Suaeda: Suaeda acuminata, Suaeda microphylla, Suaeda altissima, Suaeda spicata, Suaeda vera, Suaeda splendens.

Species of Suaeda spicata, Suaeda vera harvested in the province of Lliedia, Spain. Types of Suaeda acuminata, Suaeda microphylla, Suaeda altissima, Suaeda splendens in Ili district, Almaty region

As a result, it was established that in all studied objects, tocopherol is present in the largest quantity (from 10 to 16 mg per 100 g).

The amount of ascorbic acid varies in the range of 3.2-4.5 mg per 100g. The content of retinol in 6 studied species ranges from 1.7 to 3.0 mg per 100g. The highest content of tocopherol is found in the aerial part of Suaeda microphylla - 16 mg per 100g. Ascorbic acid is also found in the greatest amount in the aerial part of Suaeda microphylla - 4.5 mg per 100g. Retinol is found in the greatest amount in the aerial part of the species Suaeda acuminata - 3.0 mg per 100g.

Keywords: Suaeda, ascorbic acid, retinol, tocopherol, aerial parts, Amaranthaceae.

Introduction

Micronutrients considered by us belong to the class of biologically active substances known as vitamins.

Vitamins are compounds that cannot be synthesized in the human body, but at the same time are necessary for the functioning of the body, which makes them a necessary part of the diet.

For example, vitamin A deficiency (retinol) is a serious public health problem in developing countries, resulting in 130 million children with an increased risk of morbidity and mortality from infectious diseases [1].

Vitamin-related disorders include blindness (vitamin A), vitamin deficiency (vitamin B1), pellagra (vitamin B3), anemia (vitamin B6), scurvy (vitamin C), and rickets.

Some of the most valuable and essential are vitamins with antioxidant properties, carotenoids (provitamin A), ascorbate (vitamin C) and tochochromanols (vitamin E, including both tocopherols and tocotrienols) [2-6].

For this reason, an important task is to find the sources of these compounds among plants in the interests of health and veterinary medicine.

Swede (from the Arabic “Suwedmullat” or “Suaedabaccata””) is a large genus of halophyllum plants of the Mud family (Chenopodiaceae), including about 100 species around the globe, except for the Arctic zone. 25 species are described on the territory of the CIS, 17 of them in Kazakhstan. The main species of

Species of the genus *Suaeda* are annuals or perennial grasses, dwarf shrubs and shrubs, mostly with alternate narrow succulent leaves with small flowers. They usually grow in masses in saline places, sea coasts, and coast of saline reservoirs, as well as on depleted steppe and sandy soils. Most representatives of Kazakhstani species of *Suaeda* are valuable winter and autumn forage plants [7].

Representatives of the genus *Suaeda* can serve as a source of flavonoids, alkaloids, polysaccharides, carotenoids, saponins, coumarins, tannins and other biologically active substances [8].

Many types of *Suaeda* in folk medicine have long been used as raw material for the production of potash, from which people used it for cooking the so-called “black” soap, which was used as an anti-inflammatory and wound-healing agent for various skin diseases [9].

According to folk remedies, the aerial part of *Suaedaphysophora* Pall. used as an anthelmintic agent. Broths, dry, water, alcoholic extracts and tinctures have antihypertensive properties. Aqueous extract improves cardiac activity, is less toxic than papaverine, and is proposed as a remedy for the symptomatic treatment of hypertension [10].

According to modern scientific data, herbal medicine based on *Suaedaphysophora* Pall. has a strong hypertensive (for nonadrenaline - 55%, against 37%), antioxidant (for propyl gallate - 89.02%, against 95.5%), antibacterial (*Salmonella typhi, Pseudomonadsorengenosia* - for tetracycline - 55%, against 100%) and weak anti-inflammatory (for ibuprofen - 35%, against 65%) activity [11].

Based on the literature on pharmacological agents, the aerial part of *Suaedamaritima* is used in medicine as a means for the complex treatment of hepatitis. Broths, dry, water, alcoholic extracts and tinctures have antiviral, antibacterial, hepatoprotective, laxative and antioxidant activities [12].

From the literature it is known about the presence of antimicrobial activity in *Suaedamonoica*. The antimicrobial activity of the halophyte *Suaedamonoica* (Forrst ex Geilm) was studied using the extracts of the leaves of this plant on various test microorganisms, including several antibiotic-resistant bacteria and pathogens. Thus, it turned out that the aqueous extract of *Suaedamonoica* has the highest antimicrobial activity against the following microorganisms: *Rhizopusstolonifer*, *Mucarrecemosus*, *Saccharomyces cerevisiae*, and relatively moderate activity against *Bacillus subtilis*, *Klebsiellapneumoniae*, *Bacillus megaterium*, *Lactobacillus acidophilus*, *Escherichia coli*, *Enterobacteriaerogenes*, *Enterobactercloace*, *Rhizoctoniasolana*.

A high level of antimicrobial activity was also shown by the methanol extract against *Bacillus megaterium* bacteria, and moderate against the microorganism *Lactobacillus acidophilus*. Hexane extract has the highest level of antimicrobial activity against bacteria of the species *Bacillus subtilis*, *Lactobacillus acidophilus* and moderate against *Bacillus megaterium*, *Escherichia coli*, *Enterobacter aerogenes*, *Enterobacter cloace*, *Klebsiella pneumonia*. Chloroform extract is only effective against bacteria *Klebsiella pneumonia* [13].

The study concluded that water, methanol and hexane extracts of *Suaeda monoica* leaves have great potential as antimicrobial agents. As a result, they can be used as inhalation drugs in the treatment of infectious diseases of the respiratory tract and ear canals caused by resistant pathogenic microorganisms, as well as for wastewater treatment of infectious diseases clinics [14].

The methanol and ethanol extracts of the plant *Suaeda monoica* have high antioxidant activity. To detect antioxidant activity, these extracts were tested on various model antioxidant systems. This fact indicates a high value of the potential of the aerial part of *Suaeda monoica*, which can be used to treat mediated diseases caused by free radicals [15].

In addition, *Suaeda monoica* is used in the complex treatment of hepatitis, as the plant has a pronounced antiviral activity, which is explained by the presence of triterpenoids and styrenes in the phytochemical composition of this plant [16].

Ethanol extract of the plant *Suaeda baccata* and, isolated from this plant, its constituent component, triglareal alkaloid, exhibit pronounced antimicrobial activity against *Staphylococcus aureus* (*Staphylococcus* stamp) [17].
A significant content of biologically active substances in the aerial and underground organs of the medicinal plant *Suaeda japonica* predetermined its use in medicine as a remedy with antioxidant, antidiabetic, and anti-neuroinflammatory activities [18].

Thus, the diversity of biologically active substances in the composition of various species of *Suaeda*, and the associated therapeutic effect cause the need for further research on various species of these plants.

The objects of study were selected aboveground parts of the following representatives of the genus *Suaeda*: *Suaeda acuminata*, *Suaeda microphylla*, *Suaeda altissima*, *Suaeda spicata*, *Suaeda vera*, *Suaeda splendens*.

Species of *Suaeda spicata*, *Suaeda vera* harvested in the province of Lledia, Spain. Types of *Suaeda acuminata*, *Suaeda microphylla*, *Suaeda altissima*, *Suaeda splendens* in Ili district of Almaty region.

Herbal raw materials are harvested in accordance with the requirements of the Global Fund of the Republic of Kazakhstan harmonized with the European Pharmacopoeia.

**Materials and methods**

Determination of the content of vitamin C (ascorbic acid) is carried out as follows: a sample of at least 0.3 g (0.3 ml) is placed in a centrifuge tube, the walls of which are covered with sodium citrate powder. After centrifuging the sample for 30 minutes at 3000 rpm, it is transferred to another tube and an equal amount of bidistilled water and a double amount of freshly prepared 5% solution of metaphosphoric acid are added thereto. The protein precipitate is stirred with a stick and centrifuged for 10 min at 3000 rpm. The amount of the supernatant (0.1-0.5 ml) is introduced into porcelain titration cuvettes (2 parallel samples) and titrated with a 0.001 n-0.0005 n solution of sodium salt of a dichlorophenol-indophenol from a special 0.1 ml micropipette.

In parallel, a “blind” experiment is carried out with a 5% solution of metaphosphoric acid and bidistilled water (1:1).

To determine the concentration of vitamins A (retinol) and E (tocopherol) using the method of simultaneous fluorometric analysis. To 0.2 ml (g) of the sample, add 1 ml of bidistilled water and shake for 30 seconds. After that add 1 ml of 96% ethanol and shake again for 30 seconds. Then adding 5 ml of hexane, repeat the shaking procedure again (similar measures are carried out with the standard). After the sample is centrifuged for 10 minutes at 1500 rpm. For spectrometry, a clearly separated hexane layer (3 ml) was taken; which can be stored for 2 hours in tightly sealed tubes in a dark place.

In parallel with the experimental samples, standard and control (blank) samples are prepared. In standard samples, 0.2 ml of a standard solution (tocopherol and retinol acetate in ethanol) are taken instead of the test sample. In the control samples instead of prototypes - water.

Spectrofluorimetry (Hitachi Spectrofluorometer, Japan): tocopherol is carried out at an excitation wavelength of 292 nm and a fluorescence of 310 nm; retinol - at 335 and 430 nm, respectively.

The results are shown in Figure 1.

**Results and discussion**

In the aerial part of the selected representatives of the genus *Suaeda*, we determined the content of the following nutrients: ascorbic acid, retinol and tocopherol.

It has been established that in all samples, tocopherol is the dominant micronutrient, not less than 10 mg per 100 g.

The highest content of tocopherol is observed in the aboveground part of the plant *Suaedamicrophylla* (16 mg per 100g), and the lowest in the aboveground part of *Suaeda acuminata* (10 mg per 100g), these figures are quite high for the aboveground parts of the plant, common in arid areas.
Thus, it was revealed that the above-ground parts of the studied representatives of the genus *Suaeda* can be considered as a source of ascorbic acid, and the seeds and inflorescences are a rich source of tocopherol, based on the fact that the daily human need for vitamin E is 2-6 mg [19-21].

The content of ascorbic acid in the studied species ranges from 3.20 to 4.50 mg per 100g, which is little, but typical for the stems of arid plant species.

*Suaedamicrophylla* (4.50 mg per 100g) also has the highest content.

Retinol is present in selected species in a relatively small amount, the concentration ranges from 1.70 to 3.00 mg per 100g in *Suaedasplendens*.

Conclusion
In 6 representatives of the genus *Suaeda*: *Suaedacuminata, Suaedamicrophylla, Suedaaltissima, Suedaspicata, Suedavera, Suedasplendens*, the following micronutrients were determined: ascorbic acid, retinol and tocopherol. It has been established that in all the objects studied, tocopherol is present in the greatest quantity.

The investigated plant species once again confirmed the importance of the genus *Suaeda*, as a plant requiring attention and careful chemical study, and identifying various types of biological activity.

For the first time, a comparative analysis of the content of ascorbic acid, retinol and tocopherol in the described representatives of the genus *Suaeda*. 

---

**Figure 1** - The content of ascorbic acid, retinol and tocopherol in the aerial parts of the plant *Suaedacuminata, Suaedamicrophylla, Suedaaltissima, Suedaspicata, Suedavera, Suedasplendens*, in mg per 100g
E.S. Iksanov, Ю.А. Литвиненко, Г.А. Сейтимова, Г.Ш. Бурашева

Казахский национальный университет имени аль-Фараби;
Научно-исследовательский институт новых технологий и материалов Республика Казахстан, 050012, г.Алматы, ул.Карасай батыра, 95а,

**АСКОРА (SUAEDA) ТЕКТІ ОСІМДІҚТІН КЕЙБІР МИКРОНУТРИЕНТТЕРІН САЛЬСЫТЫРМАЛЫ САРАПТАУ**

**Аннотация.** Келтірілген мәкаләдә Amaranthaceae әкімділес, (Suaeda) аскорба текти алты осімдіктің құрамындағы кеңінен микроинтриенттерге, атан айқында, аскорбин қышқылы, ретинол және токоферолдың сандақ мәлімері салыстырмалы сараптау жұрғізілген.

Бұл жұмыста (Suaeda:) аскорба тегінің, жер беті болғанының өңірлерінің зерттеу жасалған: Suaeda acuminate, Suaeda microphylla, Suaedalattissima, Suaedaspicata, Suaedavera, Suaedasplendens.

Аскорбанның Suaedaspicata, Suaedavera тұрғылар Испаниядан, Lledia аймақтың, жаңа жиналған. Ал аскорбанның Suaeda acuminate, Suaeda microphylla, Suaedalattissima, Suaedasplendens тұрғылар Алматы облысы, ілде ауданың дайындалған.

Зерттеу нәтижесінде барлық аскорба осімдіктерінің жеткілікті мәлімдеге токоферол анықталған (100 г-да 10-мг-нан 16-мг-га дейін). Аскорбанның қышқылының мәлімдеге 100 г-да 3,2-4,5 мг. Ал алған зерттелген осімдіктерге ретинолдың 100 г-да 1,7-3,0 мг. және білгілі болған.

Suaeda microphylla тегінің жер беті болғанының токоферол 100г.-да 16 мг, ал аскорбанның қышқылы 100г.-да 4,5мг. анықталған.

Аскорбанның Suaeda acuminate түрінде 100г.-да 3,0 мг ретинолдың кон мәлімдеге бары берілі болған.

**Түйін сөз: Suaeda, аскорбанның қышқылы, ретинол, токоферол, жер беті болғанының, Amaranthaceae.**

**Information about authors:**

Iksanov Yerbol Saginovich - PhD Department of Chemistry and Chemical Technology of the Al-Farabi Kazakh National University, Kazakhstan National University, e-mail: erbol.in@gmail.com, mobile number: 87775166526, https://orcid.org/0000-0003-4640-9584

Litvinenko Yuliya Alekseevna - candidate of chemical sciences, Lecturer, Department of Chemistry and Chemical Technology of the Al-Farabi Kazakh National University, e-mail: yuliya_litvinenk@rambler.ru, https://orcid.org/0000-0002-6387-187X
REFERENCES


Publication Ethics and Publication Malpractice
in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.