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Өсімдіктердің биологиясы және биотехнологиясы институтының

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## ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК  
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## NEWS

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OF THE REPUBLIC OF KAZAKHSTAN  
of the Institute of Plant Biology and Biotechnology

**БИОЛОГИЯ ЖӘНЕ МЕДИЦИНА  
СЕРИЯСЫ**



**СЕРИЯ**

**БИОЛОГИЧЕСКАЯ И МЕДИЦИНСКАЯ**



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## **NEW STRAINS OF FUNGI OF GENUS *TRICHODERMA*, ALLOCATED FROM THE RHIZOSPHERE OF CUCUMBERS AND POTATOES GROWING IN THE ALMATY REGION**

**Abstract.** This paper presents the results of a microbiological analysis of soil samples taken from the rhizosphere of potato of sort "Gala" and rhizosphere of cucumbers of "Buyan FI" sort, cultivated in the Almaty region of Kazakhstan for the presence of soil saprophytic fungi of the genus «*Trichoderma*». A morphological-microscopic description of two new strains of «*Trichoderma*» fungus is given. According to the characteristic morphological and microscopic features, the isolates obtained from the soil of the rhizosphere of the potato of sort "Gala" and cucumbers of sort "Buyan FI" were accordingly attributed to the species «*Trichoderma asperellum*» and «*Trichoderma album*».

**Keywords:** rhizosphere, cucumber, potato, strain, fungi, *Trichoderma*.

One of the important areas of modern research is the increase in the productivity of plants. This indicator depends on the species and the conditions of growing plants. Soil microorganisms have a great influence on the growth and development of plants. It should be noted that among them there are both phytopathogens having a negative effect, and microorganisms - antagonists, which have a positive effect on the plant organism [1-3].

One of the most common microscopic fungi on the planet is the fungi of the genus *Trichoderma*, suppressing more than 60 species of plant pathogens [1-3].

Very promising use of preparations based on fungi of the genus *Trichoderma* in the fight against root rot. Root rot is currently a scourge of fields used for cereals, legumes, vegetable, technical and other crops. Particularly dangerous are fusarium root rot, the causative agents of which are fungi of the genus *Fusarium*. They infect both cucumbers and potatoes throughout the entire vegetation period [4-6]. Some species of *Fusarium* produce dangerous mycotoxins, infecting the grain, causing severe diseases of people and animals [7].

In addition to *Fusarium* rot, great harm is caused by white rot, the causative agent of *Sclerotinia sclerotiorum*. The disease affects plants of both open and protected soil. It appears on all plant organs in all phases of their development. It causes death of seedlings, wilting of adult plants, decay of fruits [8].

In the late stages of growth and development of the plant, it is affected by an alternaria, the causative agent of which is *Alternaria spp.* Infection of crops with an alternaria begins with the spores left on the stubble. Infection can also occur during the vegetative period [9].

It should also be noted such a disease as late blight, the causative agent of which is *Phytophthora infestans* [10].

*Phytophthora*, like any fungus, consists of mycelium, sporangium and conidia. Mycelium has the form of a web of white color. It lives and develops in the tissues of plants. The fungus multiplies by spores and asexual means - conidia. Spores are formed in sporangia. After the spores mature, the membrane of the sporangium bursts, and they come out. Further, spread with water, get on plants and start a new life cycle.

The purpose of this work was to identify fungi of the genus *Trichoderma* in the rhizosphere of cucumbers of the brand "Buyan F1" and potato varieties "Gala", growing in the Almaty region for further use as agents of biological control of phytopathogens affecting vegetable crops.

**Materials and methods.** The soil samples obtained in 2017 from the rhizosphere of "Buyan F1" cucumbers and "Gala" potato growing in the «Galym» farm of the Sarkand district of the Almaty region served as the object of the study.

The isolation of fungi from soil samples was carried out by methods commonly used in microbiology [11].

The soil suspension was plated on a Czapek nutrient medium in Petri dishes.

The composition of the Czapek medium (g/l): sucrose – 20.0; NaNO<sub>3</sub> – 2.0; KH<sub>2</sub>PO<sub>4</sub> – 1.0; MgSO<sub>4</sub>·7H<sub>2</sub>O – 0.5; KCl – 0.5; FeSO<sub>4</sub>·H<sub>2</sub>O – 0.01; agar – 20.0.

The fungal colonies were isolated from petri dishes on a sloping nutrient medium of the same composition. A pure culture of the fungus (strain) was obtained after a number of passages.

Morphological and microscopic studies of isolated strains were carried out on the Czapek medium, identification was carried out according to the corresponding determinants [5, 10].

**Results and discussions.** Microbiological analysis of soil samples from the potato and cucumber rhizosphere was carried out in the "Galym" farm of Sarkand district, Almaty region. From the rhizosphere of the potato "Gala" and cucumbers "Buyan F1" there was isolated one isolate of the fungus genus – *Trichoderma*.

Morphological and microscopic characteristics of the isolate isolated from the rhizosphere of the "Gala" carofel.

On Czapek's medium, a powerful, smooth, radially divergent substratum mycelium of gray color first develops. The grayish shade of the mycelium is created by a certain elevation of mycelia to the surface of the substrate. For two days, the average radius of the colony reaches 3-4 cm. The average diameter of the vegetative hypha is 8-15 microns. The surface of the fungal colony before the formation of the aerial mycelium is even, uniformly fibrous, diverging from the center of the sowing to the periphery. 30-35 hours after sowing, a uniform aerial mycelium of a cotton-like structure, grayish-white, rises from substrate mycelia. The aerial mycelium gazon develops with a slight (2-3 mm) lag from the edge of the colonies formed by the substrate mycelium.

The onset of conidia occurs gradually within 70-80 hours after inoculation with a culture content in a thermostat at 27 °C. Conidiation occurs in the entire surface of the lawn at first in the form of small scattered glomeruli 3-5 mm in size, and then they expand to form a continuous conidial lawn.

The color of the conidial lawn changes from matte to a light green hue at young age to matt dark green in adulthood.

On cone-shaped water, the conidiophores rise upward, regardless of the position of vegetative mycelial hyphae, in mature form and their height is about 40-50 microns on average; they are branched dichotomically or cruciform, the diameter of the middle part is 5-6 microns. The lateral branches diverge from the main branch of the conidiophore by tiers and the lower lateral branches can give secondary branches, at the end of which the whiskers are located sterigmata not more than 4 pieces in one place. Sterigmata are keg-shaped, the length on average is 5 microns. At the end of the sterigmata, conidial heads are formed, they are spherical, up to 10 microns in diameter. In the heads under the microscope, conidiospores are looked through, which easily decompose during maturation, especially at high humidity. The spores are spherical and rarely, with a single examination pale green, but in mass dark green, diameter 2.5-3.5 microns.



Picture 1 – Culture of the «*Trichoderma asperellum*» fungus:  
 a – growth on Czapek's nutrient medium; b – microstructure

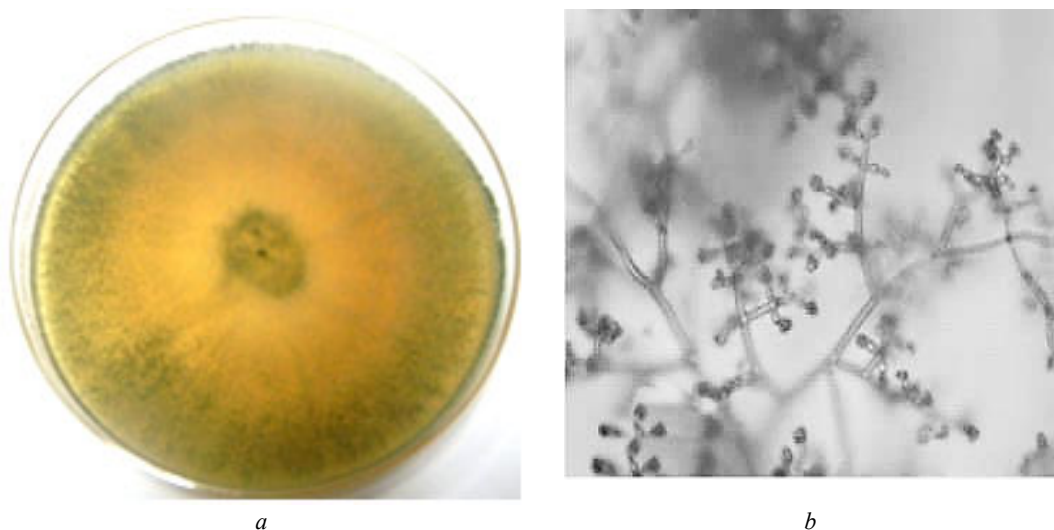
There are intercalary chlamydospores, spherical, smooth with a diameter of 8-10 microns. The reverse side of the colony is not colored. The mature culture of this fungus is a specific mushroom smell.

According to morphological and microscopic features, the isolate is referred to the species *Trichoderma asperellum* (Picture 1).

Morphological and microscopic characteristics of the isolate isolated from the rhizosphere of the cucumber of "Buyan F1" grade.

On Czapek's medium, an abundant colorless (glassy) mycelium first develops, which extends radially from the sowing point, forming a flat colony of fibrous structure. The average diameter of the vegetative hypha is 9-12 microns. For two days, the average radius of the colonies reaches only 1-1.5 cm, and by the beginning of the second week of growth it is 3-4 cm. At this time, separate white bundles of the aerial mycelium appear on the surface of the fungal colony, resembling cumulus clouds. The size of these beams is initially from 2 to 5 mm, then they gradually growing together, merge with one another, forming a continuous, bumpy mushroom lawn. The aerial mycelium lags 10-15 mm behind the substrate in its development.

By the middle of the second week of growth on the surface of the mushroom lawn, small, rare, white with a yellow hue of grains appear (the beginning of conidia formation), which gradually turn to the egg-yellow and then the greenish-yellow color by the end of the second week of growth. In comparison with other species of the genus, the growth and development of this species is much slower.



Picture 2 – Culture of the *Trichoderma albumfungus*:  
 a – growth on Czapek's nutrient medium; б – microstructure

On congeneric water, the conidiophores are well distinguishable, they rise from the branches of the aerial mycelium and have a height of 25-30 microns, and the diameter of the middle part is 5-6 microns. Branching dichotomic, most often, cruciform. At the ends of the branches sterigmata are placed, their number is not more than 5, and the dimensions may be different, but not more than 5 microns in length. On the tops of the sterigma there are colorless conidial heads of round form, consisting of a conidia-con cluster of glued together mucous substances. These conidial heads outwardly resemble berries of blackberries and have a size of 12-15 microns. Conidies in the heads under the microscope are well seen, individually they are almost colorless, but they refract light, round, oval or ovate, often at one end somewhat pointed, smooth, with an average value of 4x3.5 microns.

Chlamydospores are rare, intercalary, round, smooth-walled, 6-8 microns in diameter. During the development of the fungus, the pigment is not released into the substrate. However, the reverse side of the colony is yellow. According to morphological and microscopic features, the isolate is referred to the *Trichoderma album* (Picture 2).

Thus, two new strains of the *Trichoderma* fungus are isolated from the rhizosphere of the "Gala" potato and the "Buyan F1" cucumbers cultivated in the Almaty region of Kazakhstan, classified according to morphological and microscopic characteristics as *Trichoderma asperellum* and *Trichoderma album*. It is planned to study the antagonistic activity of new strains against pathogens of potato and cucumber diseases with the aim of developing effective domestic biopreparations for plant protection on their basis.

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### АЛМАТЫ ОБЛЫСЫНДА ӨСЕТІН КАРТОП ПЕН ҚИЯР РИЗОСФЕРАСЫНАН БӨЛІНІП АЛЫНҒАН *TRICHODERMA* ТЕКТЕС САҢЫРАУҚҰЛАҚТАРДЫҢ ЖАҢА ШТАММДАРЫ

**Аннотация.** Бұл жұмыста Қазақстанның Алматы облысында өсірілетін, картоп «Гала» және қияр «F1 Буян» ризосферасының топырағынан алынған жинақта *Trichoderma* тегінің сапрофиттік саңырауқұлақтарының болу үлгілерін микробиологиялық талдау нәтижелері ұсынылған. Екі *Trichoderma* саңырауқұлақтарының жаңа штаммдарына микроскопиялық морфологиялық сипаттамасы берілген. «Гала» картоп пен «F1 Буян» қиярдың ризосфера топырағынан ажыратып алынған, морфологиялық және микроскопиялық сипатына тән, тиісінше *Trichoderma asperellum* және *Trichoderma album* түрлеріне жатқызылды.

Қияр«Буян F1»мен «Гала» картобының ризосферасынан алынған, *Trichoderma* тектес саңырауқұлақтар өсіріндісі туралы деп, пікір ұсынылды. Бұл зерттеу ең көп таралған микроскопиялық саңырауқұлақтар тегі - *Trichoderma* тегіне арналады. Тамыр шірік қоздырғыштарына қарсы-антагонизм танытатын *Trichoderma* саңырауқұлақ өндіру үшін эксперименттік әдістері жасалды. Алматы облысында өсіп келе жатқан көкөніс дақылдары ризосфера топырағынан, ең агрессивті антагонистер бөлініп алынды.

**Түйін сөздер:** ризосфера, қияр, картоп, штамм, саңырауқұлақтар, *Trichoderma*.

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### НОВЫЕ ШТАММЫ ГРИБОВ РОДА *TRICHODERMA*, ВЫДЕЛЕННЫЕ ИЗ РИЗОСФЕРЫ ОГУРЦОВ И КАРТОФЕЛЯ, ПРОИЗРАСТАЮЩИХ В АЛМАТИНСКОЙ ОБЛАСТИ

**Аннотация.** В настоящей работе представлены результаты микробиологического анализа образцов почвы, взятых из ризосферы картофеля сорта «Гала» и огурцов сорта «Буян F1», культивируемых в Алматинской области Казахстана на наличие почвенных сапрофитных грибов рода *Trichoderma*. Дано морфолого-микроскопическое описание двух новых штаммов гриба *Trichoderma*. По характерным морфологическим и микроскопическим признакам изоляты, полученные из почвы ризосферы картофеля сорта «Гала» и огурцов сорта «Буян F1», были соответственно отнесены к видам *Trichoderma asperellum* и *Trichoderma album*.

**Ключевые слова:** ризосфера, огурцы, картофель, штамм, грибы, *Trichoderma*.

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## NEW LOCALITIES OF ENDEMIC AND RELIC SPECIES OF FLORA IN EAST KAZAKHSTAN

**Abstract.** One of the ways to preserve rare species of relic and endemic plants is protecting their habitats and phytocenoses in which these species exist at the present time. In connection with this now, in the era of sharp increase in anthropogenic stress, it is important to study flora and vegetation, to find new habitats of rare plant species in the mountainous regions of Kazakhstan, to draw up maps of their distribution area and take specific measures of protection. The purpose of this work is to study the geographical distribution of rare endemic and relict flora species of Eastern Kazakhstan. Materials for the study were collected during expeditions in 2012-2017. The study of the distribution of rare endemic and relict plants was carried out by a route-reconnaissance method. Routes of field research were planned according to cartographic forest inventory materials of land use and administrative maps of the East Kazakhstan region. The route of the expedition was compiled in such a way as to visit the most probable and characteristic places of growth of the studied plant species. The studies were conducted according to generally accepted methods: while describing plant communities with the participation and dominance of the plant species under study, conventional geo-botanical methods were used. As a result of the research new locations of rare, endemic and relict plant species have been discovered on East Kazakhstan territory. The new growth sites for *Daphne altaica*, *Sibiraea altaicensis* and *Amygdalus ledebouriana* were determined. When registering the finds their exact coordinates were determined, the names of the tracts, the exposition of slopes and other necessary information was indicated.

**Key words:** endemics, relics, areal, distribution, mapping.

At present, there is a significant depletion of the gene pool of plants of the natural flora, and especially relic and endemic species, most of which are rare and are on the verge of extinction. Relict species of plants are of great scientific interest, since they are carriers of reliable information on the vegetation cover of past epochs [1].

One of the ways of preserving rare species of relic and endemic plants is the protection of their habitats and phytocenoses in the composition of which they are included. In connection with this, now, in the era of sharp increase in anthropogenic stress, it is important to study flora and vegetation, find new habitats of rare plant species in the mountainous regions of Kazakhstan, draw up maps of their distribution range and take specific measures of protection.

The purpose of this work is to study the geographical distribution of rare endemic and relict flora species of Eastern Kazakhstan.

Materials for the study were collected during expeditions in 2012-2017. The study of the distribution of rare endemic and relict plants was carried out by a route-reconnaissance method. Routes of field research were planned for cartographic forest inventory materials of land use and administrative maps of the East Kazakhstan region. The route of the expedition was compiled in such a way as to visit the most probable and characteristic places of growth of the studied plant species.

The studies were carried out according to generally accepted methods: in the description of plant communities with participation and dominance of the plant species under study, the generally accepted

geobotanical methods were used. B. A. Bykov [2]; E. M. Lavrenko [3]. Authors of taxa are cited in accordance with the rules adopted in the summary of S. K. Cherepanov [4], S. A. Abdulina [5].

The location of the thickets was established, guided by the biological characteristics and ecological confinement of the species under study, as well as using herbarium material.

Authenticity of plants was determined with the help of works "Flora of Kazakhstan" [6-9], "Illustrated determinant of plants of Kazakhstan" [10].

Conducted in recent years (2012-2017) in the East Kazakhstan region, flora studies have made it possible to identify new habitats of endemic and relict plant species. For the three species, new habitats have been determined, when registering the finds, their exact coordinates have been determined, the names of the tracts, the exposition of the slopes and other necessary information have been indicated.

***Daphne altaica* Pall.** A kind of shrubs of the genus *Daphne* of the family *Thymelaeaceae*. The narrow endemic of Altay and adjoining mountains south of the Zaisan depression (Saur, Tarbagatay), relict of the tertiary forest subtropical flora of the Turgan type, the species is listed in the Red Data Book [11].

*Daphne altaica* root shoots deciduous shrub in height 1-1,5 cm. With brown, from below dark-gray bark, well recognizable by forked form of branches. Young branches are pubescent, old naked. The leaves are large, elliptical, entire. Blooms in the fifth year of life. Flowers are bisexual, with a simple perianth, sitting in groups (three to seven) at the ends of shortened branches. Perianth is snow-white, ridge-pale, with a cylindrical tube and four deflected rounded bends. Flowers have a strong pleasant aroma and a little like lilac flowers, only smaller. Blossoms in May - June, fruits (juicy black bone with single seeds) ripen in June - July [6].

It grows on the northern slopes of the mountains and in the foothills, in deciduous forests, bushes, rarely enters the shrub steppes. The main threats are grazing and fires. It occurs in Altay, Saur, Manyrak, Tarbagatay.

*Daphne altaica* has a medicinal value, it is used in folk medicine, the plant is poisonous.

Conducted in recent years (2012-2017) in the East Kazakhstan region, flora studies have revealed new habitats of the *Daphne altaica* [12, 13].

On the ridge Naryn at the foot of the mountain Atzhal there are large thickets. The eastern slopes of Mount Atzhal, along the gorges with coordinates N 49° 05.505'; E 084° 29.143' are covered with dense shrub vegetation from *Spiraeatrilobata* L., *S. media* Schmidt., *Rosa acicularis* Lindl., *Rosa alberti* Regel., *Lonicera tatarica* L., *Cotoneaster melanocarpa* Lodd., *Rubusidaeus* L., *Daphne altaica* Pall., *Amygdalus ledebouriana* Schlecht. Under the canopy of the bushes a rich species diversity of herbaceous vegetation is developed.

Shrub dense thickets stretch along the southeastern slope to a height of 1300-1500 m. At the level of 1200 m, aspen groves appear on the slopes of northwestern exposures in the first tier, in the second tier the bushes *Spiraeatrilobata* L., *S. media* Schmidt., *Rosa acicularis*, *Rosa alberti* Regel., *Lonicera tatarica* L., *L. altaica* L., *Cotoneaster melanocarpa* Lodd., *Daphne altaica* Pall., *R. idaeus* L. From herbaceous vegetation, *Artemisia absintium* L., *A. vulgare* L., *Thalictrum collinum* Wallr., *Liliumpilosiusculum* (Freun) Misch., *Origanum vulgare* L., *Medicago valcata* L., *Aconitum volubile* Pall. ex Koelle, *Thermopsis lanceolata* R. Br., *Campanula glomerata* L., *Hypericum perforatum* L., *Rubus saxatilis* L., *Crepissibirica* L., *Centaurea ruthenica* Lam., *Orobus luteus* L., *Delphinium elatum* L., *Aconitum leucostomum* Worosch.

We discovered a *Daphne altaica* population in the eastern part of the Kalbinsk ridge on Mount Sandyktas. The population is located on the south-eastern slope at an altitude of 1056-1062 m above sea level. The total area of the population is 0.2 hectares, coordinates N 49° 17.908'; E 082° 29.819' (picture).

The *Daphne altaica* is found among dense shrub vegetation from *Lonicera tatarica* L., *Caragana arborescens* Lam., *R. spinosissima* L., *Rosa acicularis* Lindl., *Rosa alberti* Regel., *Cotoneaster melanocarpa* Lodd., *Daphne altaica* Pall. Among the foci there are some herbaceous species, *Clematis integrifolia* L., *Dictamnus angustifolius* G. Don ex Sweet., *Delphinium cyananthum* Nevski., *Fragariaviridis* (Duch.) Weston, *Trifolium lupinaster* L., *Filipendula vulgaris* Moench., *Potentilla recta* L., *Phlomoidestuberosa* (L.) Moench., *Galium verum* L. and etc.

***Sibiraea altaiensis* (Laxm.) Schneid.** shrub *Rosaceae* Juss. family, about 150 cm tall. The branches are relatively thick, characterized by a reddish-brown bark. The leaves are sessile, bluish-green, whole and entire. Flowers unisexual, collected in separate racemose-paniculate inflorescences. Sepals and petals, like all *Rosaceae*, five. Calyx widely bell-shaped, corolla white. The fruit consists of five upright



Flowering *Daphne altaica* on the Kalbinsk Ridge

leaflets (longer than the cup), each containing two small brown seeds. Seed reproduction. Blooms Siberaea in May-June, fructifies in July-August [7].

A rare, endangered species, the endemic of Altay, the distribution of which only slightly exceeds the boundaries of Kazakhstan. It grows in open mountain valleys and on the slopes of the mountains.

Leaves are sometimes used as a substitute for tea, but in folk medicine in the treatment of fever, liver disease (hepatitis) and the cardiovascular system. *Sibiraeaaltaiensis* is an effective ornamental plant, grows well in seeds from seeds. It is very attractive not only during flowering, but also in autumn, when the leaves are painted in bright crimson colors. It is protected in the Katon-Karagai State National Park [14].

Quite large thickets of Altay endemic are found in the *Sibiraeaaltaiensis* on the ridge of Tarbagatay of Southern Altay, on the right bank of the Taldybulak river at an altitude of 1816 m above sea level with coordinates N 49°06.355', E 086°07.890'.

Cenopopulations with the participation of *Sibiraeaaltaiensis* are grouped in a *herbage-bush* type of phytocenosis, which occurs along the right bank of the Taldybulak River. The shrub layer is dense, well developed. Of the shrubs - *Sibiraeaaltaiensis*, *Pentaphylloidesfruticosa* (L.) O.Scywarz, *Salix sajanensis* Nas., *Spiraea media* Franz Schmidt. From forbs are found: *Polygonum viviparum* L., *Geranium pretense* L., *G. divaricatum* Ehrh., *G. sibiricum* L., *Lamium album* L., *Galiumverum* L., *G. boreale* L., *Myosotis palustris* (L.) L., *Thalictrum flammula* L., *Veronica longifolia* L., *Ligulariaaltaica* DC, *Alchimilla sibirica* L., *Papaver medicinale* L., *Polygala hybrida* DC., *Valeriana dubia* Bunge., *Polemonium caeruleum* L., *Vicetia nuifolia* Roth, *Campanula glomerata* L., *Trollius altaicus* CA Mey., *Dracocephalum ruyschiana* L., *Dracocephalum integrifolium* Bunge, *Pyrethrum krylovianum* Krasch., *Aconitum leucostomum* Worosch. and etc.

A large population of *Sibiraeaaltaiensis* is found on the slopes of the southern and south-eastern exposition of Mount Shubartos of the Tarbagatay Range of the Southern Altay. at an altitude of 1870 m above sea level with coordinates N 49°06.564', E 086°07.847'. Tests were made on 20 plants on an area of about 2.5 hectares.

Cenopopulations with the participation of *Sibiraeaaltaiensis* are grouped into a *herbage-shrubby-siberian* type of phytocenosis, which occurs along the slopes of southern and south-eastern exposures. The shrub layer is dense, well developed. Of the bushes - *Rosa alberti* Regel., *R. acicularis* Lindl., *Sibiraeaaltaiensis*, *Spiraea media* Franz Schmidt. Herbal cover consists of *Dactylis glomerata* L., *Poa pratensis* L., *Koeleriaaltaica* (Domin) Kryl., *Alopecurus pratensis* L., *Lilium martagon* L., *Thalictrum alpinum* L., *Pedicularis elata* Willd., *Dracocephalum ruyschiana* L., *Trollius altaicus* CA Mey., *Bupleurum aureum* Fisch., *Galiumverum* L., *G. boreale* L., *Medicago falcata* L., *Ligulariaaltaica* DC, *Vicetia nuifolia* Roth, *Hedysarum neglectum* Ledeb. and etc.

On the slope of Mount Shubartos *Sibiraeaaltaiensis* rises to an altitude of 1892-1899 m above sea level along the slopes of the southern, south-eastern exposure.

*Sibiraeaaltaiensis* is found on the ridge of the Southern Altay on the slopes of the Shubarkaragai mountain. The *Sibiraeaaltaiensis* saplings occupy a considerable area along the eastern and south-eastern slopes at an altitude of 1693 m above sea level with coordinates N 49°03.436', E 086°00.179'.

Of the tree species *Larixsibirica* is encountered, the shrubby vegetation is represented by continuous thickets of *Sibiraeaaltaiensis*, with an admixture of *Spiraea media* Franz Schmidt, *Pentaphylloides-fruticosa* (L.) O.Scywarz., *Cotoneaster uniflorus* Bunge. The herbaceous stage is represented by *Dactylis-glomerata* L., *Calamagrostisepigeios* (L.) Roth, *Poasibirica* Roshev., *Chamaenerionangustifolium* (L.) Scop., *Geranium albiflorum* Ledeb., *Thalictrum alpinum* L., *Trolliusaltaicus* CAMEy., *Myosotis palustris* (L.) L., *Lathyruspratensis* L., *Stellariapalustris* Retz., *Galiumboreale* L., *Alchemilla altaica* Juz., *Sanguisorbaalpina* Bunge., *Antennariadioica* (L.) Gaertn., *Saussureafrolowii* Ledeb., *Euphorbia lutescens* CFMey., *Phlomoideasalpina* Pall., *Hedysarumalpinum* L., *Veratrum lobelianum* Bernh., *Gentianafetissowii* Regel & Winkl., *Trolliusaltaicus* CAMEy., *Dracocephalumruyschiana* L. *Swertiaobtusa* Ledeb., *Thermopsis lanceolata* R. Br., *Scaligeria setacea* (Sehrenk.) Korov. and etc.

*Amygdalusledebouriana* Schlecht., bush of the family *Rosaceae* Juss. A rare, endemic species, is listed in the Red Book of Kazakhstan.

The height of the shrub reaches 1,5-1,8 m. The branches are glabrous, spread out, with numerous shortened branches. The cortex of perennial branches is gray or cranate-gray, annual reddish-brown, stipules narrow-lanceolate or lanceolate, entire-toothed or dentate. Leaves are regular, on shorter shoots sit in bundles, all naked, lanceolate or oblong-ovoid, apically pointed, less often obtuse, at the base gradually narrowed into a short stalk, along the edges serrate-dentate. Flowers are bright pink, solitary. Blossoms in late May. The fruits are thickly felt and furry. It grows in the grassy-meadow steppe, on mountain slopes, in river valleys [7,8].

We found it on the northeastern shrub of the town of Saryshoky, the Naryn Ridge, the Southern Altay Range, in the vicinity of the Kokterek village of the Katon-Karagai District, N 49° 05.537', E 084° 29.165', at an altitude of 724 m above sea level [15].

The northeastern slopes of the Saryshoky mountain, the gorges are covered with dense shrubby vegetation from *Spiraeatrilobata* L., *S. media* Schmidt., *Amygdalusledebouriana* Schlecht., *Rosa acicularis* Lindl., *Rosa alberti* Regel., *Lonicera tatarica* L., *Cotoneaster melanocarpa* Lodd., *Rubusidaeus* L., *Daphne altaica* Pall. Under the canopy of the bushes a rich species diversity of herbaceous vegetation is developed. From herbaceous vegetation there are *Artemisia absintium* L., *A. vulgare* L., *Thalictrum collinum* Wallr., *Liliumpilosiusculum* (Freun) Mischz., *Origanum vulgare* L., *Medicago valcata* L., *Aconitum volubile* Pall. ex Koelle, *Thermopsis lanceolata* R. Br., *Campanula glomerata* L., *Hypericum perforatum* L., *Rubussaxatilis* L., *Crepissibirica* L., *Centaurea ruthenica* Lam., *Orobis luteus* L., *Delphinium elatum* L., *Aconitum leucostomum* Worosch.

Thus, new locations of *Daphne altaica*, *Sibiraeaaltaiensis* and *Amygdalusledebouriana* have been established, in the territory of East Kazakhstan. All modern materials on the distribution of the above three types of flora of Eastern Kazakhstan are included in the electronic database of the East Kazakhstan State University.

For the three species, new growth sites have been identified, which will be indicated on the maps of their distribution areas. When registering the finds, their exact coordinates were determined, the names of the tracts, the exposition of the slopes and other necessary information were indicated.

This work was a part of the research on the project "Molecular systematics of endemic, rare and economically valuable plant species of Western, Central and Eastern Kazakhstan" on the PCF "Study of genetic diversity and conservation of genetic resources of endemic, rare and economically valuable plant species in the Republic of Kazakhstan" 2015-2017 and fundamental scientific research of the East Kazakhstan State University named after S.Amanzholov on priorities of science development for 2015-2017 on the topic "Development of biotechnological methods for the conservation of endemic and medicinal plants in conditions *in vitro*".

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### **НОВЫЕ МЕСТООБИТАНИЯ ЭНДЕМИЧНЫХ И РЕЛИКТОВЫХ ВИДОВ РАСТЕНИЙ ФЛОРЫ ВОСТОЧНОГО КАЗАХСТАНА**

**Аннотация.** Одним из путей сохранения редких видов реликтовых и эндемичных растений является охрана их местообитания и фитоценозов, в состав которых они входят. В связи с чем, ныне, в эпоху резкого усиления антропогенного стресса, актуально изучение флоры и растительности, нахождение новых местообитаний редких видов растений в горных районах Казахстана, составление карт их ареала распространения и принятие конкретных мер охраны. Целью данной работы явилось изучение географического распространения редких эндемичных и реликтовых видов флоры Восточного Казахстана. Материалы для исследования собирались во время экспедиций 2012-2017 гг. Изучение распространения редких эндемичных и реликтовых растений осуществлялось маршрутно-рекогносцировочным методом. Маршруты полевых исследований намечали по картографическим лесоустроительным материалам землепользования и административным картам Восточно-Казахстанской области. Маршрут экспедиции был составлен с таким расчетом, чтобы посетить наиболее вероятные и характерные места произрастания изучаемых видов растений. Исследования проводились по общепринятым методикам: при описании растительных сообществ с участием и доминированием изучаемых видов растений были использованы общепринятые геоботанические методы. В результате проведенных исследований на территории Восточного Казахстана обнаружены новые местонахождения редких, эндемичных и реликтовых видов растений. Определены новые места произрастания для *Daphne altaica*, *Sibiraea altaiensis* и *Amygdalus ledebouriana*, при регистрации мест находок определены их точные координаты, указывались названия урочищ, экспозиция склонов и другие необходимые сведения.

**Ключевые слова:** эндемики, реликты, ареал, распространение, картирование.

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### **ШЫҒЫС ҚАЗАҚСТАН ФЛОРАСЫНЫҢ ЭНДЕМИК ЖӘНЕ РЕЛИКТ ӨСІМДІКТЕРІНІҢ ЖАҢА МЕКЕН ОРЫНДАРЫ**

**Аннотация.** Реликт және эндемик түрлерді тіршілік ететін орындары мен олар құрамына енетін фитоценоздарды қорғауға алу оларды сақтаудың бірден-бір жолы. Сол себепті, қазіргі таңда, антропогендік стресстің күрт күшеюі дәуірінде флораны және өсімдіктер жамылғысын зерттеу, Қазақстанның таулы аймақтарында сирек кездесетін өсімдіктердің мекен ететін жаңа орындарын табу, олардың таралу ареалдарының картасын түзу және оларды қорғау шараларын ұсыну өзекті мәселелердің бірі. Берілген жұмыстың мақсаты, Шығыс Қазақстан флорасының эндемик және реликт өсімдіктерінің географиялық таралу аймақтарын анықтау. Зерттеу материалдары 2012-2017 жылдары жүргізілген экспедициялар уақытында жиналды. Сирек кездесетін эндемик және реликт өсімдіктерді зерттеу маршруттық-рекогносцирлау әдісімен жүргізілді. Далалық зерттеулердің маршруттары жер пайдалану картографиялық материалдары мен Шығыс Қазақстан облысының әкімшілік карталарының көмегімен жасалды. Экспедициялардың маршруттары зерттеуге алынған өсімдік түрлерінің таралуы мүмкін болатын жерлерді неғұрлым кеңінен қамтыды. Зерттеулер жалпыға мәлім әдістер көмегімен жүргізілді, өсімдіктер жамылғысына сипаттамалар геоботаникалық әдістермен жүргізілді. Зерттеу нәтижесінде Шығыс Қазақстан облысының аумағында сирек кездесетін эндемик және реликт түрлердің мекен ететін жаңа орындары анықталды. *Daphne altaica*, *Sibiraea altaiensis* және *Amygdalus ledebouriana* түрлерінің жаңа мекен ететін орындары анықталды, олар табылған жерлердің нақты координаттары анықталып, сайлардың аттары, тау беттерінің экспозициясы және т.б. қажетті мағлұматтар көрсетілді.

**Түйін сөздер:** эндемик, реликт, ареал, таралу, картаға түсіру.

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## ALIEN FISH SPECIES IN THE KARGALY STATE WILDLIFE SANCTUARY (THE SYDRAYA RIVER, REPUBLIC OF KAZAKHSTAN)

**Abstract.** The Syrdarya river is one of the main rivers of Central Asia. A sharp ecological crisis happened here at the last quarter of the XX century as a result of irrational water use. Government of the Republic of Kazakhstan undertakes some measures to mitigate ecological situation in the region. Presence of alien fish species considered as an indicator of environment changes. Our research was conducted during 2015-2017 in the Kargaly state wildlife sanctuary for evaluate modern diversity and dynamics of alien fish species without fishery press. This preserve is situated at a typical segment of floodplain part of the Syrdarya river. Two main types of fluvial biotopes as a circulating lake in former riverbed and river *per se* were investigated. Conventional methods of water and fish investigations were used. Water temperature, turbidity, pH, mineralization, concentrations of dissolved oxygen and some heavy metals (*Fe*, *Cu*, *Cd*, *Pb*) were investigated. Significant variability of these physical and chemical parameters depended from precipitation and flood regulation, and strongly impact on fish communities. 14 indigenous and 11 alien fish species were discovered. Alien fish species were presented by white amur *Ctenopharyngodon idella*, silver carp *Hypophthalmichthys molitrix*, abbotina (or false gudgeon) *Abbottina rivularis*, pseudorasbora [or stone moroco, or topmouth gudgeon] *Pseudorasbora parva*, sawbelly *Hemiculter leucisculus*, bitterling *Rhodeus ocellatus*, gambusia [or mosquitofish] *Gambusia holbrooki*, chinese medaka *Orizias sinensis*; eleotris [or beautiful sleeper] *Micropercops cinctus*; goby fish *Rhinogobius cheni*; and snakehead *Channa argus*. There all alien fish species were presented as well by adult as young individuals that indicated quite favorable living conditions for them. Heterogeneity of fish distribution was revealed as a result of their environmental plasticity. Variability of fish number and species composition depend upon flood regimen. Indigenous piscivorous fish species effectively control alien others. Unstable and unlike to natural flood regimen is more favorable for alien fish species.

**Key words:** fishes, fauna, indigenous, alien, Syrdarya river, Kargaly State Wildlife Sanctuary, abiotic conditions.

**Introduction.** During the first half of the last century the Aral-Syrdarya watershed was one of the most important fishery regions not only for the Republic of Kazakhstan, but for the former USSR too [1]. First introductions of fishes from the Caspian basin had been done in 1930-thes and were failed. Second introduction of the grass carp, black carp, silver carp, spotted silver carp was provided from the Amur river basin in 1960-thes and accompanied with introduction of some other unintentional fish species. G.M.Doukravets and V.P.Mitrofanov gave detailed description of the history of fish introductions for the periods of sustainable hydrological regiment of the Syrdarya river and before crisis [2]. Crop production became the priority for the region in the second part of the XX century. Irrational use of waters of the Syrdarya and Amudarya rivers lead to flow reduction, the surface of the Aral Sea decrease and drastic changes in ecosystems of the region that was named as ecological catastrophe or ecological crisis [3-6]. In the first decade of the XXI century the Government of the Republic of Kazakhstan realized some actions for reduce the problem and now the flow of the Syrdarya river exceeds the evaporation. In the Kazakhstan



sector of the river several nature protected areas has been created for rehabilitation of flood-plain ecosystems and conservation of native biodiversity [5-7].

It is known that richness and diversity of alien fish species can be a result of disturbances of freshwater ecosystems as well as its cause [8, 9]. Generally, biological invasions are considered as an unfavorable factor for native fish fauna [10, 11]. However, the impact of each alien fish species should be assessed singly [12]. So that investigation of modern diversity of alien fish species in the Syrdarya river is scientifically interesting and important for efficient management of fish resources and protection of native fish fauna.

Fishery selectively impacts on fish fauna by catching the biggest fishes which play important role in food webs. This kind of human activity is prohibited in state wildlife reserves and so there is possible to evaluate indirect human impacts as water pollution, soil erosion, and alien fish species to water biota. An evaluation of diversity and relative abundance of alien fish species in the Kargaly State Wildlife Sanctuary (KR) was the aim of our investigation.

**Materials and Methods.** KR located on the Syrdarya river southward of the Shiili town. Coordinates of the cordon are 43°57'52.2" N, 66°48'52.5" E. The protection of flood-plain vegetation is the general purpose of the KR. Protected site is typical for the plain segment of the Syrdarya river. The river bed is bended and creates some floodplain lakes. Hydrological regimen of the site is completely regulated with irrigation dams and is not purposed for any other aims.

Data were collected in summer time 2015-2017. Physical and chemical water characteristics were assessed by the most common methods [13, 14]. Turbidity of the water was determined using a turbidimeter HI 93703 "Hanna Instruments", salinity, temperature and pH – using joint device of the same manufacturer HI 98129. The color of the water was determined visually, the odor was organoleptic. The content of individual elements in water samples was determined by inductively coupled plasma mass spectrometry (ICP-MS) in accordance with [15, 16].

Drag net 15 m length with 3 mm mesh size, gill nets 25 length and mesh sizes from 16 to 100 mm, hook fishing tackles were used for fish catches. The precise quantitative evaluation of fishes cannot be realized for any big lake or river [17], and so one site on the main stream and a site on the floodplain lake were chosen for investigation of dynamics of fishes. The main criteria for the sites choice were the ability to provide total fish catchment and presence of alien fish species in the first year of investigation.

The names for many common fish species were given according to the FishBase [18]. Local subspecies, which taxonomical status has not been revised, were given under original names. Fishes analysis was done according to the most common scheme by I.F.Pravdin [19]. Big fishes with total weight about 1kg and more were investigated at the catchment site, smaller fishes were fixed in 4% formaldehyde and then analyzed in the laboratory. The age of fish in the samples was determined from analysis of scales and vertebrae [20, 21].

Some indexes of fish assemblages were used as: N – total number of fishes per 100 m<sup>2</sup>, S – number of species (richness), D – Simpson's index of diversity, E – Simpsons's index of uniformity, H – Shennon's index, e – Pielou's index of uniformity [22]. Indigenous and alien fish species were counted. Binary logarithm was used for Shennon's and Pielou's indexes calculating.

**Results and discussion.** Volume of water in the Syrdarya river in the KR is regulated with irrigation dams and depended on precipitation and cropland area. During the investigation period the least level of water was observed in 2015 and the maximal in 2017. The data presented in the table 1 show significant fluctuation of the main characteristics in different years. In the all investigated samples of water concentrations of *Fe*, *Cu*, *Cd* and *Pb* did not exceed the maximal permissible concentration for fishery water bodies.

Fish fauna of the KR were presented by native fish species as well as some alien. Indigenous fish species here are pike *Esox lucius* Linnaeus, 1758; roach *Rutilus rutilus* (Linnaeus, 1758); Syrdarya dace *Squalius squaliusculus* (Kessler, 1874); redeye *Scardinius erythrophthalmus* (Linnaeus, 1758); Aral shemaya *Alburnus (Chalcalburnus) chalcoides aralensis* (Berg, 1923); stripped bystryanka *Alburnoides taenatus* (Kessler, 1872); asp *Aspius aspius* (Linnaeus, 1758); eastern bream *Abramis brama orientalis* Berg, 1949; Aral white-eye *Abramis sapa aralensis* Tiapkin, 1939; sabrefish *Pelecus cultratus* (Linnaeus, 1758); goldfish *Carassius gibelio* (Bloch, 1782); carp *Cyprinus carpio* Linnaeus, 1758; perch *Perca fluviatilis* Linnaeus, 1758 and sander (pike-perch) *Sander lucioperca* (Linnaeus, 1758).



Table 1 – General characteristics of water biotopes in 2015-2017

Biotope	Year	Water characteristics					
		Color	Temperature, °C	Turbidity, FTU	pH	Mineralization, ppm	Dissolved oxygen, ppm
Main stream	2015	clear brown	26.1-29.3	79-81	6.5-8.2	540-602	6.02-8.16
	2016	clear brown	29.3	94	6.7-8.0	598-602	6.58-7.14
	2017	brown	26.1	101	6.9-7.1	540-543	No data
Flood-plain lake	2015	green	25.1-29.0	9.12	6.5-7.2	563	6.70-8.03
	2016	blue green	24.3-29.0	12.61	7.0-7.2	691	7.21-7.72
	2017	blue green	27.8-28.2	8.31	7.4-7.5	603	No data

Alien fish species are grass carp *Ctenopharyngodon idella* (Valenciennes, 1844), silver carp *Hypophthalmichthys molitrix* (Valenciennes, 1844), false gudgeon *Abbottina rivularis* (Basilewsky, 1855), topmouth gudgeon (pseudorasbora) *Pseudorasbora parva* (Temminck et Schlegel, 1846), sawbelly *Hemiculter leucisculus* (Basilewsky, 1855), ocellated bitterling *Rhodeus ocellatus* (Kner, 1866), mosquitofish *Gambusia holbrooki* (Girard, 1859), Chinese medaka (or ricefish) *Orizias sinensis* Chen, Uwa et Chu, 1989; beautiful sleeper *Micropercops cinctus* (Dabry de Thiersant, 1872); Chinese goby *Rhinogobius cheni* (Nichols, 1931); snakehead *Channa argus* (Cantor, 1842). All revealed fish species were presented by adults as well as young fishes that indicated their satisfactory survival rate in the present conditions.

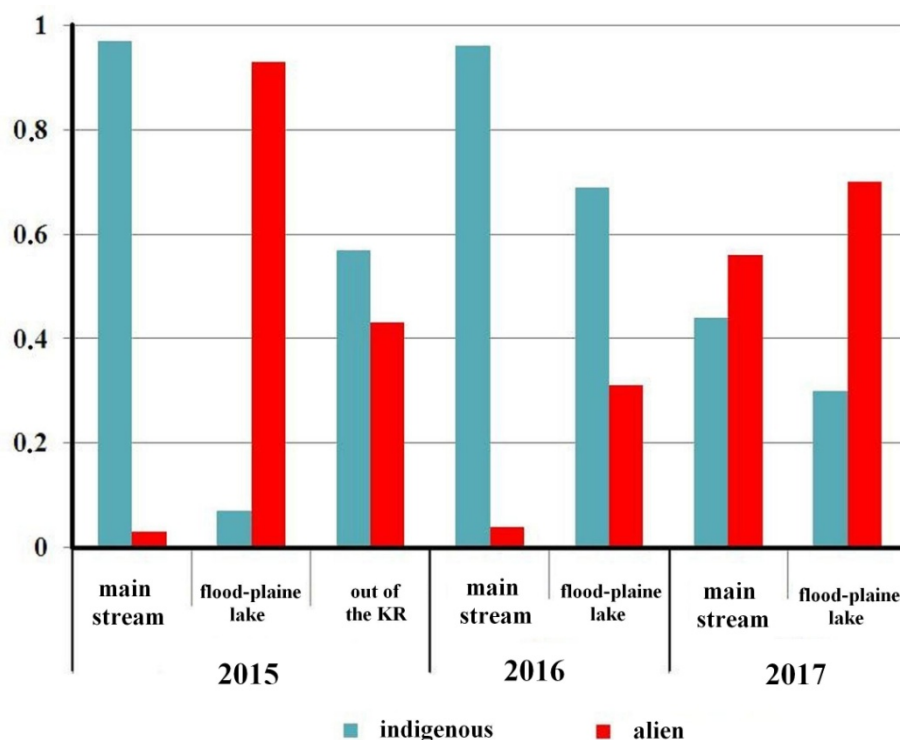
Table 2 – Indexes of young fish assemblages in the KR 2015-2017

Indexes	2015 год			2016 год		2017 год	
	Main stream	Flood-plain lake	Out of the KR	Main stream	Flood-plain lake	Main stream	Flood-plain lake
Number of indigenous fishes:							
Goldfish	0	0	19	1	2	2	8
Carp	0	0	0	3	0	0	0
Roach	30	1	14	21	15	30	12
Bystyanka	0	0	0	0	3	0	0
Sabrefish	0	0	0	0	0	0	3
Asp	2	1	0	19	11	4	0
Perch	0	0	0	3	0	0	0
Pike-perch	6	0	0	0	0	0	0
Number of alien fishes:							
Abbottina	1	0	3	0	0	0	0
Pseudorasbora	0	1	2	0	4	26	15
Bitterling	0	0	11	0	0	1	1
Sawbelly	0	0	0	0	0	0	15
Silver carp	0	0	0	1	2	0	0
Medaka	0	0	1	0	0	10	11
Chinese goby	0	26	1	1	6	2	10
Beautiful sleeper	0	0	7	0	2	6	2
Indexes:							
S, species	4	4	8	7	8	8	9
N, individuals	39	29	58	49	45	81	77
D	1.62	1.24	4.53	2.92	4.83	3.78	6.64
E	0.40	0.31	0.57	0.42	0.60	0.42	0.74
H (log <sub>2</sub> )	1.06	0.64	2.44	1.89	2.58	2.19	2.86
e (log <sub>2</sub> )	0.53	0.32	0.81	0.67	0.86	0.69	0.90

Maximal age of investigated pseudorasbora was 3 years old, false gudgeon, ocellated bitterling and mosquitofish - 2 years old, medaka, beautiful sleeper and goby – only 1 year old. It is less that is known for these species form native range [23]. So that, we can suppose an effective control of lifespan of these alien fish species doing by indigenous predatory fish species.

Spotted silver carp *Aristichthys nobilis* (Richardson, 1845), black amur *Mylopharyngodon piceus* (Richardson, 1846), anabarilius *Anabarilius polylepis* (Regan, 1904) and three-lips *Opsariichthys uncirostris* (Temminck et Schlegel, 1846) were known in the basin [2, 24], but were not revealed in boundaries of the KR. Spotted silver carp and black amur are commercially valuable fish species, and never been usual in the Kazakhstan part of the river [2]. For the Syrdarya river *Anabarilius polylepis* only once had been mentioned by V.E.Karpov [24 – p.156]. Most probably naturalization of this species did not happen. Unintentional introduction of three-lips in the Syrdarya watershed was the result of neglecting introduction of grass carp and silver carp from water bodies of China [25, 26]. This fish species was revealed in the all Kazakhstan segment of the river, but only by 1-2 specimens for every case [27].

Indexes of young fish assemblages in shallow places of the river and floodplain lake are presented in the table 2. Young roaches and aspms dominated in the shore zone of the river in relatively water-short 2015 and 2016, but in high-water 2017 there dominated alien pseudorasbora. Young fishes of indigenous roach and alien Chinese goby dominated in the shallows of the flood-plain lake. Only alien fish species dominated there in 2017 (figure).



Indigenous and alien fish ratio in 2015-2017

Adult indigenous fishes like roach, asp, sabrefish as well as their baby fishes each year dominated at the depth from 1 and 5-10 m far away from the shore in spite of dominance of alien fishes in the shallow waters. Only snakehead as alien fish species was able to live in the depth water. It was only one alien piscivorous fish that inhabited waters in the KR. Snakeheads were observed in the floodplain lake every year during the investigations. Examination of the feeding revealed prevalence of the indigenous fish species like roach, goldfish and carp. In contrast with indigenous piscivorous fishes, snakehead prefers hunting close to shoreline and willingly eats died fishes. This particularity allows selective angling of snakehead using bits of fishes for lure. 18 fishes were caught using this lure and 16 from them were snakeheads, 2 indigenous piscivorous fishes like pike-perch and pike were caught too.

Table 3 – Adaptive abilities of alien fish species in the Syrdarya river

Fish species	Biotopes	Maximal temperature, °C		Maximal turbidity, FTU		Absence of water plants	
		juv.	adult	juv.	adult	juv.	adult
Grass carp	LC	28	28	9.12	81	I	0
Silver carp	RLC	28	32	9.12	9.12	I	S
Bitterling	RLTC	32	32	101	101	S	S
Pseudorasbora	LTC	34	34	101	101	S	S
Abbottina	LTC	34	34	81	81	S	S
Mosquito fish	LC	34	34	81	81	0	0
Ricefish	LC	34	34	81	101	0	0
Beautiful sleeper	LTC	34	34	81	101	0	S
Snakehead	RLC	32	32	12.61	81	0	I
Chinese goby	RLC	34	34	101	101	S	S

*Note.* Fishes: juv. - baby fishes, adult - adult fishes. Biotopes: L - lentic, R - main stream, T - tributaries and branches, C - canals. Occurrence: U - usual, S - seldom; I - infrequent; 0 - did not revealed.

Some environmental conditions were investigated to better comprehension particularities of fish distribution in the river and adaptive abilities of alien fish species (table 3).

Presented data show that many of alien fish species are able to bear rather hot water from 28 to 34 °C and have tendency to inhabit lentic biotopes where living conditions are too hot for indigenous fish species. If water temperature fall down (in night time or flowage growing), indigenous piscivorous fishes, mostly asp, can effectively regulate the number of alien fishes at sites without aquatic plants and tree roots.

Interaction between alien and native fish fauna as well as cumulative impact of all stressors on the native fauna was weakly known until recently [9]. The obtained data allow clarify the cause of the sharp increase of number of alien fish species in the most water full year. High level of river during spring time creates wide spawning area for many of indigenous and alien fish species. Then water decrease leads to isolation many small water bodies in the high-water bed. Increase of temperature of water up to 28–32 °C results in elimination of indigenous fishes and gives advantages alien fishes like pseudorasbora, ricefish and goby fish. Subsequent scenario depends on flow volume:

1) Prolonged low level of water will lead to the fishes die (usually birds have time to eat up all the fishes) as that happened in 2015 and 2016, or

2) Repeated increase of water level and submergence of the small water bodies will give the alien fish species a chance to fully realize their ability to multiple spawning as that happened in 2017.

Indigenous alien fishes as asp and pike-perch can do an effective control of the number of alien fish species in uncovered and slightly covered by water plants sites, but their avoid thickly grassed shallow places.

#### Conclusions:

1. Fluctuating level of water in the Syrdarya river during summer season benefits alien fishes to spawn in flooded shallows.

2. Native piscivorous fish species are able doing an effective control of alien non-commercial fish species in uncovered sites of the main stream and lake.

Obtained data confirm heterogeneity and landscape-level impacts of non-native aquatic species that obliged society and scientists to scrutinize interaction between indigenous and alien fish species in the local scale for the further integration obtained knowledge for whole basin [28].

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### ҚАРҒАЛЫ ҚОРЫҒЫНДАҒЫ БӨГДЕ БАЛЫҚ ТҮРЛЕРІ (ҚАЗАҚСТАН РЕСПУБЛИКАСЫ, СЫРДАРІЯ ӨЗЕНІ)

**Аннотация.** Сырдария өзені - Орталық Азиядағы ең маңызды өзендердің бірі. XX ғасырдың соңғы ширегінде су ресурстарын тиімсіз пайдалану нәтижесінде күрделі экологиялық дағдарыстар болды. Қазақстан Республикасының Үкіметі осы аймақтағы экологиялық жағдайларды жақсартуға бағытталған шаралар ұйымдастырады. Суқойма жағдайының көрсеткіштерінің бірі бөгде балық түрлерінің көптігі болып табылады. Сондықтан 2015-2017 жылдары Қарғалы мемлекеттік табиғи қорық аумағындағы бөгде балық түрлерінің қазіргі алуантүрлілігіне және динамикасына, балық қауымдастық құрамына балық аулауды болдырмаудың әсері туралы зерттеулер жүргізілді. Бұл қорық өзеннің жазық ағынының сегментінде орналасқан. Тіршілік ету ортасының негізгі екі түрі зерттелді: өзен және ағынды өзендер. Су құрамын және балықты зерттеудің дәстүрлі әдістері пайдаланылды. Кейбір ауыр металдар (Fe, Cu, Cd, Pb) және температура, ластану, минералдану, рН, ерітілген оттегі зерттелді. Осы параметрлердің елеулі ауытқуы судың шығарылу режиміне және ихтиофаунаның алуантүрлілік құрылымын анықтауға байланысты. Мұнда барлығы 14 жергілікті және 11 бөгде балық түрлері кездесті. Бөгде балық түрлері ақ амур *Stenopharyngodon idella*, ақ дөңмаңдай *Hypophthalmichthys molitrix*, жалған теңге - балық *Abbottina rivularis*, амур шабағы *Pseudorasbora parva*, құрлыққұрсақ *Hemiculter leucisculus*, теңбіл кекіре *Rhodeus ocellatus*, гамбузия *Gambusia holbrooki*, медака *Orizias sinensis*; элеотрис *Micropercops cinctus*; бұзаубас балық *Rhinogobius cheni* және жыланбас - балықтары *Channa argus* кездесті. Барлық шабақтар және ересек бөгде балық түрлері көрсетілген, бұл олардың тіршілік етуіне қолайлы жағдайлардың бар екенін көрсетеді. Экологиялық пластинкада балықтың біркелкі бөлінбеуі анықталды. Түрлер мен особтар санының өзгергіштігі гидрологиялық режимге байланысты. Ашық суқоймаларда жергілікті жыртқыш балық түрлері бөгде балық түрлерінің санын тиімді пайдалануға мүмкіндік береді. Судың тұрақсыз режимі бөгде балық түрлеріне қолайлы болып табылады.

**Түйін сөздер:** балық, фауна, жергілікті, бөгде, Сырдария, Қарғалы мемлекеттік табиғи қорық, абиоти-калық фактор.

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### ЧУЖЕРОДНЫЕ ВИДЫ РЫБ В КАРАГАЛИНСКОМ ЗАКАЗНИКЕ (РЕКА СЫРДАРЬЯ, РЕСПУБЛИКА КАЗАХСТАН)

**Аннотация.** Сырдарья является одной из важнейших рек Центральной Азии. В результате нерационального использования водных ресурсов в последней четверти двадцатого века здесь произошел острый экологический кризис. Правительство Республики Казахстан предпринимает меры, направленные на смягчение экологической ситуации в этом регионе. Обилие чужеродных видов рыб является одним из индикаторов состояния водоемов. В 2015-2017 годах было проведено изучение современного разнообразия и динамики чужеродных видов на территории Карагалинского государственного природного заказника, что позволяет избежать влияния промысла на сообщество рыб. Этот заказник расположен на сегменте равнинного течения реки. Были изучены два основных типа местообитаний – проточная старица и собственно река. Применялись традиционные методики изучения воды и рыб. Были изучены температура, мутность, минерализация, рН, содержание растворенного кислорода и некоторых тяжелых металлов (Fe, Cu, Cd, Pb). Существенные колебания данных параметров зависят от режима пропусков воды и определяют структуру разнообразия ихтиофауны. Всего здесь было обнаружено 14 аборигенных и 11 чужеродных видов рыб. Чужеродные виды представлены белым амуром *Stenopharyngodon idella*, белым толстолобиком *Hypophthalmichthys molitrix*, абботтиной *Abbottina rivularis*, псевдорасборой *Pseudorasbora parva*, востробрюшкой *Hemiculter leucisculus*, глазчатым горчаком *Rhodeus ocellatus*, гамбузией *Gambusia holbrooki*, медакой *Orizias sinensis*; элеотрисом *Micropercops cinctus*; бычком *Rhinogobius cheni* и змееголовом *Channa argus*. Все чужеродные виды представлены молодью и взрослыми особями, что указывает на благоприятные условия их существования. Неравномерность распределения рыб определяется их экологической пластичностью. Изменчивость числа видов и особей зависит от гидрологического режима. Аборигенные хищные виды рыб эффективно контролируют численность чужеродных на открытых участках водоемов. Нестабильный режим пропусков воды благоприятствует чужеродным видам рыб.

**Ключевые слова:** рыбы, фауна, аборигенный, чужеродный, Сырдарья, Карагалинский государственный природный заказник, абиотические факторы.

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**INFLUENCE OF BIOCIDES ON GROWTH AND DEVELOPMENT  
OF CORROSIVE-DANGEROUS MICROFLORA**

**Abstract.** The problem of protection of buildings and constructions from aggressive chemical and biological impacts of the environment becomes very urgent now. Microbiological corrosion is the important factor influencing reliability and durability of steel concrete designs. In this connection, the problem of protecting building constructions and structures from aggressive biological influences is of great urgency. The aim of the research was to study the effect of biocides based on copolymers and copper sulfate on the development of corrosive microorganisms. It has been established that copper sulfate possessed the least effective inhibitory effect on thione and sulfate-reducing bacteria (SRB). When it was added, the growth of the investigated bacteria was suppressed at a concentration of 1%. Copolymers with different mole composition were more active. Their effect on the inhibition of thiobacteria and SRB occurred at concentrations of 0.1-0.5%. The most sensitive to their effects were *T. ferrooxidans* and SRB. On heterotrophic bacteria and fungi, the compounds tested had a bactericidal effect only at a concentration of 1%. Copper sulfate was more effective with respect to micromycetes and yeast, while inhibition of their growth occurred at concentrations of 1% and 0.5%, respectively.

**Keywords:** biocorrosion, corrosive-dangerous microorganisms, thione and sulfate-reducing bacteria, heterotrophic microorganisms, biocides.

**Introduction.** Biological corrosion are the processes of damage to metals, metal structures and other building materials caused by the products of vital activity of living organisms that settle on the surface of building structures. Significant role in biocorrosion is played by such microscopic organisms as bacteria and microscopic fungi, for the development and reproduction of which under certain conditions of operation of buildings and structures a favorable environment is created [1].

Information on the role of the microbiological factor in the corrosion of metals and other materials is accumulated every year, generalized, and losses are calculated for the economy. Numerous species of microbial corrosion testifies to the unusually wide spread of this phenomenon in various spheres of human activity [2-5]. The activity of microorganisms, according to several authors, can be caused by 50 to 80% of corrosion damage [6-9].

Microbiological corrosion can proceed independently and accompany electrochemical, soil, atmospheric and other types of corrosion of metals. The action of microorganisms on metals can occur differently. First of all, corrosive metabolites of microorganisms can cause corrosion: mineral and organic acids and bases, enzymes and others. They create a corrosive medium in which corrosion occurs in the presence of water according to the usual laws of electrochemistry. Colonies of microorganisms can create on the surface of metals growths and films of mycelium or mucus, under which ulcerative (pitting) corrosion can develop [10-13].

The problem of protecting building constructions, buildings and structures from aggressive chemical and biological influences of the environment is of great importance. In public buildings and structures, in particular in subways, in areas with high humidity and certain climatic conditions, microbiological corrosion becomes an important factor affecting the reliability and durability of structures made of metal, concrete and reinforced concrete.

To protect reinforced concrete structures from biological corrosion, an effective and basic method is surface treatment with bactericidal agents. These include synthetic biocides, as well as substances containing metal ions that penetrate into the cells inhibit respiratory chain enzymes and disrupt oxidative phosphorylation processes, resulting in the cell killing. In addition, with their action, cytoplasmic proteins can be coagulated [14-16].

The purpose of this work is to study the effect of biocides based on copolymers and copper sulfate on the development of corrosive-dangerous microorganisms.

**Materials and methods.** The bactericidal properties of copper sulfate and N, N-dimethyl-N, N-diallyl ammonium chloride copolymers (DMDAAC) with N, N-dimethylacrylamide (DMAA) with respect to thiobacteria and SRB, as well as heterotrophic microorganisms have been studied. Copolymers were synthesized and provided by Doctor of Chemistry, associate professor of JSC “Kazakh-British Technical University” K.Zh. Abdiyev.

For cultivation of *Thiobacillusthioparus* bacteria, the Bayerink’s medium were used, *Thiobacillus thiooxidans* – Waxman’s medium, *Thiobacillusferrooxidans* – medium 9K, *Thiobacillusdenitrificans* – Baalsrud’s medium. Sulfate-reducing bacteria (SRB) were grown on Postgate's medium [17]. To study the effect of biocides on the development of these bacteria, they were cultured on appropriate selective media into which the biocides investigated were added in various concentrations: 0.01-1.0%. Their impact was assessed by the presence or absence of growth of microorganisms.

The effect of biocides on the growth of heterotrophic bacteria, fungi and yeast was verified by diffusion into agar from wells on solid nutrient media (nutrient agar, potato-dextrose agar and glucose-peptone agar) at concentrations of 0.01-1%. Their effect was judged by the zones of suppression of the growth of these microorganisms.

**Research results and discussion.** Thionic and sulfate-reducing bacteria, as well as heterotrophic microorganisms, were isolated from the damaged sites of reinforced concrete structures. The bactericidal properties of copper sulfate and N, N-dimethyl-N, N-diallyl ammonium chloride copolymers (DMDAAC) with N, N-dimethylacrylamide (DMAA) with respect to isolated microflora. Copolymers with different mole composition were used:

- 1) DMDAAC :DMAA – 95:5 (B1)
- 2) DMDAAC :DMAA – 80:20 (B2)
- 3) DMDAAC :DMAA – 75:25 (B3).

The results of the study showed that the development of *Thiobacillusthiooxidans* bacteria was noted at concentrations of synthetic biocides and copper sulfate 0.01-0.5%, higher concentration of 1% inhibited the growth of these bacteria (Table 1).

Table 1 – Influence of the biocides under study on bacterial growth *T. thiooxidans*

Biocides	Concentration of biocides, %				
	0,01	0,05	0,1	0,5	1,0
B1	+	+	+	+	–
B2	+	+	+	+	–
B3	+	+	+	+	–
CuSO <sub>4</sub>	+	+	+	+	–

Note. «+» - marked growth, «-» - growth is absent.

The development of *T. ferrooxidans* was inhibited even at lower concentrations of the test compounds. Thus, under the influence of copolymers B1, B2 and B3, their growth was not observed at concentration of 0.1% (Table 2). When biocide B3 was used at concentration of 0.05%, a slight growth of these bacteria was noted. Less effective was copper sulfate, which inhibited their growth at concentration of 1%.

For bacteria *T. thioparus* and *T. denitrificans*, inhibition of growth occurred at concentration of synthetic compounds of 0.5%. CuSO<sub>4</sub> suppressed the growth of these bacteria at concentration of 1% (Table 3, 4).

Table 2 – Influence of the biocides under study on bacterial growth *T. ferrooxidans*

Biocides	Concentration of biocides, %				
	0,01	0,05	0,1	0,5	1,0
B1	+	+	–	–	–
B2	+	+	–	–	–
B3	+	+	–	–	–
CuSO <sub>4</sub>	+	+	+	+	–

Note. «+» - marked growth, «–» - growth is absent.

Table 3 – Influence of biocides under study on bacterial growth *T. thioparus*

Biocides	Concentration of biocides, %				
	0,01	0,05	0,1	0,5	1,0
B1	+	+	+	–	–
B2	+	+	+	–	–
B3	+	+	+	–	–
CuSO <sub>4</sub>	+	+	+	+	–

Note. «+» - marked growth, «–» - growth is absent.

Table 4 – Influence of biocides under study on bacterial growth *T. denitrificans*

Biocides	Concentration of biocides, %				
	0,01	0,05	0,1	0,5	1,0
B1	+	+	+	–	–
B2	+	+	+	–	–
B3	+	+	+	–	–
CuSO <sub>4</sub>	+	+	+	+	–

Note. «+» - marked growth, «–» - growth is absent.

SRB reacted to the addition of copolymers of DMDAAC and DMAA starting at concentration of 0.1%. Copper sulfate inhibited the growth of bacteria, starting at concentration of 0.5% (Table 5).

Table 5 – Effect of biocides under study on the growth of sulfate-reducing bacteria

Biocides	Concentration of biocides, %				
	0,01	0,05	0,1	0,5	1,0
B1	+	+	–	–	–
B2	+	+	–	–	–
B3	+	+	–	–	–
CuSO <sub>4</sub>	+	+	+	–	–

Note. «+» - marked growth, «–» - growth is absent.

The study of the effect of biocides on the heterotrophic microflora showed that at concentration of 0.01-0.5% they did not exert an inhibitory effect on bacteria and fungi. Their effect on the growth of microorganisms occurred at concentration of 1% (Table 6, 7).



Table 6 – Influence of biocides under study on the growth of heterotrophic bacteria

Culture	Zones of growth suppression under the action of biocides, mm			
	B1	B2	B3	CuSO <sub>4</sub>
A2-1	14,7±0,6	14,3±0,6	–	12,7±0,6
A2-2	14,3±0,6	14,7±0,6	–	14,3±0,6
A2-4	15,3±1,5	15,3±0,6	–	15,3±2,1
A2-6	14,0±1,0	15,7±1,2	–	16,0±1,0
A5-1	13,7±0,6	16,0±0,6	11,0±0	14,3±0,6
A5-2	16,0±5,2	17,0±0	11,0±0	7,3±1,2
A5-3	13,7±0,6	17,0±0	11,3±0,6	15,3±0,6
G2-1	15,0±0	16,3±0,6	12,3±0,6	17,3±0,6
G2-2	14,7±0,6	16,7±0,6	13,3±1,5	18,0±1,0
G2-3	7,7±0,6	17,0±1,0	11,3±0,6	16,7±0,6
G2-6	14,7±0,6	15,7±0,6	–	16,0±1,0
G2-7	15,3±1,5	14,7±0,6	–	14,0±1,0
G5-1	13,7±0,6	15,7±0,6	11,0±0	17,7±0,6
G5-2	13,7±0,6	14,3±0,6	–	13,3±1,2

Note. Significance level  $p < 0,05$ .

It can be seen from the table that under the influence of biocide B1, the areas of inhibition of bacterial growth were 7.7-16.0 mm. The G2-3 culture was less sensitive to this compound. Biocide B2 also affected all the bacterial cultures under study, while the clarification zones were 14.3-17.0 mm. B3 was less effective among synthetic biocides, using which growth inhibition zones were observed only in seven cultures and amounted to 11.0-13.3 mm.

All investigated bacteria reacted on CuSO<sub>4</sub>. The largest zone of enlightenment was noted in the G2-2 culture, which was 18 mm. The culture A5-2 was less sensitive to the action of copper sulfate (7.3 mm).

Virtually the same effect studied biocides had on fungi. Under the influence of biocides B1 and B2, the areas of suppression of fungal growth were 14.3-18.3 mm. The culture *Penicilliumchrysogenum* 17GM was the most sensitive to these compounds. The growth of this culture was also suppressed by biocide B3, whereas it did not exert a depressing effect on other cultures of fungi. The culture *Aspergillus* sp. 1GM was resistant to the influence of copolymers.

Table 7 – Influence of biocides under investigation on the growth of mycelial fungi

Culture	Zones of growth suppression under the action of biocides, mm			
	B1	B2	B3	CuSO <sub>4</sub>
1GM	–	–	–	21,3±1,2
2GM	14,3±0,6	15,7±2,1	–	22,7±0,6
8GM	15,0±0,1	15,3±2,5	–	15,0±1,7
10GM	14,6±2,1	14,7±1,2	–	16,3±1,5
11GM	14,3±0,6	16,1±1,5	–	14,5±0,6
14GM	15,7±2,1	16,4±0,6	–	27,0±1,7
17GM	18,3±2,5	17,6±1,2	8,3±1,5	26,7±2,9

Note. Significance level  $p < 0,05$ .

1% solution of copper sulfate suppressed the growth of all fungi studied. The largest enlightenment zones were recorded for 14GM and 17GM cultures, which were 27 mm and 26.7 mm, respectively. The strains 11GM, 8GM and 10GM were less sensitive to the action of copper sulfate.

Yeasts were more sensitive to the action of the test compounds. Thus, the biocides B1 and B2 had a depressing effect on them already at a concentration of 0.1% (Table 8). With increasing concentration the zone of bleaching on solid nutrient media increased. The culture *Exophiala sp. 6gA* was more stable.

Table 8 – Effect of biocides under study on yeast growth

Biocides	Concentration, %	Zones of growth suppression, mm		
		1gA	5gA	6gA
B1	0,1	11,3±0,6	10,7±0,6	-
	0,5	15,3±1,5	15,7±1,2	11,7±1,5
	1,0	16,0±0	16,0±1,0	13,3±0,6
B2	0,1	13,3±0,6	11,7±0,6	10,7±1,2
	0,5	15,3±0,6	12,3±2,1	11,0±1,0
	1,0	16,7±0,6	17,3±2,1	14,0±3,5
B3	0,1	-	-	-
	0,5	-	-	-
	1,0	-	-	-
CuSO <sub>4</sub>	0,1	-	-	-
	0,5	8,3±1,2	10,7±2,5	-
	1,0	31,7±1,5	23,0±2,6	19,7±1,5
<i>Note.</i> Significance level p<0,05.				

Copolymer B3 did not suppress the development of the yeast cultures studied. Copper sulfate began to affect the growth of yeast 1gA and 5gA at a concentration of 0.5%. An increase in the concentration of up to 1% led to a significant increase in the bleaching zones. The strain *Erythrobasidium clade sp. 1gA* was more sensitive.

**Conclusions.** Thus, the conducted studies showed that copper sulfate possessed the lowest bactericidal action with respect to thionic and sulfate-reducing bacteria. When it was added, the growth of the studied bacteria was suppressed at a concentration of 1%, and only for SRB, their development was not observed at a lower concentration of 0.5%. The copolymers of N, N-dimethyl-N, N-diallyl ammonium chloride (DMDAAC) and N, N-dimethylacrylamide (DMAA) with different mole composition exhibited a more active effect. Their effect on the inhibition of thionic and sulfate-reducing bacteria occurred at concentrations of 0.1-0.5%. *T. ferrooxidans* and SRB were the most sensitive to their effects.

On heterotrophic bacteria and fungi, the compounds tested had a bactericidal effect only at a concentration of 1%. Biocides B1 and B2 had approximately the same activity, while copolymer B3 suppressed the growth of only 7 bacterial cultures and 1 fungus culture. Copolymers B1 and B2 inhibited the development of yeast starting at a concentration of 0.1%. Biocide B3 did not exert a suppressive effect on all yeasts. Copper sulfate was more effective with respect to fungi and yeast, while inhibition of their growth occurred at concentrations of 1% and 0.5%, respectively.

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### **КОРРОЗИЯЛЫҚ-ҚАУІПТІ МИКРОФЛОРАНЫҢ ӨСП-ӨНУІ МЕН ДАМУЫНА БИОЦИДТЕРДІҢ ӘСЕРІ**

**Аннотация.** Қазіргі таңда ғимараттар мен құрылыстарды қоршаған ортаның агрессивті химиялық және биологиялық әсерінен қорғау мәселесі өте өзекті болып келеді. Микробиологиялық коррозия темірбетон конструкцияларының сенімділігі мен ұзақ мерзімділігіне ықпал ететін маңызды фактор болып табылады. Осыған байланысты, құрылыстар конструкциясы мен ғимараттарды агрессивті биологиялық әсерден қорғау мәселесі өте өзекті. Зерттеудің мақсаты коррозиялық-қауіпті микроорганизмдердің дамуына сополимерлер мен мыс сульфаттарының негізіндегі биоцидтердің әсерін зерттеу болып табылады. Мыс сульфаты тионды және сульфатредуцирлеуші бактерияларды (СРБ) азайтуға қарсы ең аз тиімді ингибиторлық әрекетке ие екендігі анықталды. 1% концентрация қосылған кезде зерттелген бактериялардың өсуі баяулады. Әртүрлі молярлық құрамды сополимерлер анағұрлым белсенділік көрсетті. Олардың СРБ және тионды бактерияларды баяулату әсері 0,1-0,5% концентрациясында орын алды. Олардың әсеріне ең сезімтал *T. ferrooxidans* және СРБ болды. Гетеротрофты бактериялар мен жіпшумақты саңырауқұлақтарда сыналған қосылыстар тек 1% концентрацияда бактерицидтік әсерге ие болды. Мыс сульфаты микромицеттер мен ашытқыларға қатысты тиімді болғанымен, олардың өсуінің баяулауы тиісінше 1% және 0,5% концентрация кезінде байқалды.

**Түйін сөздер:** биокоррозия, коррозиялық-қауіпті микроорганизмдер, тионды және сульфатредуцирлеуші бактериялар, гетеротрофты микроорганизмдер, биоцидтер.

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### ВЛИЯНИЕ БИОЦИДОВ НА РОСТ И РАЗВИТИЕ КОРРОЗИОННО-ОПАСНОЙ МИКРОФЛОРЫ

**Аннотация.** Проблема защиты зданий и сооружений от агрессивных химических и биологических воздействий окружающей среды в настоящее время становится весьма актуальной. Микробиологическая коррозия является важным фактором, влияющим на надежность и долговечность железобетонных конструкций. В связи с этим большую актуальность представляет проблема защиты строительных конструкций и сооружений от агрессивных биологических воздействий. Целью исследований было изучение влияния биоцидов на основе сополимеров и медного купороса на развитие коррозионно-опасных микроорганизмов. Установлено, что наименее эффективным ингибирующим действием по отношению к тионовым и сульфатредуцирующим бактериям (СРБ) обладал медный купорос. При его добавлении рост исследуемых бактерий подавлялся при концентрации 1%. Более активное действие проявляли сополимеры с разным мольным составом. Их воздействие по ингибированию тионовых бактерий и СРБ происходило при концентрациях 0,1-0,5%. Самыми чувствительными к их воздействию были *T. ferrooxidans* и СРБ. На гетеротрофные бактерии и мицелиальные грибы исследуемые соединения оказывали бактерицидное действие только при концентрации 1%. Медный купорос был более эффективен по отношению к микромицетам и дрожжам, при этом ингибирование их роста происходило при концентрациях 1% и 0,5% соответственно.

**Ключевые слова:** биокоррозия, коррозионно-опасные микроорганизмы, тионовые и сульфатредуцирующие бактерии, гетеротрофные микроорганизмы, биоциды.

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**APPROBATION OF ACCELERATED BIOTECHNOLOGICAL PRODUCTION OF ELITE SEED POTATOES FOR ENSURING SEED INDUSTRY IN THE REPUBLIC OF KAZAKHSTAN**

**Abstract.** Production of healthy seed mini-tubers is the basis for obtaining high-quality potato seed material. The technology of pilot production of elite seed potatoes on a small scale has been developed and tested (approved) in order to accelerate the production of domestic potato seed material. The prospects of this technology application are shown with use/availability of modern greenhouse complexes at the first stages of the technological process of “super-superelite” category of minituber material production. Virus free plants-regenerants of domestic high-yielding “Aksor” cultivar were obtained from a small number of tubers and propagated with the use of micrograftage method. Minitubers for the production of super-superelite seed material were obtained from the regenerant plants under conditions of closed (isolated) soil/ground in the first year. In the second year of the project superelite potato seeds were obtained from super-superelite minituber material under field conditions and were transferred to the elite seed-growing farms for further production of seeds of “elite” category in the third year of the project implementation.

Features of this technology consist in a continuous process of obtaining healthy test-tube plants (*in vitro*) and minitubers within 3 years. Conducting regular excavation of tuber material during the cultivation of plants in the greenhouse leads to an increase in the amount of minitubers harvest from one generation, as well as to cyclical production of super-superelite material 2 times a year. Results are the following: reduction of the period of elite seeds production to 3 years, a low demand for production areas, a slowdown in the norms of seed material consumption and a high coefficient of its reproduction.

**Key words:** potato, *in vitro* cultures, virus free plants-regenerants, microclonal propagation, potato original seeds, minitubers, potato elite seed material.

Potatoes are the most important food, technical and fodder crops. In addition, being the most important and significant vegetable source of food energy, vitamins, minerals and antioxidants among forbs (non-grain plants) in the world, potato considered as a unique product for healthy nutrition. Potato tubers contain on the average 76-78% of water, 17-19% of starch, 1-2% of proteins, and about 1% of minerals and vitamins [1]. In Kazakhstan, the priority direction of potato use is its production to ensure food security of the current and future generations of the country. Potato production in the country by profitability is one of the most promising branches of agriculture (from 50% to 300%) over the past few years [2].

Nowadays, the issue of producing high-quality seed material remains one of the most acute in this industry for a number of reasons. Firstly, not all regions of the republic own seed-growing farms for the production of original and elite seed potato material, and those that are - do not cover all the needs of potato growing farms with high-quality seeds of local cultivars. Secondly, most of the territory of our country is not suitable for potato cultivation due to difficult climatic conditions [3]. At present, more than 190 thousand hectares of land resources in the territory of Kazakhstan are occupied for potato production,

and the main regions in which the largest gross harvest of potatoes are recorded are Almaty, South Kazakhstan, Pavlodar, Zhambyl and North-Kazakhstan regions [4]. With the annual domestic production of potatoes, oriented only to the domestic market, consumers' needs are covered by only 50-60%, while the rest of the market is occupied by imported potatoes of very different quality from Russia, Kyrgyzstan, China and Pakistan [5,6]. The lack of a high-quality initial planting material of domestic potato varieties in the country makes it necessary to import potato seeds of foreign selection cultivars that are not adapted to local climatic conditions, quickly lose their qualitative characteristics, become susceptible to diseases, thereby reducing its yields and further reproduction becomes impractical [7]. Thus, in order to increase the efficiency of potato growing in the republic, it is necessary to organize a high-tech and cost-effective system of virus-free potato seed production.

The existing scheme for the production of "superelite" and "elite" categories seed potatoes by the traditional way requires from 4 to 6 years, and seed potatoes grown in the field are exposed to a high risk of infection with viral and bacterial diseases, which to a considerable extent reduces its quality and terms of use in further reproductions.

The risk of minituberous material contamination significantly reduces due to its cultivation in the greenhouse complex, and elite seed potato material production reduces as well by one year with use of the new scheme of accelerated production of healthy elite seed material on a biotechnological basis.

The accelerated scheme of healthy elite seed material obtainment was developed at the laboratory of Plant Bioengineering and concludes the following: virus free regenerant-plants and minitubers of domestic high-yielding potato cultivar will be obtained from a small number of tubers and propagated in the first year of the project, followed by production of minitubers, super-superelite and superelite seed material under closed and open soil conditions in the second year, and production of elite potato seeds from superelite tuberous material on fields on third year. Elite potato seeds then will be transferred to the elite seed-growing farms for further potato production.

Pilot biotechnological production of virus-free elite seed potato products of domestic varieties on the basis of cultivation technology developed in the laboratory allowed to evaluate experimentally the profitability of this technology, to reveal the weak and strong aspects of this scheme of seed production, and also to evaluate the prospects of such an approach for solving the problem of providing potato growing and peasant farms with elite seed material of potatoes of domestic cultivars.

Clone selection of the initial potato tuber material, isolation of meristem material and obtaining of healthy test-tube plants under *in vitro* conditions was carried out in each repeated cycle during each year.

Potato of domestic cultivar "Aksor" obtained from originator-variety at Kazakh National scientific research institute of potato and vegetable growing (KazNIKO) was used as an initial potato tuber material. Cultivar characteristics: relatively heat resistant, drought-resistant, medium-ripening and medium-yielding. The productive potential of yield is in the range of 55 t / ha. Relatively resistant to diseases, of universal use [8].

Primary test-tube regenerant plants were obtained using method of apical meristems isolation out of healthy sterilized potato tubers in combination with thermotherapy [9]. Further apical meristems were transferred to the universal Murasige Skoog (MS) mediums and were cultivated in a room with regulated light and temperature conditions [10, 11] (Figure 1).

Microclonal reproduction of potato primary test-tube plants were performed by standard method of micro-graftage [12].

The test-tube potato regenerant plants were tested for infection with PVY, PVM, PRVL viruses using potato virus detecting diagnostic kits. Evaluation of the ELISA results was performed on a photometer at a wavelength of 450 nm. As a result of testing, the absence of a viral infection was detected in 19 of 21 batches (15 samples each) of test-tube potato plants. The batches of infected with virus M potato plants were eliminated.

The virus-free plants were replicated for their further transfer to *ex vitro* conditions and the production of potato minitubers in a closed ground/soil. 350 potato primary test-tube plants of "Aksor" cultivar were obtained from 19 lines in the first year. In the second and third year there were produced 252 primary test-tube plants from 21 lines and 800 test-tube plants from 7 lines of "Aksor" potato.



Figure 1 – Test-tube plants production from potato apical meristems

At the first stage of rooting and adaptation to the natural light and temperature conditions, potato regenerant plants were transplanted into individual plastic cups with an autoclaved soil mixture (peat - soil - sand in a ratio of 1:1:0,1). Plants were washed with a MS cultural medium, transplanted into aseptic soil and placed in a light-climatic room with an 18-hour light day, humidity 70%, lighting 3000-5000 lux, and temperature: day +25°C/night +22°C. Watering was carried out as the soil dries up with a Knopp modified nutrient solution for normal growth and development of plants.

The second adaptation stage of cultivation was conducted 3 weeks after planting test-tube plants into the soil/ground. Humidity in the climatic room was reduced to 56%, the temperature regime remained the same, watering of the plants was performed twice a week. The percentage of survived potato plants at this stage composed 92% from the number of plants that passed the first stage of adaptation. Adapted potato test-tube plants were planted in the greenhouse complexes of the elite seed-growing farm "Orken" to produce the original seeds.

#### Potato minitubers (original seeds) production

5400 pcs or 270 kg of harvest of "Aksor" potato minituberous material were obtained from test-tube plants during their cultivation in closed soil in the first year at the site of elite seed-growing farm "Orken".

The harvest of potato minitubers material of "Aksor" cultivar were collected in the amount of 2000 pcs in winter period at "Orken" farm's greenhouse complex from 2500 healthy test-tube plants in the second year.

For a continuous cycle of minitubers production, all the adapted test-tube potato plants were planted in the open ground in spring of the following year. Due to force majeure financial and climatic conditions in the summer of 2016 and 2017, during the second and third year of the project implementation, 90 kg and 52 kg of potato minituber material were obtained from 5000 healthy test-tube plants under the conditions of the greenhouse and field, respectively (Figure 2).



Figure 2 – Harvest from "Aksor" cultivar minitubers



Super-superelite seed material production from original seeds in greenhouse complexes.

In the first year of the project potato minituberous material were obtained out of 2,500 healthy test-tube plants on the fields of the "Orken" peasant farm which was stored from October to December. 3500 pcs of potato minitubers out of 5400 saved and maintained their viability due to natural loss during the storage period.

In January of the second year a minituberous potato seed material was placed on germination at a temperature of +18°C + 20°C for 14 days and planted in a greenhouse complex of the "Orken" elite seed-growing farm in order to produce super-superelite potato seed material. All necessary agrotechnical steps were carried out during the cultivation of plants in the greenhouse in winter period and a crop of super-super-elite potato was harvested in an amount of 150 kg and placed for short-term storage for further planting in the spring.

Production of "super-superelite" seed material from original seeds under field conditions on the second and third years

2000 pcs of potato minitubers of "Aksor" cultivar obtained in greenhouses in the winter period were planted into the open ground on the second year of the project. 81 kg of potato minitubers were planted under field conditions in the third year. All required agrotechnical measures were performed during cultivation of plants on the fields. The harvest of seed potatoes of the "super-superelite" category was collected in the second decade of October of the second and third years (Figure 3). 480 kg of super-superelite potato material were obtained in autumn of second year of project realization which composes 80% of initially expected harvest. Seed potato of super-superelite category were then stored for their further planting in spring period.



Figure 3 – "Super-superelite category seed potato of "Aksor" cultivar

1000 kg of "super-superelite" category potato were collected in autumn of the third year which composed 100% of initially expected harvest. Seed potato material of "super-superelite" category were transferred to the "Orken" farm for the storage and assessment of the quality of obtained seed potato.

"Superelite" category seed material production in the field conditions and their transfer to the elite seed-growing farms of Almaty region for the production of elite seeds and evaluation of its quality

150 kg of seed material of the "super-superelite" category of "Aksor" cultivar were planted to the open ground in the second year considering unfavorable spring weather conditions. 432 kg of "super-superelite" seed material of "Aksor" variety from the previous year planted in the third year.

Harvesting of potatoes was carried out in the second decade of October of the second year and in 3-4 decades in October of the third year (Figure 4).

In the second year the harvest of potato of superelite category of "Aksor" cultivar composed 315 kg. For the third year the harvest of potatoes of this category was about 4000 kg. Obtained superelite seed material was transferred to the seed-growing peasant farm "Orken" for further production of elite seeds and assessment of its quality.





Figure 4 – Collection of harvest from superelite category potato

*Elite seed material production.* The seed material of the "superelite" category in the amount of 283 kg was planted in the field at the end of May 2017 considering the negative spring weather conditions. All required agrotechnical measures were performed during cultivation of plants on the fields. The harvest collection of potato seed material of "elite" category in the amount of 5000 kg was performed in first decade in October. Elite seed material was transferred to the "Orken" elite seed-growing farm for the evaluation of seed quality for further use in the production of elite seeds.

Thus, on the basis of experimentally obtained results from pilot technology, it was shown that the new scheme for accelerated biotechnological production of the healthy elite seed material proved the possibility of reducing the production period of the "elite" seed material to three years on the basis of obtaining minituber and super-superelite potato seed material in winter periods under greenhouse conditions.

The key factors for the successful implementation of the testing production scheme are the availability of an efficiently operating greenhouse complex for the cultivation of first-generation test-tubes plants and adult plants.

The results of the first year of approbation showed the success of the applied biotechnological methods for obtaining and replicating on an industrial scale of the healthy test-tube regenerant-plants. The results of the second year of studies confirmed the prospects of cultivation of plants in a greenhouse complex for the production of minituber seed material and super-superelite. The effectiveness of technology for obtaining seed material, taking into account the adjustment of quantitative indicators for the third year, was as follows (in percent from expected): 100% (5 tons) of "elite" category seed material, 80% (4 tons) of "superelite" -100% (1 ton) of "super-superelite and 2% (1800 pieces/52 kg) of original seed material (minitubers).

Summarizing, the obtained results indicated the prospects of using this accelerated technology for the production of elite seed potatoes taking into account the identified weak points (lack of financing and the influence of climatic factors), which allows us to further assume the possibility of effective implementation of this technology in production/industry.

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### **ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ ТҰҚЫМ ӨНДІРІСІН ҚАМТАМАСЫЗ ЕТУ МАҚСАТЫНДА ЭЛИТТІ ТҰҚЫМДЫҚ КАРТОПТЫҢ BIOTEХНОЛОГИЯЛЫҚ ӨНДІРІСІНІҢ ЖЫЛДАМДАТЫЛҒАН АПРОБАЦИЯСЫ**

**Аннотация.** Сауықтырылған тұқымдық мини-түйнектерді өндіру картоптың жоғары сапалы тұқымдық материалын алудың негізі болып табылады. Картоптың тұқымдық отандық материалын жылдамдата алу үшін азғана өндірістік масштабта элиталық тұқымдық картоптың пилоттық өндіріс технологиясы жасап шығарылды және қабылданды. Бұл технологияны жаңа заманға сай жылыжай құрылғылары болған жағдайда «суперсуперэлита» категориясына жататын мини-түйнектік материалды алудың технологиялық процесінің бірінші сатысында пайдаланудың болашағы бар екендігі көрсетілді. Түйнектің азғана мөлшерінен микрокалемшелеу әдісімен картоптың отандық өнімділігі жоғары «Аксор» сортының сауықтырылған регенерант-өсімдіктері алынды және көбейтілді. Бірінші жылы регенерант-өсімдіктерден жабық топырақ жағдайында супер-суперэлиталық тұқымдық материал алу үшін минитүйнектер алынды. Екінші жылы егістік жағдайында супер-суперэлитаның тұқымдық материалдарынан картоптың суперэлиталық тұқымы алынды және элиталық тұқым шаруашылығы жобасының үшінші жылдық жобасына өндіруге «элита» категориясына жататын тұқым берілді.

Бұл технологияның ерекшелігі сауықтырылған пробиркалық өсімдік (*in vitro*) пен минитүйнектерді 3 жыл бойы үздіксіз алуға негізделген. Жылыжайда өсімдікті өсіру кезінде түйнектік материалды жүйелі түрде қазып алу. Бір ұрпақтан минитүйнектердің өнімінің санының артуы. Супер-суперэлиталық материалды жылына екі рет алу мүмкіндігі. Элиталық тұқым өндіру уақытының 3 жылға дейін қысқаруы, өндіріс аумағының қажеттілігінің азаюуы, тұқымдық материалдың шығынының төмендеуі және оны көбейту коэффициентінің жоғары болуы осы технологияның нәтижелері болып табылады.

**Түйін сөздер:** картоп, *in vitro* өскен клеткалар, сауықтырылған регенерант-өсімдік, микроклондау арқылы көбейту, картоптың бастапқы тұқымы, мини түйнек, картоптың элиталық тұқымдық материалы.

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### **АПРОБАЦИЯ УСКОРЕННОГО BIOTEХНОЛОГИЧЕСКОГО ПРОИЗВОДСТВА ЭЛИТНОГО СЕМЕННОГО КАРТОФЕЛЯ ДЛЯ ОБЕСПЕЧЕНИЯ СЕМЕНОВОДСТВА В РЕСПУБЛИКЕ КАЗАХСТАН**

**Аннотация.** Производство оздоровленных семенных мини-клубней является основой для получения высококачественного семенного материала картофеля. Для ускоренного получения отечественного семенного материала картофеля разработана и апробирована технология пилотного производства элитного семенного картофеля в малых промышленных масштабах. Показана перспективность ее применения при наличии современных тепличных комплексов на первых этапах технологического процесса получения миниклубневого материала категории «суперсуперэлита». Из небольшого числа клубней получены и размножены методом микрочеренкования безвирусные растения-регенеранты отечественного высокоурожайного сорта картофеля «Аксор». Из растений-регенерантов в условиях закрытого грунта в первый год получены миниклубни для производства супер-суперэлитного семенного материала. Из клубневого материала супер-супер-элиты на второй год в полевых условиях получены суперэлитные семена картофеля и переданы в элитсхоз для производства семян категория «элита» уже на третий год выполнения проекта.

Особенности данной технологии заключаются в непрерывном процессе получения оздоровленных пробирочных растений (*in vitro*) и миниклубней в течение 3-х лет. Проведение регулярной выемки клубневого материала во время культивирования растений в теплице приводит к увеличению количества урожая миниклубней с одного поколения, а также цикличному получению супер-суперэлитного материала 2 раза в год. Результатами являются сокращение сроков производства элитных семян до 3 лет, низкая потребность в производственных площадях, снижение норм расхода семенного материала и высокий коэффициент его размножения.

**Ключевые слова:** картофель, культуры *in vitro*, безвирусные растения – регенеранты, микроклональное размножение, оригинальные семена картофеля, миниклубни, элитный семенной материал картофеля.

## NEWS

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## UTILIZING INDUCED MUTAGENESIS IN KAZAKHSTANI WHEAT BREEDING

**Abstract.** Mutagenic effect of physical factors and chemical substances (aziridine or ethylene imine, nitro-ethylurea, nitrosoethyleneurea) leads to increase of the spectrum of hereditary variability for breeding purposes, which however is not studied in full extent. Ecological study of anthropogenic factors action leading to disruption of certain links between chemical elements and their combinations, raise of heavy metals concentration in soil, facilitate examination of mutagenic and toxic properties of heavy metals. Increase in wheat yields by improving its genotype is one of the most urgent problems of agriculture and economy. At present, using traditional methods of selection and genetic studies, such as backcross selection, distant hybridization, and experimental mutagenesis, increased efficiency of obtaining genetically modified and improved forms of wheat [1-5]. Heavy metals are defined as metals having a density higher than 5 g/cm<sup>3</sup>. Of the total 90 naturally occurring elements divided into three classes by the degree of their threat, 53 are considered heavy metals and few are of biological importance. Accumulation of heavy metals such as cadmium (Cd) in the environment is now becoming a major cause of environmental pollution. Toxic metals can inactivate proteins, shifting metal cofactors, blocking active centers or causing allosteric changes. Besides, large number of those possesses ability of inducing mutagenic changes, tumors and causing macroscopic changes. Molecular mechanism of heavy metals toxicity is not completely understood. Cd is non-essential element that negatively affects plant growth and development, released into the environment by power stations, heating systems, metal working industries or urban traffic, which has high cumulative effect with almost no biodegradation. In plants it affects such processes as stomata opening, transpiration and photosynthesis, consequently chlorosis, leaf rolls and stunting are the main symptoms of Cd toxicity in plants accompanied by root browning, leaf red-brownish discoloration. It can also reduce the absorption of nitrate from root to shoot by inhibiting the nitrate reductase activity in shoots. The negative effect of Cd on plant growth was accompanied by an increase in dry to fresh mass ratio in all organs. Several researches have suggested that an oxidative stress could be involved in cadmium toxicity, by either inducing oxygen free radical production, or by decreasing enzymatic and non-enzymatic antioxidants [6-9]. On the other hand, the use of induced mutagenesis showed high efficiency in the production of forms with high yield, quality bakery, lodging resistance, modified plant height and resistance. Moreover, this paper is an attempt of summarizing results performed by our group in this direction.

**Key words:** breeding, chemical mutagenesis, isogenic substituted wheat lines.

**Introduction.** Plant breeding requires genetic variation of useful traits for crop improvements. Chemical (base analogs, alkylators, ICR-compounds), physical (gamma rays, X-rays, ion beam) or biological (viruses, bacteria) agents can induce sudden heritable changes occurring in the genetic information of an organism not caused by genetic segregation or genetic recombination. Mutation breeding involves the development of new varieties by generating and utilizing genetic variability through chemical and physical mutagenesis [4]. Qualitatively new forms, such as dwarf mutants in wheat and barley, ultra-fast mutants in barley, resistant to fungal diseases of forms of plants, high-leasing and highly productive mutants serving as progenitors of new high-yielding varieties are obtained by chemical mutagenesis [3, 5]. However, obtaining mutants and their study – is only the first stage of selection work.

It is possible to use hybridization in selection of mutations. More important is the use of mutants in hybridization to obtain positive transgressions. Preparation of mutants and their use for hybridization requires the study of genetic nature of emerging changes, which is crucial for the selection of effective mutagens with specific action, and to broaden and deepen understanding of the nature of wheat evolution. Mutants having complex morphological, physiological and biochemical changes affecting economically valuable properties can be further used to locate genes that determine the trait followed Intervarietal replacement of chromosomes [11]. Isogenic lines are convenient objects for many biological and agricultural experiments. Main advantage of these lines is high genetic similarity among themselves and with the control line, which allows estimating the contribution to the formation of crop marking characteristics and applying them as effective donor marker signs. One of the possibilities to create new varieties with economically valuable traits, and primarily in the direction of selection on productivity and disease resistance to wheat rust, and their improvement in economically valuable attributes is the method of hybridization. Interspecific hybridization in wheat breeding to leaf rust resistance requires use of *T. timopheevii*. In order to overcome hybrids sterility methods facilitating the gene transfer from distant wheat species have been recently developed [10]. Some of them are based on the methods of chromosome engineering, others on methods of genetic control of meiotic recombination, third on the methods of genetic engineering. However, to obtain mutants and study them – this is only the first stage of the selection work. More important is the using mutants in the hybridization to obtain positive transgressions. Hybridization gives possibility to better use of mutations in wheat breeding. Obtaining of mutants and using them for hybridization require the study of the genetic nature of appearing changes, which have great importance for the selection of effective and specific action of mutagens, and for extension and deepening of understanding the nature of wheat evolution. The aim of our work is the obtainment of mutants with agriculturally valuable traits, distant and interspecific wheat hybrids and their breeding analysis. We have found that the treatment of seeds with  $CdCl_2$  induces changes in wheat, which are expressed in the appearance of the first generation (M1) of powerful plant with productive breeding and valuable traits - elongated ears, larger grains, grain weight with the main spike, 1000 grain weight, etc. These plants have the characteristics of the initial variety, but on a number of quantitative traits superior control options. Signs of altered forms stably transferred to the M2 generation - M4. In this regard, it was of interest to study the effect of 0.01% aqueous solution  $CdCl_2$  the variability of quantitative indicators of internal anatomical structures of wheat.

**Materials and methods.** Spring soft wheat Kazakhstanskaya 126 variety (*Triticumaestivum* L. var. *ferrugineum* Al.), a series of its monosomic lines and such varieties as Nadezhda, Kazakhstanskaya 4 and Shagala served the objects of the current research. Kazakhstanskaya 126 variety was developed at Kazakh SRI of Agriculture and crop production by crossing soft wheat Lutescence 47 with the local variety Kozhebiday and subsequent two-time selection. Isogenic lines of Avocet variety by *Yr* genes, *T. timopheevii* species. Wheat grains of Nadezhda and Kazakhstanskaya 126 varieties were processed by phosphoric acid ( $H_3PO_4$ ) in 5-10% aqueous solutions. For that different concentrations of phosphoric acid: 0.01; 0.1 and 0.5% were tested. Wheat grains were then incubated in a solution of appropriate concentration.

M1 and M3 mutants obtained in the process of  $CdCl_2$  4 varieties of soft wheat of local selection – Shagala, Kazakhstanskaya 3, Zhenis, Lutescens 32 served the objects of the study. The modified plants subsequently laid in the form of lines (A-1, A-2). During the experiment, we used following methods: cytogenetic, hybridological, statistical and morphological.

Cytological studies were carried out at press time preparations using a microscope LOMO Mikmed-1. Genetic analysis of  $F_1$  hybrids and  $F_2$  conducted qualitative and quantitative traits of wheat. Statistical analysis was limited to the determination of the arithmetic mean and its error of the analyzed quantitative traits and to determine the reliability of the difference between the arithmetic means using the Student's *t* test (*t*), a genetic – finding a significant value  $\chi^2$  [12]. Accounting of chromosomal abnormalities in MI, AI and AII of meiosis was performed on temporary acetocarmine preparations under the microscope MBI-3. The representativeness of research result was provided an adequate sample size - 60-100 plants.

**Results and their discussion.** *Genetic analysis of mutant wheat.* Chemical mutagenesis in plant selection is used as an effective method to enhance the variability of the starting material. In the world literature there is sufficient information about the creation of commercial varieties, which derived from

experimental mutagenesis. To use the selected mutants in selection process is necessary to examine their genetic nature. For this, in genetic research are using two methods: analyzes and reciprocal crosses.

*Analyzing cross.* In order to establish the nature of any mutational change by variables usually used carrying reciprocal crosses between the original form and receiving on the basis of its mutant subsequent analysis of the hybrids  $F_1$ . In our studies in  $M_2$  generation plants modified in a number of quantitative and qualitative characteristics was preserved the properties displayed in  $M_1$ . To establish the homo and heterozygous genotype of mutant plants was carried out analyzing cross with an initial variety. Mutant forms with signs of anthocyanin coloration of the stem, pubescent leaf surface, lengthening with spike crossed with an initial variety of Kazakhstanskaya 3 [13]. In  $BC_1$  splitting signs to change and corresponds to the normal ratio of 1:1, and in  $F_2$  is 3:1 ( $\chi^2 = 1.89$ ). Similar results were obtained with the mutant varieties of Shagala with coloration of the stem and leaf axils by anthocyanin. Hybrids  $BC_1$  and  $F_2$  were observed splitting on the grounds of lengthening the stem and normal nodes in the ratio of 1:1 and 3:1, respectively, which indicates that the heterozygous nature of the mutant and monogenic inheritance of this trait. In contrast, cleavage by productive tillering, length and density of the spike in  $BC_1$  corresponded to 3:1, and a  $F_2$  population of 15:1, 13:9 and 3:7, respectively. This shows that symptoms of mutant lines are inherited by a polymer, and complementary mechanisms of epistatic interactions non-allelic genes. This shows that the reaction of plants for the chemical compounds depends on the genotype of wheat

Table 1 – Genetic analysis of  $F_2$  and  $BC_1$  hybrids by crossing mutants with variety Kaz. 3

Characteristicsofmutants	The ratio of altered (modified) and normal plants					
	$BC_1$			$F_2$		
LINE 1						
The length of the spike	27:25	1:1	0.06	188:57	3:1	0.40
Beardlessspike	32:29	1:1	0.04	168:48	3:1	0.89
Anthocyaninsstem	10:13	1:1	0.20	126:32	3:1	1.89
Pubescencesheet	8:10	1:1	0.20	112:28	3:1	1.87
LINE 3						
Crankedstem	22:20	1:1	0.90	118:31	3:1	1.38
Tilleringofplants	45:13	3:1	0.20	120:5	15:1	1.14
The length of the spike	45:18	3:1	0.42	223:51	13:3	0.003
Anthocyanin color of sheet leaves	19:23	1:1	0.38	97:29	3:1	0.26
The thickness of the spike	33:31	1:1	0.06	85:54	9:7	1.38

Further studies had shown that the arising changes in  $M_1$  by the elements of productivity of the varieties Kazakhstanskaya 3, Shagala appeared in subsequent generations  $M_2 - M_6$ . It was proved to conduct reciprocal crossing, where the modified attributes are inherited independently from direction of the crossing. Phenotypic variation of plants was accompanied by a violation of the process of meiosis.

*Cytological analysis of mutant plants  $M_2$ .* Chemical mutagens because of its ability to induce a higher frequency of mutations are used in many countries around the world to create a breeding material. Chromosomal aberrations and violation of cell division during meiosis is one of the major test for mutagenicity of various influences. The most notable in this regard is a meiotic cell division, especially in subjects such as wheat, having a large number of hard identifiable chromosomes. Moreover, violations, reaching the meiotic division, are more likely to be transmitted to the next generation. Mutant plants generation  $M_2$  percentage of damaged cells into  $M_1$  meiosis was 35, and at anaphase AI and AII - 20, which indicates a significant reduction in percent disorders cells compared with mutant plants  $M_1$  (64% AI and 68% - A II) [14]. Violation of phenomenon is cytomixis – the transition of contents to neighboring cells,  $M_1$  amounted 20-30% of all the studied cells, while  $M_2$  the percentage of such cells decreased to 7-9%. So, the percentage of abnormalities in mutant forms of Kazakhstanskaya 3 variety in  $M_2$  was 55%, in contrast, violation that noted in generation  $M_1$  - 90-95%.

The same decrease in the percentage of violations observed by mutants of varieties Zhenis, Lutescens 32 and Shagala. In AI and AII, as well as observed in exercise book some minor violations as a lagging chromosome fragments on the pole, bridge, asynchronous division. Bare cells were occasionally observed [14].

*Cytological analysis of mutant plants M3.* To characterize meiosis in mutant lines M3 and identification monosomic, disomic plant in F1 hybrids with the mutant P1, seen 1080 cells. The results of cytological analysis of mutant plants M3 are shown on Figure 1. As seen in Figure 2 the proportion of cells with pyknosis mutants M3 line L1 of Kazakhstanskaya 3 variety was 0.29; mutant of variety Zhenis - 0.10; Lutescens 32 - 0.23; line - L3 variety Shagala - 0.21 compared with impaired cell M1 (respectively). The proportion of cells with univalents was respectively: 0.19; 0.009; 0.16. So, in the older generation of mutants (M3) the variety Kazakhstanskaya 3 and Shagala, selected for practical selection, the proportion of cells with impaired in M1 meiosis is much reduced with mutants like M1 and M2. Violations in meiosis M2 plant from the above varieties have the same character as the M1 plants in meiosis. Typical violations of mutant progeny plants M1-M3 were pyknosis; offset spindle metaphase I; availability univalents, polyvalent of micronuclei in exercise books; asynchronous cell division in AI [14-15].

Comparative study of the effect of different concentrations of phosphoric acid has shown that 5% is set as the optimum concentration of the substance to study the ontogeny and cell division activity of root meristem of wheat germ. Effect of chemical compounds has been considered previously in studies of different directions. However, the genetic basis of variations in plant re-action to the action of these compounds has not been studied. Below is the data for the study of reactions of treated grains under laboratory conditions (Table 2).

Table 2 – Study of cell division and aberrations in anaphase of mitosis

Mutagenandits concentration, %	Total number of analyzed cells	Aberrations	The average percentage of affected cells
Kazakhstanskaya 126			
Control	750	5	0.66±0.01
H <sub>3</sub> PO <sub>4</sub> 0.1%	750	8	1.00±0.01
H <sub>3</sub> PO <sub>4</sub> 0.01%	750	11	1.40±0.01
H <sub>3</sub> PO <sub>4</sub> 0.5%	750	29	3.80±0.40
Nadezhda			
Control	750	3	0.40±0.01
H <sub>3</sub> PO <sub>4</sub> 0.1%	750	14	1.86±0.02
H <sub>3</sub> PO <sub>4</sub> 0.01%	750	17	2.26±0.01
H <sub>3</sub> PO <sub>4</sub> 0.5%	750	37	4.9±0.04

The treated grains were sown in test sites. Pheno-logical observations showed that high level of mono phosphorus (5%) leads to a weak mutagenic effect, while its 0.1% concentration contributes to the development of the biomass. Weak mutagenic effect of 5% concentration is apparently linked to a strong acidification of pH. This is proven by some aberrations of chromosomes in mitosis and meiosis disturbances in plants treated with H<sub>3</sub>PO<sub>4</sub>. Mitosis in mutant plants was accompanied by a massive stick-ing of chromosomes (pyknosis) and offset spindle of metaphase plate (Figure 1).

Mutagenic effect and its importance in the breeding are determined by the results of the mitotic activity and the nature of the aberrations in cell division. They allow us to determine the degree of variability in plants obtained by the action of chemical and physical factors.

The inducing activity of a specific phosphoric acid concentration (5%) on grain germination, cell division and aberrations in mitosis of meristematic cells of test options compared with control obtained by the action of H<sub>3</sub>PO<sub>4</sub> was studied. The action of the different concentrations of the chemical compound (H<sub>3</sub>PO<sub>4</sub>) was observed within the plant ontogeny. Thus, 0.1% H<sub>3</sub>PO<sub>4</sub> concentration has a minor deviation (1.00 ± 0.01) on the normal course of mitosis compared to control (0.66 ± 0.01) [17].



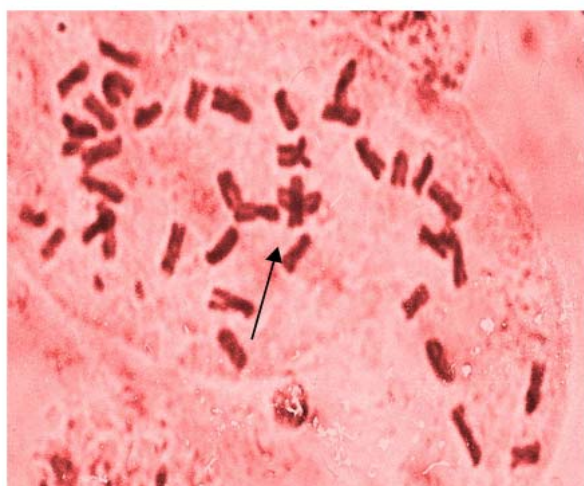


Figure 1 – Mitosis of mutant plants, ditelocentrics are indicated by arrow (x40)

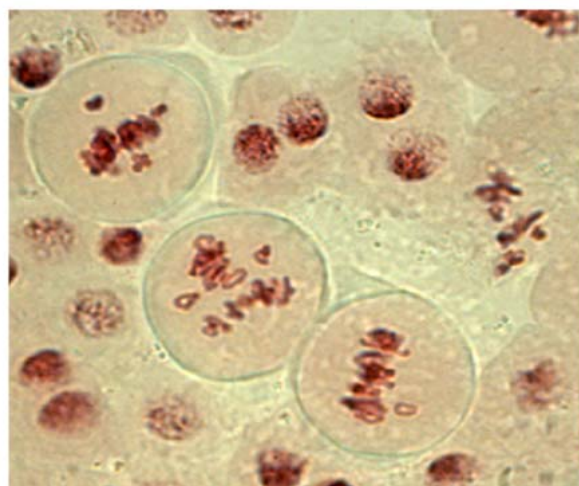


Figure 2 – Sticking of chromosomes in plants, treated with phosphoric acid (x40)

Structural analysis of elements of productivity isogenic lines revealed three lines – IL-Hg, IL-BgHg and IL-Pc, differing significantly by increase of productivity indicators of the spike and 1000 grain weight in comparison with control. Isogenic line IL-Hg with hairy spike can be morphologically well tested during the heading stage and has more saturated color of glume compared to the control. Indicators of spike productivity and weight of 1000 grains of the line IL-Hg was significantly higher than such in control (Table 3).

The length of the spike averaged  $13.0 \pm 0.2$  cm. with the number of spikelets counting  $20.0 \pm 0.4$ . The number of grains in the main spike counts  $63.2 \pm 1.0$  with a weight of  $2.9 \pm 0.1$  g. Grain is medium size, oval with shallow groove. The average value of the weight of 1000 grains was  $48.1 \pm 1.4$  g, in comparison with control –  $44.7 \pm 0.7$  g.

Isogenic line IL-BgHg has a hairy, black ear. The median length of the spike in IL-BgHg line was  $13.1 \pm 0.1$  cm. The number of spikelets on average counts  $20.0 \pm 0.1$ . the number of grains  $65.4 \pm 0.2$ , which was significantly higher than control. Grain size is medium, the groove is not deep. The weight of 1000 grains in line IL-BgHg significantly exceeds such in control counting  $49.7 \pm 0.3$  g ( $P < 0.001$ ). Observed increase in spike productivity indices in lines IL-BgHg and IL-Hg can possibly be associated with the presence of a dominant allele of glume pubescence Hg in these lines. Isogenic line IL-Pc is characterized by the purple color of straw. The length of the spike in line IL-Pc in average is  $12.5 \pm 0.5$  cm. Number of spikelets  $19.6 \pm 0.2$ , number of grains  $63.2 \pm 1.0$ . Weight of grain from the main spike in average is  $2.7 \pm 0.1$ . Major grain has articulate groove. The weight of 1000 grains in line IL-Pc is  $48.4 \pm 0.6$  g, deviation from control is significant under at  $P < 0.001$ . The increase in the average weight of grain from isogenic line IL-Pc is confirmed by the improved grain filling. This can possibly be associated with the increase in productivity of photosynthesis, due to the intensification of this process in anthocyanin containing plants.

Table 3 – Elements of productivity of spike of morphologically marked isogenic lines

Variety/line	Productivity of the main spike				
	Length of spike, cm	Number of spikelets, pc.	Number of grains, pc.	Weight of grain, g	Weight of 1000 grains, g
Kaz. 126	$12.2 \pm 0.1$	$19.0 \pm 0.3$	$51.7 \pm 1.6$	$2.4 \pm 0.1$	$44.7 \pm 0.7$
IL-Hg	$13.0 \pm 0.2^{***}$	$20.0 \pm 0.4^{**}$	$63.2 \pm 1.0^{***}$	$2.9 \pm 0.1^{***}$	$48.1 \pm 1.4^{**}$
IL-Pc	$12.5 \pm 0.5$	$19.6 \pm 0.2$	$63.2 \pm 1.0^{***}$	$2.7 \pm 0.1^*$	$48.4 \pm 0.6^{***}$
IL-BgHg	$13.1 \pm 0.1^{***}$	$20.0 \pm 0.1^{***}$	$65.4 \pm 0.2^{***}$	$3.0 \pm 0.1^{***}$	$49.7 \pm 0.3^{***}$

Deviation from control is significant under \*  $P < 0.05$  \*\*  $P < 0.01$  \*\*\*  $P < 0.001$ .

Earlier upon action with 0.01% aqueous solution of cadmium chloride as a mutagen on the variety Kazakhstanskaya 3 and Shagala mutant lines: L1, L2 and L3 were selected. Mutant forms have long spikes, elongated glumes, glassy large grain, anthocyanin coloration of the stem and leaf axils eyelets, as well as the high weight of 1000 grains. Several lines were higher and thicker culm, thickening and lengthening of the stem nodes, increased productive tillering. These selection and mutant forms of the important features, firmly inherited from generation to generation (M1-M6). In this regard, one of the objectives of this study is to localize genes responsible for economic-valuable signs of mutant forms. It is known that the elongation glumes spike was positively correlated with elongated grains. This fact is a direct proof of the high productivity of the ear mutant form A1. Under natural conditions, when intraspecific hybridization to obtain such form is rarely possible. Therefore, before using a mutant in order to hybridization it was necessary to genetically examine this property of wheat using the method of chromosome engineering. To carry out this work obtained F<sub>1</sub> hybrids seeds using a variety of monosomic lines Kazakhstanskaya 126 in the amount of 22 crossing combinations. Comparative monosomic analysis of the hybrids on the basis of extension glume will be held study of F<sub>1</sub> offspring based on harvest of 2013. Identification of mono- and disomics of Kazakhstanskaya 126 variety served as pre-requisite for this work [17].

*Interspecific hybridization.* Tetraploid endemicspecies *Triticum timopheevii* Zhuk. (genetic formula AtAtGG) is characterized by a unique gene pool controlling resistance to many diseases of wheat. Creating and intensive involvement in the selection process of wheat donors with effective Lr-resistance genes transmitted from wild relatives could significantly expand its genetic basis for one or the other economically valuable traits. High performance pollinating (up to 90 spikes per hour) by native pollen permitted analysis of the actual compatibility of the initial parental forms. Table 4 shows the results of cross-species hybridization.

Table 4 – Fertility of reciprocal hybrids of distant hybridization

#	Combination of breeding	Number of		Percentage of grain folding, %
		pollinated flowers	folded grains	
<i>Soft wheat x T. timopheevi</i>				
1	F <sub>0</sub> ( <i>T. timopheevi</i> x Nadezhda)	190	119	62.63
2	F <sub>0</sub> (Nadezhda x <i>T. timopheevi</i> )	72	11	15.28
3	F <sub>0</sub> ( <i>T. timopheevi</i> x κ-2780)	150	61	40.67
4	F <sub>0</sub> (κ-2780 x <i>T. timopheevi</i> )	56	6	10
5	F <sub>0</sub> (32 shortst. x <i>T. timopheevi</i> )	56	0	0
<i>Soft wheat x T. dicoccum</i>				
1	F <sub>0</sub> ( <i>T. dicoccum</i> x Nadezhda)	282	181	64.18
2	F <sub>0</sub> (Nadezhda x <i>T. dicoccum</i> )	156	41	26.28
3	F <sub>0</sub> ( <i>T. dicoccum</i> x κ-2780)	150	71	47.33
4	F <sub>0</sub> (κ-2780 x <i>T. dicoccum</i> )	130	14	10.77
5	F <sub>0</sub> ( <i>T. dicoccum</i> x 32 shortst.)	32	17	53.12
6	F <sub>0</sub> (32 shortst. x <i>T. kiharae</i> )	33	0	0
<i>Soft wheat x T. kiharae</i>				
1	F <sub>0</sub> ( <i>T. kiharae</i> x Immune1498)	84	34	40.47
2	F <sub>0</sub> (Immune1498 x <i>T. kiharae</i> )	108	12	11.11
3	F <sub>0</sub> ( <i>T. kiharae</i> x κ-2780)	32	17	53.12
4	F <sub>0</sub> (κ-2780 x <i>T. kiharae</i> )	102	17	16.66
5	F <sub>0</sub> ( <i>T. kiharae</i> x 15/20977)	18	8	44.44
6	F <sub>0</sub> (15/20977 x <i>T. kiharae</i> )	118	14	11.86
7	F <sub>0</sub> ( <i>T. kiharae</i> x Nadezhda)	50	29	58
8	F <sub>0</sub> (Nadezhda x <i>T. kiharae</i> )	52	10	19.23
9	F <sub>0</sub> (USA18 x <i>T. kiharae</i> )	48	4	8.33
10	F <sub>0</sub> ( <i>T. kiharae</i> x USA18)	22	12	54.54
11	F <sub>0</sub> ( <i>T. kiharae</i> x USA19)	24	12	50
12	F <sub>0</sub> (USA19 x <i>T. kiharae</i> )	82	23	28.05



*Hybrids with T. timopheevii.* Experimental data shown in Table 4 suggests that the hybridization with different wild cultures of wheat species is successful. However, tying of grains in various combinations ranges from 0 to 64.18%. Apparently, the percentage depends on the genotype of variety from which samples were taken for cross-breeding, as well as from the crossing direction. Thus, the percentage of successful crosses of *T. timopheevii* with soft wheat is relatively high in the case, when the wild form is taken as the parent form. Depending on the number of successfully pollinated spikes the number of hybrid progeny grains varies. Compatibility level of *T. timopheevii* with soft wheat variety Nadezhda is relatively high, and the average is about 62.63%, k-2780– 40.67%, and the percentage of backcrossing luck in hybrid progeny plummets 15.28% and 10%, respectively. F<sub>1</sub> hybrids (*T. timopheevii* to x-2780) of 150 – 61%, and 56 from the reciprocal mating pollinated flowers ensued only 10% of the grain.

*Hybrids with T. dicoccum.* F<sub>1</sub> hybrid offspring with wild species *T. dicoccum* with soft wheat was similar to the results of previous combinations produced with *T. timopheevii*. It is interesting to note that in this case the percentage of luck is much higher than, those combinations where variety Nadezhda served as a father. Thus, from 282 pollinated flowers luck percentage was 64.18%, and in the reciprocal crosses from 156 pollinated flowers tie a percentage of grains appeared 26.28%. Percentage of luck in direct (*T. dicoccum* x k-2780) crossed with the sample to 2780, amounted to 47.33% and -10.77% in reverse [17].

*Hybrids with T. kiharae.* Hybrids of wheat with *T. kiharae*, less productive than the hybrids with the previous combinations. However, in this case, there is a sharp drop in interest luck compared with those combinations where the parent form is taken *T. kiharae*. For example, the percentage of good luck in the forward mating ranged from 54.54% to 40.47% and 28.05% from reverse to 8.33%. This variety of indicators can be explained by the genotype – by environmental conditions for growing plants.

Thus, the study of reciprocal hybrids F<sub>1</sub>, obtained by crossing wheat with wild species – *T. timopheevi*, *T. dicoccum*, revealed clear differences in the percentage of grain formation. In plants, a hybrid combination with *T. timopheevi*, *T. dicoccum* and *T. kiharae* cytoplasm wheat, under which the mother plants as soft wheat has been used, the percentage of luck somewhat lower compared to the hybrids, which served as the parent form of wild species. Hence, one can adopt clearly that the use of the wild-type form as maternal genomes increases compatibility than in the opposite mating. For hybrids derived from crosses with *T. timopheevi* soft wheat characteristic heteroplasmic condition: simultaneously present copies of the wild (the parent) and wheat (paternal) types [17]. Moreover, interspecific hybrids showed high resistance to fungal diseases. However, the instability of the genome of interspecific hybrids requires backcrossing, continuous monitoring of the number of chromosomes in the hybrid offspring and identifying of stable introgressive lines with 42 chromosomes.

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#### **ЖАСАНДЫ МУТАГЕНЕЗДІ ҚАЗАҚСТАНДЫҚ БИДАЙ СЕЛЕКЦИЯСЫНДА КОЛДАНУ**

**Аннотация.** Физикалық факторлардың мутагендік әсері және химиялық заттың шығу тегі (мысалы, азиридин, этиленмин, нитрозометилмочевина, нитрозоэтиленмочевина) селекциялық мақсатта тұқым қуалаушылық өзгерістіктің өсуіне алып келеді және олардың толығырақ зерттелуін талап етеді. Антропогендік факторлардың экологиялық әсерінің зерттелуі, белгілі бір химиялық элементтер арасындағы байланыстары мен комбинациялар бұзылысына алып келе алатын, топырақтағы ауыр металдар концентрациясының жоғарлауына, ауыр металдың мутагендік және токсиндік құрамын танып білуге ықпал етеді.

Генотипті жақсарту арқылы бидай өнімділігін арттыру ауыл шаруашылығында және экономикада маңызды мәселелердің бірі болып табылады. Қазіргі кезде селекциялық және генетикалық зерттеулердің дәстүрлі әдістерін қолдану, мысалы, қанықтырушы шағылыстыру жүргізу, алшақ будандастыру және экспериментальді мутагенез, генетикалық түрлендірілген және бидайдың жақсартылған түрін алу тиімділігін арттырады [1-5]. Ауыр металдар 5 г/см<sup>3</sup> жоғары тығыздықтағы металдар ретінде анықталады.

Барлығы табиғатта табылған 90 элемент, олардың қауіп дәрежесіне қарай үш сыныпқа бөлінген, 53-і ауыр металдар, ал олардың кейбіреулері биологиялық маңызға ие. Ауыр металдардың жинақталуы, мысалы, кадмий (Cd) қоршаған ортаны ластаудың негізгі себебі болып табылады.

Токсинді металдар ақуыздарды белсендіре алады, белсенді орталықтарды блоктауға немесе аллостериялық өзгерістерге себеп болады. Сонымен қатар, олардың көпшілігі мутагенді өзгерістерді тудыруға қабілетті, ісіктер мен макроскопиялық өзгерістерге әкеледі. Ауыр металдардың токсинді молекулалық механизмі толығымен анықталмаған. Cd – екінші деңгейдегі элемент, өсімдіктердің өсуіне және дамуына теріс әсер етеді. Қоршаған ортаға ол электр станциялары арқылы бөленеді, жылу жүйелері, металл өңдеу немесе транспорт қозғалыстары арқылы, іс жүзінде биодеградациясыз жоғары кумулятивтік әсерге ие. Өсімдіктерге ол тыныс алу және фотосинтез сияқты процестерге әсер етеді, құрамында жоғары мөлшердегі кадмий бар өсімдікте жапырақтың хлорозы байқалады, олардың шеттері қызыл-қоңыр түсті, және өсу қарқынының төмендеуі мен тамыр жүйесіне зиян келтіреді. Cd-дің теріс әсері барлық органдарда құрғақ және жаңа массаның артуымен бірге жүреді. Бірнеше зерттеулер тотығу стресті кадмий токсинділігіне байланысты немесе индукция арқылы оттегінің еркін радикалдарының пайда болуымен, ферментативті және ферментативті емес антиоксиданттарды азайту арқылы болуы мүмкін екендігін көрсетті [6-9]. Екінші жағынан, сапалық астықты түр алуда индуцирленген мутагенезді пайдалану жоғарғы тиімділікті көрсетті. Бұл мақала осы бағытта біздің топпен алынған нәтижелердің жиынтығы болып табылады.

**Түйін сөздер:** селекция, химиялық мутагенез, бидайдың изогенді алмастырылған линиясы.

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### **ПРИМЕНЕНИЕ ИСКУССТВЕННОГО МУТАГЕНЕЗА В СЕЛЕКЦИИ КАЗАХСТАНСКОЙ ПШЕНИЦЫ**

Мутагенное действие физических факторов и веществ химического происхождения (к числу последних относятся, например, азиридин, этиленмин, нитрозометилмочевина, нитрозоэтиленмочевина) приводит к увеличению спектра наследственной изменчивости для селекционных целей и требует их более детального изучения. Исследование экологического влияния антропогенных факторов, способных приводить к нарушению определенных связей между химическими элементами и их комбинациями, повышению концентрации тяжелых металлов в почве, способствуют пониманию мутагенных и токсических свойств тяжелых металлов.

Повышение урожайности пшеницы путем улучшения ее генотипа является одной из наиболее актуальных проблем сельского хозяйства и экономики. В настоящее время использование традиционных методов селекции и генетических исследований, таких как проведение насыщающих скрещиваний, отдаленная гибридизация и экспериментальный мутагенез, повышает эффективность получения генетически модифицированных и улучшенных форм пшеницы [1-5]. Тяжелые металлы определяются как металлы с плотностью выше 5 г/см<sup>3</sup>.

Из общего числа 90 встречающихся в природе элементов, разделенных на три класса по степени их угрозы, 53 считаются тяжелыми металлами, а некоторые из них имеют биологическое значение. Накопление тяжелых металлов, таких как кадмий (Cd) в настоящее время становится основной причиной загрязнения окружающей среды.

Токсичные металлы могут инактивировать белки, замещая металлические кофакторы, блокировать активные центры или вызывать аллостерические изменения. Кроме того, многие из них обладают способностью индуцировать мутагенные изменения, опухоли и вызывать макроскопические изменения. Молекулярный механизм токсичности тяжелых металлов в полной мере не раскрыт. Cd – второстепенный элемент, отрицательно влияющий на рост и развитие растений. В окружающую среду он выделяется электростанциями, системами отопления, при металлообработке или движении транспорта, обладает высоким кумулятивным эффектом, практически без биодеградации. В растениях он влияет на такие процессы, как открытие устьиц, дыхание и фотосинтез, при повышенном содержании кадмия у растений наблюдается хлороз листьев, красно-бурый цвет их краев и прожилок, задержка роста и повреждения корневой системы. Он также может привести к уменьшению абсорбции нитрата от корня до побега путем ингибирования активности нитратредуктазы в побегах. Отрицательное влияние Cd на рост растений сопровождается увеличением соотношения сухой и свежей массы во всех органах. Несколько исследований показали, что окислительный стресс может быть связан с токсичностью кадмия либо путем индукции образования свободных радикалов кислорода, либо путем уменьшения ферментативных и неферментативных антиоксидантов [6-9]. С другой стороны, использование индуцированного мутагенеза показало высокую эффективность при создании форм с повышенной урожайностью, улучшением хлебопекарных свойств, измененным ростом и сопротивляемостью растений. Данная статья представляет собой попытку обобщения результатов, полученных нашей группой в этом направлении.

**Ключевые слова:** селекция, химический мутагенез, изогенные замещенные линии пшеницы.

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**MOLECULAR AND GENETIC CHARACTERISTICS  
OF KAZAKHSTANI RAINBOW TROUT  
WITH ISSR-PCR ANALAYSIS**

**Abstract.** For the first time a molecular genetic research of the Kazakhstani rainbow trout population *Parasalmo mykiss* presented by samplings from the mountain and foothill rivers of the Almaty region was conducted. From the biopsies tissue of the ventricular finlets kingfish the genomic DNA was isolated for further molecular and genetic research and determination of fish taxonomic belonging to one of the forms of *Parasalmo (Oncorhynchus) mykiss* species. The Kamchatka mikizha has some common characteristics with rainbow trout. Therefore, some scientists consider it related to one of rainbow trout type, and others are for the salmon family's independent species. The genomic DNA of Kazakhstani trout, isolated by phenol-chloroform extraction, was analyzed by two ISSR markers. As a result clear polymorphic profiles were obtained, indicating a genetic similarity the Kazakhstani rainbow trout, caught from the Ornek and Ulken-Kakpak rivers, with the Kamchatka rainbow trout. And they also pointed to the high genetic variability of the individuals caught from Tekes river. The obtained preliminary data indicate the possibility of using ISSR markers for studying this species and are the basis for further research in this direction. These results provide a perspective for the possible isolation of the Kazakhstani rainbow trout species into a separate ecological form.

**Keywords:** rainbow trout, genomic DNA, ISSR-markers, PCR analysis, ecoform.

**Introduction.** The Kamchatka mikizha *Parasalmo (Oncorhynchus) mykiss* (Walbaum, 1792) inhabits in the Pacific basin's reservoirs of the Asian and American coasts. Usually the *P. (O.) mykiss* species is represented by anadrom, estuarine and residential forms. It is known that the anadrom mikizha inhabits the tundra-mountain rivers of the Western and Eastern coasts of Kamchatka, the Okhotsk coast of the continent and the Amur liman. The freshwater mikizha, which is called Rainbow trout, is also widely distributed in Kamchatka [1].

The Kamchatka mikizha was introduced in the 80s of the XX century in the mountain and foothill reservoirs of the southeastern part of Kazakhstan: in Ulken-Kakpak river and Uryukty and Buzumbai lakes in small batches of 2000-3000 pieces per reservoir. In these reservoirs the mikizha grew well and developed for some time [2]. However, the monitoring of Kamchatka mikizha population in Kazakhstani reservoirs was not carried out, despite the fact that it was a valuable commercial species. Six water reservoirs of the Almaty region were investigated in 2015 only, in which the state of the Kazakhstani rainbow trout population (synonym "mikizha") was investigated: the presence, abundance, biometrics and other parameters of fish habitat [3, 4].

However, at present the potential of the species should be assessed not only using standard biometric studies, but also on the basis of accurate information on the genetic structure of the species's population

and the level of their genetic variability. In this connection, there is the necessity arising to investigate the genetic structure of the rainbow trout population in Kazakhstani reservoirs by using modern molecular and genetic markers.

One of the using the molecular markers is the amplification of intermicrosatellite DNA fragments located between two inverted SSR loci of the genome (Inter-Simple Sequence Repeat, ISSR-PCR) [5]. ISSR-typing uses primers complementary to the selected microsatellite motif [6]. Compare with other methods the ISSR-typing is characterized by better reproducibility, and it's used effectively to detect an intraspecific and interspecific genetic variability, identification of species and populations [7].

With reference to the above mentioned the purpose of this work was to reseach the genetic structure of the Kazakhstani rainbow trout population by ISSR-PCR markers.

**Objects and methods of research.** Control samplings of rainbow trout were obtained from Tekes, Ornek and Ulken-Kakpak Mountain rivers (Almaty region). The catch time was July, as the rainbow trout spawning occurs at a river temperature of 4.8-5.0°C [8]. With the catch each individual was taken from a fragment of the pectoral fin, and then the fish was released into the reservoir.

The fin fragments were fixed in 96% ethanol and transported to the molecular genetics laboratory of the Institute of General Genetics and Cytology for further research.

The genomic DNA from the fin was isolated by standard phenol-chloroform extraction method (1:1), including homogenization in liquid nitrogen [9]. The concentration of isolated DNA was measured with a DNA photometer (Biofotometer Plus, Eppendorf, Germany). For photometric analysis, the adsorption of aqueous DNA solutions was measured at three wavelengths: 260, 280, and 320 nm.

For 80 ng of isolated DNA and 10 µl PCR mixture (PCR Master Mix, Thermo Fisher Scientific, USA) containing specific primers in a concentration of 0.1-0.3 µmol were used for PCR. The primers used in the research were synthesized on the basis of the molecular genetics laboratory of the Institute of General Genetics and Cytology of the Ministry of Education and Science of the Republic of Kazakhstan (Almaty, Kazakhstan), and are presented in Table 1.

Table 1 – Primers used in the amplification of ISSR fragments of rainbow trout

#	5'→3'	T of annealing, °C	Length b.p.
1	(cag cagcagcagcagcag cag)t	55	22
2	(cag cagcagcag cag)	54	15

The PCR amplification program included the denaturation at 95°C for 5 minutes, then 40 cycles: 95°C for 45 seconds, (54-55)°C for 45 seconds, and 72°C for 45 seconds and the final elongation is 5 minutes at a temperature of 72°C on the Mastercycler nexus gradient (Eppendorf, Germany).

The electrophoretic separation of the reaction products was carried out in a vertical polyacrylamide gel in 1% Tris-acetate buffer, at a voltage of 60 V and a current strength of 90A for 1 hour and 40 minutes. The gel was stained by the dye «SYBR Gold Nucleic Acid Gel Stain» (Thermo Fisher Scientific, USA) with incubation for 20 minutes. Fixation of the result and determination of the size ranges of obtained ISSR fragments was carried out using the Quantum-ST5-1100 gelling system (Vilber Lourmat, France).

Mathematical processing of data was carried out using population genetics methods using the POPGENE Version 1.32 program. To determine the genetic characteristics of rainbow trout populations, the following parameters characterizing the genetic structure were calculated: absolute and effective number of alleles, genetic diversity according to Nei (or expected heterozygosity), information indicator of Shannon variety. The values were calculated on the basis of an analysis of the incidence of DNA ISSR fragments in different populations. Similarities of genotypes were made with the help of computer programs “Statistica 8.0” by the cluster analysis through the dendrograms construction.

Due to the fact that until now the population-genetic research of the Kazakhstani rainbow trout has not been conducted, the choice of ISSR primers was made on the basis of an analysis of foreign literary data. Since the rainbow trout is a freshwater form of the Kamchatka mikizha *Parasalmo (Oncorhynchus) mykiss*, we selected two primers: (cag)5 and (cag)7t, which were effective for differentiating trout from some geographical groupings (river basins of Kamchatka, Chile and North America) [5]. This made it possible to draw a conclusion about their perspectivity for the Kazakhstani trout.

**Results and discussion.** Patterns of ISSR fragments for selected primers were obtained for individuals of rainbow trout of all three fish populations from the Tekes, Ornek and Ulken-Kakpak rivers. The ISSR spectra analysis for all three populations revealed 11 amplified DNA fragments, of which 9 (81.82%) were polymorphic. This indicator separately for each population was for the Tekes river – 7, the Ornek river – 4 and the Ulken-Kakpak river – 4. Figure 1 shows the polymorphic DNA fragments for the primer (cag)5.

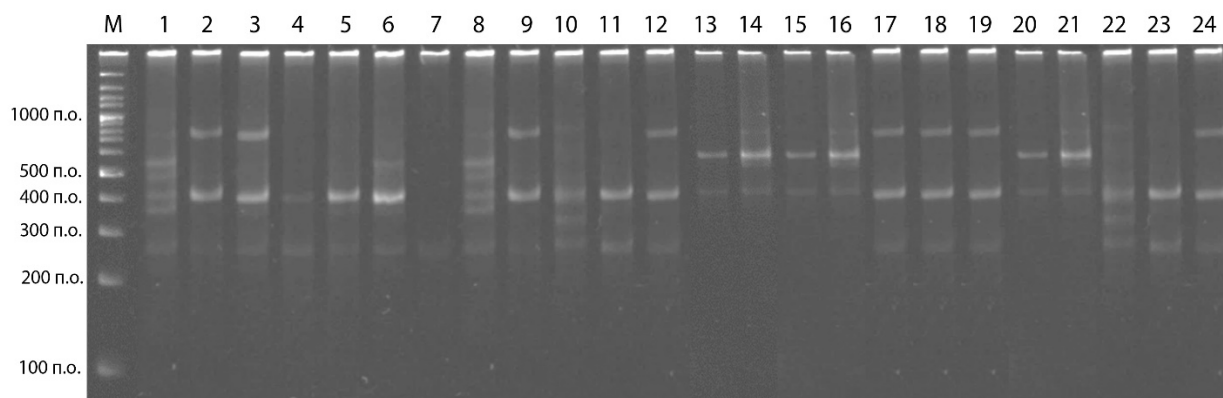


Figure 1 – Polymorphic ISSR profile of the primer (cag)5: 1-24 – the tested samplings, M – 100 b.p. Plus Ladder marker

The part of polymorphic loci of the rainbow trout population from the Tekes river was 63.64%, Ornek river was 36.36% and Ulken-Kakpak river was 36.36%. This suggests that the population of rainbow trout consisted of genetically more heterogeneous individuals from the Tekes river, while the populations from the Ornek and Ulken-Kakpak rivers were more homogeneous.

The greatest number of polymorphic loci revealed primer (cag)5: the size range of DNA fragments by used primer was from 250 to 1000 b.p.

The analysis of both primers showed that almost all of the tested samplings contained a DNA fragment with a molecular weight of 400 b.p. It can be considered as a species marker for rainbow trout.

Based on the DNA polymorphism's analysis of Kazakhstani rainbow trout allele frequencies were determined by the two ISSR markers. The estimation of the genetic diversity parameters is shown in Table 2 for the three investigated populations.

An estimate of the average of expected heterozygosity separately for the populations showed that the least heterozygous was characterized by for rainbow trout individuals from the Ulken-Kakpak river (0.0936), the largest was from the Tekes river (0.1659). The mean value of the expected heterozygosity for all three populations was 0.1543 (Table 3).

Our data on the expected heterozygosity of rainbow trout from Kazakhstani rivers turned out to be lower than similar statistics obtained by Russian colleagues for mikizha from river basins of the Kamchatka western and eastern coasts. The size of expected heterozygosity in their study was reached to 0.958. There was also a greater heterozygosity for mikizha individuals of Chilean oxbow 0.6851 and North America 0.7145 [10], Alaska from 0.55 to 0.59 [11], California from 0.62 to 0.79 [12].

The lowest level of allelic diversity ( $n_e$ ) was shown for rainbow trout samplings from the Ulken-Kakpak and Ornek rivers: 1.1321 and 1.1493, respectively; the highest one is from the Tekes river sampling. On average this index was 1.2238 alleles per locus. For rainbow trout from seven river systems of Kamchatka it was from 1.9 to 9.8 alleles per locus. In North American samplings of the Kamchatka rainbow trout the average number of alleles per locus was 7.15, in Chilean samplings – 5.2 [10].

Apparently, this circumstance can be explained by the greater rainbow trout populations' isolation in Kazakhstani reservoirs and by the absence of long-range migrations in comparison with the Kamchatka, Chile, and North America populations, as a result of which the influx of "new alleles and genotypes" is declining in the population. Thus, the rainbow trout population (freshwater form of Kamchatka mikizha *Parasalmo (O.) mykissin* Kazakhstani reservoirs is genetically less variable than the Kamchatka rainbow trout populations *Parasalmo (O.) mykiss* from other regions and continents.

Table 2 – Frequency of ISSR markers of research rainbow trout populations

Primer	The size range of fragments, b.p.	Allelic frequency		
		Tekes river	Ornek river	Ulken-Kakpak river
(cag)5	251-300	0.0646	0.2094	0.1548
	301-350	0	0.0646	0.0742
	351-400	0.2094	0	0
	401-450	0.6464	1.0000	1.0000
	451-500	0.1340	0	0
	501-550	0.1340	0	0
	551-600	0.0646	0.2929	0.1548
	601-650	0	0	0
	651-700	0	0	0
	701-750	0.2094	0	0
(cag)7t	751-800	0	0.1340	0.2441
	301-350	0	0.6464	0.0742
	351-400	0.2094	0	0
	401-450	0.6464	1.000	1.000
	451-500	0.1340	0	0
	501-550	0.1340	0	0

Table 3 – Indicators of the genetic diversity of rainbow trout populations.

Population from the river	na	ne	h*	I*
Tekes	1.6364 (0.5045)	1.2465 (0.2741)	0.1659 (0.1620)	0.2675 (0.2422)
Ornek	1.3636 (0.5045)	1.1493 (0.2470)	0.0998 (0.1549)	0.1592 (0.2372)
Ulken-Kakpak	1.3636 (0.5045)	1.1321 (0.2066)	0.0936 (0.1399)	0.1529 (0.2220)
For the total sample size	1.8182 (0.4045)	1.2238 (0.2751)	0.1543 (0.1426)	0.2643 (0.1986)

*Note.* “na” is the absolute number of alleles per locus; “ne” is the effective number of alleles per locus; h\* is genetic diversity according to Nei, or expected heterozygosity; I\* is information indicator of the Shannon variety, for all the above parameters, standard deviations are given in parentheses.

The use of ISSR markers (cag)5 and (cag)7t also allowed to evaluate the degree of genetic differentiation of investigated three samplings. Similarities of genotypes were made by the cluster analysis method through the dendrogram construction. Figure 2 shows the genetic relationships of rainbow trout individuals involved in the analysis.

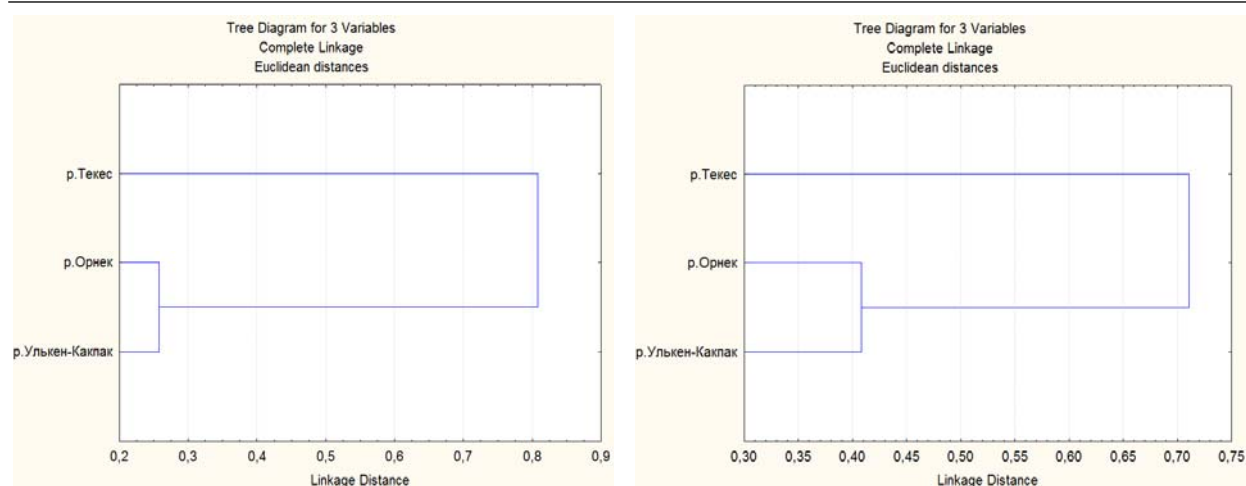


Figure 2 – Dendrogram of genetic distances between research rainbow trout populations by ISSR markers

According to the dendrogram both markers showed the genetic similarities of the rainbow trout individuals caught from the Ornek and Ulken-Kakpak rivers. Individuals from the Tekes river showed heterogeneity in the used ISSR markers. It can be assumed that this population has the highest level of variability in microsatellite markers and differs with a higher level of genetic diversity than other investigated rainbow trout populations in the Ornek and Ulken-Kakpak rivers.

In conclusion we can say that the goals and objectives were performed: when analyzing two inter-microsatellite markers for Kazakhstani rainbow trout we were able to identify the qualitative and quantitative principles of the genetic differences between the samplings from the three investigated Tekes, Ornek and Ulken-Kakpak rivers (Almaty region, Kazakhstan).

This investigation initiated the research of the genetic structure of Kazakhstani populations *Parasalmo (O.) mykiss* (Walbaum 1792). The preliminary obtained data prove the perspectivity of used ISSR markers for research this species and the importance for planning the further investigations in which an increase in the number of rainbow trout samplings and analyzed genetic markers is expected. It should also be noted that this developed technology could be recommended for practical use in the future.

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### **ҚАЗАҚСТАНДЫҚ ҚҰБЫЛМАЛЫ БАХТАҚ ПОПУЛЯЦИЯСЫНЫҢ ISSR-PCR АНАЛИЗ НЕГІЗІНДЕ МОЛЕКУЛЯРЛЫҚ-ГЕНЕТИКАЛЫҚ СИПАТТАМАСЫ**

**Аннотация.** Алғашқы рет Алматы облысының таулы және тау бөктері өзендерінің іріктемелерінен келтірілген *Parasalmo mykiss* құбылмалы бахтақ популяциясына молекулярлық-генетикалық зерттеу жүргізілді. Құрсақтық жүзбеканаттарының биопсиялық ұлпаларынан одан кейінгі молекулярлық-генетикалық зерттеу және *Parasalmo (Oncorhynchus) mykiss* микижаның бір формасына жататын балықтың таксономиялық тиесілігін анықтау үшін геномдық ДНҚ алынды. Камчаткалық микижа мен құбылмалы бахтаққа жалпы тән сипаттар бар, сондықтан, бір ғалымдар оны құбылмалық бахтақтың бір түрі десе, басқалары – албырт тұқымдасының өзіндік түрі деп есептейді. Қазақстандық бахтақтың фенол-хлороформдық экстракциясы әдісімен алынған геномдық ДНҚ-сы екі ISSR-маркермен талданған. Нәтижесінде Өрнек және Үлкен-қақпақ өзендерінен ұстап алынған қазақстандық бахтақ дараларының камчаткалық микижасымен генетикалық ұқсастығын көрсететін нақты полиморфтық профильдер алынды. Сонымен қатар, олар Текес өзені дараларының жоғары генетикалық вариабелділігін көрсетті. Алдын-ала алынған мәліметтер ISSR-маркерлердің осы түрді зерттеуге қолдану мүмкіндігін және осы бағытта кейінгі зерттеулерді жүргізуге негіз болатынын көрсетті. Бұл нәтижелер қазақстандық құбылмалы бахтақтың жеке экоформаға жекелену мүмкіндігіне перспективті болып саналады.

**Түйін сөздер:** құбылмалы бахтақ, геномдық ДНҚ, ISSR-маркерлер, ПЦР-анализ, экоформа.

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### МОЛЕКУЛЯРНО-ГЕНЕТИЧЕСКАЯ ХАРАКТЕРИСТИКА КАЗАХСТАНСКОЙ ПОПУЛЯЦИИ РАДУЖНОЙ ФОРЕЛИ НА ОСНОВЕ ISSR-PCR АНАЛИЗА

**Аннотация.** Впервые проведено молекулярно-генетическое исследование казахстанской популяции радужной форели *Parasalmomykiss*, представленной выборками из горных и предгорных рек Алматинской области. Из биопсированной ткани брюшного плавничка была выделена геномная ДНК для дальнейшего молекулярно-генетического исследования и определения таксономической принадлежности рыб к одной из форм микижи *Parasalmo (Oncorhynchus) mykiss*. Камчатская микижа имеет общие характерные черты с радужной форелью, поэтому одни ученые считают ее одним из видов радужной форели, а другие – самостоятельным видом семейства лососевых. Геномная ДНК казахстанской форели, выделенная методом фенол-хлороформной экстракции, была проанализирована по двум ISSR-маркерам. В результате получены четкие полиморфные профили, указывающие на генетическое сходство с камчатской микижей казахстанских особей форели, пойманных из рек Орнек и Улкен-Какпак. Также они указывали на высокую генетическую вариабельность особей реки Текес. Полученные предварительные данные указывают на возможность применения ISSR-маркеров для изучения данного вида и являются основой для проведения дальнейших исследований в этом направлении. Эти результаты дают перспективу для возможного обособления казахстанского вида радужной форели в отдельную экоформу.

**Ключевые слова:** радужная форель, геномная ДНК, ISSR-маркеры, ПЦР-анализ, экоформа.

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## NEWS

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**B. Sh. Kedelbaev<sup>1</sup>, K. M. Lakhanova<sup>2</sup>, Zh. B. Makhatov<sup>1</sup>**<sup>1</sup>M. Auezov South Kazakhstan State University, Shymkent, Kazakhstan,<sup>2</sup>Yassawi International Kazakh-Turkish University, Turkestan, Kazakhstan.E-mail: *kulzada.lakhanova@iktu.kz* *kulzada56@mail.ru***STUDY OF THE PROCESS OF SORBITOL PRODUCTION  
FROM WHEAT STRAW**

**Abstract.** The article presents the results of the study of the enzymatic combined (hybrid) hydrolysis-hydrogenation process for the production of sorbitol. This article describes the results of the pre-treatment and enzymatic hydrolysis of wheat straw, as well as the synthesis of sorbitol in order to increase the yield of valuable products needed for industry. Pretreatment of straw was carried out in the temperature range 190-250°C with a variation in the concentration of sulfuric acid from 0.6 to 2.5% by weight. The optimum temperature and duration of hydrolysis of straw with sulfuric acid were 160°C - 170°C and 30-80 minutes, respectively. In all straw hydrolysis experiments, the best results were achieved with a sulfuric acid concentration of 1.6% by weight and an experimental temperature of 150-160°C. Studies of the processes of enzymatic hydrolysis of straw have been carried out. Since the paper is practically pure cellulose, then, with the same kinetic parameters of the fermentolysis processes, the amount of formed sugars in the case of fermentolysis of straw would be 1.49 times less than when using paper. The resulting purified glucose hydrolyzate was subjected to hydrogenation in the presence of a nickel-aluminum-iron-chromium catalyst. The catalyst of the alloy with 7.0% chromium exhibits the greatest activity, the yield of sorbitol at which at 100°C and 6MPa for 60 minutes of hydrogenation is 50.5%, and the rate of hydrogenation of glucose is 1.46 times higher than for skeleton nickel without an additive. It is shown that with increasing hydrogen pressure from 2 to 12 MPa and 40-120°C, the rate of hydrogenation of glucose on titanium-promoted nickel-aluminum-iron catalysts increases.

**Key words:** wheat straw, sorbitol, cellulose, catalyst, enzymatic hydrolysis, biomass.

The growing interest in the use of plant biomass, rich in polysaccharides, determines the search for optimal methods for its processing. The main criterion in waste processing is their cost, volume, availability and localization, as well as chemical composition and technological properties. The processing of renewable plant materials in industrial-important substances is of great practical interest.

Cellulose-containing raw materials in the country are available in almost unlimited quantities in the form of wood, straw, solid household waste, etc. However, its effective conversion into biologically digestible sugars is a complex task, over which scientific collectives all over the world work. In this case, the possibilities of using directly microorganisms, complexes of cellulolytic enzymes, chemical hydrolyzing agents for the effective conversion of non-food raw materials into digestible sugars are explored.

According to the statistic data, wheat and cotton are the leaders in crop yields in the Republic of Kazakhstan. Gross harvest of wheat in 2011 amounted to 22.7 million tons, while in the fields of agricultural enterprises an average of 11.1 million tons of wheat straw was formed, only 10 percent of which is used for feeding livestock and as litter to animals, the rest of it is plowed up into the ground and burned in the fields. Thus, cereal straw is a large-capacity, affordable and promising secondary resource of agricultural production in the Republic of Kazakhstan. One of the cheapest and available types of cellulose-containing raw materials for large-tonnage production of energy carriers, in particular fuel alcohol, is straw. This is a huge potential raw material base. Finally, the existing agricultural infrastructure

makes it possible to solve the problem of delivering straw for processing, provided that the processing enterprise is located near the elevator [1].

Given the low degree of effective use of straw cereals at present, the main attention is paid to the problem of saccharification of this type of secondary raw materials. The plant cell wall has a high resistance to degradation. Fungi and bacteria that use cellulose as a source of carbon have developed a complex set of enzymes that hydrolyse cellulose, releasing glucose monomers. Enzymatic hydrolysis is a promising method of processing plant biomass. However, during the enzymatic hydrolysis of ligno-cellulosic materials in their native form, the yield of sugars reaches less than 20% of the theoretically possible yield. Overcoming the physico-chemical barriers that hamper the availability of cellulose for enzymes is an important issue, the solution of which is directly related to the search for low-cost pre-treatment methods for raw materials. The effectiveness of this process determines the yield of the target product in the process of enzymatic hydrolysis of cellulose and the economic feasibility of the entire technology as a whole. Despite the relatively high catalytic activity of sulfuric, hydrochloric and phosphoric acids, their use in the hydrolysis of lignocellulose is still not economically effective, since they have a strong corrosive activity, their cost is high, and the neutralization of their excess in hydrolyzates is associated with costs and environmental stress. Perspective is the use of sulfuric acid, which allows to reduce the consumption of hydrolyzing agent due to its recovery. In this regard, the determination of optimal pre-treatment regimes using sulfuric acid, as well as the study of the effect of its conditions on the efficiency of enzymatic hydrolysis of wheat straw, is an urgent task. The development of complex processing of wheat straw will not only improve the ecological situation, but also will provide raw materials and additional products for the industry.

The development of complex processing of carbohydrate-containing plant raw materials and waste will allow not only to improve the ecological situation, but also to obtain raw materials and additional products for the chemical industry and biotechnological productions. Thus, the processing of renewable carbohydrate-containing plant material and waste into industrially important chemicals is of great practical interest

Of particular interest is the search for catalytic technologies of a one-stage, combined (hybrid) process for obtaining valuable substances directly from this raw material, excluding the technological stages of separation and purification of intermediates. One-stage organization of the process makes it possible to obtain from the plant polysaccharide by the hydrolysis-hydrogenation reaction of compounds such as xylitol and sorbitol. Intensive research is being carried out in this direction in the world. A wide range of catalytic systems for the hydrolytic transformations of a renewable polysaccharide are proposed, for example, catalytic systems based on carbon, oxides, zeolites, ion exchange resins. Various technological schemes for the implementation of such processes have been developed, various variations of the methods for similar processing of polysaccharides of carbohydrate-containing plant material and waste are proposed.

However, the literature data published so far on the use of various catalytic systems in the conversion of these polysaccharides often contradict each other, and the catalysts proposed exhibit little activity or stability. It should be noted that most researchers have studied exclusively the hydrolysis of polysaccharides into glucose, and the number of works devoted to the possibility of obtaining, for example, from wheat straw of xylitol and sorbitol as a result of combined (hybrid) process processes is extremely small. Although, these compounds are substances that are highly demanded in many modern branches of the chemical, food, perfume, medical, and other industries. In particular, sorbitol and xylitol are widely used in the production of surfactants, synthetic resins, varnishes, drying oil, vitamin C, food products, etc.

To date, a fairly large number of experimental data on the hydrolysis of cellulose to glucose has been obtained, but information on single-stage hybrid processes for the production of sorbitol and xylitol is not enough, and the results described in the literature often do not agree with each other.

Analysis of the literature [2-11] on the topic of the work showed that in the field under study there are a number of unresolved problems, the search for solutions of which seems useful for the creation of effective catalytic technologies for the conversion of carbohydrate-containing plant material and waste into valuable chemicals.

In [12], a method is proposed that pertains to genetic engineering and can be used in the microbiological industry. Arabidopsis producing yeasts or fungi transform the DNA encoding the D-xylose-forming D-arabitol dehydrogenase and DNA encoding xylitol dehydrogenase. Then, transformed yeast or fungi under conditions that ensure the synthesis of xylitol. Xylitol is removed. Yeast is selected from *Lygosaccharomycesrouxii*, *Candidapolymorpha*, *Torulopsiscandida*, *Pichiafarinosa*, *Torulasporahansenii*. Mushrooms are selected from *Dendryphiellasalina* and *Schizophyllumcommune*. The method makes it possible to convert readily available sources of carbon, such as D-glucose to xylitol.

In [13], cellulose and hemicellulose in biomass are first decrystallized first with concentrated sulfuric acid and subjected to the first hydrolysis, resulting in a hydrolyzate saturated with sugar and acid. After that, the silicon oxides contained in the biomass are removed and sent to the processing. Then, the remaining solid residues are subjected to repeated decrystallization and re-hydrolysis. The resulting sugar solution is thereafter subjected to fermentation, using for this purpose microorganisms, preferably yeast and bacteria, providing fermentation of both hexoses and pentoses simultaneously. The method makes it possible to obtain sugars from biomass containing cellulose and hemicellulose, which is economically efficient and does not pollute the environment.

In [14] describes a process for pretreating a cellulose-containing feedstock for enzymatic hydrolysis, which involves preparing a feed slurry and treating it with an acid solution. A solution of nitric acid with a concentration of 2,8-6,5% is used as the acid solution. The solution is heated to a temperature of 98-100 °C and held for 1-5 hours. The product obtained is filtered, washed. And as a cellulose-containing raw material use miscanthus or fruit shells of cereals. The acid solution worked out after one cycle is strengthened with concentrated nitric acid to a solution concentration of 2,8-6,5% and repeatedly used again. The solution spent 18-25 cycles is neutralized with ammonia to obtain a solution of ammonium nitrate for use as a fertilizer.

A method related to the microbiological as well as the food industry and which can be used in the disposal of waste containing cellulose is described in [15]. The method involves pretreating cellulose-containing raw materials from which barley or rice grains are used, or cotton linters, or wheat straw to break down the crystal structure and increase its specific surface area. This treatment is carried out by extrusion. The obtained extrudate is subjected to enzymatic hydrolysis with enzymatic preparations of Asp. mix B 2000 or B1mix or celloviridine G20x at a mass ratio of the enzyme: extrudate 1-3: 1-9, respectively. The proposed method is non-waste, environmentally friendly and inexpensive, characterized by a high degree of bioconversion of raw materials with a significant reduction in the time required for its implementation.

A method was developed [16] comprising the step of hydrolyzing a cellulose-containing biomass to obtain an aqueous sugar solution. The resulting aqueous sugar solution is then filtered through a nanofiltration membrane and/or a reverse osmosis membrane. The purified sugar solution is collected from the inlet side and the fermentation inhibiting substances are removed from the filtrate side. These fermentation inhibiting substances are one or more compounds from organic acids, furan compounds and phenolic compounds. The invention makes it possible to obtain a sugar syrup purified from the fermentation-inhibiting compounds in a simple manner and to increase the efficiency of the fermentation of various chemical products.

Silveira et al [17] compared the activity of 6 strains of *Zymomonasmobilis* with respect to D-sorbitol and gluconic acid.

The strain of *Zymomonasmobilis* ATSS-29191 compared to others showed relatively good growth and high yield of products. For this strain, the effect of the initial concentration of substrates on the yield of D-sorbitol and gluconic acid in the batch process was investigated [18]. The equimolar concentrations of glucose and fructose ranged from 100 to 750 g / l. Increase in productivity occurred at an increase in the initial concentration of the substrate to 650 g / l. At 750 g / l, a drop in productivity was observed.

It was also found that with an initial concentration of 100 g / L, glucose and fructose were equally converted to sorbitol and gluconic acid, especially during the initial reaction period. However, after 20 minutes there was a shift in the metabolism of sugars, characterized by: an increase in glucose consumption, a strong decrease in fructose intake, a decrease in the yield of sorbitol, and a decrease in the concentration of gluconic acid. An increase in the concentration of substrates to 600 g / l led to an almost complete conversion of sugars to sorbitol and gluconic acid.

This article describes the results of the pre-treatment and enzymatic hydrolysis of wheat straw, as well as the synthesis of sorbitol in order to increase the yield of valuable products needed for industry. To develop the processing technology, wheat straw was formed, formed as waste in the agricultural sector of the Republic of Kazakhstan. Previously investigated plant raw materials were crushed and sorted. The individual monosaccharides in the hydrolysates were analyzed by paper chromatography using Filtrak FN-3, 11 and 14 in butanol-acetic acid-water solvents (4: 1: 5). The substances were detected by spraying first with a first developer of K<sub>2</sub>SO<sub>4</sub>, then a mixture of benzidine, acetone and hydrochloric acid in a ratio of 10: 2: 1. Alloys were prepared in the high-frequency melting furnace of the brand according to the technology developed by us. A calculated amount of aluminum was placed in a quartz crucible and gradually heated to 100-110<sup>0</sup>C, then the calculated amount of nickel, iron and titanium was introduced. As a result of the exothermic reaction, the temperature of the melt rose to 170-180<sup>0</sup>C, which was mixed for 3-5 minutes by an induction field. In graphite molds, the alloy was cooled in air and ground to 0.25 mm grains. Activation of the alloys was carried out by leaching with 10 aqueous solution of caustic sodium, taken in a volume of 40 cm<sup>3</sup> per 1 g of alloy in a boiling water bath for 1 hour, after which the catalyst was washed from alkali with water until neutral reaction with phenolphthalein. The catalysts thus obtained were used for the hydrogenation of glucose. For the rapid identification of the optimum catalyst and the study of kinetic regularities, the experiments were initially carried out in a modified batch reactor. The device is equipped with a hermetic drive with a power of 0,6 kW, the speed of rotation of the stirrer is 2800 rpm, which allows to remove the diffusion complications of the reaction.

Pretreatment of straw was carried out in the temperature range 190-250<sup>0</sup>C with a variation in the concentration of sulfuric acid from 0.6 to 2.5% by weight. Increasing the temperature to a greater extent, compared with the increase in the concentration of acid, contributed to a reduction in the processing time required to achieve the maximum yield of reducing substances (RS). more than decomposition of monosaccharides. The yield of monosaccharides therefore increases with the reaction temperature. The influence of the concentration of sulfuric acid at temperatures below 150 ° C is noticeable, but with increasing temperature to 160 ° C it disappears.

The optimum temperature and duration of hydrolysis of straw with sulfuric acid were 160<sup>0</sup>C - 170<sup>0</sup>C and 30-80 minutes, respectively. As the concentration of sulfuric acid increases, the rate of decomposition of sugars increases. The optimum concentration of sulfuric acid is 1.77% by weight. Pretreatment of straw with a variation of the hydromodule from 1: 3 to 1: 5 was carried out under conditions of 1.6% by weight. sulfuric acid and at a temperature of 150 ° C. The highest yield of RS was achieved with the hydromodule 1: 3.5, 1: 5 and 1: 5.8 and amounted to 26.8%, 27.0% and 29.2% respectively. The monosaccharide composition of the hydrolysates was mainly represented by glucose, the concentration of which reached 25 g / l in the hydrolysates.

Thus, the treatment of straw is 1.35% by weight. sulphurous acid at a temperature of 150<sup>0</sup>C, a hydromodule of 1:3 for 60 min allows to obtain hydrolysates with a concentration of reducing substances up to 7.6%, which will promote their further use in the microbiological industry. When using the hydromodule 1: 4.5, the maximum concentration of reducing substances in the hydrolyzate is reached at a temperature of 160<sup>0</sup>C, sulfuric acid concentration of 1.6% by weight. The yield of reducing substances was 25.57% of the absolutely dry substance. In all straw hydrolysis experiments, the best results were achieved with a sulfuric acid concentration of 1.6% by weight and an experimental temperature of 150-160<sup>0</sup>C.

#### Studies of the processes of enzymatic hydrolysis of straw

Model experiments for the study of enzyme kinetics were carried out using paper and cotton wool as the source of cellulose. In the experimental processes of fermentolysis, wheat straw that was pre-ground, screened and dried to constant value in a drying cabinet at a temperature of 120<sup>0</sup>C for 2 hours was used, which was pre-soaked in an autoclave at an excess pressure of 0.05-0.1 MPa for 0.5 - 1 hour.

The processes of fermentolysis were carried out while maintaining active acidity in the range of 4.9-5.0 units. pH and temperature of 49<sup>0</sup>C. The duration of fermentolysis was 7-10 hours.

Studies of the kinetics and stoichiometry of the reactions of enzymatic hydrolysis of disperse solid-phase vegetable substrates were carried out in a laboratory fermentolizer with automated pH control and thermostating.

The results of the experiment are given in Table 1.

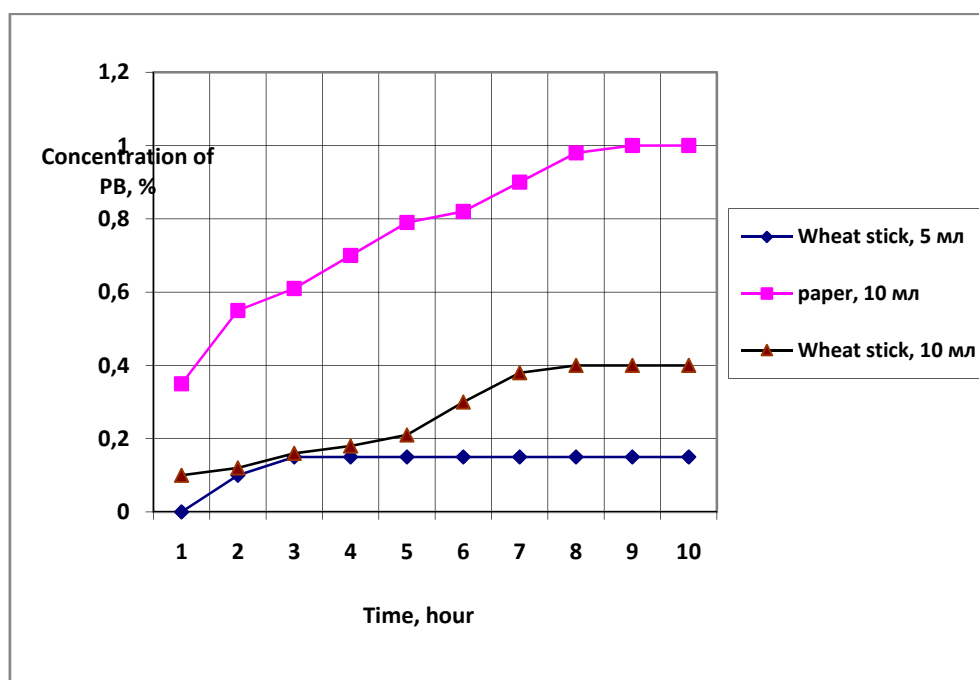
Table 1 – Results of fermentolysis of the wheat sticks in the fermenter

Process number	Number of enzymes, units activity	The maximum concentration of RS, %	Output RS, %
1	62-75.8	0.43	4.3
2	62-75.8	0.46	4.6
3	6.2-17.6	0.46	4.6
4	31-37.9	0.48	4.8
5	62-75.8	0.32	3.2
6	1.6-1.9	0.26	2.6
7	3.0-3.8	0.26	2.6
8	4.6-5.7	0.22	2.2

In order to reduce the error and verify the action of the enzyme on single-component substrates, a series of experiments were carried out on the fermentolysis of comminuted, de-impregnated paper into a 6-liter fermentolizer.

It is easy to verify that the dependence of the final concentration of RS (hence, the average rate of fermentolysis) on the average value of the enzyme activity is linear, which theoretically follows from the Michaelis-Menten model.

The results of comparative processes of fermentolysis of straw and paper are shown in Figure.



Variation in the concentration of RS in the processes of fermentolysis of paper and wheat straw

Since the paper is practically pure cellulose, then, with the same kinetic parameters of the fermentolysis processes, the amount of formed sugars in the case of fermentolysis of straw would be 1.49 times less than when using paper. However, in reality, the structure of the straw is characterized by a higher packing density of fibers and the presence of other interfering components, which leads to a slowing of the rate of the fermentolysis process by a factor of 2.5.

The resulting purified glucose hydrolyzate was subjected to hydrogenation in the presence of a nickel-aluminum-iron-chromium catalyst. From Table 2 it can be seen that the nickel catalysts under investigation, under the conditions studied by us, show high activity and stability with respect to sorbitol, the rate of formation of the latter varies with the number of doping metals in the initial alloys. The catalyst

Table 2 – The effect of the amount of added titanium additive on the activity of the nickel-aluminum-iron catalyst, (PN2 = 6MPa, Top-1000C)

Additive, %	t op., °C	Sorbitol yield (%) in time (min)					W*10 <sup>4</sup>
		0	10	20	40	60	
0	100	14.4	18.6	23.4	31.4	38.1	10.9
1.0	100	14.5	18.3	24.5	31.3	38.5	11.3
3.0	100	16.3	22.5	27.8	37.0	43.7	12.8
5.0	100	17.9	24.2	28.7	40.5	48.3	14.1
7.0	100	18.7	25.3	32.1	41.4	50.5	15.9
10.0	100	15.3	23.0	29.7	34.1	49.3	14.8

of the alloy with 7.0% chromium exhibits the greatest activity, the yield of sorbitol at which at 100°C and 6MPa for 60 minutes of hydrogenation is 50.5%, and the rate of hydrogenation of glucose is 1.46 times higher than for skeleton nickel without an additive.

It is shown that with increasing hydrogen pressure from 2 to 12 MPa and 40-120°C, the rate of hydrogenation of glucose on titanium-promoted nickel-aluminum-iron catalysts increases. However, the hydrogen pressure limit values have not been established. The "seeming" tendency of the reaction rate to is due to the lack of a hydrogenated compound on the surface of the catalyst, as indicated by the fractional order of the reaction for glucose. The order for hydrogen depends both on the temperature of the experiment and on the pressure of hydrogen. Experiments on the influence of the concentration of glucose and hydrogen show that the reaction order for the hydrogenated substance varies from zero to fractional, and in hydrogen, fractional.

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### **БИДАЙ САБАНЫНАН СОРБИТТИ АЛУ ҮДЕРІСІН ЗЕРТТЕУ**

**Аннотация.** Мақалада сорбитті алу мақсатында гидролиз – сутектендірудің ферментативті аралас (гибридті) процестерін зерттеудің нәтижелері көрсетілген. Дәл осы мақалада өндіріске қажетті бағалы өнімдердің шығымын жоғарылату мақсатында сорбит синтезін сонымен қатар бидай сабанының ферментативті гидролизін және қайта өңдеудің зерттеу нәтижелері көрсетілген. Сабанды қайта өңдеуді температурасы 190-250°C диапазонында күкірт қышқылы концентрациясының масс. 0,6 бастап 2,5 % түрлендіріп жүргізілді. Сабанды күкірт қышқылында гидролиздеудің оңтайлы температурасы және ұзақтығы 160–170°C және 30–80 минутты құрады. Сабанды гидролиздеудің барлық тәжірибелеріндегі ең жақсы нәтиже күкірт қышқылының концентрациясы масс 1,6% және температурасы 150–160°C кезінде жетті. Сабанды ферментативті гидролиздеу процестеріне зерттеулер жүргізілді. Қағаз тәжірибе жүзінде қаншалықты таза целлюлоза болып табылады, онда ферментативті процесінің кинетикалық параметрлері бірдей кезінде, сабан ферментативті жағдайында түзілетін қантмөлшері қағазды қолданғанға қарағанда 1,49 есе аз. Алынған тазаланған глюкоза гидролизаты никель-алюминий-темір-хромдық катализатордың қатысуымен сутектендірілді. 7,0% хром құймасынан жасалған катализатор сорбиттің шығуына үлкен белсенділік көрсетеді, 100°C және 6МПа, 60 минут кезіндегі сутектендіру 50,5%, ал глюкозаны сутектендіру жылдамдығы 1,46 есе жоғары қоспасыз қаңқалы никельге қарағанда. Көрсетілді, сутектің қысымының өсуі 2-ден 12 МПа дейін және 40-120°C глюкозаны сутектендіру жылдамдығы монтаждалған титан никель-алюминий-темір катализаторында үлкейеді.

**Түйін сөздер:** бидай сабаны, сорбит, целлюлоза, катализатор, ферментативті гидролиз, биомасса.

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### **ИССЛЕДОВАНИЕ ПРОЦЕССА ПОЛУЧЕНИЯ СОРБИТА ИЗ ПШЕНИЧНОЙ СОЛОМЫ**

**Аннотация.** В статье приведены результаты по изучению ферментативного совмещенного (гибридного) процесса гидролиз-гидрирование с целью получения сорбита. В настоящей статье изложены результаты исследования предобработки и ферментативного гидролиза пшеничной соломы, а также процесс синтеза сорбита с целью повышения выхода ценных продуктов, необходимых для промышленности. Предобработку соломы проводили в диапазоне температур 190–250°C при варьировании концентрации сернистой кислоты от 0,6 до 2,5 % масс. Оптимальная температура и продолжительность гидролиза соломы сернистой кислотой составили соответственно 160–170°C и 30–80 минут. Во всех экспериментах гидролиза соломы наилучшие результаты достигнуты при концентрации сернистой кислоты 1,6 % масс и температуре опыта 150-160°C. Проведены исследования процессов ферментативного гидролиза соломы. Поскольку бумага является практически чистой целлюлозой, то, при одинаковых кинетических параметрах процессов ферментативного гидролиза, количество образовавшихся сахаров в случае ферментативного гидролиза соломы было бы в 1,49 раза меньше, чем при использовании бумаги. Полученный очищенный глюкозный гидролизат подвергали гидрированию в присутствии никель-алюминий-железо-хромового катализатора. Катализатор из сплава с 7,0% хрома проявляет наибольшую активность, выход сорбита на котором при 100°C и 6 МПа на 60 минуте гидрирования составляет 50,5%, а скорость гидрирования глюкозы в 1,46 раза выше, чем на скелетном никеле без добавки. Показано, что с ростом давления водорода от 2 до 12 МПа и 40–120°C скорость гидрирования глюкозы на промотированных титаном никель-алюминий-железо катализаторах увеличивается.

**Ключевые слова:** солома пшеницы, сорбит, целлюлоза, катализатор, ферментативный гидролиз, биомасса.

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**MOLECULAR-GENETIC MONITORING OF CAMELS  
OF ARVANA BREED OF ARYS-TURKESTAN POPULATION  
WITH THE USAGE OF DNA-TECHNOLOGY**

**Abstract.** In this article identification and certification questions of high dairy effective genotypes of camels of Arvana breed of Arys-Turkestan population with the usage of DNA-technology are considered. Performed molecular-genetic analysis has shown, that population of camels has subdivision on breed parameter. Each subpopulation of camels of Arvana breed has a distinctive gene pool for the given population. The obtained data can be used at development of actions for preservation of their unique gene pools well adapted for local conditions. In the Arys-Turkestan zone of camel breeding («Syzdybekov A», «Usenov N» farms) are identified and passported high dairy effective genotypes of Arvana camels, with the use of DNA-technology in number of 200 heads of animals. Interpopulation distinctions between populations of camels on 7 microsatellite loci have been received on population «Usenov N» an average alleles – 6.28, heterozygosity-0.68, inbreeding – 0.0096, feature of the given population in 2 loci presence of private alleles, as is distinctive line of the given population. Distinctive feature of population «Syzdybekov A.» is presence in 3 loci of private alleles. On the given population an average quantity of alleles – 6.43, heterozygosity-0.70, inbreeding – 0.0077.

**Key words:** camels, DNA, primers, loci, alleles, STR-polymorphism, genetic monitoring.

**Introduction.** The major problem of genetic researches in animal industries is perfection of methods of genotypic estimation of animals essentially influencing on productivity of selection process. Studying of polymorphic systems of blood of animals has provided zoengineering science with a quality monitoring of an origin, an estimation of genetic features of breeds, herds and lines, definitions of level of genetic similarity between them and forecasting of heterosis effect [1].

Modern achievements in the field of molecular genetics, successes in decoding of genomes of many animals and plants, including camels (2014), have essentially expanded a base of marker-auxiliary selection and have caused an actuality of strategy and tactics development of genetic monitoring in animal industries taking into account specificity of each subindustry. Now many selection programs on improvement of breeds of animals are based on use of genetic markers that opens real possibilities for monitoring of genealogical structure, preservation of an optimum level of a genetic variety, selection of animals with the a glance of their genotypic estimations. For improvement of quality of production of animal industries of Kazakhstan and its integration on the world market application of the advanced selection-genetic methods which allow to create new highly productive breeds, types and lines of the animals adapted for this or that zone of cultivation is required. For efficiency of selection process, selection of highly productive individuals should be carried out with observance of strict genetic monitoring. In breeding animal industries, including camel breeding, the method of the genetic control of an origin of agricultural animals is very important, and genetic certification of significant genotypes is an obligatory element of zootechnical control in breeding economy. Identification of allele pool of domestic breeds of camels of a dairy direction earlier in Kazakhstan was not carried out. Thereupon genetic

researches for carrying out of optimization of structure, identification and certification of valuable genotypes, and also ordering of genetic resources in dairy camel breeding are actual.

Scientific novelty of research consists in studying and detection of the selection importance of domestic breeds of camels with use of DNA-technologies in which research of biological tests (non-invasive procedure) gives possibility of an estimation of animals at a birth, being based on 7 microsatellites of DNA. Genetic profiles of camels will be constructed and genetic value of certain loci and their alleles variants is identified.

The practical importance of work consists in DNA-analysis carrying out (in laboratory conditions of institute) for definition of breeding value of animals from economy of various categories. Results of research will allow to isolate perspective animals with certain genetic markers to use them in the further selective-breeding work for formation of highly productive herd on dairy efficiency. Created electronic genetic database on the basis of optimization of structure, identification of animals and ordering of genetic resources will be promoted to acceleration of selective-breeding work. Certification of the researched breeding animals gives the objective characteristic of each individual on genetic parameters.

The work purpose is identification of possible polymorphisms of 7 STR-markers at population of camels, using a polymerase-chain reaction method (PCR) and on this basis identification and certification of high dairy effective camels of Arvana breed of Arys-Turkestan population.

For object in view performance of following problems were solved: to lead selection of biomaterials from animals of the Arys-Turkestan zone of camel breeding, to carry out the primary molecular-genetic multiplex analysis of the received biomaterials of camels of a dairy direction on 7 loci of microsatellites, to establish genetic profiles of camels of a dairy direction, to carry out complex analysis of investigated populations of camels of a dairy direction by modern methods of population genetics, to carry out action on pawning for a long-term storage of isolated DNA of camels of a dairy direction, to develop an electronic genetic database and on its basis to carry out ordering of the received population-genetic data.

The estimation of a spectrum of a genetic variety of breeds demands studying whenever possible the big number of the isolated populations in various ecological-climatic zones. The existing contribution to a genetic variety of breeds is brought by the regional populations which gene pool, as a rule, was formed in the conditions of relative isolation and on the basis of local cattle - the carrier of own unique allele pool. Besides, on allele profiles of breeds used in an agricultural production, considerable influence render plans of selection-breeding work [2].

In cattle breeding for today the following questions are actual: studying of genetic features of breed, their phylogenesis and breed forming, similarities and distinctions, revealing of genetic anomalies at animals, their origins.

Studying of genetic structure of artificial formed populations in animal industries represents the big theoretical interest, and also allows to formulate the proved recommendations for perfection of existing breeds and breeding work with them, corresponding to actual requirements of economic practice [3].

In the characteristic of allele pool breeds and populations of agricultural animals find application genetic markers of different types. At camels, the greatest distribution have received two types - erythrocytic antigens of blood groups and microsatellites. Genetic markers allow to judge degree of heterozygosity of animals, degree of consolidation of hereditary qualities of breeds, types, lines, about genetic distinctions between them.

For effective selection on increase of quantity of protein in milk modern genetic and biotechnological methods, in particular the molecular-genetic analysis are used, allowing to reveal polymorphism of genes of proteins of milk. It is established positive connection of a genotype and haplotype on autosomal loci with protein-dairy properties of milk of camel female [4].

Sequencing of camels' genome allows to identify genes or genomic areas of loci of quantitative signs (QTLs), which are important at selection on reproductive, feeding and meat-and-milk qualities. The mutations forming new versions of alleles, spending the basis of one gene, lead to formation of new sequence of amino acids in protein (kappa-casein). All listed phenomena unite in concept gene or point mutations. They can be harmful (BLAD, CVM), useful (kappa-casein) or neutral (blood groups, microsatellites).

Introduction of method of polymerase chain reaction (PCR) in laboratory practice became one of the most important events in clinical laboratory diagnostics in last decades. PCR method lifts diagnostics on

essentially new level - level of definition of DNA or RNA that allows carrying out straight detection of the infectious agent or a genetic mutation.

In the developed countries PCR method is used both in medicine, and in agriculture. In our republic PCR method is applied in medical institutions, and in animal industries, particularly, in cattle breeding, it is applied boundedly.

Genetic typing at DNA level can be used at diagnostics of hereditary diseases, such as the combined immunodeficiency (SCID - severe combined immunodeficiency disease), a periodic paralysis of horses (HYPP, hyperkaliemic periodic paralysis) and others.

The question, which is closely connected with identification and the control of an origin revealing of carriers of the genetic defects causing display of hereditary diseases at camels. Now the laboratory can offer identification of some of the most widespread hereditary diseases at camels. Search work on revealing of markers for revealing of genetic defects, characteristic for camels of domestic livestock is conducted also.

Monitoring of immunogenotypic indicators at animals is necessary for realization of genetic potential and reception of healthy posterity. In this connection monitoring of the maintenance of the basic classes of antibodies at camels promotes maintenance of immunity and as consequence, to preservation of health of animals and reception of viable posterity.

The international society on studying of genetics of animals offers panels of loci of microsatellites for principal views of the agricultural, domestic and cultivated animals in which are included the most informative loci used at the control of reliability of an origin. Thus, microsatellite profiles can be used as criteria of an estimation of genuineness of strain of camels [5].

Earlier scale works on identification, ordering and certification of genetic resources of domestic breeds of camels in Kazakhstan were not carried out.

**Methods.** Objects of researches were served biosamples (histologic tests) of camels of Turkmen Arabian Arvana breed.

The method of DNA-researches was applied on the basis of institute laboratory in department of genetics of agricultural animals. As a material biological materials of animals from two base economy (LLP «Usenov N», LLP «Syzdybekov A») are used. For DNA isolation there have been used commercial sets of leading firms of manufacturers: GenePak PCR Core; Qiagen; Lithex; DNA-technology; Diatom DNA; ExtraGene DNA Prep.

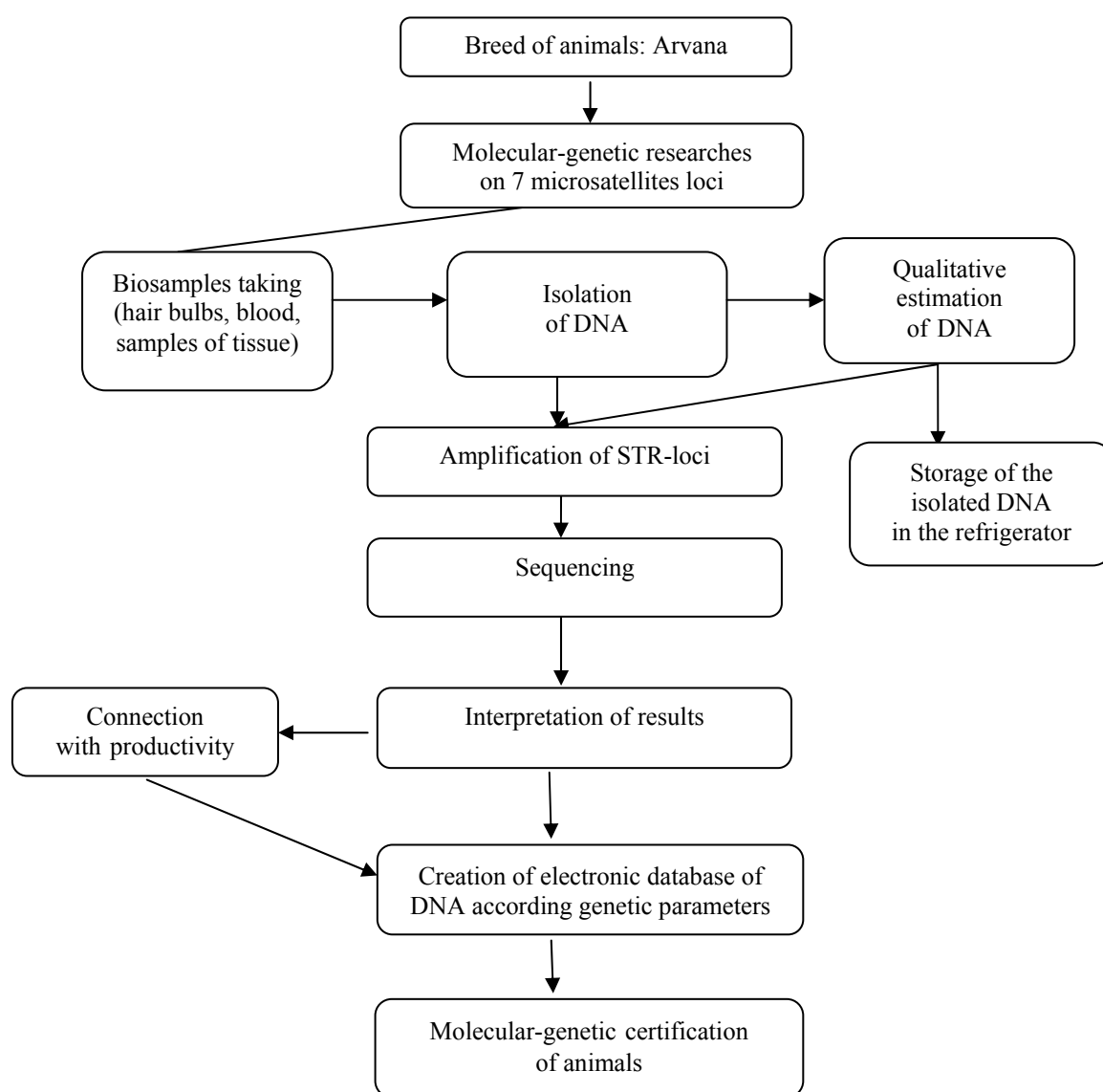
For the purpose of studying of interbreeding differentiation the genetic analysis of typing results of 200 heads of animals of domestic Arvana breed has been carried out on 7 loci of microsatellites of DNA according to the research scheme (figure).

As material for researches the samples of DNA isolated from histologic tests with use of sets Diatom DNA and ElxtraGene DNA Prep served. The isolated samples of DNA were amplified on amplifier 2720 Thermal Cycler, on the basis of a set of primers of StockMarks firm. All works on isolation, amplifications and sequencing have been carried out according to reports of the manufacturer, adapted to the concrete complete of reagents.

Polymorphism of microsatellites of DNA defined with the help of sequenator ABI-310. The panel of typing of DNA consists of 7 microsatellites, characteristic for carrying out of genetic examination of an origin of camels. Interpretation of graphic profiles of results of samples genetic typing and definition of genotypes of camels were carried out with the recommendation of the International institute of camel breeding (International Camelid Institute) and the International society of genetics of animals (International Society for Animal Genetics) [6].

Genetic-populational analysis taking into account frequencies of occurrence of alleles of microsatellite loci, level of multiformity and heterozygosity degrees, was carried out by the standard techniques. Biometric calculations were carries out according to Statistical calculations carried out with use of a statistical package and own development with use of an algorithmic language of programming Fortran PowerStation. Databases are developed with use of package Microsoft Office Access 2007.

The final stage of amplified fragments analysis is identification of alleles and an establishment of genetic profiles of investigated samples of DNA [7]. The established genetic profile of an animal is a basis for registration of the genetic report of testing in which are specified revealed allele variants on each investigated locus.



Scheme of researches

Table 1 – Specific loci for camels genetic typing

#	Loci	Length	Primer (5'-3') straight	Primer (5'-3') reverse
11	LCA8	211-261	GCTGAACCAATGCAAAGA	AATGCAGATGTGCCTCAGTT
22	LCA37	124-174	AAACCTAATTACCTCCCCCA	CCATGTAGTTGCAGGACACG
33	LCA56	133-171	ATGGTGTTTACAGGGCGTTG	GCATTACTGAAAAGCCCAGG
44	LCA65	159-193	TTTTTCCCCTGTGGTTGAAT	AACTCAGCTGTTGTCAGGGG
55	LCA66	216-266	GTGCAGCGTCCAAATAGTCA	CCAGCATCGTCCAGTATTCA
66	YWLL29	210-232	GAAGGCAGGAGAAAAGGTAG	CAGAGGCTTAATAACTTGCAG
77	YWLL44	84-136	CTCAACAATGCTAGACCTTGG	GAGAACACAGGCTGGTGAATA

**Results.** Researches were carries out on biomaterials (histologic materials) animals from two base economy (LLP «Usenov N», LLP «Syzdybekov A»). The size of sample was 102 heads (2 bores-male, 50 female camels and 50 colts) of each economy.

The carried out researches of studied sample of camels have revealed presence of 47 alleles 7 loci of microsatellites, that on the average on a locus has made accordingly 6.71 for Arvana breed [8].

In microsatellite loci at studied types of animals identified 5 private alleles. Number of effective alleles (they bring the greatest contribution to calculation of degree of heterozygosity) were in all loci of microsatellites that specifies in more uniform distribution of alleles of microsatellites in population. The analysis of microsatellite profiles has allowed to differentiate animals of the given breed correctly.

Table 2 – Revealed allele variants at population of camels of Arvana breed. By a fat font private alleles are allocated

Loci	Number of alleles	Name of the alleles
LCA8	9	213, 215, <b>217</b> , 219, 227, 229, 239, 241, 243
LCA37	7	128, 134, 148, 152, 158, 160, 162
LCA56	6	139, 141, 147, 151, 153, 155
LCA65	6	161, 163, 165, 171, 173, <b>175</b>
LCA66	7	218, 220, <b>222</b> , 228, 230, 240, <b>242</b>
YWLL29	4	216, 220, 222, 226
YWLL44	8	96, 98, 108, 110, 114, 116, 120, <b>122</b>
Average number of alleles	6.71	Observed heterozygosity – 0.69, expected – 0.67, size of casual inbreeding – 0.0083

Advantage of microsatellites at detection of a pedigree belonging is caused by that first, gives in to a differentiation polymorphism level, and secondly is possible classification on private alleles.

Use of homogeneous selection is directed on fastening of signs of efficiency of parents in posterity. On the basis of it it is possible to draw a conclusion, that microsatellite profiles can be used as criteria of an estimation of degree of heterogeneity of selection of parental pairs at thoroughbred cultivation. [9]

It is necessary to notice, that the revealed laws should be extended with care to camels of other breeds, types or even herds. The data cited in the present work though are scientifically proved and experimentally proved, demand acknowledgement within the limits of more scale researches both in pedigree, and in population aspect. [10]

We also result of the analysis of a genetic variety of Arvana breed camels with application as criteria of an indicator of heterozygosity and sizes of casual inbreeding for two populations (see tables 3, 4).

Table 3 – Revealed allele variants and indicators of a genetic variety at camels of Arvana breed (population LLP «Usenov N»). By a fat font private alleles are allocated

Loci	Number of alleles	Name of the alleles
LCA8	8	213, 215, 219, 227, 229, 239, 241, 243
LCA37	7	128, 134, 148, 152, 158, 160, 162
LCA56	6	139, 141, 147, 151, 153, 155
LCA65	5	161, 163, 165, 171, 173
LCA66	6	218, 220, <b>222</b> , 228, 230, 240
YWLL29	4	216, 220, 222, 226
YWLL44	8	96, 98, 108, 110, 114, 116, 120, <b>122</b>
Average number of alleles	6.28	Observed heterozygosity – 0.68, expected – 0.72, indicator of casual inbreeding – 0.0096

Table 4 – Revealed allele variants indicators of genetic variety at camels of Arvana breed (population of LLP «Syzdybekov A»).  
By a fat font private alleles are allocated

Loci	Number of alleles	Name of the alleles
LCA8	9	213, 215, <b>217</b> , 219, 227, 229, 239, 241, 243
LCA37	7	128, 134, 148, 152, 158, 160, 162
LCA56	6	139, 141, 147, 151, 153, 155
LCA65	6	161, 163, 165, 171, 173, <b>175</b>
LCA66	6	218, 220, 228, 230, 240, <b>242</b>
YWLL29	4	216, 220, 222, 226
YWLL44	7	96, 98, 108, 110, 114, 116, 120
Average number of alleles	6.43	Observed heterozygosity – 0.70, expected – 0.71, indicator of casual inbreeding – 0.0077

As follows from the above-stated data interbreeding distinctions between populations of camels on 7 microsatellite loci have been received on population «Usenov N» an average alleles – 6.28, heterozygosity-0.68, inbreeding – 0.0096, feature of the given population that at 2 loci present private alleles, as is distinctive line of the given population. Distinctive feature of population «Syzdybekov N» is presence in 3 loci of private alleles. On the given population average alleles – 6.43, heterozygosity-0.70, inbreeding – 0.0077.

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#### **ДНҚ ТЕХНОЛОГИЯЛАРЫН ҚОЛДАНА ОТЫРЫП, АРЫС-ТҮРКІСТАН ПОПУЛЯЦИЯСЫНДА ӨСІРІЛЕТІН АРУАНА ТҰҚЫМДЫ ТҮЙЕЛЕРГЕ МОЛЕКУЛЯРЛЫ-ГЕНЕТИКАЛЫҚ МОНИТОРИНГ ЖҮРГІЗУ**

**Аннотация.** Мақалада ДНҚ-технологияларын қолдана отырып Арыс-Түркістан популяциясында өсірілетін аруана текті асыл тұқымды түйелерді бірегейлендіру және құжаттандыру қарастырылған. Барлық генетикалық және генеалогиялық зерттеу жергілікті шаруашылықтарда жүргізілді. Түйе малдарының зерттелген тұқымдарында толық айырмашылық табылды. Әрбір тұқымда өздеріне тән аллелдер табылды. Арыс-Түркістан аймағында өсіріліп жатқан (ш/қ «Сыздықбеков А», ш/қ «Үсенов Н») түйелерден асыл тұқымды мал тобын құру үшін, сүт өнімділігі жоғары генотипті малдарды ДНҚ-технологиясын қолдана отырып, 200 бас түйелерді бірегейлендіру және құжаттандыру. Өртүрлі мал тобындағы түйелердің айырмашылығы

«Усенов Н» ш/к малдарда аллельдердің орташа саны - 6,28, гетерозиготалығы - 0,68, туыстығы - 0,096. Бұл мал тобының ерекшелігі 2 локуста өзіне тән аллельдер кездесті. «Сыздықбеков А» ш/ш мал тобының айрықша ерекшелігі 3 локуста өзіне тән аллельдер кездесті. Бұл мал тобының орташа аллельдер саны - 6,43, гетерозиготалығы - 0,70, туыстығы - 0,0077.

**Түйін сөздер:** түйе, ДНК, праймерлер, локус, аллельдер, STR-полиморфизм, генетикалық мониторинг.

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### **МОЛЕКУЛЯРНО-ГЕНЕТИЧЕСКИЙ МОНИТОРИНГ ВЕРБЛЮДОВ ПОРОДЫ АРВАНА АРЫСЬ-ТУРКЕСТАНСКОЙ ПОПУЛЯЦИИ С ИСПОЛЬЗОВАНИЕМ ДНК-ТЕХНОЛОГИИ**

**Аннотация.** В статье рассмотрены вопросы идентификации и паспортизации высокомолочных генотипов верблюдов породы арвана арысь-туркестанской популяции с использованием ДНК-технологии. Проведенный молекулярно-генетический анализ показал, что популяция верблюдов имеет подразделенность по параметру породы. Каждая субпопуляция верблюдов породы арвана имеет отличительный для данной популяции генофонд. Полученные данные могут быть использованы при разработке мероприятий по сохранению их уникальных генофондов, хорошо адаптированных к местным условиям. В Арысь-Туркестанской зоне верблюдоводства (КХ «Сыздықбеков А.», КХ «Усенов Н.») идентифицированы и паспортизированы высокомолочные генотипы верблюдов арвана с использованием ДНК-технологии в количестве 200 голов животных. Межпопуляционные различия между популяциями верблюдов по 7 микросателлитным локусам были получены по популяции «Усенов Н» среднее число аллелей - 6,28, гетерозиготность - 0,68, инбридинг - 0,0096, особенность данной популяции в 2-х локусах присутствие приватных аллелей, что и является отличительной чертой данной популяции. Отличительной особенностью популяции «Сыздықбеков А» является наличие в 3 локусах приватных аллелей. По данной популяции среднее число аллелей - 6,43, гетерозиготность - 0,70, инбридинг - 0,0077.

**Ключевые слова:** верблюды, ДНК, праймеры, локусы, аллели, STR-полиморфизм, генетический мониторинг.

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**ZOOPHILOUS FLIES (Brachycera, Cyclorrhapha)  
OF SOUTH-EAST KAZAKHSTAN**

**Abstract.** Types of the zoophilous flies, having veterinary-medical importance in the conditions of cattle farms, are presented. The brought types of family Muscidae, Calliphoridae, Sarcophagidae, Oestridae, Hippodermatidae are harmful for animals. Seasonal-daily dynamics zoophilous flies differed depending on type of insects, these periods are different region in miscellaneous; the general length of time of the hold up on animal in South-east Kazakhstan forms 160-165 days. On nature of the feeding revealed flies pertain to Saprophytes (licking), Sarcophages (the incitantsmyasis), Haemophages (blood-sucking), but on larval development divided on Sarcophages, Necrophages and Coprophages.

**Keywords:** zoophilous, imago, musca, larvae, flies.

A very large group of Diptera insects, covering about 25 families, 95 genera, more than 257 species, belongs to zoophilic flies. We here consider round-toothed short-bellied zoophilic flies (Cyclorrhapha). In the rooms, pens, summer camps and pastures, a large number of zoophilic flies are milled and attack animals, causing anxiety, reducing their productivity and contributing to the spread of infectious agents, invasive diseases among animals and humans. Most of them are synanthropic and there are a considerable number of field and pasture species. Larvae of some species spoil the feed, as well as finished products of livestock (meat, dairy products, skins, etc.). Studies have shown that flies can carry over 63 species of pathogens of dangerous diseases [1]. The diversity of habitat and nutrition conditions of zoophilic diptera makes them potential carriers of microorganisms, protozoa, and the role of flies as intermediate hosts of helminths is known. Pasture flies are the intermediate economic nematodes *Thelazia gulosa*, *T. skrjabini*, *Parabronemaskrjabini*, *Stephanofilaria stileesi*, *Setariaservi* [2]. Zoophilic flies differ in a complex form of feeding: in some adult forms, phytophagia, hematophagia or saprophagia and non-rophagia, coprophagy predominate, and in larvae in the development cycle only - necrophagia, coprophagy, sarco-phagia. Under what conditions they multiply and inhabit, how environmental conditions affect their mass reproduction, successful struggle depends on this. In this paper new generalized additional results on ecology and biology of dominant species to annotated note of zoophilic flies are presented [3]. The need to study the species diversity of zoophilic flies and their bioecological features is of definite scientific and practical interest in reducing the circulation of flies

**Material and methods of research.** The material was the perennial entomological surveys in livestock farms. For the study of bioecological features of dominant species of flies, collection and visualization of zoophilic flies attacking animals in the conditions of the dairy complex of the state farms “Kaskelensky” Kaskelen, “Ilysky” of the Ili district of the Almaty region, as well as in livestock breeding, was carried out from April to September of the state farms “Kuraksu”, “Mataisky” of the Borlyutobinsky district, the collective farm named after Abay of the Kapal district in the former Taldykorgan region. To study regional features of the ecology, in particular seasonal and daily activity of the most harmful species of zoophilic flies, catching (a 20-minute registration fee) and visual recording of them directly on animals was conducted. The daily rhythm of activity is determined by the hourly calculation of flies attacking animals. Possible flock breeding biotypes have been studied in each insect species for several years, which depend on temperature, air humidity and soil. Places of fruit of flies, biotopes of development of larvae and pupae serve as an object for developing an ecological basis for regulating their numbers. In

visual accounting, the total number of flies on animals was determined by taking into account 5 minutes. To do this, on both sides of the animal, two counters count the number of flies in one minute, recording the data, driving the flies and repeating the reading five times. Adding data from both sides and dividing by 5 produces the average number of flies attacking animals.

**Results.** *Drosophila funebris* Fln. Infrastructure Muscomorpha, superfamily - Drosophiloidea, Family - Drosophilidae. Sinanthropus. They are widespread in all settlements, dairy farms, medical point in Kaskelensky, Ilysky and in the Alakol Nature Reserve in the rounds "Toguztubek, Tuyuksu, Kokpekty, Baibal, Karamoyin" of the Almaty region. Of zoophilic flies, they are small, 3-4 mm. Head rounded, forehead with 3 orbital setae, of which the first is directed forward, and the posterior backward. A coarse, pinnate aster. Abdomen - brown with wide blackish bandages. The view is not rare. Imago is inhabited in warehouses, in latrines, potato storage facilities, in garbage dumps, in manure stores, in dwellings, etc. In the summer, animals attack, sit down in the eyes, mouth, and ears. In warm rooms, where there is an optimal breeding environment, they are found throughout the year. In the dwelling and in the production premises flies with salted wandering ferments, fruits, vegetables are brought in. They feed on the juice of rotting vegetables and fruits or bread sourdoughs. The life expectancy of the adult is up to a week. Females are prolific. From egg to imago - 10 days. Larvae feed mainly bacteria of acetic acid fermentation [4], therefore imago is common in the premises of the corresponding production. Polyvoltine appearance. Contaminated vegetables and fruits, worries animals [5] and people. They are of great importance in the epidemiology of gastrointestinal and other diseases.

It is widely spread, except in the Far North.

*D. melanogaster* Lw. (= *D. Fasciata*). They eat the juice of plants and rotting organic substances, juice of vegetables, fruits, larvae - microorganisms of acetic acid fermentation. Departing from the room, they sit on the animals. Sinanthropus. Polyvoltine appearance. Females lay eggs. Has high fertility. From egg to adult on average 10 days. In the laboratory, they get a good separation. *Drosophila* is widely used for research in genetics. Biology and ecology as in the previous species of fruit flies.

Distributed in the dairy complex of state farms "Kaskelensky" of Kaskelen, "Ilysky" of Ili districts of Almaty region, as well as in cattle-breeding farms of the state farm "Kuraksu" of Borlyutobinsky district, kolkhoz Abay of Kapalsky district in the former Taldykorgan region.

*Fanniacanicularis* L. Small housefly – "small room fly". The Muscidae family are real flies. A species that is of medical-veterinary importance. Flies of medium size are widely distributed everywhere, both in cities and in rural areas, in dwellings and cattle-breeding premises. Sinanthropus. Habitats: in latrines, in landfills, in livestock premises, especially in pigsties and on adjacent territories. Shade-loving, licking type, so in the hot months, the maximum of the flight is noted - in the morning and in the evening. In rooms at night, they usually concentrate at the ceiling, on wires, wall protrusions, stucco decorations, etc. Numerous appearance. Fecundity of females up to 200 eggs [6, 7]. Both eggs and larvae, possessing hydrostatic adaptations, are able to develop in a liquid medium. Larvae develop in feces, semi-liquid pig manure, in the accumulation of chicken manure, in wet garbage, less often in garbage and animal manure. They are of great importance in the spread of gastrointestinal and other diseases [1, 5, 7, 8].

Spread. Cosmopolitan (Europe, North America, Asia). In southeastern Kazakhstan, in all natural areas of the Almaty region.

*Fannialeucosticta* Mg. In all rural areas of southeast Kazakhstan and in all rounds of the Alakol reserve [5]. Habitat of the adult: garden, bazaar, places where there are scum, fresh fruit, human dwelling. Larvae develop in summer type latrines, in garbage dumps and in pig manure. Thermophilic and xerophilic appearance. Place of imago are garbage dumps, pig manure and thick drying feces in rural lavatories. Mass flight - July-September, maximum activity falls on the hottest hours day. In the desert regions - a large species. Harmfulness - mechanical transfer pathogenic microorganisms.

Distribution - the south of Europe, the Caucasus, the South, the Middle Belt of Western Europe, Central Asia, North Africa, Taiwan, Java [5, 6].

*Fanniascalaris* F. Crawling along the body and licking the discharge from the eyes and nose, they disturb and prevent grazing, because of what animals lose weight. Habitat of the adult - dwelling, wood planting, feces, manure, slops, rotting fruits and vegetables; in places of open sale of products. Kind of thermophilic. Attractive places for adults are wandering fluids (kvass, wine). Larvae prefer substrates that are in semi-liquid state (pig litter, semi-liquid garbage cans, toilet feces with deep culling). Numerous

view. It has medical and veterinary importance. The carrier of intestinal infections [1; 8]. Limiting factors include the elimination of conditions that promote the reproduction of flies, as well as the destruction of larvae and pupae in substrates by various insecticides.

Distribution: Europe, North America, Central Asia (boreal Holarctic); rural areas of Almaty region [6, 8].

*Musca domestica* L. The housefly is floppy. They have two subspecies - *Musca domestica* L.; *Musca domesticavicina* Macq. Distributed everywhere in cities, and in rural areas, in dwellings and close to them. Everywhere in the settlements of the Almaty region. The imago is not so closely connected with the premises, being caught not infrequently on animals in noticeable amounts far from populated areas. Kind - most closely associated with the environment of a person. Food is provided by a wide variety of substances of both vegetable and animal origin; to maintain the normal life of flies, it is necessary that their food include carbohydrates and proteins (the latter are required for the development of the ovaries); The necessary nutrients for the life of the fly are drawn from both human food and from the dregs of its economy. A single copulation is enough for the female to lay fertilized eggs all her life. The development of animals occurs in manure of various animals and in decomposing substances, garbage pits, garbage receptacles and in feces, under the litter, under littered forages, green in the cattle feeders, cowshed and food waste, as well as in substrates of animal origin and so on. The larvae are omnivorous. For pupation in the pre-pupal stage, they crawl out to a more surface layer of the substrate or into the ground. The maximum life expectancy of imago is 62 days. The development cycle from egg to adult at a temperature of 25-35 ° C is completed in 14-16 days. [9]. Females during a life postpone up to 600 eggs [1; 6]. Imago has saprophagia. The view is numerous. The maximum number is observed in the hot season; winter in the phase of pupae, and adults hibernate only in a warm room. With the greatest number of harms, attacking animals [10, 11].

The epidemiological significance of flies is very high: pathogenic microbes in their intestines remain viable and come out with feces or eructations, remaining in these

"Fly spots" for some time alive; carry microbes and on the surface of the body, which promotes the abundance of hairs and bristles on their covers. The variety of habitat conditions and nutrition of houseflies make them potential carriers of very many micro-organisms that are clearly pathogenic to humans and domestic animals (causative agents of dysentery, paratyphoid, typhoid, cholera, tuberculosis, diphtheria). The housefly can carry protozoa and eggs of the worms both on the legs and in the intestine [1, 2]. To regulate the number, it is proposed to establish a sanitary order in the biotopes, where the development of larvae is possible.

A universally widespread synanthropic species.

*Musca sobrens* Wd. Bazaar fly. Distribution: all areas of the Almaty region. Mass quantities are found in peasant farms and settlements, in the bazaar and other places of open sale of food. In the premises is rare. The imago is fed with fruits, sweets, dairy and meat products, garbage, etc. Attacks on people and domestic animals (cattle, sheep), in which the secretions of sweat glands, mucous membranes of the eyes, nose and mouth are poured, and also lick blood and purulent discharge. Females lay eggs on pig manure and in garbage dumps. The larvae are coprophagous.

Numerous, synanthropic appearance. According to several authors [1; 6; 8] the species has epidemiological significance in the spreading of the wand of Koch-Wicks - causative agent of epidemic-conjunctivitis.

The species is characterized by temperate, subtropical and tropical belts of the Old World.

*Musca tempestiva* Fall. Dark color, average size of the adult. Imago are common in the forest areas of the foothills of Zailiysky, ZhungarAlatau on litter and on animals. By eco-logical features is that they sit on pets and a person, licking the secretion of mucous membranes, sweat glands or wounds. The female lays eggs on the litter of cattle, pigs, horse manure, as well as dung prepared for drying [10]. Preimaginal stage 9-10 days. Imago-saprophagus, facultative haemato-phage. The larvae are coprophagous. The period of mass flying is limited by the summer months. Disturbs animals and people, has a medical and veterinary importance. Malicious appearance [6; 9; 11]. Biothermal treatment of manure is necessary for regulating the population.

General distribution: Europe, Central Asia. Distribution in the Almaty region: forest, foothills of Zailiysky, Dzhungar Alatau.

*Musca amica* Zim. The imago is found on cattle-breeding farms in the mountainous zone of the Almaty region [10]. Crawling along the body of livestock, they mechanically carry out pathogenic microorganisms and helminth eggs mechanically on their paws and on hairs. The species is an intermediate host of the causative agent of conjunctivokeratitis of cattle - the nematode *Thelaziagulosa* Rail. et Hen. Female calves in the eyes of animals lay eggs that fall into tearful excretions, from there fly eggs swallow, in the body of flies develop larvae, upon reaching the invasive stage advances to its proboscis. When the flies sit in the eyes, the larvae of the calves come out of its proboscis, into the conjunctival sac of cattle, because of which the blindness comes to the cattle [2; 6]. The number of flies in the summer is medium. A view of the desert zone was not found. Reducing the size of the species requires preventive measures aimed at destroying flies in the larval stage.

Distribution - Siberia, Mongolia, North China, Europe, Kazakhstan.

*Musca autumnalis* Degeer. Field Fly. Distributed in the southeast of Kazakhstan. It is one of the most common pasture-type flies widespread in the desert area of the Almaty region. With regard to heat, appearance. Habitat: Imago is common everywhere, especially pastures on a cow and manure. On hot summer days, females attack animals and humans, concentrating on the mucous membranes and wounds of the skin. Larvae develop in cow dung. The duration of development of larvae is 5-6 days. Pupation occurs in the soil. Numerous in pasture and in the field, in the presence of animals found only in the pen, the rooms do not fly. The largest peak in abundance was recorded in July-August [10, 11]. The beginning of flying in the pens is observed at the end of April, the end of the summer is in the middle of October. It has medical and veterinary importance.

Males often live on flowers of plants. Are optional hematophagi. It is an intermediate host of the nematode *Thelaziarhodesi*, which cause conjunctivitis and keratitis of cattle. Inflamed conjunctiva strongly swollen, that eyelids completely cover the eye.

Proposals for regulating the number. Biothermal treatment of manure of large horned cattle [6].

Distribution - Europe, Central Asia.

*Musca larvipara* Ports. Viviparous field fly. Distributed in the southeast of Kazakhstan. In desert areas of the Almaty region, flies are common in pastures; females in large numbers come across cow dung or animals, adding blood to the wounds. They are most active in hot days and hours with intense sunlight. Females are viviparous; give rise at a time to one larva of the stage on the surface of the cow dung. Imagosaprophagy, hematophagous. The flies of zoophilic flies were observed only in the living rooms of a calf from the third decade of April; in late April, was observed from 12 to 16 hours. In early May, a single flight was registered in the calves at a temperature of 12-16 ° C. At a temperature of 18-20 °, the intensity of the flight was 15-20 specimens. for a 20 minute fee [10, 11]. Males rarely fly on animals. They are common in vegetation. Numerous view. A species that is of medical-veterinary importance. Mass attack of females causes anxiety of animals. By merging the secretions of the conjunctiva, these species are themselves invaded by calves and they develop nematodes and then larvae infect healthy animals.

Regulation of numbers - biothermal treatment of cattle manure.

General distribution of the species. Europe, Northern Mongolia, Central Asia, North. Africa [6].

*Musca osiris* Wd. A species that is of medical-veterinary importance. Distribution: desert areas of Almaty region. The beginning of flying in the pens is observed at the end of April, the end of the summer is in the middle of October. Habitat: pastures, animals, slaughterhouse, bazaar. Alakol district, neighboring settlements [10, 11]. Closely related to animals. In the pasture, the field is attacked by a man. Concentrate near the eyes, mouth and in the wounds of animals. Flies are very thermophilic and sun-loving. Females are very annoying cattle. Bleeding appearance, Larvae develop in the cow litter. Numerous view. Harmfulness - a vector of infectious diseases of domestic animals [6].

To regulate the species, biothermal treatment of manure is proposed - the environment of development of larvae [9].

General distribution. Moderate, subtropical and tropical belt of the Old World.

*Musca vitripennis* Mg. They were found in animals in desert areas, as well as in the underground farms of the Alakol Reserve Cardon, the Zhungar National Park. Imago attacked sheep, cattle. Relatively thermophilic appearance. Imago-licking. The larvae are coprophagous. In the summer period there are a significant number [10]. Has epizootological and epidemiological significance. The species has a

medicinal value. Regulation of numbers is achieved by combating the preimaginal phase of species development [6].

Distribution: Middle and southern strip of Europe, North Africa, Northern Iran, Turkmenistan, Kazakhstan.

*Morelia hortorum* Fl. They occur in the foothills and mountain pastures of the Zailiysky Ala-Tau (Assy's lair, the Turgen gorge), in the pastures of the foothill zone of the Enbekshi-Kazakh district in the Almaty region. Ecological peculiarities of the species - flies are common on the leaves of deer trees and on large herbaceous plants with colonies of aphids in wildlife conditions, as well as near dwellings on litters, faeces, garbage pits, etc. In considerable numbers they come across wandering berries, meat, etc. Especially females, both saprophytes, and facultative haematophages met on cattle in pasture. In a considerable number they are found in the restrooms of the rural type. In the gardens and vineyards, flies are found on fruits and berries. Flies matter in the transfer of pathogenic flora to fruits, berries, etc.

The place of development of the preimaginal stage of flies is served by substrates of organic origin (excrement of domestic animals, carrion, kitchen scum, etc.). Discovered in an open pen and in cages of calves [11]. Puparia of this species are destroyed [12] larvae of the perepochoptera - *Trybliographa submontana* (Hymenoptera, Eucoilidae).

Spread. Europe, Mongolia, Siberia to Yakutsk, Kazakhstan. Distributed in the southeast of Kazakhstan.

*Ophyracapensis* Wd. (= *O. anthrax* Mg.). Distributed in the desert regions of the Almaty region. Licking appearance. Crawling on the body disturb the animals. Habitat species: on the leaves of shrubs, on the walls of latrines; in the premises in which meat products are stored. Crawling along the body licking animals. Found in the vicinity of the houses of belly-novodas and huntsmen. On a large part of the range, the species is not rare. Thermophilic appearance. Coprophagous larvae. Larvae from stage II feed on larvae of houseflies, in particular larvae of calorie flies, that is, they pass to predation. They hibernate in the phase pupae in the ground. Economic significance: larvae from stage II reduce the number of larvae of houseflies. Regulating the number requires compliance with sanitary conditions. Limiting factors include the elimination of conditions that promote the reproduction of flies, as well as the destruction of larvae and pupae in substrates by various insecticides.

Distribution: Central Asia, Caucasus, Southern Europe, North Africa.

*Hydrotaea dentipes* F. The common cervix is common in the southeast of Kazakhstan, in the rural areas of the Almaty region. The habitat of a fly is associated with the conditions of the farm, the wildlife and close to housing. In the living quarters do not fly. Licking allocation from the eyes, nose, ears and disturb the animals. According to ecological features of the species, the larvae are predators; developing in clusters of manure and faeces, destroy larvae of houseplants and other flies. Larvae of stages 1 and 2 feed on the general sub-stratum; and the larvae of stage III become predatory, feeding on larvae of various flies, especially room, bazaar flies and autumn flies [6]. The role of the larvae of the common jaw in reducing the number of synanthropic flies is considerable; it is especially noticeable in areas with sandy soil. Economic importance - the fight against them can increase the number of room and bazaar flies.

Distribution: Central Asia, Europe.

*Lyperosia irritans* L. Small cowhide. The species has a medical-veterinary value. Habitat: cattle-breeding buildings and open pens, ectoparasite with a long stay on the host. They do not fly into the dwelling [13, 14]. An active bloodsucker, closely associated with cattle, strongly annoying with his injections of domestic ruminants, contribute to the emergence of dermatitis. Activity is high in the morning and evening hours. The peak of numbers was recorded in July-August in the morning and evening hours [10, 11]. The female lays eggs in fresh litter of cattle. Larvae are developing in cow dung. Out of the laid eggs, larvae leave in 12-18 hours. The development of the entire stage of the larvae takes place 3-4, pupae in 5-7 days. Development from egg to adult lasts 8-10 days. It causes a decrease in milk yield and fatness of livestock [14, 15]. Biothermal treatment of cattle manure is proposed to regulate the number.

Geographical distribution: Europe, North Africa, North America, America, Japan, Central Asia, Kazakhstan. It is widespread on all cattle-breeding farms in Almaty region.

*Lyperosia titillans* Bezzi. Southern cow litter. Habitats are closely related to settlements where there are domestic animals, especially cattle. Pasture appearance. The active bloodsucker; proboscis spiny-

sucking type, attack both pets and humans. The skin contributes to the emergence of dermatitis. Long-term attacks are intrusive in the field on hot sunny days. Imago is the intermediate host of the nematode *Parabronemaskrjabini*. In the room flies rarely. Li-chicks are cathartic. The development of larvae occurs in cow manure, under the litter, under the lying fodder, the greens of the calf and cowshed, in food waste, in substrates of animal origin. The number of fly larvae in the calf feeding troughs was up to 300 specimens. per 100 sq. cm. Development from eggs to adults lasts 8-10 days at a temperature of 24-26 °C [15; 13]. In peasant farms of the desert zone, a massive species. Regulation of the number is connected with the environment where larvae and pupae develop [10; eleven]

Spread. South of Europe, Central Asia, Southern Kazakhstan. Distributed in the desert and foothills of the Almaty region, where large cattle are bred.

*Stomoxys calcitrans* L. Autumn Chopper. Registered in all surveyed livestock farms, where there is a large cattle. The habitats of flies are closely connected with the settlements. It is common everywhere, and it falls into the premises for livestock, and outside them, on the walls of houses illuminated by the sun, on tree trunks or bushes. The room flies regularly, but in small quantities. Are active bloodsuckers; willingly attack cattle; in a smaller number - on other domestic animals; in the living quarters of the arboreal can suck the blood of a person. Skin stabs are painful, strongly disturbing animals. The maximum number is observed in late summer - early autumn. Imago-hematonecrophage, in addition there is phytosaprophagia (silage, haylage, swampy hay). They hibernate on the pupal, imaginal phases. The female lays eggs in groups of 20-25 copies; the total fecundity of the female is 300-400 eggs. The development of larvae occurs under the litter, under littered feed in the feeding troughs, in manure accumulations mixed with straw both in nature and indoors; In pure manure without any admixture of straw or grass, the larvae of the flounder are rarely found [13-15]. The larvae are coprophagous.

The species is harmful, having significance in the fact that both females and males are blood-suckers. They carry viruses, trypanomies among farm animals; they are intermediate intermediate nematodes *Habrone ma microstoma*-parasite of ungulate animals; also - intermediate cestode *Dicrotaenia carioca*-parasite of domestic birds [6]. In order to regulate the size, it is advisable not to allow the accumulation of silage and straw residues, since when rotting, the larvae of the autumn develop [10, 11].

General distribution. The species is widely spread, except for the extreme Northern latitudes.

*Muscina stabulans* Flln. Houseflies. The view in the pens, in the rooms, in the summer camps and in the pasture deprive the animals of their quarters. Flies are common everywhere, both in the city and in nature. Habitats: imago are common in pastures, manure, on decaying substances, fruits, flowing plant sap, etc., also come everywhere near the dwelling-on the walls of latrines, cribs, in places where food is sold openly (fruits and berries). They are common in trees, shrubs and large herbaceous plants affected by aphids; In the spring the fly is found on the flowing birch sap, where it meets *Protophormia terraenovae* R.-D. [6]. Larvae develop in various substances of both plant and animal origin. Houseflies are one of the most versatile species with respect to habitats and the nature of feeding of synanthropic flies. Possessing coprophytosaprophyey, the female lays eggs on the substrate: feces, food, manure, garbage dumps; where larvae develop. In stage III, larvae of other species of flies are eaten. In the garden and vineyards, houseflies often visit fruits and berries. Numerous view. Imago tolerates infections and eggs of helminths. Imago is not only related to animals, but also spoils products of animal and plant origin of epidemiological importance.

General distribution: the species is distributed universally.

*Dasyphora asiatica* Zim. Pest of livestock. Distributed in livestock-raising regions of Almaty region. Habitat: on manure, on the walls of constructions. They enter the room, Sinanthropus. The view is especially common in early summer and late autumn. Screwworm develop, mainly, in cow dung. Development occurs with complete pre-rotation. During the course of their life, females lay eggs several times in substrates containing nutrients for the development of larvae. After the third stage, the larvae crawl over to dry manure, soil and pupate. Number and severity are not defined. By regulating the numbers, the struggle is to bring about a sanitary order in the biotopes of larval development.

Distribution: Europe, Central Asia, Siberia, Transbaikalia, Kamchatka, Japan, China, Mongolia, North America (plains).

*Haematobia stimulans* Meig. Coward calf. It is widespread in sheep breeding and livestock farms. Places of detection of the species: pastures, on leaves of shrubs, in grass, even on trampled paths, etc. A

species having medical and veterinary significance. They attack animals on pasture, active bloodsuckers; for a long time are on animals, causes dermatitis, swelling of the subcutaneous tissue. Female before laying eggs feed on manure liquid and need repeated blood intake. Female laying eggs on the fresh litter of cattle, which feed and released larvae. A plentiful flight is observed in early summer and in autumn (September). Like all gignals that require repeated blood tests, they can tolerate various diseases (Siberian sore, leishmaniasis, thuleremia, typhoid fever, sepsis, etc.) from sick animals to healthy animals [6, 9-11, 13-15]. Regulating the size of the population requires combating the preimaginal stage of development. The limiting factors include the elimination of conditions that promote the emergence of flies and the destruction of larvae and winged insects. It is desirable to keep the territory of the cowshed and cattle-breeding premises clean.

General distribution. The whole of Europe, Northern Mongolia, Siberia, Kazakhstan.

*Calliphoravicina* Rovjneau-Desvoidy (= *C. Erythrocephala* Mg.). Calliforides - Blue meat flies. Superfamily Tachinoidea, Sem. Calliphoridae. In the Almaty region, the Sasykkol lake system is widespread on livestock farms and in the region. Sinanthropus. Imagoes are common in carrion, meat, fish, in markets, in kiosks, in slaughterhouses, near garbage dumps, manure. In living quarters flies relatively rarely. Specifics of the species: flies are large, body-dark, with a metallic cast tinge. Larvae are necrophagous. The species is relatively cold-loving, the activity of adults is observed at + 14 °, in hot sunny weather they concentrate in shady places. The biological range of the wide larvae develops in vertebrate bodies, mammalian excrement or parasites on mammals, birds, amphibians, molluscs, insects and worms. Pupation occurs in the soil. In large numbers are found in the spring-early summer and autumn. Sometimes larvae are recorded in the wounds of animals, where the larvae of *Wohlfahrtia* developed [10, 11]. The species has medical and veterinary significance. Carriers of intestinal infections and eggs of helminths from foci of infection to food and household items (dishes, etc.) [1, 6]. To regulate the size of the control measure, they consist in eliminating the conditions that favor the emergence of flies and in the extermination of larvae and winged adults. In the slaughter stations and in the premises for the processing of animal products, they are not made available for flies.

General distribution. All-round spread; In the temperate and tropical belts of the Old World, Europe, Central Asia, North Asia to Siberia.

*Calliphora uralensis* Vill. Distributed in urban and rural areas of Almaty region, in places of open sale of food products, Sinanthropus. Kind of blue color, with slightly light bloom. Both in cities and in rural areas falls in significant quantities in proximity to housing, animals, and in the wild. Typical on the walls of latrines of a rural type, as well as on shrubby vegetation, close to latrines, garbage pits. Outside the settlements, individuals of this species are very common on all kinds of colors, especially on umbrella, comric flowers (*Cirsium*, *Aretium*), etc. The species prefers warmly sun-heated places, imago feed on feces and all sorts of food. Females lay their eggs on liquid feces and sometimes on the fat of the thick wool of sheep. The larvae develop in it. Numerous view. Lifestyle as in *C. vicina*. Has epidemiological significance. Sometimes an occasional facultative agent of animal miases. Mechanically, dysenteric microbes and parasitic helminth eggs are transferred [6]. Proposals for the regulation of numbers: the sanitary condition of latrines. The extermination of larvae and pupae is carried out by various insecticides, which are introduced into the breeding grounds of flies [10, 11].

The general distribution: the whole of Europe, Siberia, Greenland [16].

*Calliphora vomitoria* L. Distributed in populated areas. The habitats of the fly are recorded: on calves, on carrion, on fruits, rotting vegetables, shrubby vegetation, flowers, animals, etc. Sinanthropus. Larvae are necrophagous. The life style is biologically close to *C. uralensis*. Larvae developed on animal corpses and in manure. Not a rare species, but much less common than the previous two species of Calliphora. Microprobic carriers. A species that is of medical-veterinary importance. Proposals for the regulation of numbers: sanitation in the storage of vegetables and fruits [9, 16].

Distribution - the whole of the CIS, the whole of Europe, North America, Central Asia, Kazakhstan.

*Melinda caerulea* Mg. (= *Protocalliphora caerulea* R-D). Distributed in southeast Kazakhstan. The imago is often found on the coastal part of lakes, lives on decaying fruits, shrub vegetation, flowers, litter, feces, etc. The imago feeds on various substrates of organic origin. Larvae are necrophagous, parasitize on land mollusks, on chicks of passerines [6]. The female lays the larvae in terrestrial mollusks and larvae

develop in it [16]. The female lays the larvae on rotting fruits, vegetables, plants, corpses. Small, but has a medical and veterinary importance.

Distribution - the whole of Europe, North America, Central Asia, Kazakhstan.

*Luciliasericata* Mg. Green meat fly. The body of the imago is metallic green, shiny.

Habitat - flies on corpses, meat of animals; in bulk quantities are found on open food products, in slaughterhouses, as well as in premises where there are meat products, fish products, fruits, sweets. *Sinanthropus*. Imago saprophagous. Thermophilic appearance. On sunny days are very active. It starts from April to November. Usual. Numerous in June and August. In gardens and vineyards they often visit damaged fruits and berries on trees and shrubs. In bad weather the habitat is various structures, trees, bushes, reed vegetation. Larvae are necrophagous. Larvae develop in corpses, animal meat, kitchen waste, less often in mammalian excrement. Adult flies are considerably xerophilous, and eggs and larvae are hydrophilic. The development of larvae occurs both in fresh meat, fresh fish, and in low-salted fish, meat. Larvae - necrophages, facultative sarcophagi. The species mechanically tolerates infection. An optional causative agent of the animal miase [17, 18] in association with larvae of wolfart flies. In addition, it spoils meat and dairy products. It causes damage by putting larvae on meat products. The larvae, feeding on wounds, soften the necrotic tissues, and in connection with this sterile larvae of this species were used in earlier times in hospitals to cleanse and quickly heal people's wounds [6].

Regulation of numbers is achieved by eliminating the conditions that contribute to the fruit of flies and the destruction of larvae and winged insects.

The general distribution: the whole of Europe to the latitude of Leningrad, the Caucasus, Central Asia, Central and Southern Siberia, Primorye. Distributed in all areas of the Almaty region.

*Cynomyamortuorum* L. Distributed in the desert zone of the Almaty region (*Sasykkol*, *Alakol*). Flies live on rotting meat and corpses of animals, feeding on excretions from the eyes, nose, ears, disturb animals. Less common on fruits and feces. Larvae develop in decomposed organic substrates (in the bodies of vertebrates). Average number. *Synanthropus*. The species has an epidemiological significance [6]. Proposals for the regulation of numbers: the elimination of conditions that promote the emergence of flies and the destruction of larvae.

Distribution: Holarctic species. Everywhere. Distributed in Europe, Kazakhstan, Siberia. Known also from Greenland and Alaska.

*Chrysomyaalbiceps* Wd. Calliphoridae family. Distribution in the Almaty region: in all areas of the region the species is numerous. Flies were found on meat, corpses, in the bazaar, slaughterhouses. The larvae are very mobile. Carnivorous larvae feed on other larvae of other species of flies (*Sarcophaga*, *Ravinia*, *Phormia*, *Musca*). Larvae develop in scraps of slaughterhouses, garbage with meat debris, in tropical countries - also in wounds on body of sheep [6]. In tropical countries, a tissue miase of animals is caused, which we have not registered in southeastern Kazakhstan. A species that is of medical-veterinary importance.

Regulation of numbers is achieved by the introduction of a sanitary order. Elimination factors that contribute to the emergence of flies.

The general distribution is the Crimea, Azerbaijan, Georgia; Chelyabinsk, Leningrad Oblast; Central Asia (*Kirghizia*, *TerskeyAlatau*), Far East-Southern Europe, Africa, Asia, Australia.

*Protophormiaterraenovae* R.- D. (= *P. groenlandica* Ztt.). Calliphoridae family. Spring blue fly. Distributed in the forests of the foothills of the Almaty region. In spring they appear very early, on the first sunny days. Appear in the spring in the first sunny days, mainly on sunlit walls and buildings. By the fall of the flies are going to gather in huge numbers on the walls of houses, often climbing into rooms where they can spend the winter in the imaginal phase. Habitats: during the summer maximum, they arrive at places of open food sale, especially in fish and meat rows, on garbage cans. Spring is usually found on birch flowing juice. Imago sometimes occurs in rare amounts in mid-May on umbellate flowers [6]. The female lays the larvae on kitchen scum and on pig manure, mixed with the remains of forage, on the corpses of vertebrates. The development of larvae occurs mainly in kitchen garbage, in dumps, in the form of an exception, larvae can develop in pig manure, when the remains of food are mixed with it. Hibernating in cracks in the cortex, in crevices, etc. Early in spring and autumn are numerous. Contaminated food.

It is widely distributed in the Holarctic: Europe, Siberia, China, Kazakhstan.



*Phormiarestes* Mg. Family Calliphoridae-Calliphoridae. Distributed in the south-east of Kazakhstan. Imago from the early spring appear on animals and on corpses. Imago is found on the bodies of vertebrates, in slaughterhouses, in garbage cans, as well as on leaves of shrubs, on plants, on fruits and vegetables. Larvae cause damage to products of animal and plant origin by microorganisms. Regularly come across the slaughterhouses. Sinanthropus. Imago habitats are located near dwellings and livestock farms. Plenty of places in the world. Larvae develop in corpses, rotting meat and fish and in garbage dumps with decomposing meat waste.

Holarctic view, except for the North. The European part of the CIS, except the north, the Caucasus, Central Asia; middle and southern Europe.

*Ravinia striata* F. (= *R. pernix*). Gray meat flies - Family Sarcophagidae. Color body without metal luster, usually with a light coating in the form of strips; often a paddy, iridescent, checkered. Imago is recorded on the body of sheep, cattle, located in the foothills and mountain pastures of Zailiysky, ZhungarAlatau at an altitude of 2200 -2400 m above sea level. m. Sinanthropic species. Imago also met at the Assy tract, the Turgen gorge in the Enbekshi-Kazakh district. Imago feed on substrates of organic origin. Imago come across plants, everywhere in the bazaars, stalls from April to October. Female viviparous, larvae develop in the body of mollusks and other arthropods. Substrates of organic origin (excrement of domestic animals, carrion, kitchen garbage, etc.) serve as a place for the development of larvae. Relatively large numbers were observed in June. Regulation of numbers is achieved by protecting them from reproduction. The puparia of this flies were infected by *Trybiliographasubmontana* larvae-the rider, which, possibly, regulate the abundance of imago in nature [12].

Palaearctic species: Western Europe, North Africa, Northern India, China, Middle and Near Asia, Siberia except the North, Primorye.

*Wohlfahrtiamagnifica* Schin. The species has a medical-veterinary significance. We are registered in various biotopes of the desert and mountain areas of the Almaty region. The habitats of the imago are pasture, near rivers, watering places, in parking places and on animal corpses. Females refer to obligate parasites that cause miases in sheep, goats, cattle, horses, pigs, dogs, and humans. Flight is observed in the desert zone from the end of April to the middle of October, in the mountainous (belt of the mountain steppe) zone from the second decade of May to the beginning of October, in the forest-and-lag belt from the third decade of May to the middle of September. Imago attacks animals only for reproduction. In the absence of animals, they lay larvae on humans, too, since when the larvae mature, the females are not legible. This is due to the fact that timely not lactated live larvae gnaw the inside of the mother and there is a danger to the life of the female, because of what she tries to postpone the ripe larvae faster. In the experiment for 30 min. females perished from their own larvae, which gnawed at the mother's body. The temperature range of activity of females is 13-30 ° C (optimum 18-30 ° C).

Larvae develop in the wounds of warm-blooded animals, causing diseases, miases, including in humans [19]. The larvae of this fly are affected by sheep on average 57.8% ±5.7; goats -32.7%, cattle - 36.3%, pigs - 21.9%. Imago live on average 25 days. The female lays the larva many times in the wounds of animals. Polyvoltine appearance. Numerous view in the summer. They cause significant damage to animals that have wounds on the body. Proposals for the regulation of numbers: treatment and prophylactic measures for animal wolfarthosis [20].

Distribution: Europe, Asia, America (except the North), Northern Africa [21]. Distributed in all natural and climatic zones of the Almaty region, except for the alpine belt of the mountains. Palaearctic species [22].

*Wohlfahrtia fedtschenkoi* Rohd. It is confined to a desert zone. Found in the former

Borlyutobin district; in the southern Balkhash region (sands Kushikzhal, Lockkum and Zhalkum). Imago inhabits pasture on bushes, a nectarophage. Animals rarely fly to the wounds, but the female lays live larvae for manure and animal corpses. The larvae are copro-necrophagous. The species has a medical and veterinary significance. Occur from the end of May to August, the daily activity is shown by 10 o'clock. Among the animals is a small number.

Spread. Asian species: Turkmenistan, Uzbekistan, Kazakhstan, China (Gansu-deserts North-Western Alashan, Valley Goizzo, North AlashanEjzin-gol).

*Wohlfahrtia indigena* Vill. Distributed in Saryesik-Otrau, Lokkum. Places of habitation: in the desert among shrubs, in burrows of rodents. An intensive flight in the sand Lokkum is marked in June-July.

Ecological features of the species. Females lay living larvae on excrement, on corpses of both vertebrates and invertebrates (beetles, locusts, phalanges). The larvae parasitize in the body of arthropods, mollusks. Larvae live in various rotting animal remains and excrements of vertebrates. The duration of development of the larvae is 5-6 days, the pupal phase in July is 14 days. The species has medical and veterinary significance.

Common distribution: Asian-African species, Middle and Central Asia, northern Africa. In Kazakhstan: in the desert Kyzyl-kum, SaryesikOtrau, Lockmoo.

*WohlfahrtiabellaMacquart*. Gray meat flies. Necrophages. The beginning of the flight of the adult in the mountain steppe was observed from the first decade of June. Mountain view. Habitats - mountain pastures, near rivers, springs. Larvae live in rotting animal remains. Parasitize in the body of insects or other arthropods and mollusks. The female lays the larvae on corpses and meat. Trophy of larvae - copro-necrophagy, but in manure very slowly and few of them reach maturity. The duration of development of the larval phase is up to 7 days, the pupal phase is 18-25 days. Biovoltaic species, two generations have developed in the mountainous zone. The species is many-numbered in the mountainous terrain on animals to the subalpine belt of Zhetysusky and Ili Alatau. Spoils livestock products. The species has medical and veterinary significance.

General distribution. Mountainous landscapes of the Mediterranean (Canary Islands in the west and Egypt in the East), Transcaucasia, Central Asia, China (western Tibet, Gansu and Qing-hai), Mongolia, Iran. Distribution in the Almaty region - mountainous landscapes, foothills and up to the subalpine belt (Kapal, Guards, Sarkand, Kerbulak, Talgar districts) in Zhetysu and IliiskyAlatau.

*WohlfahrtiameigeniSchin*. Habitats: pastures, near rivers, in koshars, in parking lots and watering animals. Female - facultative pathogens miaz warm-blooded animals. Females lay larvae in wounds, mucous membranes and skin integuments of animals. In the desert zone in the summer, the number is large. Inflicts considerable damage to livestock. The larvae feed on the cells of the affected organs [19]. The larvae, who died at the end of August, gave birth in the end of September and in the spring of the following year. A species that is of medical-veterinary importance. Proposals for the regulation of numbers: veterinary and preventive work as in the case of tungstosis in animals.

Distribution: Europe, Asia (except the north), North America, Middle Siberia to the subzone of southern Taiga (south of Tyumen, Omsk, Novosibirsk regions) and south of Yakutia [22]. Palearctic species. Distributed in desert areas of Almaty region.

*WohlfahrtiabalassogloiPortsch*. Found in pastures, in the desert zone (Sa-ry-icikotrau) in cattle-breeding farms "Matai", "Kuraksu". The imago, by the nature of the trophic, refers to the necrophagous. Larvae developed on decomposing organic remains and corpses of animals. Larvae also develop on plant remnants-phytophagous. On the meat, the larvae develop poorly [18]. The species can mechanically spread infections.

General distribution: Eurasian species. Iran, China, the south of Ukraine, Kazakhstan. They occur in the desert regions of the Almaty region (Pribalkhash), west of the Alakol Depression.

*WohlfahrtianubaWied*. They live on pasture, cattle-breeding buildings, bushes. Larvae are polyphagous: necrophagous, coprophagous. Females lay larvae mainly on corpses. In excreta, the larvae develop long [18; 19], only up to 10% reach maturity. Under appropriate conditions, they can be pathogens of the mias. Ordinary in the desert. In Africa (Sudan), there are miases of camels and donkeys [23, 24], but in our region there are no cases of parasitism in animals. Imago arrive on animals for feeding with secretions. A species that has a medical and veterinary significance. An optional pathogen of the animal miase.

Distribution Eurasian-African: North Caucasus, Middle, South Asia (Western Uzbekistan), Arabia (Juddah), West Pakistan, India, the whole of Africa, Kazakhstan. Distributed in Borlitobinsk, Kerbulak areas and in the Balkhash region of Almaty region.

*WohlfahrtiapavlovskiyiRohdendorf*. Distribution in the Almaty region: Samsi, Zhambyl district. Habitat - foothill landscapes, often near rivers. Ecological features of the species have been poorly studied. The species is closest to *W. bella*, differing by its darker overall coloration and other structure of the genital appendages of the male. The lifestyle and bioecological features of adults are poorly understood. In the area of the range in a rare abundance. The closest to *W. bella*, differing in the darker overall coloration and other structure of the genital appendages of the male. Palearctic species. The geographic

and ecological relation is connected with the mountainous landscape of the south-palaeartic with Tien-Shan, Altai, Sayan.

Distribution: Asian species. Khakassia, Mongolia, China, Kazakhstan.

*Parasarcophagacrossipalis* Meq. (= *P. securifera* Vill.). On the pastures of Almaty

The area is widely distributed in animals. Imago is also common on the adjacent territory of Lake. Sasykkola and Alakola. Habitats are associated with animals and sinanthropes. Larvae develop in the bodies of vertebrates. The larvae are coproconecrophages [22; 5]. A species that is of medical-veterinary importance.

Distribution: the south of the European part, the Russian Federation, Ukraine, the Caucasus, Kazakhstan, Middle Asia, Primorye, Mediterranean, North. Africa, Mongolia, north. China, Australia.

*Bellieriamaculata* Mg. Distribution in the Almaty region is the coastal parts of the Sasykkola and Alakola lakes. Habitats. Imago is common in animals, faeces, litter, manure, in places where meat products are sold openly. The species is relatively common on sheep. Larvae of coprobites.

Spread. Europe, Central Asia, Kazakhstan.

*Bellieriacrossimargo* Pandelle. Sem. Sarcophagidae. Distributed in the Almaty region. Habitats. The imago is common in animals, faeces, litter, manure, in places where food is stored. Ecological features of the species. The way of life is the polyvotinic species. Larvae develop in substrates of organic origin.

Distribution: Caucasus, Central, Western Europe, Kazakhstan and Central Asia.

*Bercaeahaemorroidalis* Fll. (= *Coprosarcophagahaemorroidalis*). Imago often live on organic remains, animals, open storage of meat products. Distributed in the former Taldykorgan region - near housing and livestock facilities on the coastal part of the Sasykkola and Alakola lakes. Imago seldom arrive on animals. The species is often found from May to October. The most important Sinanthropus, spread by man all-pervading. Larvae develop in garbage dumps, pig manure, excrement of vertebrates, feces. Development - polyvotinic, copro-necrophagy.

Spread. Caucasus, Av. Asia, Primorye. - Zap. Europe, Africa, India, East Asia, North America. America [22].

*Sarcophagacarnaria* L. Gray butcherfly. The usual widespread species in the Almaty region. The imago often falls on animals and along roads, on feces, litter, manure, in cesspools of rural type, in places of open storage of meat products, on flowers, fruits. Females are viviparous. Larvae develop in rotting meat, animal corpses, in earthworms. Sinanthropus. The number in summer is relatively large.

General distribution: Europe, north. Africa, Front and Central Asia, Mongolia, Yakutia.

*Gasterophilusnasalis* L. (= *veterinus* Clark) - intestinal gadfly. Sem. Gasterophilidae. Imago appear in July. It is established that the laying of eggs by the female occurs on those parts of the horse's skin that it can extract with lips and teeth. Larvae leave the eggs 1-2 weeks later, on the skin they cause itching. The horse combs the itchy places with the lips, while the larvae from the skin enter the oral cavity, causing inflammatory swelling of the pharynx, soft palate, the root of the tongue, and further development develops in the digestive tract. Causes the exhaustion of horses.

Distribution: the all-world.

*Gasterophilushaemorrhoidalis* L. - red-tailed gastric gadfly. Females of the gadfly lay eggs on the hair around the mouth and on the lips of the horses, the larvae emerging from the eggs cause itching, horses combing the itchy places, bring the larvae into the oral cavity that penetrate the mucous membranes of the oral cavity, injure the mucous membranes of the pharynx, soft palate and further in the digestive tract an inflammatory process occurs. Live-lose weight. Impaction of larvae for pupation was observed in April-May and in June adults fly off the gadfly. From the place of fertility, adults can fly for 5-6 km.

All-round spread.

*Oestrusovis* L. - nasopharyngeal gadfly. Family Oestridae. Parasites of sheep. Imago is found in all regions where there are sheep farms. Imago found on the walls of buildings, bushes and trees. Imago when larvae ripen fly from these areas to sheep. Infection of sheep with larvae of the gadfly was recorded from June to the end of September. Female gadflies inject larvae into the nostrils of the sheep's lump of mucus, in which up to 20 larvae are kept. Larvae, developing in the nasal and frontal sinuses, cause the exhaustion of sheep and seizures of the so-called false vertex. Female nasopharyngeal gadfly can

sometimes inject larvae into the eyes, nostrils, the mouth of a person. The adults are discouraged by hexachlorane smoke.

Distribution: middle belt and south of Western Europe, Central Asia, North. America [25].

Rhinoestrus latifrons Gan. Are distributed where there are whole-hoofed stomachs up to the subalpine belt of the mountains, and also found on the coastal part of Lake Sasykkol. Imago gadflies appear in July. The female lays up to 800 larvae throughout life. In warm, arid years, the invasion becomes larger. Rhinoostrosis in horses runs chronically, in the nasal cavities and frontal sinuses is observed in the form of rhinitis and laryngitis with exacerbation in the spring, which is associated with the increased development of larvae of gadflies.

Distribution: south-west Europe, Mongolia, China, India, Africa, Kazakhstan.

Hypodermabovis De Geer - subcutaneous gadfly. Sem. Hypodermatidae. View is found wherever large cattle are bred and the natural source of the imago is preserved every year. On the territory of the dairy-commodity complex and peasant farms, gadflies fly to bushes from the neighborhood, persistently pursuing animals. Imago gadworts do not feed (aphages), live off the stocks of nutrients recruited in the phase of the larvae. From mid-May to June, there was an intense attack of female gadflies on cattle. The female lays 5-20 eggs on the root part of the hair of the legs, abdomen, udder of cattle. After 3-5 days, larvae hatch. Animals scratch and lick skin areas where larvae penetrate. The larvae move to the root of the hair, through the hair follicles along the blood vessels and nerve trunks [9]. The larvae migrate to the host tissue 4-5 months. Migration of the larvae ends in the subcutaneous connective tissue of the back. Through the openings of the skin fall on pupation. Winged individuals come out with the onset of warm days. The appearance of one female causes anxiety, reaching the extreme excitation of cattle (the call).

All-world spread, including the north [25].

Thus, the identified zoophilic flies, depending on the type of biocenological links with animals, have topical and trophic connections in different phases of development. Of these flies, in parallel with saprophagy, necro-saprophagy (nutrition of living organisms, corpses, organic substrates), sarcophagia are larvae of the species of the family Sarcophagidae, Calliphoridae. For a number of species of zoophilic flies, their affiliation to a single type of food is difficult to define, the differentiation of which to a specific type of food is difficult, because they gradually alternate feeding were evolutionarily adapted to different types of food substrates and mixed food is predominant. Parasitic communication covers only a part of the life cycle of flies. The revealed parasites refer to the phase (age) parasites in the imaginal or larval phase of development. Some species of flies attack animals briefly for bloodsucking, others - parasitize in the larval stage for a long time, the third group - bothers animals, crawling along their body and pouring the excretions of the glandular membranes, mechanically transferring the microbes, helminths. Some facultative parasites cause tissue endo-ectoparasitism, these are mainly the larvae of the genera Wohlfahrtia, Oestridae. Lycinogenesis is characteristic of Wohlfahrtia, Oestridae. Larvae, during development, cause severe animal anxiety. The digestive enzymes released by the larvae contribute to the rapid decomposition of the tissue and translate them into a semiliquid state, which is assimilated by the larvae during development. Depending on the place of nutrition in saprophytes, sarcophagi, hematophagus, their attacks and localization on animals differ. Temporarily troubling pets with their bites bloodsucking flies cause indirect damage. They also provide in nature the circulation of pathogenic microbes and protozoa for animals and humans. The duration of the attack of zoophilic flies on animals in southeastern Kazakhstan averages 160-165 days. A large number of zoophilic flies occurs from late May to August, followed by a decline. Daily dynamics depends on the month of the year; in May, daily activity is shown from 12 to 16 hours, in June from 11 to 16 hours, in July and August from 8 to 11 and from 15 to 19 hours, in September from 12 to 16 hours. The greatest activity is manifested in July-August, in August-set to 18 hours with a population of up to 70 copies. for the fee; Activity decreased at the end of September - 2-3 individuals only from 12 to 16 hours. The number of larvae of flies even in the troughs of the calves, cows under the littered forages, zelens reached 100 cm<sup>2</sup> to a thousand specimens. Species from the family Muscidae, Calliphoridae, Sarcophagidae, Oestridae, Hypodermatidae are endogenous for animals. The main struggle is preventive measures aimed at preventing the emergence of flies by meeting sanitary requirements in the possible places of development of the larvae. Proposals for the regulation of numbers for the birth of Fannia, Muscidae-elimination of conditions conducive to the reproduction of adults, as well as destruction in substrates of larvae, pupae and adults with different insecticides; in particular:

observance of zoogeogenic conditions of keeping animals and systematic cleaning. It is much cheaper and easier to prevent the emergence of flies by timely harvesting and biotothermal decontamination of manure, especially in spring, this reduces flies' attacks on animals in the summer. An important role in regulating the number is played by preventive disinfestation of the flora of flies with insecticides. Regulation of numbers is achieved by eliminating conditions that multiply flies, as well as the destruction of larvae and pupae by various insecticides in propagation substrates. The number depends on the destruction of eggs, larvae on the body of animals by insecticides. With vegetable diseases and wolfartosis of animals it is desirable to fight against the developed recommendations. To reduce the number of these temporary parasites is much cheaper if an integrated method of control is used. The data obtained on the ecology of zoophilous flies of livestock farms will provide prerequisites for the prevention of infectious and invasive diseases.

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**ЗООФИЛЬНЫЕ МУХИ (Brachycera, Cyclorrhapha)  
ЮГО-ВОСТОЧНОГО КАЗАХСТАНА**

**Аннотация.** Излагаются виды зоофильных мух, непосредственно связанные с животными, имеющие медико-ветеринарное значение. Приведены результаты исследования многолетних обобщенных данных по особенностям биологии и экологии доминантных видов короткоусых зоофильных мух. Средняя продолжительность периода нападения зоофильных мух на животных в юго-восточном Казахстане составляет 160-165 дней. Появлению первых мух весной предшествует потепление воздуха и почвы выше 14°C. По характеру питания выявленные мухи разделяются на сапрофитов (лижущие), гематофагов (кровососущие), саркофагов (возбудители миазов), а по личиночному развитию относятся к саркофагам, некрофагам и копрофагам.

**Ключевые слова:** мухи, имаго, личинки, зоофильные.

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**ОҢТҮСТІК-ШЫҒЫС ҚАЗАҚСТАНДАҒЫ  
ЗООФИЛЬ ШЫБЫНДАРЫ (BRACHYCERA, CYCLORRHAPHA)**

**Аннотация.** Мал шарушылығында жиі кездесетін шыбындардың мезгіл мен тәулік динамикасы мен олардың өсіп өнетін ерекшеліктері баяндалады. Ірі қара мен қой қораларындағы жиі кездесетін шыбындардың өсу орындары анықталды. Науада, ылғалды жем, көкшөптер астында, қида, өсетін зиянды шыбындардың құрттары жиі кездеседі. Малға зиян келтіретін шыбындар түрі Muscidae, Calliphoridae, Sarcophagidae, Oestridae, Hippodermatidae тұқымдасына жатады. Шыбындар қоректенуіне, өсуіне байланысты сапрофит (жалаушы), саркофаг (құртататын), гематофаг (қансорғыш) және оқыра, кеңсірік құрттары болып бөлінеді. Бірнеше жылдар бойы зерттелгендіктен биологиялық, экологиялық ерекшеліктері келтірілді.

**Түйін сөздер:** шыбындар, құрттар, имаго, зоофильды.

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**CONSERVATION AND RESTORATION OF BIODIVERSITY  
OF FLORA AND FAUNA ON THE TERRITORY  
OF THE TURKESTAN REGION**

**Abstract.** This scientific work takes into account the development of activities in the field of protection and sustainable use of biological diversity, which includes a wide range of measures for the protection of habitats and species in the natural environment, as well as the formation of an integrated system of specially protected natural areas. To create an integrated system of planning activities for the protection of biological diversity, assistance for the conservation and sustainable use of biological diversity.

**Key words:** biological diversity, habitat, conservation, ecosystem, fauna, population, reserve.

The problem of reducing biodiversity is often used to draw attention to environmental problems. It can be closely related to the health of ecosystems (for example, the loss of only one species can be manifested very differently - from the extinction of the species to the complete collapse of the ecosystem itself) and the health of mankind (food derived from natural products and raw materials for the preparation of medicines). Today, as never before, there is a great threat to the existence of species and ecosystems. The disappearance of species caused by human activities continues at a threatening rate, as the present rate of extinction of species is the highest for the last 60 million years, since the disappearance of dinosaurs. According to the forecasts of studies conducted under the auspices of the United Nations, about 25% of the existing mammal species and about 12% of bird species should disappear in the next 30 years. Some scientists believe that due to the destruction several tens of thousands of species of tropical rain forests die out and disappear in the near future. In connection with the above facts, "Convention on Biological Diversity" was adopted in 1992. At the beginning of the twentieth century, the scientific community of Europe compelled governments to pay attention to the problem of preserving at least small areas of fauna. Then in all countries of the world reserves began to be created. In the world practice, there are cases when the creation of reserves on the contrary accelerated the extinction of the species. As the Turanian tiger disappeared from the face of the earth for 34 years after the opening of the Tigrovaya Balka reserve, the leopard in the territory of the Caucasian reserve disappeared for 24 years. In these cases, the animals persisted for some time outside the reserves. The time of existence of an endangered species has reduced the isolation of the reserved space. This same isolation can influence in another way, for example, such a danger as inbreeding. Due to this, the Przewalski horse was killed in the French reserve. However, the other side is also known: if the species is not restricted in the settlement space, the biological species can begin its population even with a dozen individuals. Only five individuals of muskrats brought to Europe gave rise to the population. Grizzly bears lived in the Yellowstone National Park. They have not disappeared, but scientists have noticed that for five generations, bears began to noticeably shrink. It is possible to draw an analogy: island forms of biospecies are always smaller than continental forms. For example, dwarf species of the rhino, buffalo are known on the islands of the Sunda archipelago, while even dwarf species of African fauna on the Mediterranean islands, [1-2].

Aim of the work is "Development of methods for preserving the diversity of natural biosystems of the Turkestan region at a level ensuring their sustainable existence and sustainable use, as well as the conservation of biodiversity of domesticated and cultivated forms of living organisms and human balanced natural and cultural complexes at the level providing for the development of an efficient economy and formation of an optimal environment for sustainable livelihoods".

In the process of biodiversity development there is a mixture of local native flora with planting of introduced species. For example, there are more than 90 imported plant species in Moscow. In general, the flora of cities has hundreds of species: in Kazan - 914, in Poznan - 551, in Birmingham - 547. In Voronezh, there are 780 species of plants. It now becomes apparent that the conservation of biodiversity is possible only if the ecosystem is preserved. Thus, it is necessary to care of maintenance of habitats of animals and the plants, close to natural conditions. This corresponds to the model of the "ecological framework" of urbanized areas, which should be guided in assessing the state of natural components [3]. Natural complexes included in the ecological framework of the urbanized territory should serve as reserves for large colonies of birds and mammal communities. Artificial planting and surrounding area, natural ecosystems should be connected with the core of the framework by "green corridors", this gives the whole system a holistic character and increases its stability. To restore these links - the "green corridors" - it is necessary to change some rules for caring for greenery: not to mow the grass before flowering, not to burn leaf litter, exclude the anxiety factor for animals by night illumination, restore roadside green zones and similar measures. It is necessary to restore local species of vegetation and protect the remaining natural areas that cannot be replaced by artificial plantations, which do not provide shelter and forage resources for settling animals [4]. In large cities in Europe over the past 300 years, the increase in the number of species of flowering plants due to introductions exceeds their level of disappearance [5]. In the process of aviary breeding during repatriation, the pressure by specialized predators is small, and the quantity and availability of feed is much higher. There the average life expectancy of birds and mammals grows, the success of reproduction during the season decreases, but the role of caring for the offspring and its survival increase, thereby the population size increases [6]. The scientific novelty of the project is the complex conduct of ecological monitoring of the current state of biodiversity of the region under investigation in solving problems of conservation and restoration of species of living organisms. The research work of this project is aimed at maintaining the biodiversity of the Turkestan region, preserving the evolutionarily formed natural environment, improving the ecological situation, introducing species whose numbers are being reduced due to their inordinate exploitation, creating a genetic database, preserving in-situ populations of domestic animals and crops, maintaining local populations in the initial conditions of occurrence and formation of rare species, breeds or forms.

Conservation of biodiversity by conserving populations in the case of a minimal viable population (MVP) for a particular species in a specific habitat is the best alternative, with 99% chance of remaining for 1000 years, despite the predicted impact of demographic, natural and accidental genetic disasters. One of the best examples of the definition of MVP refers to the populations of 120 snow sheep (*Ovis montanus*), living in the deserts of the southwest of the United States. Some of these populations were observed for 70 years. The study led to striking results. It turned out that 100% of populations numbering less than 50 animals died out within 50 years, while practically all populations including more than 100 individuals survived for the whole period. To create new populations of animals and plants, a basic approach is used, for example, the reintroduction program provides for the release of captive-born or trapped animals in the area of their historic range where this species no longer occurs. The goal of the program for the reintroduction of gray wolves into the Yellowstone National Park in 1995 was to restore the balance between predators and herbivores that existed in this region before human intervention. In order to use their genetically fixed adaptation to a particular environment, animals are usually released at or near the place where they or their ancestors were caught. And sometimes animals are released in other places within their range. This has to be done when creating a new protected area, if the existing population is facing a new threat and cannot normally exist in its current location, or when there are natural or artificial barriers to the natural spread of the species. The best strategy for long-term protection of biological diversity is to conserve natural communities and populations in the wild, i.e., in situ conservation. If the population is too small to survive the only way to prevent species extinction is to maintain a view under artificial conditions under the supervision of a person. This strategy is called ex situ. There are



already a number of animals extinct in the wild, but preserved in captivity, for example the deer of David (*Elaphurus davidianus*). The beautiful tree of Franklin grows only in nurseries and no longer occurs in wild conditions [7]. In Kazakhstan, with the assistance of the GEF, UNDP, UNEP, the World Bank, the World Wildlife Fund, projects are being implemented to conserve the biodiversity of the Western Tien Shan, wetlands, Siberian cranes, saiga, predators and waterfowl birds, snow leopard, saiga. Projects are being implemented to conserve mountain agrobiodiversity, forests of the Altai-Sayanecoregion. More than 30 NGOs (Non-governmental organizations) are engaged in the reproduction and restoration of biodiversity, environmental education, the development of the foundations of ecotourism. In 2007, the Biodiversity Conservation Fund of Kazakhstan was established within the framework of the United Nations Development Program in Kazakhstan, the Global Environment Facility and the Government of the Republic of Kazakhstan "Integrated conservation of priority globally significant wetlands as habitats for migratory birds: a demonstration in three project areas." At present, UNDP in Kazakhstan is implementing the following major projects: • Conservation and sustainable use of biological diversity in the Kazakhstan part of the Altai-Sayan Ecoregion (2007-2012) The project is being implemented in the East Kazakhstan region • In-situ conservation of mountain agrobiodiversity in Kazakhstan (full-scale project) (2006-2011) The project is being implemented in the Almaty region • Integrated conservation of priority globally significant wetlands as habitats for migratory birds: demonstration at three sites (2003-2010) The project is being implemented in three pilot areas - the eastern part of the Northern Caspian with the estuaries of the Volga and the Ural rivers, the Korgalzhin and Alakol lake systems [8-12].

The Turkestan region is located in the South-Kazakhstan region, which is rich in natural complexes, which have a special ecological, scientific and aesthetic significance. Specially protected natural areas - the reserves of Aksu-Jabagly, Karatau, Sairam-Ugam National Park are the centers of attraction of scientists, ecotourists, cultural figures from all over the world. A special place in this row is occupied by the territory of Turkestan, included by the world community in the list of two hundred regions that are of global significance from the point of view of the richness of biological diversity - as a place of concentration of an exceptional number of species of flora and fauna spread on the globe only at this point. In the conditions of the acutely arid climate of this zone, the problem of species conservation is the determining factor in the way of life, economic activity of the local population, the preservation and prosperity of fauna resources. The basis for maintaining ecological balance and conservation of biological diversity can serve as a developed network of specially protected natural areas [13]. Restoration of the incidence and spatial structure of populations generates their smallest quantitative indexes. In fact, traditional forms of situational conservation, such as the emergence of special onesprotected areas, the improvement of environmental legislation, the strengthening of environmental propaganda, etc., prove to be ineffective. It is necessary to develop and implement large-scale programs for the introduction of various species of living organisms into nature. It now becomes apparent that conservation of biodiversity is possible only if the ecosystem is preserved. At the same time, in the region, care should be taken to maintain the habitats of animals and plants close to natural conditions. This corresponds to the model of the "ecological framework" of urbanized areas, which should be guided when assessing the state of natural components in the area, as well as when constructing artificial plantations.

**Research methods.** Monitoring biodiversity at the regional level is a method of monitoring. At the first stage of research, first of all, taxonomic diversity is revealed, that is, species composition of the main groups of plants and animals, as well as various indicators of diversity, dominance indices, levels of alignment, etc. In the second stage, dominant species are identified, their functional role is revealed, their biomass is estimated, then the number of main species is determined, the role of abiotic factors in population dynamics is determined, and the most important energy flows are determined. One of the real effective ways to preserve the biodiversity of rare species can be breeding under controlled conditions (introduction). Cultivation of rare plants is not only a measure that guarantees their conservation as endangered species, but also an effective way to protect and restore their natural populations. The development of cultivation methods and the introduction of wild decorative and other useful plants into the culture allow to satisfy the need for these species, which will help to prevent the complete destruction of their stocks in the natural environment. In modern ecological research, methods of bioindication and biotesting will be used. The method of bioindication is based on the biological information obtained by studying the species composition of a particular ecosystem. Biotesting is an experimental method, the

essence of which is the rapid and generalized determination of the quality of the environment when it acts on laboratory cultures of test organisms. Biotesting methods are promising for rapid integrated assessment, which is useful in reconnaissance studies and is a good complement to the bioindication method.

The ecological framework should be formed as a closed integrated system capable of self-reinforcement and self-restoration. At the same time, it is necessary to preserve or restore the main types of habitats, provide migration routes and shelters for animals. Garden and park ensembles should be designed as integral ecosystems, with such selection of artificial landings that could ensure its self-maintenance. In such an artificial ecosystem, the module consisting of a phytocenosis, a stable complex invertebrates and ornithocomplex. Insects provide pollination plants, and the necrophils and soil invertebrates utilize the dead plant mass. Birds and some mammals play a key role in the resettlement and restoration of planting, as the seeds of many plants germinate only by visiting the digestive tract of animals. This project is also designed to justify the need to preserve the fauna of the republic as a source of financial resources. It should be emphasized that this is not a direct assessment of biological resources, but a calculation of the cost of environment-forming functions of natural ecosystems by analogy with services in the non-productive sphere of the economy—the so-called "ecosystem services". Omitting the theoretical justification for these calculations, we note that taking into account the "ecosystem services" provided by natural ecosystems can fundamentally change the gap between rich and poor regions, preserve the natural potential in underdeveloped regions, redistribute funds received in industrialized regions to where it is beneficial to preserve intact ecosystems.

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**ТҮРКІСТАН АУМАҒЫНДАҒЫ БИОАЛУАНДЫЛЫҒЫН  
ҚАЙТА ҚАЛПЫНА КЕЛТІРУ МЕН САҚТАУ**

**Аннотация.** Бұл ғылыми жұмыста биоалуандылықты орнықты пайдалануды табиғи ортадағы түрлердің мекені мен оларды қорғау бойынша шаралардың кең көлемін қамтиды және ерекше қорғалатын территориялардың бүтін жүйесін қалыптастырады. Биологиялық алуантүрлілікті қорғау бойынша шараларды жоспарлаудың бүтін жүйесін әзірлеу, сақтау және орнықты пайдалануды қарастырады.

**Түйін сөздер:** биоэралуандылық, тіршілік ортасы, сақтау, экожүйе, фауна, популяция, қорық.

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**СОХРАНЕНИЕ И ВОССТАНОВЛЕНИЕ БИОРАЗНООБРАЗИЯ ФЛОРЫ И ФАУНЫ  
НА ТЕРРИТОРИИ ТУРКЕСТАНСКОГО РЕГИОНА**

**Аннотация.** Данная научная работа учитывает разработку деятельности в области охраны и обеспечения устойчивого использования биологического разнообразия включающего широкий круг мероприятий по охране мест обитания и видов в природной среде, а также формирование целостной системы особо охраняемых природных территорий. Создать целостную систему планирования мероприятий по охране биологического разнообразия, содействие по сохранению и устойчивому использованию биологического разнообразия исследуемого региона.

**Ключевые слова:** биоразнообразие, обитаемая среда, сохранение, экосистема, фауна, популяция, заповедник.

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## NEWS

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### **THE FREQUENCY AND IMPACT OF PREMENSTRUAL SYNDROME ON THE QUALITY OF LIFE OF MEDICAL STUDENTS IN ALMATY**

**Abstract.** Data on the frequency and severity of premenstrual syndrome (PMS) range from 30 to 95%. According to US statistics, 70 to 90% of US women of reproductive age experience some manifestations of PMS; severe forms are registered in 5-8% of women; every third woman has a decrease in her quality of life [1]. According to M. Steiner (2000), PMS is recorded in more than 75% of Canadian women [2], and in Japanese women this percentage reaches 95% with severe symptoms of PMS reported by 1.2% [3].

Some of recent studies have established a significant prevalence of PMS in young girls. N. Nisar (2008) in her study reports that 51% of students were diagnosed with PMS, 5.8% experienced premenstrual dysphoric disorder (PMDD) [4]. According to the study by G. Pinar (2011), the incidence of PMS among students was 72.1% [5].

Many women report that premenstrual symptoms have a significant negative impact on their daily lives, they experience deterioration of various social and individual functions, such as a reduced working capacity, social activity and family relationships, including the sexual sphere.

**Keywords:** premenstrual syndrome, quality of life, frequency and severity of premenstrual syndrome, premenstrual dysphoric disorder.

**Introduction.** "PMS" means premenstrual syndrome or premenstrual tension syndrome; a condition characterized by various cyclical repetitive symptoms (physical, emotional, behavioral and cognitive) that develop in the second phase of the menstrual cycle and disappear soon after the menstruation starts [6]. A number of studies discovered that Premenstrual syndrome develops more often in women engaged in mental case, rather than in patients who have autonomic dystonia syndrome, and 4 times more than in women with body weight deficiency.

The syndrome can appear under the influence of numerous factors summoned by physical or mental overstrain, professional problems, social insecurity, chronic emotional stress [7]. In the process of the influence of Premenstrual syndrome on the quality of life the following results were discovered: absenteeisms increase, labor of productivity decreases, the quality of professional activity descends.

The negative impact on social relations guides to aggravation in interpersonal relationships in workplace. In current research conducted by the students of a medical school at the University of Urmia (Iran) in 2014, Premenstrual syndrome was identified in 39.4% of cases. The estimation of the quality of life was below in more than half of the cases, especially in the psychotic and social components. The results of this study show that Premenstrual syndrome has negatively influence on some quality of domains of life.

**Materials and methods of study.** Within the framework of the research, an anonymous questionnaire survey was conducted among medical students of Almaty with the help of 2 questionnaires at the same time. The questionnaire on the detection of PMS was developed by researchers. The quality of life was assessed using the SF-36 questionnaire (The Short Form-36). SF-36 refers to non-specific questionnaires for assessing the quality of life; it is widely distributed in the US and European countries in conducting scientific researches. It can be used both in healthy and sick people and is the "gold" standard for a study of the quality of life. The questionnaire survey was conducted on a voluntary basis. The data obtained as a result of the questioning of 1,500 students using a specially developed and approved questionnaire was used as the material for the study. The design of the study met the criteria of a one-stage clinical study; the questioning was conducted for 2 months. The generated sampling included 2061 questionnaires, of which 561 questionnaires, which is 27.2%, were filled in incorrectly, many fields were empty, the quality of life items were not filled in correctly.

**The results of the authors' research.** The average age of the respondents was  $24 \pm 4.3$  years. All the students included in the study were residents of the Republic of Kazakhstan. Living conditions were satisfactory for all students. 28.0% were married, and 54.0% of respondents had a sexual life. The structure of contraceptive methods used among sexually active respondents was as follows:  $26.0 \pm 5.2\%$  of combined oral contraceptive pills;  $48.1 \pm 4.3\%$  of condoms;  $10.0 \pm 5.7\%$  of intrauterine devices;  $15.9 \pm 5.6\%$  did not use any contraceptive methods. The lack of contraceptive methods among 15.9% of sexually active girls and low level of the use of effective modern methods of preventing unwanted pregnancies resulted in abortion in 13.0% of the respondents in the study group. Extragenital diseases were registered in the history of 38.8% students in the group with 3.3 different extragenital diseases for each student in the group.

The most frequent symptoms accompanying menstruation in the study group of students were irritability and bad mood in  $58.0 \pm 2.2\%$  and  $59.5 \pm 2.2\%$  of students, respectively. In  $34.5 \pm 2.1\%$  of students irritability turned into aggressiveness. The abdominal bloating ( $41.0 \pm 2.2\%$ ), nausea ( $20.0 \pm 1.8\%$ ) and vomiting ( $11.0 \pm 1.4\%$ ) were reported quite often. One of three students experienced breast engorgement and pain ( $32.5 \pm 2.1\%$  and  $32.0 \pm 2.1\%$ , respectively). The respondents frequently reported headaches ( $30.5 \pm 2.1\%$ ); less frequently they complained of chest pain ( $7.5 \pm 1.2\%$ ) and changes in blood pressure ( $14.5 \pm 1.6\%$ ). Severity of symptoms made 39.5% of students use painkillers to relieve pain. Poor performance, skipping classes during menstruation were reported by 34.5% of students. Despite the severity of symptoms during menstruation, absences from lessons, only 12.4% of students sought medical advice. The results of the study on PMS frequency demonstrated that  $57.4 \pm 1.6\%$  of students did not experience any changes in their health status or had single symptoms, PMS was reported in  $36.0 \pm 2.14\%$  of respondents, and the severest form was registered in  $6.6 \pm 1.11\%$  (Table 1).

Table 1 – The Frequency of Premenstrual Syndrome and Premenstrual Dysphoric Disorder in Respondents of the Study Group

No symptoms or single symptoms of premenstrual syndrome		Premenstrual syndrome		Premenstrual dysphoric disorder	
abs	%	abs	%	abs	%
861	$57.4 \pm 1.6$	540	$36.0 \pm 2.1$	99	$6.6 \pm 1.1$

Our studies showed that the presence of extragenital diseases in students had a significant impact on the frequency of PMS and PMDD. Thus, the frequency of PMS in students with EGD was  $63.9 \pm 3.4\%$ ; this rate was  $18.3 \pm 4.83\%$  ( $P < 0.05$ ) in healthy subjects without EGD (Table 2).

Statistically significant difference was also reported in the frequency of the severest form of PMDD. The EGD group demonstrated the PMDD frequency of  $12.8 \pm 2.3\%$ ; the no-EGD group demonstrated  $2.6 \pm 0.9\%$  ( $P < 0.05$ ). The frequency of PMDD according to the data of different authors may vary between 5.8% and 36.1% due to the fact that they did not take potential presence of extragenital diseases into consideration.

Table 2 – The Frequency of Premenstrual Syndrome and Premenstrual Dysphoric Disorder in Respondents of the Study Group Depending on the EGD

No symptoms or single symptoms of premenstrual syndrome		Premenstrual syndrome		Premenstrual dysphoric disorder	
With EGD	Without EGD	With EGD	Without EGD	With EGD	Without EGD
%	%	%	%	%	%
23.3±1.7	79.1±1.3	63.9±3.4*	18.3±4.8	12.8±2.3*	2.6±0.9

\*-p<0.05 statistically significant difference in the frequency of PMS and PMDD in respondents with EGD vs. the group of respondents without EGD.

Only 210 of 810 sexually active students used modern methods of contraception, which is 25.9%. Comparison of the frequency of various manifestations of PMS in two groups of students showed a significant effect of COCPs on the course of this syndrome. Thus, the group of respondents, who used combined oral contraceptive pills, demonstrated a statistically significant difference in the manifestation of almost all symptoms, except aggressiveness.

Table 3 – The Frequency of Various Symptoms Accompanying the Menstruation Depending on the Contraceptive Method among Respondents of the Study Group

Symptoms	Use contraceptives (COCP) N=210		Do not use contraceptive methods or use other methods (IUD, barrier method) N=600		P
	abs	%	abs	%	
irritability	189	40.3±5.8	279	59.7±3.4	<0.01
tearfulness	72	34.7±5.6	135	65.3±3.3	<0.001
touchiness	87	26.6±5.2	240	73.4±3.1	<0.001
bad mood	129	26.8±5.2	351	73.2±3.1	<0.001
aggressiveness	141	50.5±5.9	138	49.5±3.5	>0.05
numbness in hands	24	28.5±5.3	60	71.5±3.1	<0.001
drowsiness	78	32.5±5.5	162	67.5±3.3	<0.001
obliviousness	27	26.4±5.2	93	73.6±3.1	<0.001
swollen face, eyelids, legs	12	12.9±2.0	81	87.1±2.3	<0.001
breast pain	57	22.0±4.9	201	78±2.9	<0.001
breast engorgement	48	18.1±4.6	216	81.9±2.7	<0.001
abdominal bloating	138	41.8±5.8	192	58.2±3.4	<0.001
headaches	69	28.8±5.4	177	71.2±3.2	<0.001
nausea	51	31.4±5.5	111	68.6±3.2	<0.001
vomit	12	14.2±4.1	72	85.8±2.4	<0.001
BP changes	27	23.0±5.0	90	77.0±2.9	<0.001
chest pain	12	19.0±4.6	51	81.0±2.7	<0.001
heart palpitations	33	29.7±5.4	78	70.3±3.2	<0.001
chills	42	34.1±5.6	81	65.9±3.3	<0.001

The concept of quality of life is an individual capacity for functioning in a society (labor, social activity, family life), and also a complex of physical, emotional, mental and intellectual characteristics of a person. The results of the SF-36 questionnaire are presented in the form of scores by 8 scales formulated in such a way that a higher score indicates a higher level of quality of life. In the case of medical students without PMS, the physical performance (PF-87.4 ± 1.6), role performance subject to the physical state (RP-84.2 ± 2.4), bodily pain (BP-84.0 ± 1.9), role performance subject to the emotional state (RE-84,2 ± 2,6) do not have express deformations and are approximately equally compressed. In the group of women without PMS the average value of the scale of the general state of health is -71.9 ± 1.6; in PMS group it is 64.4 ± 2.0 (p <0.05). Extragenital diseases were more common in respondents with PMS that affected the general health status. The average value of social performance in the group of subjects is 76.3 ± 1.8 (without PMS) and 73.2 ± 1.9 (with PMS). The scale of mental health of medical students is at the level of 67.0 ± 1.6 without PMS and 60.0 ± 1.5 with PMS. Comparative assessment of the MOS SF-36 questionnaire provided the following results: in the group of women with PMS, all 8 scales tend to decrease. A significant decrease in the scale of role performance caused by the physical state (RP -68.9 ± 4.2) was observed.

### Conclusions.

1. The frequency of PMS in medical students in Almaty is 36.0±2.14% with the severest form in 6.6±1.11%.
2. The presence of extragenital diseases increases the frequency of premenstrual syndrome in students by 3 times (18.3±4.8% of 63.9±3.4%), and premenstrual dysphoric disorder – by 5 times (2.6±0.9% of 12.8±2.3%).
3. The use of combined oral contraceptive pills reduces the frequency of all premenstrual symptoms.
4. Premenstrual syndrome has a negative impact on the quality of life of students. All 8 scales of the quality of life tend to decrease in the PMS group.

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### АЛМАТЫ ҚАЛАСЫ МЕДИЦИНАЛЫҚ УНИВЕРСИТЕТТЕРІНІҢ СТУДЕНТТЕРІНДЕ ЕТЕККІРАЛДЫ СИНДРОМЫНЫҢ ЖІЛІГІ ЖӘНЕ ОНЫҢ СТУДЕНТТЕР ӨМІР САПАСЫНА ӘСЕРІ

**Аннотация.** Етеккіралды синдромының жиілігі туралы деректер кең шегінде ауытқиды – 30%-дан бастап 90%-ға дейін жетеді. АҚШ статистикалық деректеріне сәйкес репродуктивті жастағы әйелдердің 70-90 пайызы етеккіралды синдромының көріністерінен зардап шегеді, ал 5-8 пайыз әйелдер бұл сырқаттың

ауыр түріне шалдыққан, ал әр үшінші әйел өмір сапасының төмендегенін айтады. М. Steiner (2000) деректері бойынша Канадада 75 пайыз әйел етеккіралды синдромына шалдыққан, Жапонияда болса 95 пайыз әйелдер бұл аурумен сырқат, соның ішінде 1,2 пайызы ауыр түрімен ауырады.

Бір қатар зерттеулерде етеккіралды синдромының жас қыздар арасында жиі таралғаны туралы көрсетілген. Мысалы В. N. Nisar (2008) деректері бойынша бұл синдром 51 пайыз студенттерде бар, ал 5,8 пайыз студент қыздар етеккіралды дисфориялық бұзылыстарынан зардап шегеді. G. Pinar (2011) зерттеуі бойынша етеккіралды синдромы жиілігі 72,1 пайызды құрайды.

Көптеген әйелдерде етеккіралды синдромы белгілері олардың күнделікті өміріне, әлеуметтік және жеке қызметтерінің бұзылуына, жұмыс істеу қабілетіне, жанұядағы қарым-қатынасына, жыныстық өміріне елеулі теріс әсер етеді.

**Түйін сөздер:** етеккіралды синдромы, өмір сүру сапасы, етеккіралды синдромы жиілігі мен ауырлығы, етеккіралды дисфориялық бұзылыстары.

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### **ЧАСТОТА ПРЕДМЕНСТРУАЛЬНОГО СИНДРОМА И ЕГО ВЛИЯНИЕ НА КАЧЕСТВО ЖИЗНИ СТУДЕНТОК МЕДИЦИНСКИХ УНИВЕРСИТЕТОВ г. АЛМАТЫ**

**Аннотация.** Данные о частоте и тяжести предменструального синдрома (ПМС) колеблются в широких пределах – от 30 до 95%. Согласно статистики США, в стране от 70 до 90% женщин репродуктивного возраста испытывают те или иные проявления ПМС, тяжелые формы зарегистрированы у 5-8% женщин, у каждой третьей отмечается снижение качества жизни [1]. В Канаде, по данным М. Steiner (2000), ПМС фиксируется более чем у 75% женщин [2], а у жительниц Японии этот показатель достигает 95%, тяжелая степень симптомов ПМС выявлена у 1,2% японских женщин [3].

В ряде последних исследований установлена значительная распространенность ПМС у молодых девушек. В исследовании N. Nisar (2008) у 51% студенток был установлен диагноз ПМС, у 5,8% - клиника расценена как предменструальное дисфорическое расстройство (ПМДР)[4]. В исследовании G. Pinar (2011) распространенность ПМС среди студентов составила 72,1 % [5].

У многих женщин предменструальные признаки оказывают существенное отрицательное воздействие на их повседневную жизнь, отмечается нарушение различных социальных и индивидуальных функций - снижение работоспособности, социальной активности и взаимоотношений в семье, включая сексуальную сферу.

**Ключевые слова:** предменструальный синдром, качество жизни, частота и тяжесть предменструального синдрома, предменструальное дисфорическое расстройство.



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**MANAGING THE MEDICAL SERVICES QUALITY  
IN MARKETING ACTIVITIES OF OHI FUND AND  
MEDICAL ORGANIZATIONS IN THE REPUBLIC OF KAZAKHSTAN**

**Abstract.** The present article contains the description of the content analysis of the Republic of Kazakhstan Public Health Ministry issued statutory and regulatory acts on implementation of the quality management system over the period of health care organizations work with the Obligatory Health Insurance Fund since 2018. The issue is relevant because of the need to improve efficiency of the marketing interaction of the Obligatory Health Insurance Fund (OHIF) with medical organizations (MO) in achievement of the goals and objectives set in the Governmental programs for improvement of availability and quality of medical services in new conditions of the health care market players interaction. The objective of this study is to analyze the legislative and statutory acts on health care services quality management and the role of the OHI Fund in interaction with medical organizations. The methods of content-analysis of the Republic of Kazakhstan Public Health Ministry issued legislative and statutory acts, the Law on the Obligatory Health Insurance (OHI) in the Republic of Kazakhstan, orders for procurement of medical services and expert opinion on the primary medical documentation were used. The results of assessment of the expert examination of inpatient medical records revealed the need for revision of many aspects effective in the medical services quality control system adopted in the Republic of Kazakhstan as a part of transfer from quality control to quality management. The conducted expert examination of the legislative and statutory acts and inpatient records allowed us to make a conclusion that the expert activity on the part of the internal audit service, department's head, deputy head of a medical organization is far from being sufficient in the conditions of heightened requirements to the medical services quality. Medical organizations need to use total analysis, i.e. they need to analyze all aspects of medical services quality (structure and process) and not only the final result in the form of the patients' complaints or mortality. This requires involvement by the process owners (doctors, paramedical personnel) in the quality management process in order for them to monitor the process indicators in the course of their professional duties discharge. It is exactly the stages of structure and process analysis where the defect prevention mechanisms are used.

**Key words:** medical services quality management, social marketing, obligatory health insurance fund, expert assessment, defects.

**Urgency of the issue:** the issue is relevant because of the need to improve efficiency of the marketing interaction of the Obligatory Health Insurance Fund (OHIF) with medical organizations (MO) in achievement of the goals and objectives set in the Governmental programs for improvement of availability and quality of medical services in new conditions of the health care market players interaction [1]. It is well-known that starting from 2018 the medical organizations rendering the guaranteed scope of free medical services (GSFMS) shall transfer to a new more rigid format of work, i.e. conclusion of agreements with OHIF for GSFMS services and observance of the GSFMS requirements to the health care services quality. In accordance with the legislative and statutory framework adopted over the period of 2015 through 2017, OHIF was determined as the sole operator and the buyer of medical services since

2018 [2-3]. In our opinion, efficiency of achievement of the set tasks and objectives is possible subject only to implementation of the social marketing methods and tools in the MO activity including the MOs such as cancer detection centre, cardiologic centers, outpatient hospitals, etc. [2-3]. According to F. Kotler's definition, social marketing is a social process aimed at satisfaction of desires and needs of individuals and legal entities by means of free competitive exchange of services and goods of certain value for consumers [4-5]. Implementation of new public health care system - obligatory social health insurance system, will be completed in 2020.

**Objective:** Analysis of the legislative and statutory acts (over the period of 2015-2017) and OSHIF requirements to medical services quality and development of recommendations on transfer from medical services quality control to quality management at the level of medical organizations.

**Research Methods.** Content-analysis of the legislative-and-statutory documentation (LSD) on implementation of the OSHIS in the Republic of Kazakhstan; analysis of the OHI Fund's requirements at the stages of the MOs activity quality control; analysis of the medical services procurement agreement's provisions; analysis of the LSD in the system of the governmental control of medical services quality; analysis of the MO Accreditation Guidance's; analysis of the standard organizational procedures for medical services quality management. We also used the method of expert estimate of the inpatient records from several medical organizations and analyzed the treatment guidelines (CHD and breast cancer) in accordance with the quality control check-lists of the OSHI Fund.

**Results and Discussion.** The conducted content analysis of the LSD on contractual obligations observance revealed that requirements to medical organizations (MO) will be heightened starting from the new year. Firstly, the competitive environment will be strengthened in the medical services market since more than 1500 providers are registered in the register of medical organizations under the OHIF, among which more than 45% are private medical organizations. Secondly, new Medical Services Procurement Rules and the Rules of selection of the guaranteed scope of free medical services provider and reimbursement of the provider's costs have been approved [6-7]. OHIF shall conduct monitoring of fulfillment by the medical organizations of the corresponding contractual obligations both in terms of quality and scope of medical services rendered to the consumers; it shall also process the complaints and applications filed by the citizens and medical organizations on the issue of medical services rendering and the OHIF shall also conduct monitoring of the services procurement contract conditions by means of field inspections of medical organizations.

The first stage of quality control will be carried out by the Fund based on the relevant standard compliance indicators (for example: accreditation). The control will be carried out on a monthly basis prior to payment. The second stage of the control will be carried out after conclusion of the contract and shall include a number of criteria, examination of the scope, quality of treatment cases, examination of pharmaceuticals prescription, examination and monitoring of the end results of a medical organization's activity. Quality assessment parameters using the OHIF's scheme shall include: patient safety assurance, clinical efficiency, economic efficiency and achievement of the target values. Based on the results of inspections, the OHIF will be forming a database of medical organizations with positive and negative ratings that will influence contracts conclusion for the next year.

Expert part of control is aimed at control against the check-lists to the Rendered Medical Services Quality and Scope Monitoring Results Report (the criteria of outpatient care are specified).

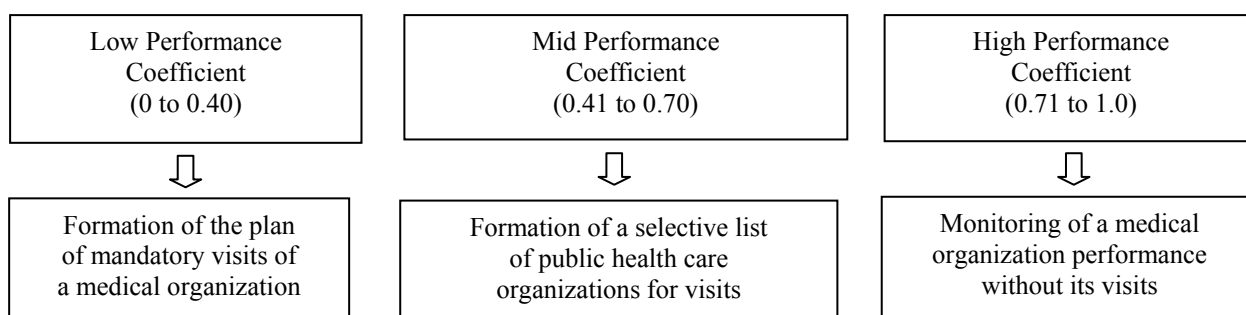
- 1) History taking quality assessment results (5 criteria);
- 2) Clinical diagnosis correctness and accuracy assessment results (7 criteria);
- 3) Detected iatrogenies and the results of iatrogenies assessment (6 criteria);
- 4) Diagnostics quality assessment results (6 criteria);
- 5) Professional specialists' advice timeliness and quality assessment results (6 criteria);
- 6) Dispensary care activities quality assessment results (10 criteria);
- 7) Results of assessment of quality of preventive activities for children of the age up to 5 years (10 criteria);
- 8) Results of assessment of quality of preventive activities for pregnant women (8 criteria);
- 9) Health care activity quality assessment results;
- 10) Treatment and preventive activities achieved results assessment results (6 criteria);
- 11) Treatment outcome assessment results (5 criteria);

12) Medical documentation keeping quality results (10 criteria);

13) Results of assessment of medical card data input into automated information system (AIS) correctness (6 criteria).

This control will be used to detect the defects in the diagnostic and treatment process. Given below are the deduction percentages applicable to confirmed detection of defects. In addition to the quality control, defects in the rendered medical services will be determined and subdivided into three groups with detailed description of detected defects (excess of the established clinical and diagnostic services (KDU) timeout, patients' complaints, ungrounded deviations of treatment and diagnostic activities from the standards from public health care activity; failure to observe the preventive medical examination standards, immunologic prophylaxis, events of non-provision or occasional provision of pharmaceuticals and healthcare products (HCP) for free provision of population within the framework of GSFMS at the outpatient level with certain diseases; ungrounded referral for hospitalization with deduction percentage of 0.10% to 0.50% depending on the defect code. The most severe defects are the detected defects with the following codes: 3.1-3.4. The events of ungrounded rendering (appreciation, increase, deviation) of medical services in the form of consulting and diagnostic aid shall be subject to deduction of 50% to 100% of the total cost of services.

In assessment of the risks related to activity carried out by the medical organizations (suppliers), the OHIF will subdivide the medical organizations into groups based on the risk zones and will prepare plans of mandatory visits of medical organizations. Given below is the scheme:



Expert analysis of the primary medical documentation of the Almaty health care stationary organizations: totally, 30 inpatient records were examined in the course of expert examination and retrospective analysis was conducted for the period of 2016-2017. We used the criteria of the check-lists annexed to the Expert Examination Report:

- 1) History taking quality assessment results (5 criteria);
- 2) Clinical diagnosis correctness and accuracy assessment results (7 criteria);
- 3) Diagnostics quality assessment results (6 criteria);
- 4) Professional specialists' advice timeliness and quality assessment results (6 criteria).

**The Results of Expert Examination and Treatment Defects Detection:**

1. The inpatient record cards examination revealed that the handwriting of physicians was illegible especially on the treatment sheets (80% of the inpatient record cards).

2. There were many defects on the treatment sheets, namely: weight and height of patients was not specified, there were no dosage calculation data for the prescribed superpotent drugs; dates and time of injections and intravenous interventions were not specified (90% of inpatient record cards).

3. Observation sheet defects: negligent keeping; diagnosis is specified in an abbreviated form in violation of the diagnosis wording requirements (80% of all cards).

4. Informed consent of a patient - in abbreviated form (50%).

5. Upon primary documentation drawing-up - inpatient record card, information on the patient's complaints was incomplete and of improper quality, life and disease history data collection is improper, daily patient examination log data and almost all inpatient record card data is the computer template text (90% of cards).

6. The final diagnosis: almost in all cards (80% of the inpatient record cards) wording does not meet the requirements of МКБ-10. The final diagnosis establishing time violation (65% inpatient record cards).

7. Patient admission diagnosis, diagnosis after examination by attending physician, diagnosis after examination by the head of the corresponding department is established with violation of the requirements of ICD-10 requirements, and the wording of such diagnoses to 70% is of a template form and is challenged.

8. Violations were also found in the treatment protocol as regards the time of a patient staying in a hospital - up to 35% of cases.

9. It was noted that in many inpatient record cards the routine patient examination and questioning wording is of a template form and the same is true is for collection of life and disease history data collection.

#### **Conclusion:**

1. Due to the increasingly greater role of medical aid quality control by the OHIF, the Committee for Medical and Pharmaceutical Activity Control under the RK Public Health Ministry establishes new requirements to the medical organizations. It is necessary to reorganize the internal audit service and to subdivide its functions into clinical audit an organizational issues audit. In our opinion, clinical audit applies directly to the process owners (doctors and paramedical personnel) and heads of departments, while organizational issues audit is the responsibility of the head and deputy head.

2. Taking into account the results of the analysis of observance of the OHIF's requirements and those of medical services procurement contracts conducted by us, we can say that only the end result control carried out at the current moment everywhere at the level of medical organizations by the internal audit service will be insufficient since it is focused on the end result (patients' complaints, etc.), i.e. quality analysis at the medical organization level misses out the most important stages of treatment and diagnostic process and the structure and the very process are not analyzed. The analysis of scientific data that we have conducted allows us to make a conclusion that it is exactly the stages of structure and process analysis where the defect prevention mechanisms are used. The clinical audit shall be carried out in accordance with the A. Donabedian triad (structure, process and result analysis).

3. Only the internal audit service employees are involved in the quality examination process and not the process owners (doctors, paramedic personnel). Therefore, it is necessary to develop common approaches and algorithms of transfer from the clinical processes (complaints, mortality) end results control and medical services quality control with development of process analysis indicators, process initial indicators and intermediary process indicators that shall be determined for prevention of treatment and diagnostic process defects. Only involvement by the process owners in the clinical audit process can help to reduce the number of defects and thus to preserve the volume of a medical organization financing and to avoid penal sanctions on the part of the OHIF.

#### **Practical Recommendations:**

1. Contract fulfillment monitoring shall be carried out on a permanent basis in a medical organization using the first and second stage quality control indicators as the basis upon conclusion of a contract and indicators of defects in the rendered medical services;

2. Internal audit service operation shall be revised to abandon the end result based control concept and to transfer to development of the process cards preventing and adjusting activities at the level of treatment and diagnostic processes, i.e. monthly analysis and monitoring shall be carried out on a monthly basis for the indicators specified in the Reports on the Results of Quality and Scope Monitoring against the Check-Lists;

3. Training and seminars on expert examination indicators, defects, and development of preventive and corrective actions shall be arranged for doctors and paramedic personnel;

4. Timely identification of defects in treatment and diagnostic process shall be ensured and prevention documents system shall be developed;

5. It is necessary to transfer from quality control to quality management based on integrated assessment of medical services quality by the A. Donabedian's scheme and to analyze the processes based on the three components (structure, process and result) in daily activity of doctors;

6. Seminars and training shall be carried out on keeping the medical documentation, correct diagnosis establishing in accordance with ICD-10 requirements.

7. The status of the treatment and diagnostic processes owner shall be granted to the doctors in the process management and analysis and work on treatment protocols standardization shall be commenced. For the purpose of the Protocols adaptation, it is necessary to develop the process cards based on the treatment protocols not violating the protocols' requirements approved by the Republic of Kazakhstan Ministry of Public Health since medical services quality improvement is possible only through standardization of medical services rendering processes.

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#### ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ МЕДИЦИНАЛЫҚ ҚОРИ МЕДИЦИНАЛЫҚ ҰЙЫМДАРЫНЫҢ МАРКЕТИНГІ ҚЫЗМЕТІНДЕГІ МЕДИЦИНАЛЫҚ ҚЫЗМЕТТЕРДІ САПАСЫН БАСҚАРУ

**Аннотация.** Мақалада заңнамалық және нормативтік мазмұны талдау 2018 жылы міндетті әлеуметтік медициналық сақтандыру жүйесінің іргетасы медициналық ұйымдардың кезеңінде сапаны басқарудың жүзеге асыру үшін Қазақстан Республикасы Денсаулық сақтау министрлігі әрекет етеді. Медициналық қызметтер нарығына қатысушылардың өзара іс-қимыл, жаңа жағдайында медициналық қызметтердің қол жетімділігі мен сапасын арттыру үшін мемлекеттік бағдарламасы мақсаттары мен міндеттеріне қол жеткізу міндетті медициналық сақтандыруға және әлеуметтік денсаулық сақтау ұйымдарының маркетингтік өзара іс-қимыл қорының тиімділігін арттыру қажеттілігіне байланысты проблемалар өзектілігі. Зерттеудің мақсаты медициналық қызмет сапасын басқару бойынша заңнамалық және нормативтік актілерді талдау және Медициналық сақтандыру қорының медициналық ұйымдармен өзара әрекеттесудегі ролі болып табылады. Заңнамалық және нормативтік актілерді талдау әдістемесі, медициналық құжаттардың сараптамалық бағасы пайдаланылды. ауруханаға науқастарды медициналық жазбаларды сараптама нәтижелері сапасын басқару үшін бақылау қозғалатын медициналық ұйымдарда медициналық қызметтердің сапасын бақылау Қазақстан жүйесінде жұмыс істейтін көптеген аспектілерін қайта қарау қажеттігін көрсетті. Медициналық қызметтің сапасына қойылатын талаптарды арттырудың жаңа жағдайларында медициналық ұйымның ішкі аудит қызметі сапаны басқару үшін жеткіліксіз. Медициналық ұйымдар толық талдау жасауға көшу керек, яғни. Сіз науқастардың шағымдары түрінде, немесе өлімі денсаулық сақтау қызметтеріне (құрылымы және технологиялық) сапасы ғана емес, түпкі нәтижеге барлық аспектілерін талдау қажет. Ол үшін кәсіптік міндеттерді орындаған кезде процесстің көрсеткіштерін қадағалау үшін процесстің иелерін (дәрігерлерді, медбикелерді) сапа менеджментіне тарту қажет. Медициналық қызметтегі ақаулардың алдын-алу механизмдері құрылымы мен процесін талдау сатысында тұр.

**Түйін сөздер:** медициналық қызмет сапасын басқару, әлеуметтік маркетинг, міндетті медициналық сақтандыру, сараптамалық бағалау, кемшіліктер.

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#### УПРАВЛЕНИЕ КАЧЕСТВОМ МЕДИЦИНСКИХ УСЛУГ В МАРКЕТИНГОВОЙ ДЕЯТЕЛЬНОСТИ ФОНДА ОМС И МЕДИЦИНСКИХ ОРГАНИЗАЦИЙ В РЕСПУБЛИКЕ КАЗАХСТАН

**Аннотация.** В статье проведен контент анализ законодательно-нормативных актов МЗРК по внедрению системы управления качеством в период работы медицинских организаций с Фондом обязательного социального медицинского страхования с 2018 года. Актуальность проблемы обусловлена необходимостью повышения эффективности маркетингового взаимодействия Фонда обязательного социального страхования (ФОМС) и медицинских организаций (МО) в достижении поставленных в Государственных программах целей и задач по повышению доступности и качества медицинских услуг в новых условиях взаимодействия участников рынка медицинских услуг. Цель исследования – анализ законодательно-нормативных актов по управлению качеством медицинских услуг и роли Фонда ОМС при взаимодействии с медицинскими организациями. Используются методы контент анализа законодательно-нормативных актов МЗ РК, Закона об ОСМС в РК, Приказы по закупу медицинских услуг, экспертная оценка первичной медицинской документации. Результаты исследования экспертной оценки медицинских карт стационарных больных показали необходимость пересмотра многих аспектов действующей в РК системы контроля качества медицинских услуг в медицинских организациях в плане перехода от контроля к управлению качеством. Проведенная нами экспертная оценка НПА и карт стационарного больного позволяет сделать заключение, что экспертная деятельность только со стороны Службы внутреннего аудита, заведующего отделением, заместителя руководителя медицинской организации в новых условиях повышения требований в качестве медицинских услуг крайне недостаточно. Медицинским организациям необходимо перейти к тотальному анализу, т.е. нужно анализировать все аспекты качества медицинских услуг (структуру и процесс), а не только конечный результат в виде жалоб пациентов или же летальности. Для этого необходимо вовлечь в управление качеством владельцев процесса (врачей, средний медицинский персонал), чтобы они при выполнении профессиональных обязанностей осуществляли мониторинг индикаторов процесса. Именно на этапах анализа структуры и процесса заложены механизмы предупреждения дефектов лечебной деятельности.

**Ключевые слова:** управление качеством медицинских услуг, социальный маркетинг, фонд обязательного социального медицинского страхования, экспертная оценка, дефекты.

## NEWS

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E-mail: aiman84@mail.ru, public\_health\_kz@mail.ru**ASSESSMENT OF THE QUALITY AND SOCIAL EFFICIENCY  
OF HOSPITAL REPLACING MEDICAL CARE (HRC)  
IN KAZAKHSTAN**

**Abstract.** This work provides and shows the patients' satisfaction level with the quality of hospital-replacement medical care and the components of the quality factor of hospital-replacement medical care influencing on the level satisfaction.

**Key words:** hospital-replacing medical care (HRC), day hospital (DH), hospitalization replacement technologies (HRT), social efficiency, medical care.

**Introduction.** Hospital-replacement technologies provide efficient use of hospital beds, the reduction of the level of unnecessary hospitalization, and besides, they help save the resources [1-4].

Since the establishment of market relations in healthcare, the issue of the quality of medical care is becoming increasingly relevant. Any medical service can find its market segment only if it is carried out at a quite high level [5-8].

One of the objectives is to assess social efficiency of delivered hospital-replacing medical care according to patients.

It was necessary to determine which factors have the greatest influence on it.

**Materials and methods of investigation.** A cross-sectional, full-design study was performed in day hospitals (DH) in Almaty. Total number of respondents, who participated in questionnaire - 1670.

According to the stated goals and tasks we carried out the sampling of medical organizations according to the criteria of inclusion and exclusion from the study.

Inclusion criteria – day hospital patients, receiving outpatient aftercare.

**Estimation process.** Information about the data sources estimation methods computational tools and statistical analysis used in derivation of our estimates are provided in our other publications.

**The results of research and discussion.** Analysis of hospital-replacing medical care availability and satisfaction with result of utilization and delivered care in day hospital ( $p < 0.0001$ ) shows that  $92.8 \pm 1.2\%$  patients consider medical care to be available,  $53.3 \pm 1.2\%$  of them expressed satisfaction and  $39.5 \pm 1.2\%$  - dissatisfaction with results of rendered medical care.

Linear model of patients' satisfaction with the quality explains the statistical significance of coefficients of determination: 22% of the variation - satisfaction with results of medical care in day hospital and 21.2% of the variation - satisfaction with results of service in the clinic by place of residence ( $R^2 = 0.0212$ ), are statistically significant.

Patients' satisfaction with hospital-replacing medical care quality is related to expenses for medicines during day hospital treatment.

Waiting time of planned hospitalization in day hospital ( $R^2 = 0.030$ ) had no significant effect on patient satisfaction.

## Linear regression analysis

Predictors (X) (M, SD)	<i>b</i> =	<i>a</i> =	<i>R</i> <sup>2</sup> =	<i>F</i> <sub>obs</sub> =	<i>R</i> <sup>2</sup> , %	95%CI
Expenditures for medicine during the treatment in day hospital <b>M=1.46 SD=0.49</b>	0.75	0.47	0.220	85.160	22.0	1.44-1.49
Satisfaction with the organization of medical care in a polyclinic <b>M=1.87 SD=1.06</b>	1.03	0.21	0.212	78.199	21.2	1.82-1.92
Satisfaction with the quality of the medical care in the polyclinic <b>M=2.28 SD=0.70</b>	0.80	0.28	0.154	40.707	15.4	2.25-2.32
Satisfaction with the level of availability of laboratory studies <b>M=1.90 SD=0.88</b>	1.02	0.22	0.152	39.225	15.2	1.86-1.94
Satisfaction with the skill level of employees <b>M=2.35 SD=0.79</b>	0.90	0.23	0.130	28.740	13.0	2.32-2.39
The reasons for not going to a polyclinic <b>M=4.01 SD=1.48</b>	1.90	-0.12	0.121	24.883	12.1	3.94-4.08
Satisfaction with conditions in the day Hospital <b>M=2.27 SD=0.58</b>	0.77	0.29	0.118	23.665	11.8	2.24-2.30

However, conditions of stay in day hospital was correlated with patients' satisfaction ( $p < 0.0001$ ). Refusal of necessary examinations and treatment was statistically significantly greater than availability of diagnostic rooms.

And availability of diagnostic rooms is interconnected with patients' satisfaction with hospital-replacing medical care quality ( $p < 0.0001$ ).

Improvement of hospital-replacing medical care quality in polyclinic had a significant influence on respondents' satisfaction with hospital-replacing medical care quality ( $p < 0.0001$ ).

Other factors were less important on their regularity: self-assessment of health ( $F_{kp} = 2.98$ ); planned hospitalization waiting time ( $F_{kp} = 1.49$ ).

Respondents' satisfaction with hospital-replacing medical care quality is mostly connected with the performance of the treatment itself, and is less connected with satisfaction with constituent factors of the process of treatment.

Respondents' opinion on the quality of hospital-replacing medical care is not shifted under the influence of socio-demographic factors.

**Conclusions.** The expediency of conducting regular monitoring of the evaluation of patient satisfaction with hospital-replacing care was demonstrated. Its results allowed to evaluate the quality of medical care in day hospitals.

Continuous monitoring of the day hospitals' performance and system of the analysis of effectiveness of using hospital-replacing technologies create a breeding ground for the growth of competitiveness of the healthcare organizations rendering hospital-replacing care.

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The authors had full access to all data in the study and had final responsibility to submit for publication.

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#### **ҚАЗАҚСТАНДАҒЫ СТАЦИОНАРДЫ АЛМАСТЫРАТЫН МЕДИЦИНАЛЫҚ КӨМЕКТИҢ САПАСЫН ЖӘНЕ ӘЛЕУМЕТТІК ТИІМДІЛІГІН БАҒАЛАУ**

**Аннотация.** Мақалада стационарды алмастыратын медициналық көмек көрсетудің сапасына пациенттердің қанағаттануларына бағалау жүргізілді және қанағаттануларына әсер ететін аурухана алмастыратын медициналық көмек көрсетудің сапасын құраушы факторлары анықталды.

**Түйін сөздер:** стационарды алмастыратын медициналық көмек, күндізгі стационар, стационарды алмастыратын технологиялар, әлеуметтік тиімділік, медициналық көмек.

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#### **ОЦЕНКА КАЧЕСТВА И СОЦИАЛЬНОЙ ЭФФЕКТИВНОСТИ СТАЦИОНАРОЗАМЕЩАЮЩЕЙ МЕДИЦИНСКОЙ ПОМОЩИ (СЗП) В КАЗАХСТАНЕ**

**Аннотация.** В работе проведена оценка удовлетворенности пациентов качеством стационарозамещающей медицинской помощи и установлены составляющие факторы качества стационарозамещающей медицинской помощи, влияющие на удовлетворенность ею.

**Ключевые слова:** стационарозамещающая медицинская помощь (СЗП), дневной стационар, стационарозамещающие технологии (СЗТ), социальная эффективность, медицинская помощь.

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**ANALYSIS OF THE RESULTS OF SOCIOLOGICAL SURVEY  
OF THE PATIENTS OF DAY PATIENT DEPARTMENTS  
OF MEDICAL ORGANIZATIONS IN ALMATY (KAZAKHSTAN)**

**Abstract.** This work provides and shows the dynamics of development of hospital-replacing forms of medical care and makes estimations in accordance with the methods, generally accepted in medical statistics.

**Key words:** hospital-replacing medical care (HRC), day hospital (DH), hospitalization replacement technologies.

**Introduction.** Modern requirements to the implementation of national health programs require the application of resource-saving technologies new to national health care system, that allow to reduce the expenditures for unreasonable hospitalization, to rationally use costly bed space in hospitals and improve patients' quality of life [1-5].

To explore key organizational, financial and clinical issues of the delivery of hospital-replacing medical care (HRC) to population at the level of outpatient sector and to determine the main directions of their solution, complex social-hygienic research was performed [6-12].

Aims of investigation: evaluation of development of HRT in Almaty, Kazakhstan.

The object of investigation - day hospitals.

**Materials and methods of investigation.** A cross-sectional, full-design study was performed in day hospital (DH) of 3 outpatient institutions (OI) of Almaty in patients above 18.

Outpatient institutions with day patient departments with maximum number of DH beds were selected as subject to density of the assigned population.

Total number of respondents, selected randomly, who participated in questionnaire - 1670.

According to the stated goals and tasks we carried out the sampling of medical organizations according to the criteria of inclusion and exclusion from the study.

Inclusion criteria - patients undergoing DH treatment, recently discharged from DH, receiving outpatient aftercare.

**The results of research and discussion.** Study of respondents' choice of the most convenient forms of medical care showed that 65.9±1.2 (Figure 1), of respondents treated in day hospital under outpatient institutions preferred treatment in day hospital, 56% of them are working-age population aged «18-59».

Results of analysis of respondents' satisfaction with hospital-replacing medical care quality showed that out of 56.9±1.2% (Figure 2) satisfied respondents 51.5±1.2% noted improved quality of care, while out of 43.1±1.2% «not fully» satisfied respondents 29.9±1.1% also noted the improvement in quality of medical care, but 19.8±1.2% respondents expected date of planned hospitalization in day hospital over a month (1-6 month) ( $p<0.0001$ ) (Figure 3).

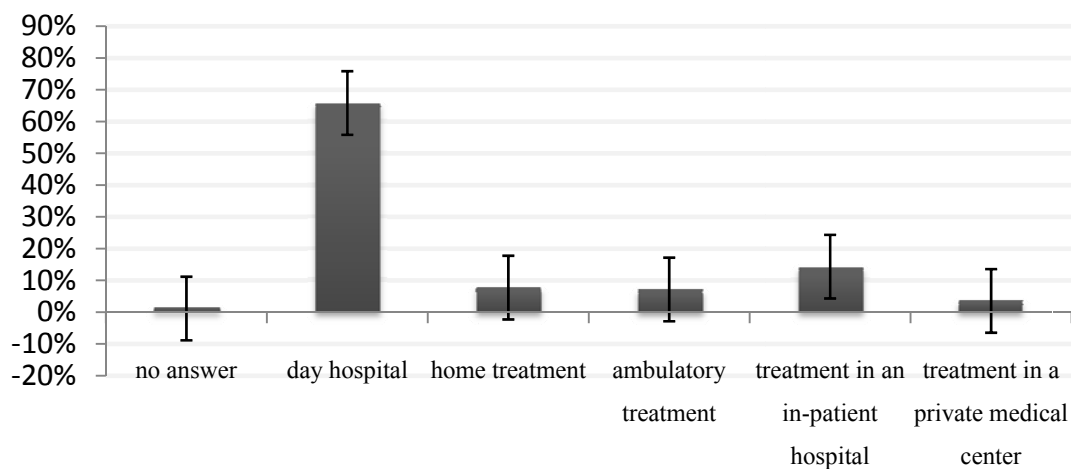


Figure 1 – Choice of respondents' of the most convenient forms of medical care

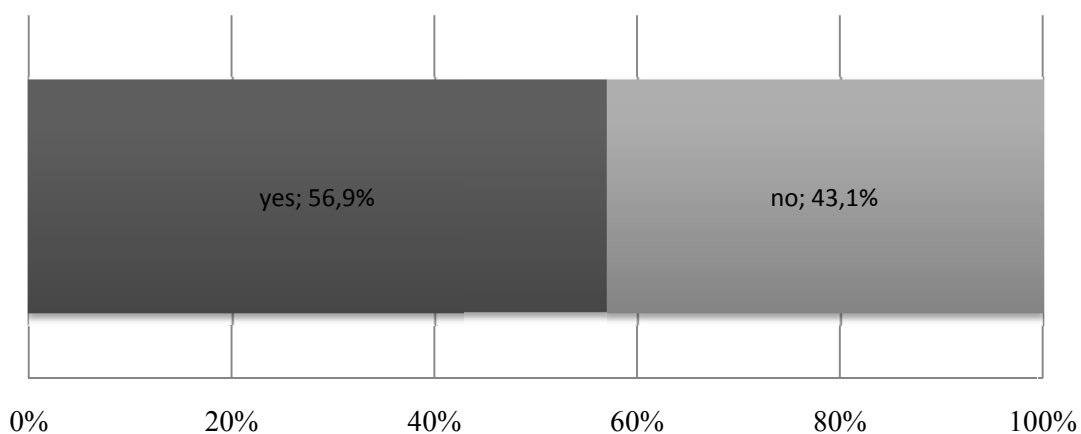


Figure 2 – Satisfaction of respondents' with hospital-replacing medical care quality

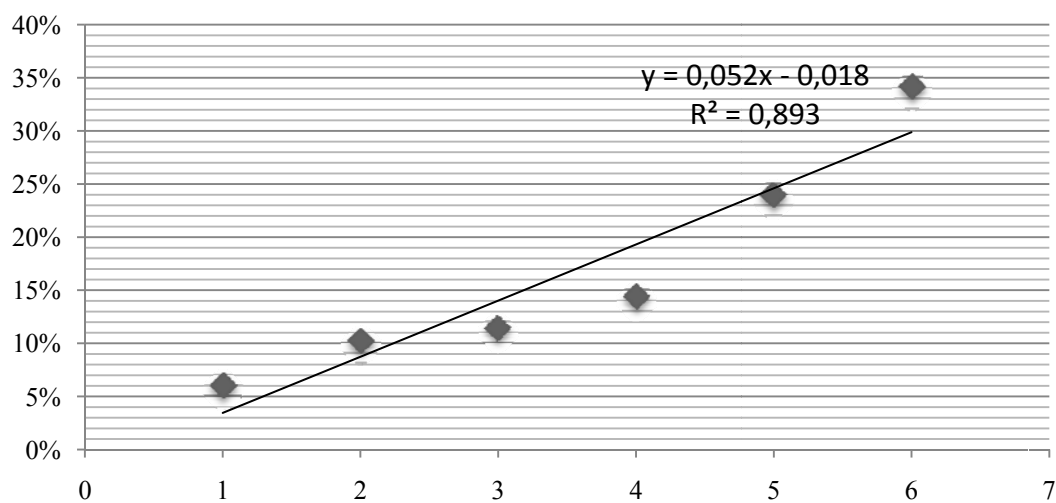


Figure 3 –Expected date of planned hospitalization in day hospital

To assess mutual influence of factors on level of respondents' satisfaction with hospital-replacing medical care quality, linear regression analysis of interrelation was conducted.

Patients' satisfaction with quality of HRC was correlated with expenditures for medicine during the treatment in day hospital ( $F_{кр} = 6.268$ ).

During treatment 29.34% spent more than 5000 tenge for medication, about 20% - up to 5000 tenge.

Linear regression analysis

Predictors (X) (M, SD)	b=	a=	R <sup>2</sup> =	F <sub>obs</sub> =	R <sup>2</sup> ,%	95%CI
Expenditures for medicine during the treatment in DH M=1.46 SD=0.49	1.79	-0.25	0.061	6.268	6.1	1.44-1.49

65.87% of respondents are ready to recommend day hospital to their relatives, friends and acquaintances. Frequency of respondents' medical resource utilization has a statistically significant correlation with reasons of the respondents' non-utilization of outpatient service  $p < 0.0001$ , and with respondents' recommendations of day hospital to their relatives  $p = 0.0016$ .

**Conclusions.** Formation of a sense of trust in a patient in the specialist and treatment in DH, and generally in the clinic, is an important sign of the successful and effective organization of medical care and a financial success of health care system.

Contributory factors of hospital replacing medical care that influence the patients' satisfaction level were determined.

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**АЛМАТЫ ҚАЛАСЫНЫҢ МЕДИЦИНАЛЫҚ ҰЙЫМДАРЫНЫҢ  
КҮНДІЗГІ СТАЦИОНАРЛАРДАҒЫ ЖҮРГІЗІЛГЕН СОЦИОЛОГИЯЛЫҚ  
ЗЕРТТЕУДІҢ НӘТИЖЕЛЕРІН ТАЛДАУ (ҚАЗАҚСТАН)**

**Аннотация.** Мақалада медициналық көмектің стационарды алмастыру түрінің даму динамикасы көрсетілген. Медициналық статистиканың жалпылай қабылданған әдістемелеріне сай көрсеткіштердің есебі берілген.

**Түйін сөздер:** стационарды алмастыратын медициналық көмек, күндізгі стационар, стационарды алмастыратын технологиялар.

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**АНАЛИЗ РЕЗУЛЬТАТОВ СОЦИОЛОГИЧЕСКОГО ИССЛЕДОВАНИЯ ПАЦИЕНТОВ  
ДНЕВНОГО СТАЦИОНАРА МЕДИЦИНСКИХ ОРГАНИЗАЦИЙ ГОРОДА АЛМАТЫ  
(КАЗАХСТАН)**

**Аннотация.** В работе показана динамика развития стационарозамещающих форм медицинской помощи. Проведены расчеты показателей в соответствии с общепринятыми в медицинской статистике методами.

**Ключевые слова:** стационарозамещающая медицинская помощь, дневной стационар, стационарозамещающие технологии (СЗТ).

## NEWS

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## **NEW STRAINS OF FUNGI OF GENUS *TRICHODERMA*, ALLOCATED FROM THE RHIZOSPHERE OF CUCUMBERS AND POTATOES GROWING IN THE ALMATY REGION**

**Abstract.** This paper presents the results of a microbiological analysis of soil samples taken from the rhizosphere of potato of sort "Gala" and rhizosphere of cucumbers of "Buyan F1" sort, cultivated in the Almaty region of Kazakhstan for the presence of soil saprophytic fungi of the genus «*Trichoderma*». A morphological-microscopic description of two new strains of «*Trichoderma*» fungus is given. According to the characteristic morphological and microscopic features, the isolates obtained from the soil of the rhizosphere of the potato of sort "Gala" and cucumbers of sort "Buyan F1" were accordingly attributed to the species «*Trichoderma asperellum*» and «*Trichoderma album*».

**Keywords:** rhizosphere, cucumber, potato, strain, fungi, *Trichoderma*.

УДК 632.93

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## **НОВЫЕ ШТАММЫ ГРИБОВ РОДА *TRICHODERMA*, ВЫДЕЛЕННЫЕ ИЗ РИЗОСФЕРЫ ОГУЦОВ И КАРТОФЕЛЯ, ПРОИЗРАСТАЮЩИХ В АЛМАТИНСКОЙ ОБЛАСТИ**

**Аннотация.** В настоящей работе представлены результаты микробиологического анализа образцов почвы, взятых из ризосферы картофеля сорта «Гала» и огурцов сорта «Буян F1», культивируемых в Алматинской области Казахстана на наличие почвенных сапрофитных грибов рода *Trichoderma*. Дано морфолого-микроскопическое описание двух новых штаммов гриба *Trichoderma*. По характерным морфологическим и микроскопическим признакам изоляты, полученные из почвы ризосферы картофеля сорта «Гала» и огурцов сорта «Буян F1», были соответственно отнесены к видам *Trichoderma asperellum* и *Trichoderma album*.

**Ключевые слова:** ризосфера, огурцы, картофель, штамм, грибы, *Trichoderma*.

Одним из важных направлений современных исследований является повышение продуктивности растений. Этот показатель зависит от видовой принадлежности и от условий выращивания растений. Большое влияние на рост и развитие растений оказывают почвенные микроорганизмы. Следует отметить, что среди них встречаются как фитопатогены, оказывающие отрицательное воздействие, так и микроорганизмы – антагонисты, оказывающие положительное влияние на растительный организм [1-3].

Одним из самых распространенных на планете микроскопических грибов являются грибы рода *Trichoderma*, подавляющие более 60 видов возбудителей болезней растений [1-3].

Весьма перспективно использование препаратов на основе грибов рода *Trichoderma* в борьбе с корневыми гнилями. Корневые гнили в настоящее время – это бич полей, занятых под зерновые, зернобобовые, овощные, технические и другие культуры. Особую опасность представляют фузариозные корневые гнили, возбудителями которых являются грибы рода *Fusarium*. Они поражают как огурцы, так и картофель в течение всей вегетации [4-6]. Некоторые виды *Fusarium* продуцируют опасные микотоксины, заражая зерно, вызывают тяжёлые заболевания людей и животных [7].

Кроме фузариозной гнили, большой вред приносит белая гниль, возбудитель *Sclerotinia sclerotiorum*. Болезнь поражает растения как открытого, так и защищенного грунта. Проявляется на всех органах растений во все фазы их развития. Вызывает гибель всходов, увядание взрослых растений, загнивание плодов [8].

На поздних стадиях роста и развития растения поражается альтернариозом, возбудителем которого является *Alternaria* spp. Заражение посевов альтернариозом начинается со спор, оставшихся на стерне. Также инфицирование может произойти и во время периода вегетации [9].

Также следует отметить такое заболевание, как фитофтороз, возбудителем которого является *Phytophthora infestans* [10].

Фитофтора, как любой гриб, состоит из мицелия, спорангия и конидия. Мицелий имеет вид паутины белого цвета. Он живет и развивается в тканях растений. Размножается гриб спорами и бесполом способом – конидиями. Споры образуются в спорангиях. После того, как споры созревают, оболочка спорангия разрывается, и они выходят наружу. Дальше распространяются с водой, попадают на растения и начинают новый жизненный цикл.

Целью настоящей работы явилось выявление грибов рода *Trichoderma* в ризосфере огурцов сорта «Буян F1» и картофеля сорта «Гала», произрастающих в Алматинской области для дальнейшего использования их в качестве агентов биологического контроля фитопатогенов, поражающих овощные культуры.

**Материалы и методы.** Объектом исследования служили образцы почвы, полученные в 2017 году из ризосферы огурцов сорта «Буян F1» и картофеля сорта «Гала», произрастающих в КХ «Галым» Саркандского района Алматинской области.

Выделение грибов из почвенных образцов проводили общепринятыми в микробиологии методами [11].

Почвенную суспензию высеивали на питательную среду Чапека в чашки Петри.

Состав среды Чапека (г/л): сахароза – 20,0;  $\text{NaNO}_3$  – 2,0;  $\text{KH}_2\text{PO}_4$  – 1,0;  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  – 0,5;  $\text{KCl}$  – 0,5;  $\text{FeSO}_4 \cdot \text{H}_2\text{O}$  – 0,01; агар – 20,0.

Колонии грибов изолировали с чашек Петри на скошенную питательную среду того же состава. Чистую культуру гриба (штамм) получали после ряда пассажей.

Морфолого-микроскопические исследования выделенных штаммов проводили на среде Чапека, идентификацию проводили по соответствующим определителям [5, 10].

**Результаты и обсуждения.** Проведен микробиологический анализ образцов почвы из ризосферы картофеля и огурцов, произрастающих в КХ «Галым» Саркандского района Алматинской области. Из ризосферы картофеля «Гала» и огурцов «Буян F1» было выделено по одному изоляту гриба рода – *Trichoderma*.

Морфолого-микроскопическая характеристика изолята, выделенного из ризосферы картофеля «Гала».

На среде Чапека сначала развивается мощный, гладкий, радиально расходящийся субстратный мицелий сероватого цвета. Сероватый оттенок мицелия создается за счет некоторой приподнятости мицелиев к поверхности субстрата. За двое суток средний радиус колонии достигает 3-4 см.

Средний диаметр вегетативной гифы равен 8-15 мк. Поверхность колонии гриба до образования воздушного мицелия ровная, однородно-волокнистая, расходящаяся от центра посева на периферию. Через 30-35 часов после посева от субстратных мицелиев поднимается равномерный воздушный мицелий ватообразной структуры, серовато-белого цвета. Газон воздушного мицелия развивается с незначительным (2-3 мм) отставанием от края колоний, образованного субстратным мицелием.

Начало конидиеобразования наступает постепенно в течение 70-80 часов после посева при содержании культуры в термостате при 27°C. Конидиеобразование происходит во всей поверхности газона вначале в виде небольших разбросанных клубочков размером 3-5 мм, а затем, разрастаясь, они сливаются, образуя сплошной конидиальный газон.

Цвет конидиального газона меняется от матово светло-зеленого оттенка при молодом возрасте до матово темно-зеленого в зрелом возрасте.

На агаризованной воде конидиеносцы поднимаются вверх, независимо от положения вегетативных гиф мицелия, в зрелом виде и высота их в среднем около 40-50 мк, они разветвлены дихотомически или крестообразно, диаметр средней части равен 5-6 мк. Боковые расходятся от главной ветви конидиеносца ярусами, и нижние боковые ветви могут дать вторичные ветвления, на конце которых мутовками расположены стеригмы не более 4 штук на одном месте. Стеригмы кеглевидные, длина в среднем равна 5 мк. На конце стеригм формируются конидиальные головки, они шаровидные, до 10 мк в диаметре. В головках под микроскопом просматриваются конидиоспоры, которые при созревании легко рассыпаются, особенно при высокой влажности. Споры шаровидные и реже, при одиночном рассмотрении бледно-зеленые, но в массе темно-зеленые, диаметр 2,5-3,5 мк.

Встречаются интеркалярные хламидоспоры, шарообразные, гладкие диаметром 8-10 мк. Обратная сторона колонии не окрашена. Зрелая культура этого гриба-специфический грибной запах.

По морфолого-микроскопическим признакам изолят отнесен к виду *Trichodermaasperellum* (рисунок 1).



Рисунок 1 – Культура гриба *Trichodermaasperellum*:  
а – рост на питательной среде Чапека; б – микроструктура

Морфолого-микроскопическая характеристика изолята, выделенного из ризосферы огурца сорта «Буян F1».

На среде Чапека сначала развивается обильный бесцветный (стекловидный) мицелий, который от точки посева простирается радиально, образуя плоскую колонию волокнистой структуры. Средний диаметр вегетативной гифы равен 9-12 мк. За двое суток средний радиус колоний достигает лишь 1-1,5 см, а к началу второй недели роста он равен 3-4 см. В это время на поверхности колонии гриба появляются отдельные белые пучки воздушного мицелия, напоминающие кучевые облака. Размер этих пучков вначале от 2 до 5 мм, затем они, разрастаясь, постепенно сливаются



между собой, образуя сплошной бугристый грибной газон. Воздушный мицелий в своем развитии отстает от субстратных на 10-15 мм.

К середине второй недели роста на поверхности грибного газона появляются мелкие, редкие, белые с желтым оттенком крупинки (начало конидиеобразования), которые постепенно к концу второй недели роста приобретают яично-желтый, а затем зеленовато-желтый цвет. По сравнению с другими видами рода рост и развитие этого вида значительно более медленное.

На агаризованной воде конидиеносцы хорошо различимы, они поднимаются от веток воздушного мицелия и имеют высоту 25-30 мк, а диаметр срединной части 5-6 мк. Разветвление дихотомитрическое, чаще всего, крестообразное. На концах ветвей размещаются стеригмы, их количество не более 5, а размеры могут быть разные, но не более 5 мкв длину. На вершинах стеригм расположены бесцветные конидиальные головки круглой формы, состоящие из скопления конидиеспорсклеенных между собой слизистым веществом. Эти конидиальные головки внешне напоминают ягоды ежевики и имеют размер 12-15 мк. Конидиеспоры в головках под микроскопом хорошо просматриваются, в отдельности они почти бесцветные, но преломляют свет, круглые, овальные или яйцевидные, часто с одного конца несколько заостренные, гладкие, величиной в среднем 4х3,5 мк.

Хламидоспоры встречаются редко, интеркалярные, круглые, гладкостенные, 6-8 мк в диаметре. В процессе развития гриба пигмент в субстрат не выделяется. Однако обратная сторона колонии имеет желтую окраску. По морфолого-микроскопическим признакам изолят отнесен к виду *Trichoderma album* (рисунок 2).

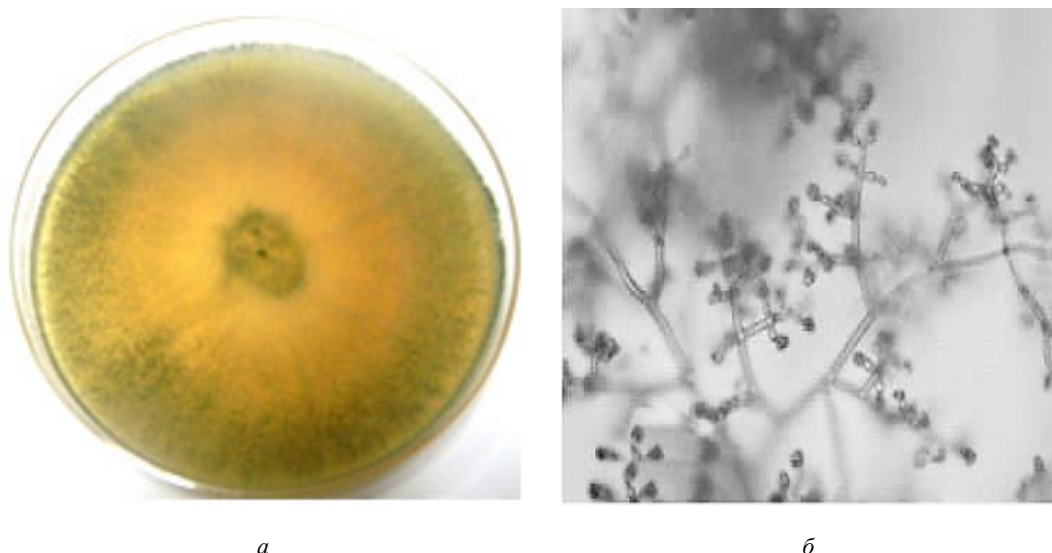


Рисунок 2 – Культура гриба *Trichoderma album*:  
а – рост на питательной среде Чапека; б – микроструктура

Таким образом, из ризосферы картофеля сорта «Гала» и огурцов сорта «Буян F1», культивируемых в Алматинской области Казахстана, выделено два новых штамма гриба *Trichoderma*, которые по морфологическим и микроскопическим признакам отнесены к видам *Trichoderma asperellum* и *Trichoderma album*. Планируется исследование антагонистической активности новых штаммов против возбудителей болезней картофеля и огурцов с целью разработки на их основе эффективных отечественных биопрепаратов для защиты растений.

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#### АЛМАТЫ ОБЛЫСЫНДА ӨСЕТІН КАРТОП ПЕН ҚИЯР РИЗОСФЕРАСЫНАН БӨЛІНІП АЛЫНҒАН *TRICHODERMA* ТЕКТЕС САҢЫРАУҚҰЛАҚТАРДЫҢ ЖАҢА ШТАММАДАРЫ

**Аннотация.** Жұмыста Қазақстанның Алматы облысында өсірілетін, картоп «Гала» және қияр «F1 Буян» ризосферасының топырағынан алынған жинақта *Trichoderma* тегінің сапрофиттік саңырауқұлақтарының болу үлгілерін микробиологиялық талдау нәтижелері ұсынылған. Екі *Trichoderma* саңырауқұлақтарының жаңа штаммдарына микроскопиялық морфологиялық сипаттамасы берілген. «Гала» картоп пен «F1 Буян» қиярдың ризосфера топырағынан ажыратып алынған, морфологиялық және микроскопиялық сипатына тән, тиісінше *Trichoderma asperellum* және *Trichoderma album* түрлеріне жатқызылды.

Қияр «Буян F1» мен «Гала» картобының ризосферасынан алынған, *Trichoderma* тектес саңырауқұлақтар өсіріндісі туралы деп, пікір ұсынылды. Бұл зерттеу ең көп таралған микроскопиялық саңырауқұлақтар тегі - *Trichoderma* тегіне арналады. Тамыр шірік қоздырғыштарына қарсы-антагонизм танытатын *Trichoderma* саңырауқұлақ өндіру үшін эксперименттік әдістері жасалды. Алматы облысында өсіп келе жатқан көкөніс дақылдары ризосфера топырағынан, ең агрессивті антагонистер бөлініп алынды.

**Түйін сөздер:** ризосфера, қияр, картоп, штамм, саңырауқұлақтар, *Trichoderma*.

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## NEWS

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**NEW LOCALITIES OF ENDEMIC AND RELIC SPECIES OF FLORA  
IN EAST KAZAKHSTAN**

**Abstract.** One of the ways to preserve rare species of relic and endemic plants is protecting their habitats and phytocenoses in which these species exist at the present time. In connection with this now, in the era of sharp increase in anthropogenic stress, it is important to study flora and vegetation, to find new habitats of rare plant species in the mountainous regions of Kazakhstan, to draw up maps of their distribution area and take specific measures of protection. The purpose of this work is to study the geographical distribution of rare endemic and relict flora species of Eastern Kazakhstan. Materials for the study were collected during expeditions in 2012-2017. The study of the distribution of rare endemic and relict plants was carried out by a route-reconnaissance method. Routes of field research were planned according to cartographic forest inventory materials of land use and administrative maps of the East Kazakhstan region. The route of the expedition was compiled in such a way as to visit the most probable and characteristic places of growth of the studied plant species. The studies were conducted according to generally accepted methods: while describing plant communities with the participation and dominance of the plant species under study, conventional geo-botanical methods were used. As a result of the research new locations of rare, endemic and relict plant species have been discovered on East Kazakhstan territory. The new growth sites for *Daphne altaica*, *Sibiraea altaicensis* and *Amygdalus ledebouriana* were determined. When registering the finds their exact coordinates were determined, the names of the tracts, the exposition of slopes and other necessary information was indicated.

**Key words:** endemics, relics, areal, distribution, mapping.

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**И. О. Байгулин<sup>1</sup>, А. Б. Мырзагалиева<sup>2</sup>, Т. Н. Самарханов<sup>2</sup>**<sup>1</sup>Институт ботаники и фитоинтродукции, Алматы, Казахстан,<sup>2</sup>Восточно-Казахстанский государственный университет им. С. Аманжолова, Усть-Каменогорск, Казахстан**НОВЫЕ МЕСТООБИТАНИЯ ЭНДЕМИЧНЫХ И РЕЛИКТОВЫХ  
ВИДОВ РАСТЕНИЙ ФЛОРЫ ВОСТОЧНОГО КАЗАХСТАНА**

**Аннотация.** Одним из путей сохранения редких видов реликтовых и эндемичных растений является охрана их местообитания и фитоценозов, в состав которых они входят. В связи с чем, ныне, в эпоху резкого усиления антропогенного стресса, актуально изучение флоры и растительности, нахождение новых местообитаний редких видов растений в горных районах Казахстана, составление карт их ареала распространения и принятие конкретных мер охраны. Целью данной работы явилось изучение географического распространения редких эндемичных и реликтовых видов флоры Восточного Казахстана. Материалы для исследования собирались во время экспедиций 2012-2017 гг. Изучение распространения редких эндемичных и реликтовых растений осуществлялось маршрутно-рекогносцировочным методом. Маршруты полевых исследований намечали по картографическим лесоустроительным материалам землепользования и административным картам Восточно-Казахстанской области. Маршрут экспедиции был составлен с таким расчетом, чтобы

посетить наиболее вероятные и характерные места произрастания изучаемых видов растений. Исследования проводились по общепринятым методикам: при описании растительных сообществ с участием и доминированием изучаемых видов растений были использованы общепринятые геоботанические методы. В результате проведенных исследований на территории Восточного Казахстана обнаружены новые местонахождения редких, эндемичных и реликтовых видов растений. Определены новые места произрастания для *Daphne altaica*, *Sibiraea altaicensis* и *Amygdalus ledebouriana*, при регистрации мест находок определены их точные координаты, указывались названия урочищ, экспозиция склонов и другие необходимые сведения.

**Ключевые слова:** эндемики, реликты, ареал, распространение, картирование.

В настоящее время наблюдается существенное обеднение генофонда растений природной флоры, и прежде всего реликтовых и эндемичных видов, большинство из которых являются редкими и находятся на грани исчезновения. Реликтовые виды растений представляют большой научный интерес, так как они являются носителями достоверной информации о растительном покрове минувших эпох [1].

Одним из путей сохранения редких видов реликтовых и эндемичных растений является охрана их местообитания и фитоценозов, в состав которых они входят. В связи с чем, ныне, в эпоху резкого усиления антропогенного стресса актуально изучение флоры и растительности, нахождение новых местообитаний редких видов растений в горных районах Казахстана, составление карт их ареала распространения и принятие конкретных мер охраны.

Цель данной работы - изучение географического распространения редких эндемичных и реликтовых видов флоры Восточного Казахстана.

Материалы для исследования собирались во время экспедиций 2012-2017 гг. Изучение распространения редких эндемичных и реликтовых растений осуществлялось маршрутно-рекогносцировочным методом. Маршруты полевых исследований намечали по картографическим лесоустроительным материалам землепользования и административным картам Восточно-Казахстанской области. Маршрут экспедиции был составлен с таким расчетом, чтобы посетить наиболее вероятные и характерные места произрастания изучаемых видов растений.

Исследования проводились по общепринятым методикам: при описании растительных сообществ с участием и доминированием изучаемых видов растений были использованы общепринятые геоботанические методы, изложенные в работе Б. А. Быкова [2]; Е. М. Лавренко [3]. Авторы таксонов цитируются в соответствии с правилами, принятыми в сводке С. К. Черепанова [4], С.А.Абдулиной [5].

Местонахождение зарослей устанавливали, руководствуясь биологическими особенностями и экологической приуроченностью изучаемых видов, а также с использованием гербарного материала.

Подлинность растений определяли с помощью работ «Флора Казахстана» [6-9], «Иллюстрированный определитель растений Казахстана» [10].

Проведенные за последние годы (2012-2017) в Восточно-Казахстанской области исследования флоры позволили выявить новые местообитания эндемичных и реликтовых видов растений. Для трех видов определены новые места произрастания, при регистрации мест находок определены их точные координаты, указывались названия урочищ, экспозиция склонов и другие необходимые сведения.

**Волчегодник алтайский (*Daphne altaica* Pall.),** вид кустарников рода Волчегодник (*Daphne*) семейства Волчниковые (*Thymelaeaceae*). Узкий эндемик Алтая и прилегающих гор южнее Зайсанской котловины (Саур, Тарбагатай), реликт третичной лесной субтропической флоры турганского типа, вид занесен в Красную книгу [11].

Волчегодник алтайский корнеотпрысковый листопадный кустарник высотой 1-1,5 м. С бурой, снизу темно-серой корой, хорошо узнаваем по вильчатой форме веток. Молодые ветви опушены, старые - голые. Листья крупные, эллиптические, цельнокрайние. Зацветает на пятом году жизни. Цветки обоеполые, с простым околоцветником, сидят группами (от трех до семи) на концах укороченных веточек. Околоцветник снежно-белый, сростнолепестный, с цилиндрической трубкой и четырьмя отклоненными закругленными долями отгиба. Цветки обладают сильным приятным ароматом и немного похожи на цветы сирени, только мельче. Цветет в мае – июне, плоды (сочные черные костянки с одиночными семенами) созревают в июне – июле [6].

Произрастает на северных склонах гор и в предгорьях, в лиственных лесах, зарослях кустарников, редко входит в кустарниковые степи. Основные угрозы – выпас скота и пожары. Встречается на Алтае, Сауре, Маныраке, Тарбагатае.

Волчягодник имеет лекарственное значение, используется в народной медицине, растение ядовитое.

Проведенные за последние годы (2012-2017) в Восточно-Казахстанской области исследования флоры позволили выявить новые местообитания волчягодника алтайского [12, 13].

На хребте Нарын у подножья горы Атжал встречаются крупные заросли. Восточные склоны горы Атжал, по ущельям с координатами N 49° 05.505'; E 084° 29.143' покрыты густой кустарниковой растительностью из *Spiraeatrilobata* L., *S. media* Schmidt., *Rosa acicularis* Lindl., *Rosa alberti* Regel., *Loniceratatarica* L., *Cotoneastermelanocarpa* Lodd., *Rubusidaeus* L., *Daphnealtaica* Pall., *Amygdalusledebouriana* Schlecht. Под пологом кустарников развито богатое видовое разнообразие травянистой растительности.

Кустарниковые густые заросли тянутся по юго-восточному склону до высоты 1300-1500 м. На уровне 1200 м на склонах северо-западной экспозиций появляются осиновые рощи в первом ярусе, во втором ярусе преобладают кустарники *Spiraeatrilobata* L., *S. Media* Schmidt., *Rosa acicularis*, *Rosa alberti* Regel., *Loniceratatarica* L., *L. altaica* L., *Cotoneastermelanocarpa* Lodd., *Daphnealtaica* Pall., *R. idaeus* L. Из травянистой растительности встречаются *Artemisiaabsintium* L., *A. vulgare* L., *Thalictrumcollinum* Wallr., *Lilium pilosiusculum* (Freun) Miscz., *Origanumvulgare* L., *Medicagoalcata* L., *Aconitumvolubile* Pall. ex Koelle, *Thermopsis lanceolata* R. Br., *Campanulaglomerata* L., *Hypericum perforatum* L., *Rubus saxatilis* L., *Crepissibirica* L., *Centaurearuthenica* Lam., *Orobosluteus* L., *Delphiniumelatatum* L., *Aconitumleucostomum* Worosch.

Нами обнаружена популяция волчника в восточной части Калбинского хребта на горе Сандыктас. Популяция размещена на юго-восточном склоне на высоте 1056-1062 м над уровнем моря. Общая площадь популяции 0,2 га, координаты N 49°17.908'; E 082°29.819' (рисунок).



Цветущий *Daphnealtaica* на Калбинском хребте

Заросли Волчника алтайского находится среди густой кустарниковой растительности из *Lonicera tatarica* L., *Caragana arborescens* Lam., *R. spinosissima* L., *Rosa acicularis* Lindl., *Rosa alberti* Regel., *Cotoneaster melanocarpa* Lodd., *Daphne altaica* Pall. Среди кустарников произрастают некоторые травянистые виды, *Clematis integrifolia* L., *Dictamnus angustifolius* G. Don ex Sweet., *Delphiniumcyananthum* Nevski., *Fragaria viridis* (Duch.) Weston, *Trifolium lupinaster* L., *Filipendula vulgaris* Moench., *Potentilla recta* L., *Phlomoidesteruberosa* (L.) Moench., *Galium verum* L. и др.

**Сибиркаалтайская** (*Sibiraea altaiensis* (Laxm.) Schneid.) кустарник семейства Розоцветные (*Rosaceae* Juss.), около 150 см высотой. Ветки относительно толстые, отличаются красновато-бурой корой. Листья сидячие, сизовато-зеленые, цельные и цельнокрайние. Цветки однополые, собраны в раздельные кистевидно-метельчатые соцветия. Чашелистиков и лепестков, как у всех розоцветных, пять. Чашечка широко колокольчатая, венчик белый. Плод состоит из пяти прямостоячих листовок (длиннее чашечки), в каждой из которых содержится по два мелких коричневых семени. Размножение семенное. Цветет сибирка в мае-июне, плодоносит в июле-августе [7].

Редкий, исчезающий вид, эндемик Алтая, распространение которого лишь незначительно выходит за пределы Казахстана. Растет в открытых горных долинах и на склонах гор.

Листья иногда используют как заменитель чая, а в народной медицине - при лечении лихорадки, болезни печени (гепатит) и сердечнососудистой системы. Сибирка – эффективное декоративное растение, в культуре хорошо растет из семян. Она очень привлекательно не только в период цветения, но и осенью, когда листья окрашиваются в яркие багряные цвета. Охраняется в Катон-Карагайском государственном национальном парке [14].

Достаточно крупные заросли алтайского эндемика – Сибирки алтайской нами обнаружен на хребте Тарбагатай Южного Алтая, по правому берегу речки Талдыбулак на высоте 1816 м над уровнем моря с координатами N 49°06.355', E 086°07.890'.

Ценопопуляции с участием сибирки алтайской сгруппированы в *разнотравно-кустарниковый* тип фитоценоза, который встречается по правому берегу речки Талдыбулак. Кустарниковый ярус – густой, хорошо развитый. Из кустарников – *Sibiraea altaiensis*, *Pentaphylloides fruticosa* (L.) O.Scywarz, *Salix sajanensis* Nas., *Spiraea media* Franz Schmidt. Из разнотравья встречаются: *Polygonum viviparum* L., *Geranium pratense* L., *G. Divaricatum* Ehrh., *G. sibiricum* L., *Lamium album* L., *Galium verum* L., *G. boreale* L., *Myosotis palustris* (L.) L., *Thalictrum flavum* L., *Veronica longifolia* L., *Ligularia altaica* DC, *Alchemilla sibirica* L., *Papaver medicinale* L., *Polygala hybrida* DC., *Valeriana dubia* Bunge., *Polemonium caeruleum* L., *Vicia tenuifolia* Roth, *Campanula glomerata* L., *Trollius altaicus* C.A.Mey., *Dracocephalum ruyschiana* L., *Dracocephalum integrifolium* Bunge, *Pyrethrum krylovianum* Krasch., *Aconitum leucostomum* Worosch. и др.

Крупная популяция сибирки алтайской обнаружена на склонах южной и юго-восточной экспозиции горы Шубартос хребта Тарбагатай Южного Алтая. на высоте 1870 м над уровнем моря с координатами N 49°06.564', E 086°07.847'. Отборы производились на 20 растениях на площади около 2,5 га.

Ценопопуляции с участием сибирки алтайской сгруппированы в *разнотравно-кустарниково-сибирковый* тип фитоценоза, который встречается по склонам южной и юго-восточной экспозиций. Кустарниковый ярус – густой, хорошо развитый. Из кустарников – *Rosa alberti* Regel., *R. acicularis* Lindl, *Sibiraea altaiensis*, *Spiraea media* Franz Schmidt. Травяной покров представлен из *Dactylis glomerata* L., *Poa pratensis* L., *Koeleria altaica* (Domin) Kryl., *Alopecurus pratensis* L., *Lilium martagon* L., *Thalictrum alpinum* L., *Pedicularis elata* Willd., *Dracocephalum ruyschiana* L., *Trollius altaicus* C.A. Mey., *Vupleurumaureum* Fisch., *Galium verum* L., *G. boreale* L., *Medicago falcata* L., *Ligularia altaica* DC, *Vicia tenuifolia* Roth, *Hedysarum neglectum* Ledeb. и др.

По склону горы Шубартос сибирка алтайская поднимается до высоты 1892-1899 м над уровнем моря по склонам южной, юго-восточной экспозиции.

*Sibiraea altaiensis* обнаружен на хребте Южный Алтай на склонах горы Шубаркарагай. Заросли сибирки занимают значительную площадь по восточным, юго-восточным склонам на высоте 1693 м над уровнем моря с координатами N 49°03.436', E 086°00.179'.

Из древесных пород встречается *Larix sibirica*, кустарниковая растительность представлена сплошными зарослями *Sibiraea altaiensis*, с примесью *Spiraea media* Franz Schmidt, *Pentaphylloides fruticosa* (L.) O.Scywarz, *Cotoneaster uniflorus* Bunge. Травянистый ярус представлен *Dactylis glomerata* L., *Calamagrostis epigeios* (L.) Roth, *Poa sibirica* Roshev., *Chamaenerion angustifolium* (L.) Scop., *Geranium albiflorum* Ledeb., *Thalictrum alpinum* L., *Trollius altaicus* C.A. Mey., *Myosotis palustris* (L.) L., *Lathyrus pratensis* L., *Stellaria palustris* Retz., *Galium boreale* L., *Alchemilla altaica* Juz., *Sanguisorba alpina* Bunge., *Antennaria dioica* (L.) Gaertn., *Saussurea frolovii* Ledeb., *Euphorbia lutescens* C.F. Mey., *Phlomis alpina* Pall., *Hedysarum alpinum* L., *Veratrum lobelianum* Bernh., *Gentiana*



*tissowii* Regel & Winkl., *Trolliusaltaicus* C.A.Mey., *Dracocephalumruyschiana* L. *Swertiaobtusa* Ledeb., *Thermopsis lanceolata* R. Br., *Scaligeriasetacea* (Sehrenk.) Korov. и др.

**Миндаль Ледебуря (*Amygdalusledebouriana* Schlecht.)**, кустарник семейства Розоцветные (*Rosaceae* Juss.). Редкий, эндемичный вид, занесен в Красную книгу Казахстана.

Высота кустарника достигает 1,5-1,8 м. Ветки голые, растопыренные, с многочисленными укороченными веточками. Кора многолетних ветвей серая или красновато-серая, однолетних красновато-коричневая, прилистники узколанцетные или ланцетные, цельнокрайние или зубчатые. Листья очередные, на укороченных побегах сидят пучками, все голые, ланцетные или продолговато-яйцевидные, на верхушке заостренные, реже туповатые, в основании постепенно суженные в короткий черешок, по краям пильчато-зубчатые. Цветки ярко-розовые, одиночные. Цветет в конце мая. Плоды густо войлочно-мохнатые. Растет в разнотравно-луговой степи, на горных склонах, в долинах рек [7, 8].

Нами обнаружен на северо-восточном кустарниковом склоне г.Сарышoky, хребта Нарын, Южного Алтая, в окрестности с.Коктерек Катон-Карагайского района, N 49° 05.537', E 084° 29.165', на высоте 724 м над уровнем моря [15].

Северо-восточные склоны горы Сарышoky, ущелья покрыты густой кустарниковой растительностью из *Spiraeatrilobata* L., *S. Media* Schmidt., *Amygdalusledebouriana* Schlecht., *Rosaacicularis* Lindl., *Rosaalberti* Regel., *Loniceratatarica* L., *Cotoneastermelanocarpa* Lodd., *Rubusidaeus* L., *Daphnealtaica* Pall. Под пологом кустарников развито богатое видовое разнообразие травянистой растительности. Из травянистой растительности встречаются *Artemisiaabsintium* L., *A. vulgare* L., *Thalictrumcollinum* Wallr., *Lilium pilosiusculum* (Freun) Misch., *Origanumvulgare* L., *Medicagovalcata* L., *Aconitumvolubile* Pall. exKoelle, *Thermopsis lanceolata* R. Br., *Campanulaglomerata* L., *Hypericumperforatum* L., *Rubussaxatilis* L., *Crepissibirica* L., *Centaurearuthenica* Lam., *Orobosluteus* L., *Delphiniumelatum* L., *Aconitumleucostomum* Worosch.

Таким образом, установлены новые местонахождения *Daphne altaica*, *Sibiraea altaiensis* и *Amygdalusledebouriana*, - на территории Восточного Казахстана. Все современные материалы о распространении вышеперечисленных трех видов флоры Восточного Казахстана занесены в электронную базу данных Восточно-Казахстанского государственного университета.

Для трех видов определены новые места произрастания, которые будут указаны на картах их ареалов распространения. При регистрации мест находок определились их точные координаты, указывались названия урочищ, экспозиция склонов и другие, необходимые сведения.

Настоящая работа явилась частью исследования по проекту «Молекулярная систематика эндемичных, редких и хозяйственно ценных видов растений Западного, Центрального и Восточного Казахстана» по ПЦФ «Изучение генетического разнообразия и сохранение генетических ресурсов эндемичных, редких и хозяйственно ценных видов растений в Республике Казахстан» на 2015-2017 гг. и фундаментальных научных исследований Восточно-Казахстанского государственного университета им. С. Аманжолова по приоритетам развития науки на 2015-2017 годы на тему «Разработка биотехнологических способов сохранения эндемичных и лекарственных растений в условиях *in vitro*».

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### **ШЫҒЫС ҚАЗАҚСТАН ФЛОРАСЫНЫҢ ЭНДЕМИК ЖӘНЕ РЕЛИКТ ӨСІМДІКТЕРІНІҢ ЖАҢА МЕКЕН ОРЫНДАРЫ**

**Аннотация.** Реликт және эндемик түрлерді тіршілік ететін орындары мен олар құрамына енетін фитоценоздарды қорғауға алу оларды сақтаудың бірден-бір жолы. Сол себепті, қазіргі таңда, антропогендік стресстің күрт күшеюі дәуірінде флораны және өсімдіктер жамылғысын зерттеу, Қазақстанның таулы аймақтарында сирек кездесетін өсімдіктердің мекен ететін жаңа орындарын табу, олардың таралу ареалдарының картасын түзу және оларды қорғау шараларын ұсыну өзекті мәселелердің бірі. Берілген жұмыстың мақсаты, Шығыс Қазақстан флорасының эндемик және реликт өсімдіктерінің географиялық таралу аймақтарын анықтау. Зерттеу материалдары 2012-2017 жылдары жүргізілген экспедициялар уақытында жиналды. Сирек кездесетін эндемик және реликт өсімдіктерді зерттеу маршруттық-рекогносциялау әдісімен жүргізілді. Далалық зерттеулердің маршруттары жер пайдалану картографиялық материалдары мен Шығыс Қазақстан облысының әкімшілік карталарының көмегімен жасалды. Экспедициялардың маршруттары зерттеуге алынған өсімдік түрлерінің таралуы мүмкін болатын жерлерді неғұрлым кеңінен қамтыды. Зерттеулер жалпыға мәлім әдістер көмегімен жүргізілді, өсімдіктер жамылғысына сипаттамалар геоботаникалық әдістермен жүргізілді. Зерттеу нәтижесінде Шығыс Қазақстан облысының аумағында сирек кездесетін эндемик және реликт түрлердің мекен ететін жаңа орындары анықталды. *Daphne altaica*, *Sibiraea altaiensis* және *Amygdalus ledebouriana* түрлерінің жаңа мекен ететін орындары анықталды, олар табылған жерлердің нақты координаттары анықталып, сайлардың аттары, тау беттерінің экспозициясы және т.б. қажетті мағлұматтар көрсетілді.

**Түйін сөздер:** эндемик, реликт, ареал, таралу, картаға түсіру.



## NEWS

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**ALIEN FISH SPECIES  
IN THE KARGALY STATE WILDLIFE SANCTUARY  
(THE SYRDARYA RIVER, REPUBLIC OF KAZAKHSTAN)**

**Abstract.** The Syrdarya river is one of the main rivers of Central Asia. A sharp ecological crisis happened here at the last quarter of the XX century as a result of irrational water use. Government of the Republic of Kazakhstan undertakes some measures to mitigate ecological situation in the region. Presence of alien fish species considered as an indicator of environment changes. Our research was conducted during 2015-2017 in the Kargaly state wildlife sanctuary for evaluate modern diversity and dynamics of alien fish species without fishery press. This preserve is situated at a typical segment of floodplain part of the Syrdarya river. Two main types of fluvial biotopes as a circulating lake in former riverbed and river *per se* were investigated. Conventional methods of water and fish investigations were used. Water temperature, turbidity, pH, mineralization, concentrations of dissolved oxygen and some heavy metals (*Fe, Cu, Cd, Pb*) were investigated. Significant variability of these physical and chemical parameters depended from precipitation and flood regulation, and strongly impact on fish communities. 14 indigenous and 11 alien fish species were discovered. Alien fish species were presented by white amur *Ctenopharyngodon idella*, silver carp *Hypophthalmichthys molitrix*, abbotina (or false gudgeon) *Abbottina rivularis*, pseudorasbora [or stone moroco, or topmouth gudgeon] *Pseudorasbora parva*, sawbelly *Hemiculter leucisculus*, bitterling *Rhodeus ocellatus*, gambusia [or mosquitofish] *Gambusia holbrooki*, chinese medaka *Orizias sinensis*; eleotris [or beautiful sleeper] *Micropercops cinctus*; goby fish *Rhinogobius cheni*; and snakehead *Channa argus*. There all alien fish species were presented as well by adult as young individuals that indicated quite favorable living conditions for them. Heterogeneity of fish distribution was revealed as a result of their environmental plasticity. Variability of fish number and species composition depend upon flood regimen. Indigenous piscivorous fish species effectively control alien others. Unstable and unlike to natural flood regimen is more favorable for alien fish species.

**Key words:** fishes, fauna, indigenous, alien, Syrdarya river, Kargaly State Wildlife Sanctuary, abiotic conditions.

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## ЧУЖЕРОДНЫЕ ВИДЫ РЫБ В КАРАГАЛИНСКОМ ЗАКАЗНИКЕ (РЕКА СЫРДАРЬЯ, РЕСПУБЛИКА КАЗАХСТАН)

**Аннотация.** Сырдарья является одной из важнейших рек Центральной Азии. В результате нерационального использования водных ресурсов в последней четверти двадцатого века здесь произошел острый экологический кризис. Правительство Республики Казахстан предпринимает меры, направленные на смягчение экологической ситуации в этом регионе. Обилие чужеродных видов рыб является одним из индикаторов состояния водоемов. В 2015-2017 годах было проведено изучение современного разнообразия и динамики чужеродных видов на территории Карагалинского государственного природного заказника, что позволяет избежать влияния промысла на сообщество рыб. Этот заказник расположен на сегменте равнинного течения реки. Были изучены два основных типа местообитаний – проточная старица и собственно река. Применялись традиционные методики изучения воды и рыб. Были изучены температура, мутность, минерализация, рН, содержание растворенного кислорода и некоторых тяжелых металлов (*Fe, Cu, Cd, Pb*). Существенные колебания данных параметров зависят от режима пропусков воды и определяют структуру разнообразия ихтиофауны. Всего здесь было обнаружено 14 аборигенных и 11 чужеродных видов рыб. Чужеродные виды представлены белым амуром *Stenopharyngodon idella*, белым толстолобиком *Hypophthalmichthys molitrix*, абботтиной *Abbottina rivularis*, псевдорасборой *Pseudorasbora parva*, востробрюшкой *Hemiculter leucisculus*, глазчатым горчаком *Rhodeus ocellatus*, гамбузией *Gambusia holbrooki*, медакой *Orizias sinensis*; элеотрисом *Micropercops cinctus*; бычком *Rhinogobius cheni* и змеоголовом *Channa argus*. Все чужеродные виды представлены молодью и взрослыми особями, что указывает на благоприятные условия их существования. Неравномерность распределения рыб определяется их экологической пластичностью. Изменчивость числа видов и особей зависит от гидрологического режима. Аборигенные хищные виды рыб эффективно контролируют численность чужеродных на открытых участках водоемов. Нестабильный режим попусков воды благоприятствует чужеродным видам рыб.

**Ключевые слова:** рыбы, фауна, аборигенный, чужеродный, Сырдарья, Карагалинский государственный природный заказник, абиотические факторы.

**Введение.** На протяжении первой половины прошлого века Арало-Сырдарьинский бассейн был одним из важнейших внутриконтинентальных рыбодобывающих регионов не только Казахстана, но и всего бывшего СССР [1]. Первые работы по вселению сюда рыб из Каспийского бассейна были проведены в 1930-х годах и закончились неудачей. Вместе с проведенной в 1960-х годах акклиматизацией белого амура, черного амура, белого и пестрого толстолобиков из бассейна р.Амур сюда проникли еще несколько видов. История вселения чужеродных видов рыб в период естественного гидрологического режима р.Сырдарья и предкризисный период подробно описана Г.М.Дукравцом и В.П.Митрофановым [2]. Во второй половине XX столетия в развитии этого региона приоритетным стало растениеводство. Нерациональное использование водных ресурсов рек Сырдарья и Амударья привело к значительному сокращению стока этих рек, усыханию Аральского моря и коренной перестройке экосистем региона, которая на социальном уровне получила оценку «экологическая катастрофа» или «экологический кризис» [3-6]. В первое десятилетие XXI века Правительством Республики Казахстан был реализован ряд мер, благодаря которым сток р.Сырдарья в Малый Арал стабильно превышает испарение. На казахстанском участке реки создан ряд особо охраняемых природных территорий, целями которых является восстановление пойменных экосистем и сохранение естественного биологического разнообразия [5-7].

Обилие и процветание чужеродных видов рыб может быть как результатом, так и причиной неблагополучия пресноводных экосистем [8, 9]. В целом биологические инвазии рассматриваются

как фактор, негативно влияющий на естественное разнообразие ихтиофауны [10, 11], однако роль каждого чужеродного вида нуждается в отдельной оценке [12]. Поэтому изучение видового состава и современного состояния инвазионных видов рыб реки Сырдарьи представляет большой научный интерес, важно для рационального управления рыбными ресурсами и сохранения разнообразия аборигенной ихтиофауны.

Рыболовство оказывает избирательное воздействие на состав ихтиофауны, изымая из сообщества многочисленных и крупных рыб, контролирующих всю пищевую цепь. Условия особо охраняемых природных территорий исключают влияние промысла и позволяют оценить совокупное влияние опосредованных факторов антропогенного воздействия (загрязнение воды, почвенная эрозия, регуляция стока, инвазионные виды) на водную биоту. Целью нашего исследования являлась оценка современного разнообразия и динамики относительной численности чужеродных видов рыб в пределах Карагалинского государственного природного заказника (далее Карагалинский заказник), расположенного на р.Сырдарье.

**Материалы и методики исследования.** Карагалинский государственный природный заказник расположен на р.Сырдарье, южнее поселка Чиили (Шиили). Координаты кордона: 43°57'52.2" с.ш., 66°48'52.5" в.д. Основной задачей заказника является сохранение разнообразия пойменной растительности. Заповедный участок реки является типичным для равнинного течения р.Сырдарьи: основное русло слабо извивается, местами образуя большие проточные старицы. Гидрологический режим этого участка реки целиком определяется расположенными выше гидротехническими сооружениями ирригационного назначения и не предусматривает специальных мероприятий по поддержанию естественного биологического разнообразия рыб на территории данной ООПТ.

Сбор материала проводился в 2015-2017 гг. Физические и химические показатели воды определяли по общепринятым методикам [13, 14]. Мутность измеряли с помощью турбонифриметра HI 93703 "Hanna Instruments", количество растворенного в воде кислорода – с помощью оксиметра той же фирмы. Содержание тяжелых металлов в пробах воды определяли методом масс-спектрометрии с индуктивно-связанной плазмой (ИСП-МС) в соответствии с [15, 16].

Для отлова рыб использовали ставные сети с размером ячеи 14, 20, 30, 40, 50, 70, 100 мм длиной 25 м каждая, мальковую волокушу длиной 15 м с ячеей 3 мм, рыболовный сачок 500x700 мм с ячеей 3 мм и крючковую снасть. Поскольку точная количественная оценка рыбного населения практически не осуществима в крупных водоемах [17], для изучения динамики разнообразия и доминирования молоди рыб были выбраны по одному участку в проточной старице и основном русле. Основными критериями при выборе данных участков являлись возможность их полного облова имеющимися орудиями лова и наличие чужеродных видов в первый год исследований.

Названия большинства видов рыб приводятся в соответствии с FishBase [18], для местных подвигов, чей таксономический статус не подвергался ревизии, сохранены исходные названия. Биологический анализ рыб проводили по схеме, предложенной И.Ф.Правдиным [19]. Крупных рыб весом более 1 кг анализировали на месте, мелких рыб фиксировали в 4% растворе формалина и затем исследовали в лаборатории. Определение возраста рыб проводили по чешуе и позвонкам [20, 21]. Для описания видовой структуры сообществ молоди использовали следующие показатели:  $N$  – общая численность на  $100 \text{ м}^2$ ;  $S$  – общее число видов в сообществе (видовое богатство),  $D$  – индекс разнообразия Симпсона,  $H$  – индекс разнообразия Шеннона,  $E$  – равномерность распределения по Симпсону;  $e$  – индекс выровненности Пиелу (равномерность распределения по Шеннону) [22]. Учитывали все представленные в уловах виды рыб – аборигенные и чужеродные. При расчетах показателя Шеннона и Пиелу использовали двоичный логарифм. Учитывали только численность каждого вида.

**Результаты и обсуждение.** Количество воды в р.Сырдарье в районе Карагалинского заказника определяется расположенными выше водохранилищами ирригационного назначения и зависит от количества осадков в вегетационный период и посевных площадей. В период наблюдений наименьший уровень воды был в 2015 г., наибольший – в 2017 г. Приведенные в таблице 1 данные показывают значительные колебания абиотических показателей в одни и те же сезоны и в тех же местах, но в разные годы. Ни в одной из проб концентрации железа, меди, кадмия и свинца не превышали соответствующих значений ПДК для рыбохозяйственных водоемов.

Таблица 1 – Абиотические показатели водных биотопов в 2015-2017 г.

Биотоп	Год	Характеристики воды					
		цвет	температура, °С	мутность, FTU	pH	минерализация, мг/дм <sup>3</sup>	растворенный кислород, мг/дм <sup>3</sup>
Река	2015	Светло-коричневая	26.1-29.3	79-81	6.5-8.2	540-602	6.02-8.16
	2016	Светло-коричневая	29.3	94	6.7-8.0	598-602	6.58-7.14
	2017	Коричневая	26.1	101	6.9-7.1	540-543	Нет данных
Старица	2015	Зеленая	25.1-29.0	9.12	6.5-7.2	563	6.70-8.03
	2016	Зелено-голубая	24.3-29.0	12.61	7.0-7.2	691	7.21-7.72
	2017	Зелено-голубая	27.8-28.2	8.31	7.4-7.5	603	Нет данных

В районе Карагалинского заказника ихтиофауна представлена как аборигенными, так и чужеродными видами рыб. Аборигенными видами являются обыкновенная щука *Esox lucius* Linnaeus, 1758; плотва *Rutilus rutilus* (Linnaeus, 1758); сырдарьинский елец *Squalius squaliusculus* (Kessler, 1874); красноперка *Scardinius erythrophthalmus* (Linnaeus, 1758); аральская шемая *Alburnus (Chalcalburnus) chalcoides aralensis* (Berg, 1923); полосатая быстрянка *Alburnoides taenatus* (Kessler, 1872); жерех *Aspius aspius* (Linnaeus, 1758); восточный лещ *Abramis brama orientalis* Berg, 1949; аральская белоглазка *Abramis sapa aralensis* Tiapkin, 1939; чехонь *Pelecus cultratus* (Linnaeus, 1758); серебряный карась *Carassius gibelio* (Bloch, 1782); сазан *Cyprinus carpio* Linnaeus, 1758; обыкновенный окунь *Perca fluviatilis* Linnaeus, 1758 и судак *Sander lucioperca* (Linnaeus, 1758).

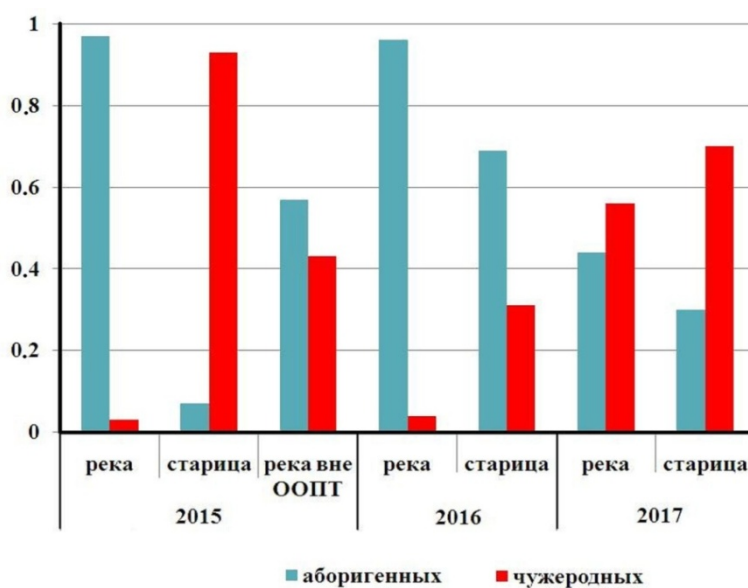
Чужеродные виды: белый амур *Ctenopharyngodon idella* (Valenciennes, 1844), белый толстолобик *Hypophthalmichthys molitrix* (Valenciennes, 1844), речная абботтина *Abbottina rivularis* (Basilewsky, 1855), псевдорасбора (амурский чебачок) *Pseudorasbora parva* (Temminck et Schlegel, 1846), востробрюшка *Hemiculter leucisculus* (Basilewsky, 1855), глазчатый горчак *Rhodeus ocellatus* (Kner, 1866), гамбузия *Gambusia holbrooki* (Girard, 1859), китайская медака *Orizias sinensis* Chen, Uwa et Chu, 1989; элеотрис *Micropercops cinctus* (Dabry de Thiersant, 1872); китайский бычок *Rhinogobius cheni* (Nichols, 1931); амурский змееголов *Channa argus* (Cantor, 1842). Все зарегистрированные виды рыб представлены как взрослыми особями, так и молодью, что указывает на их удовлетворительную выживаемость в данных условиях. Максимальный возраст пойманной на территории заказника псевдорасборы составил 3 года, абботтины, горчака и гамбузии – 2 года, медаки, элеотриса и бычка – 1 год. Это меньше предельного возраста, известного для каждого вида в естественном ареале [23] и позволяет предположить эффективный контроль продолжительности жизни и соответственно численности чужеродных видов.

Из чужеродных видов, известных для бассейна реки Сырдарьи [2, 24], в пределах заказника не были обнаружены пестрый толстолобик *Aristichthys nobilis* (Richardson, 1845), чёрный амур *Mylopharyngodon piceus* (Richardson, 1846), многочешуйный анабарилиус *Anabarrilius polylepis* (Regan, 1904) и трегубка (треогуб) *Opsariichthys uncirostris* (Temminck et Schlegel, 1846). Пестрый толстолобик и чёрный амур являются ценными промысловыми видами, численность которых в пределах Республики Казахстан и ранее не была значительной [2]. Об обнаружении в р.Сырдарье многочешуйного анабарилиуса имеется единственное сообщение В.Е.Карпова [24 – на с.156]. Вероятно, натурализация этого вида до настоящего времени не произошла. Трегубка в бассейн р.Сырдарьи попала случайно при вселении белого амура и толстолобика из водоемов Китая [25, 26]. Единичными экземплярами, но постоянно этот вид попадает на всем протяжении казахстанского участка р.Сырдарьи [27].

В таблице 2 представлены показатели разнообразия сообществ молоди рыб в мелководных зонах старицы и самой реки. В относительно маловодные 2015 и 2016 годы на мелководьях реки доминировали молодь плотвы и жереха, а в наиболее многоводном 2017 г. – псевдорасборы. На мелководьях старицы в 2015 и 2016 годах доминировали чужеродный амурский бычок и молодь аборигенной плотвы. В наиболее многоводном 2017 г. на обоих участках доминировали чужеродные виды (рисунок).

Таблица 2 – Показатели разнообразия молоди рыб в Карагалинском заказнике, 2015-2017 гг.

Показатели	2015 год			2016 год		2017 год	
	река	старица	река вне ООПТ	река	старица	река	старица
Численность аборигенных видов, экземпляров:							
Карась	0	0	19	1	2	2	8
Сазан	0	0	0	3	0	0	0
Плотва	30	1	14	21	15	30	12
Быстрянка	0	0	0	0	3	0	0
Чехонь	0	0	0	0	0	0	3
Жерех	2	1	0	19	11	4	0
Окунь	0	0	0	3	0	0	0
Судак	6	0	0	0	0	0	0
Численность чужеродных видов, экземпляров:							
Абботтина	1	0	3	0	0	0	0
Псевдорасбора	0	1	2	0	4	26	15
Горчак	0	0	11	0	0	1	1
Востробрюшка	0	0	0	0	0	0	15
Толстолобик	0	0	0	1	2	0	0
Медака	0	0	1	0	0	10	11
Бычок	0	26	1	1	6	2	10
Элеотрис	0	0	7	0	2	6	2
Интегральные показатели:							
S, видов	4	4	8	7	8	8	9
N, экземпляров	39	29	58	49	45	81	77
D	1.62	1.24	4.53	2.92	4.83	3.78	6.64
E	0.40	0.31	0.57	0.42	0.60	0.42	0.74
H (log <sub>2</sub> )	1.06	0.64	2.44	1.89	2.58	2.19	2.86
e (log <sub>2</sub> )	0.53	0.32	0.81	0.67	0.86	0.69	0.90



Соотношение численности аборигенных и чужеродных видов в 2015-2017 гг.

Несмотря на доминирование чужеродных видов рыб на мелководьях, на глубине от 1 м и глубже и удалении более 5-10 м от берега во все годы исследований доминировали аборигенные виды рыб – плотва, жерех, чехонь, которые были представлены как взрослыми особями, так и молодь. Из чужеродных видов на глубине был обнаружен только змееголов.

На территории заказника единственным чужеродным видом хищных рыб является змееголов. В период исследований этот вид постоянно встречался в проточной старице. Изучение состава пищи змееголова показало, что он питается преимущественно аборигенными видами рыб – плотвой, карасем и сазаном. В отличие от аборигенных хищников змееголов предпочитает охотиться вблизи берега и охотно поедает мертвую рыбу. Эта особенность позволяет проводить селективное изъятие змееголова с помощью ловли на крючки, используя в качестве наживки куски рыбы. Из 18 пойманных на такую наживку рыб 16 были змееголовы, по одному разу поймались аборигенные судак и щука.

Для объяснения особенностей распределения различных видов были изучены условия обитания в самой реке, старице и оценены адаптивные особенности чужеродных видов рыб (таблица 3).

Таблица 3 – Адаптивные возможности чужеродных видов рыб р. Сырдарья

Виды рыб	Биотопы	Максимальная температура воды, °С		Максимальная мутность, FTU		Отсутствие водной растительности	
		juv.	adult	juv.	adult	juv.	adult
Белый амур	LC	28	28	9.12	81	I	0
Белый толстолобик	RLC	28	32	9.12	9.12	I	S
Горчак	RLTC	32	32	101	101	S	S
Псевдорасбора	LTC	34	34	101	101	S	S
Речная абботтина	LTC	34	34	81	81	S	S
Восточная гамбузия	LC	34	34	81	81	0	0
Медака	LC	34	34	81	101	0	0
Элеотрис	LTC	34	34	81	101	0	S
Змееголов	RLC	32	32	12.61	81	0	I
Китайский бычок	RLC	34	34	101	101	S	S

*Примечание.* Рыбы: juv. – молодь, adult – взрослые. Биотопы: L (lentic) – непроточные и слабопроточные, R (river) – крупные реки, T (tributary) – притоки р. Сырдарья, C (canal) – каналы. Встречаемость: U (usual) – обычный вид, S (seldom) – встречается иногда; I (infrequent) – встречается редко; 0 – не встречается.

Представленные в таблице 3 данные показывают, что многие чужеродные виды способны переносить температуру воды от 28 до 34 °С и тяготеют к слабопроточным или непроточным участкам, осваивая недоступную для аборигенных видов температурную зону. При снижении температуры воды в ночное время и при увеличении проточности аборигенные хищные виды рыб (преимущественно жерех) эффективно контролируют численность непромысловых чужеродных видов на участках, где водная растительность или густые корни деревьев отсутствуют.

До недавнего времени совместное влияние чужеродных видов и других негативных факторов на аборигенную биоту оставалось слабо изученным [9]. На основе полученных сведений становится ясной причина резкого увеличения численности короткоциклических чужеродных видов в наиболее многоводный год. Высокий уровень паводковых вод в весенний период создает благоприятные условия для нереста большинства аборигенных и чужеродных видов рыб. Следующее за этим падение уровня воды приводит к обособлению небольших водоемов, расположенных на пойменной террасе и усыхающем русле. В этих небольших водоемах повышение температуры воды до 28–32 °С приводит к элиминации аборигенных видов и способствует размножению мелких чужеродных видов рыб: псевдорасборы, бычка, медаки. Дальнейшая судьба чужеродных видов зависит от режима подачи воды:

1) при низком уровне воды они погибнут при высыхании водоема (как правило, до этого их успевают съесть птицы) – так было в 2015 и 2016 годах,

2) при повторном подъеме уровня и затоплении поймы чужеродные виды в полной мере смогут реализовать способность к многократному нересту, как это случилось в 2017 году.

Аборигенные хищники – жерех и судак эффективно контролируют численность чужеродных видов на открытых участках и слабо заросших мелководьях.

Наши исследования подтверждают факт неравномерного распределения чужеродных видов в связи со сложностью ландшафта и необходимость изучения взаимодействий аборигенных и чужеродных видов в локальном масштабе для последующей интеграции полученных данных для всего бассейна [28].

#### **Выводы:**

1. Неустойчивый гидрологический режим р. Сырдарья в течение лета способствует преимущественному размножению непромысловых чужеродных видов рыб на затопляемых мелководьях.

2. В условиях заповедного режима аборигенные хищные виды рыб эффективно контролируют численность чужеродных непромысловых видов на открытых участках водоемов.

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### **ҚАРҒАЛЫ ҚОРЫҒЫНДАҒЫ БӨГДЕ БАЛЫҚ ТҮРЛЕРІ (ҚАЗАҚСТАН РЕСПУБЛИКАСЫ, СЫРДАРІЯ ӨЗЕНІ)**

**Аннотация.** Сырдария өзені - Орталық Азиядағы ең маңызды өзендердің бірі. XX ғасырдың соңғы ширегінде су ресурстарын тиімсіз пайдалану нәтижесінде күрделі экологиялық дағдарыстар болды. Қазақстан Республикасының Үкіметі осы аймақтағы экологиялық жағдайларды жақсартуға бағытталған шаралар ұйымдастырады. Суқойма жағдайының көрсеткіштерінің бірі бөгде балық түрлерінің көптігі болып табылады. Сондықтан 2015-2017 жылдары Қарғалы мемлекеттік табиғи қорық аумағындағы бөгде балық түрлерінің қазіргі алуантүрлілігіне және динамикасына, балық қауымдастық құрамына балық аулауды болдырмаудың әсері туралы зерттеулер жүргізілді. Бұл қорық өзеннің жазық ағынының сегментінде орналасқан. Тіршілік ету ортасының негізгі екі түрі зерттелді: өзен және ағынды өзендер. Су құрамын және балықты зерттеудің дәстүрлі әдістері пайдаланылды. Кейбір ауыр металдар (Fe, Cu, Cd, Pb) және температура, лас тану, минералдану, рН, ерітілген оттегі зерттелді. Осы параметрлердің елеулі ауытқуы судың шығарылу режиміне және ихтиофауна алуантүрлілік құрылымын анықтауға байланысты. Мұнда барлығы 14 жергілікті және 11 бөгде балық түрлері кездесті. Бөгде балық түрлері ақ амур *Ctenopharyngodon idella*, ақ дөнмаңдай *Hypophthalmichthys molitrix*, жалған теңге - балық *Abbottina rivularis*, амур шабағы *Pseudorasbora parva*, құрлыққұрсақ *Hemiculter leucisculus*, теңбіл кекіре *Rhodeus ocellatus*, гамбузия *Gambusia holbrooki*, медака *Orizias sinensis*; элеотрис *Micropercops cinctus*; бұзаубас балық *Rhinogobius cheni* және жыланбас - балықтары *Channa argus* кездесті. Барлық шабақтар және ересек бөгде балық түрлері көрсетілген, бұл олардың тіршілік етуіне қолайлы жағдайлардың бар екенін көрсетеді. Экологиялық пластинкада балықтың біркелкі бөлінбеуі анықталды. Түрлер мен особтар санының өзгергіштігі гидрологиялық режимге байланысты. Ашық суқоймаларда жергілікті жыртқыш балық түрлері бөгде балық түрлерінің санын тиімді пайдалануға мүмкіндік береді. Судың тұрақсыз режимі бөгде балық түрлеріне қолайлы болып табылады.

**Түйін сөздер:** балық, фауна, жергілікті, бөгде, Сырдария, Қарғалы мемлекеттік табиғи қорық, абиотикалық фактор.

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## NEWS

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## INFLUENCE OF BIOCIDES ON GROWTH AND DEVELOPMENT OF CORROSIVE-DANGEROUS MICROFLORA

**Abstract.** The problem of protection of buildings and constructions from aggressive chemical and biological impacts of the environment becomes very urgent now. Microbiological corrosion is the important factor influencing reliability and durability of steel concrete designs. In this connection, the problem of protecting building constructions and structures from aggressive biological influences is of great urgency. The aim of the research was to study the effect of biocides based on copolymers and copper sulfate on the development of corrosive microorganisms. It has been established that copper sulfate possessed the least effective inhibitory effect on thione and sulfate-reducing bacteria (SRB). When it was added, the growth of the investigated bacteria was suppressed at a concentration of 1%. Copolymers with different mole composition were more active. Their effect on the inhibition of thiobacteria and SRB occurred at concentrations of 0.1-0.5%. The most sensitive to their effects were *T. ferrooxidans* and SRB. On heterotrophic bacteria and fungi, the compounds tested had a bactericidal effect only at a concentration of 1%. Copper sulfate was more effective with respect to micromycetes and yeast, while inhibition of their growth occurred at concentrations of 1% and 0.5%, respectively.

**Keywords:** biocorrosion, corrosive-dangerous microorganisms, thione and sulfate-reducing bacteria, heterotrophic microorganisms, biocides.

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## ВЛИЯНИЕ БИОЦИДОВ НА РОСТ И РАЗВИТИЕ КОРРОЗИОННО-ОПАСНОЙ МИКРОФЛОРЫ

**Аннотация.** Проблема защиты зданий и сооружений от агрессивных химических и биологических воздействий окружающей среды в настоящее время становится весьма актуальной. Микробиологическая коррозия является важным фактором, влияющим на надежность и долговечность железобетонных конструкций. В связи с этим большую актуальность представляет проблема защиты строительных конструкций и сооружений от агрессивных биологических воздействий. Целью исследований было изучение влияния биоцидов на основе сополимеров и медного купороса на развитие коррозионно-опасных микроорганизмов. Установлено, что наименее эффективным ингибирующим действием по отношению к тионовым и сульфатредуцирующим бактериям (СРБ) обладал медный купорос. При его добавлении рост исследуемых бактерий подавлялся при концентрации 1%. Более активное действие проявляли сополимеры с разным мольным составом. Их воздействие по ингибированию тионовых бактерий и СРБ происходило при концентрациях 0,1-0,5%. Самыми чувствительными к их воздействию были *T. ferrooxidans* и СРБ. На гетеротрофные бактерии и мицелиальные грибы исследуемые соединения оказывали бактерицидное действие только при концентрации 1%. Медный

купорос был более эффективен по отношению к микромицетам и дрожжам, при этом ингибирование их роста происходило при концентрациях 1% и 0,5% соответственно.

**Ключевые слова:** биокоррозия, коррозионно-опасные микроорганизмы, тионовые и сульфатредуцирующие бактерии, гетеротрофные микроорганизмы, биоциды.

**Введение.** Биологическая коррозия – это процессы повреждения металлов, металлоконструкций и других строительных материалов, вызванные продуктами жизнедеятельности живых организмов, поселяющихся на поверхности строительных конструкций. Значительную роль при биокоррозии играют такие микроскопические организмы, как бактерии и микроскопические грибы, для развития и размножения которых при определенных условиях эксплуатации зданий и сооружений создается благоприятная среда [1].

Сведения о роли микробиологического фактора в коррозии металлов и других материалов с каждым годом накапливаются, обобщаются, подсчитываются убытки, наносимые экономике. Многочисленность видов микробной коррозии свидетельствует о необычайно широком распространении этого явления в различных сферах деятельности человека [2-5]. Деятельностью микроорганизмов, по мнению ряда авторов, может быть обусловлено от 50 до 80% коррозионных повреждений [6-9].

Микробиологическая коррозия может протекать самостоятельно и сопровождать электрохимическую почвенную, атмосферную, морскую и другие виды коррозии металлов. Действие микроорганизмов на металлы может происходить различно. Прежде всего, коррозию металлов могут вызывать агрессивные метаболиты микроорганизмов: минеральные и органические кислоты и основания, ферменты и другие. Они создают коррозионно-активную среду, в которой в присутствии воды протекает коррозия по обычным законам электрохимии. Колонии микроорганизмов могут создавать на поверхности металлов наросты и пленки мицелия или слизи, под которыми может развиваться язвенная (питтинговая) коррозия [10-13].

Большую актуальность представляет собой проблема защиты строительных конструкций, зданий и сооружений от агрессивных химических и биологических воздействий окружающей среды. В общественных зданиях и сооружениях, в частности, в метрополитенах, в зонах с высокой влажностью и определенными климатическими условиями микробиологическая коррозия становится важным фактором, влияющим на надежность и долговечность конструкций из металла, бетона и железобетона.

Для защиты железобетонных конструкций от биологической коррозии эффективным и основным способом является обработка поверхности бактерицидными средствами. В их число входят синтетические биоциды, а также вещества, содержащие ионы металлов, которые при проникновении внутрь клетки ингибируют ферменты дыхательной цепи и нарушают процессы окислительного фосфорилирования, в результате чего клетка гибнет. Кроме того, при их воздействии возможно свертывание белков цитоплазмы [14-16].

Цель настоящей работы – изучить влияние биоцидов на основе сополимеров и медного купороса на развитие коррозионно-опасных микроорганизмов.

**Материалы и методы.** Были изучены бактерицидные свойства медного купороса и сополимеров N,N-диметил- N,N-диаллиламония хлорида (ДМДААХ) с N,N-диметилакриламидом (ДМАА) по отношению к тионовым бактериям и СРБ, а также гетеротрофным микроорганизмам. Сополимеры были синтезированы и предоставлены д.х.н., ассоциированным профессором АО «Казахстанско-Британский технический университет» К.Ж. Абдиевым.

Для культивирования бактерий *Thiobacillusthioparus* использовали среду Бейеринка, *Thiobacillusthiooxidans* – среду Ваксмана, *Thiobacillusferrooxidans* – среду 9К, *Thiobacillusdenitrificans* – Баалсруда. Сульфатредуцирующие бактерии (СРБ) выращивали на среде Постгейта В [17]. Для изучения влияния биоцидов на развитие этих бактерий их культивировали на соответствующих селективных средах, в которые вносились исследуемые биоциды в различных концентрациях: 0,01-1,0%. Их влияние оценивалось по наличию или отсутствию роста микроорганизмов.

Влияние биоцидов на рост гетеротрофных бактерий, мицелиальных грибов и дрожжей проверяли методом диффузии в агар из лунок на твердых питательных средах (питательный агар, картофельно-декстрозный агар и глюкозо-пептонный агар) при концентрациях 0,01-1%. Об их воздействии судили по зонам подавления роста этих микроорганизмов.

**Результаты и обсуждение.** Из поврежденных участков железобетонных конструкций были выделены тионовые и сульфатредуцирующие бактерии, а также гетеротрофные микроорганизмы. Были изучены бактерицидные свойства медного купороса и сополимеров N,N-диметил-N,N-диаллиламония хлорида (ДМДААХ) с N,N-диметилакриламидом (ДМАА) по отношению к выделенной микрофлоре. Использовались сополимеры с разным мольным составом:

- 1) ДМДААХ :ДМАА = 95:5 (Б1)
- 2) ДМДААХ :ДМАА = 80:20 (Б2)
- 3) ДМДААХ :ДМАА = 75:25 (Б3).

Результаты исследования показали, что развитие бактерий *Thiobacillusthiooxidans* отмечалось при концентрациях синтетических биоцидов и медного купороса 0,01-0,5%, более высокая концентрация 1% ингибировала рост этих бактерий (таблица 1).

Таблица 1 – Влияние исследуемых биоцидов на рост бактерий *T. Thiooxidans*

Биоцид	Концентрация биоцидов, %				
	0,01	0,05	0,1	0,5	1,0
Б1	+	+	+	+	–
Б2	+	+	+	+	–
Б3	+	+	+	+	–
CuSO <sub>4</sub>	+	+	+	+	–

*Примечание.* «+» - отмечен рост, «-» - рост отсутствует.

Развитие бактерий *T. ferrooxidans* подавлялось уже при более низких концентрациях исследуемых соединений. Так, под воздействием сополимеров Б1, Б2 и Б3 их рост не наблюдался при концентрации 0,1% (таблица 2). При использовании биоцида Б3 в концентрации 0,05% отмечался слабый рост этих бактерий. Менее эффективным оказался медный купорос, который подавлял их рост при концентрации 1%.

Таблица 2 – Влияние исследуемых биоцидов на рост бактерий *T. Ferrooxidans*

Биоцид	Концентрация биоцидов, %				
	0,01	0,05	0,1	0,5	1,0
Б1	+	+	–	–	–
Б2	+	+	–	–	–
Б3	+	+	–	–	–
CuSO <sub>4</sub>	+	+	+	+	–

*Примечание.* «+» - отмечен рост, «+» - слабый рост, «-» - рост отсутствует.

Для бактерий *T. thioparus* и *T. denitrificans* ингибирование роста происходило при концентрации синтетических соединений 0,5%. CuSO<sub>4</sub> подавлял рост этих бактерий при концентрации 1% (таблица 3, 4).

Таблица 3 – Влияние исследуемых биоцидов на рост бактерий *T. Thioparus*

Биоцид	Концентрация биоцидов, %				
	0,01	0,05	0,1	0,5	1,0
Б1	+	+	+	–	–
Б2	+	+	+	–	–
Б3	+	+	+	–	–
CuSO <sub>4</sub>	+	+	+	+	–

*Примечание.* «+» - отмечен рост, «-» - рост отсутствует.

Таблица 4 – Влияние исследуемых биоцидов на рост бактерий *T. Denitrificans*

Биоцид	Концентрация биоцидов, %				
	0,01	0,05	0,1	0,5	1,0
Б1	+	+	+	–	–
Б2	+	+	+	–	–
Б3	+	+	+	–	–
CuSO <sub>4</sub>	+	+	+	+	–

*Примечание.* «+» - отмечен рост, «-» - рост отсутствует.

СРБ реагировали на добавление сополимеров ДМДААХ и ДМАА, начиная с концентрации 0,1%. Медный купорос ингибировал рост бактерий, начиная с концентрации 0,5% (таблица 5).

Таблица 5 – Влияние исследуемых биоцидов на рост сульфатредуцирующих бактерий

Биоцид	Концентрация биоцидов, %				
	0,01	0,05	0,1	0,5	1,0
Б1	+	+	–	–	–
Б2	+	+	–	–	–
Б3	+	+	–	–	–
CuSO <sub>4</sub>	+	+	+	–	–

*Примечание.* «+» - отмечен рост, «-» - рост отсутствует.

Изучение влияния биоцидов на гетеротрофную микрофлору показало, что при концентрации 0,01-0,5% они не оказывали ингибирующего воздействия на бактерии и мицелиальные грибы. Их действие на рост микроорганизмов наблюдалось при концентрации 1% (таблица 6, 7).

Таблица 6 – Влияние исследуемых биоцидов на рост гетеротрофных бактерий

Культура	Зоны подавления роста под действием биоцидов, мм			
	Б1	Б2	Б3	CuSO <sub>4</sub>
A2-1	14,7±0,6	14,3±0,6	–	12,7±0,6
A2-2	14,3±0,6	14,7±0,6	–	14,3±0,6
A2-4	15,3±1,5	15,3±0,6	–	15,3±2,1
A2-6	14,0±1,0	15,7±1,2	–	16,0±1,0
A5-1	13,7±0,6	16,0±0,6	11,0±0	14,3±0,6
A5-2	16,0±5,2	17,0±0	11,0±0	7,3±1,2
A5-3	13,7±0,6	17,0±0	11,3±0,6	15,3±0,6
Г2-1	15,0±0	16,3±0,6	12,3±0,6	17,3±0,6
Г2-2	14,7±0,6	16,7±0,6	13,3±1,5	18,0±1,0
Г2-3	7,7±0,6	17,0±1,0	11,3±0,6	16,7±0,6
Г2-6	14,7±0,6	15,7±0,6	–	16,0±1,0
Г2-7	15,3±1,5	14,7±0,6	–	14,0±1,0
Г5-1	13,7±0,6	15,7±0,6	11,0±0	17,7±0,6
Г5-2	13,7±0,6	14,3±0,6	–	13,3±1,2

*Примечание.* Уровень значимости  $p < 0,05$ .

Из данных таблицы видно, что под воздействием биоцида Б1 зоны подавления роста бактерий составляли 7,7-16,0 мм. Менее чувствительной к данному соединению была культура Г2-3. Биоцид Б2 также воздействовал на все исследуемые культуры бактерий, зоны просветления при этом

составляли 14,3-17,0 мм. Менее эффективным среди синтетических биоцидов был Б3, при использовании которого зоны подавления роста наблюдались только у семи культур и составляли 11,0-13,3 мм.

На  $\text{CuSO}_4$  реагировали все исследуемые бактерии. Самая большая зона просветления отмечена у культуры Г2-2, которая составляла 18 мм. Менее чувствительным к действию медного купороса была культура А5-2 (7,3 мм).

Практически такое же воздействие исследуемые биоциды оказывали на мицелиальные грибы. Из данных таблицы 7 видно, что под воздействием биоцидов Б1 и Б2 зоны подавления роста грибов составляли 14,3-18,3 мм. Наиболее чувствительной к данным соединениям была культура *Penicilliumchrysogenum* 17ГМ. Рост этой же культуры подавлял и биоцид Б3, тогда как на другие культуры мицелиальных грибов он не оказывал угнетающего действия. Устойчивой к влиянию сополимеров была культура *Aspergillus* sp. 1ГМ.

Таблица 7 – Влияние исследуемых биоцидов на рост мицелиальных грибов

Культура	Зоны подавления роста под действием биоцидов, мм			
	Б1	Б2	Б3	$\text{CuSO}_4$
1ГМ	–	–	–	21,3±1,2
2ГМ	14,3±0,6	15,7±2,1	–	22,7±0,6
8ГМ	15,0±0,1	15,3±2,5	–	15,0±1,7
10ГМ	14,6±2,1	14,7±1,2	–	16,3±1,5
11ГМ	14,3±0,6	16,1±1,5	–	14,5±0,6
14ГМ	15,7±2,1	16,4±0,6	–	27,0±1,7
17ГМ	18,3±2,5	17,6±1,2	8,3±1,5	26,7±2,9

Примечание. Уровень значимости  $p < 0,05$ .

1% раствор медного купороса подавлял рост всех исследуемых микромицетов. Самые большие зоны просветления отмечены у культур 14ГМ и 17ГМ, которые составляли 27 мм и 26,7 мм соответственно. Менее чувствительными к действию медного купороса были культуры 11ГМ, 8ГМ и 10ГМ.

Дрожжи были более чувствительными к действию исследуемых соединений. Так, биоциды Б1 и Б2 оказывали на них угнетающее воздействие уже при концентрации 0,1% (таблица 8). С возрастанием концентрации зоны просветления на твердых питательных средах увеличивались. Более устойчивой была культура *Exophialasp.* 6гА. Соплимер Б3 не подавлял развитие исследуемых дрожжевых культур.

Таблица 8 – Влияние исследуемых биоцидов на рост дрожжей

Биоцид	Концентрация, %	Зоны подавления роста, мм		
		1гА	5гА	6гА
Б1	0,1	11,3±0,6	10,7±0,6	–
	0,5	15,3±1,5	15,7±1,2	11,7±1,5
	1,0	16,0±0	16,0±1,0	13,3±0,6
Б2	0,1	13,3±0,6	11,7±0,6	10,7±1,2
	0,5	15,3±0,6	12,3±2,1	11,0±1,0
	1,0	16,7±0,6	17,3±2,1	14,0±3,5
Б3	0,1	–	–	–
	0,5	–	–	–
	1,0	–	–	–
$\text{CuSO}_4$	0,1	–	–	–
	0,5	8,3±1,2	10,7±2,5	–
	1,0	31,7±1,5	23,0±2,6	19,7±1,5

Примечание. Уровень значимости  $p < 0,05$ .

Медный купорос начинал оказывать влияние на рост дрожжей 1gA и 5gA при концентрации 0,5%. Увеличение концентрации до 1% привело к значительному увеличению зон просветления. Более чувствительным оказался штамм *Erythrobasidiumcladesp.* 1gA.

**Выводы.** Таким образом, проведенные исследования показали, что наименее эффективными бактерицидными свойствами по отношению к тионовым и сульфатредуцирующим бактериям обладал медный купорос. При его добавлении рост исследуемых бактерий подавлялся при концентрации 1%, и только для СРБ развитие не наблюдалось при более низкой концентрации 0,5%. Более активное действие проявляли сополимеры N,N-диметил- N,N-диаллиламония хлорида (ДМДААХ) и N,N-диметилакриламидом (ДМАА) с разным мольным составом. Их воздействие по ингибированию тионовых и сульфатредуцирующих бактерий происходило при концентрациях 0,1-0,5%. Самыми чувствительными к их воздействию были *T. ferrooxidans* и СРБ.

На гетеротрофные бактерии и мицелиальные грибы исследуемые соединения оказывали бактерицидное действие только при концентрации 1%. Биоциды Б1 и Б2 обладали примерно одинаковой активностью, тогда как сополимер Б3 подавлял рост только 7 бактериальных культур и 1 грибной культуры. Развитие дрожжей сополимеры Б1 и Б2 ингибировали, начиная с концентрации 0,1%. Биоцид Б3 не оказывал подавляющего воздействия на все дрожжи. Медный купорос был более эффективен по отношению к микромицетам и дрожжам, при этом ингибирование их роста происходило при концентрациях 1% и 0,5% соответственно.

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### **КОРРОЗИЯЛЫҚ-ҚАУІПТІ МИКРОФЛОРАНЫҢ ӨСП-ӨНУІ МЕН ДАМУЫНА БИОЦИДТЕРДІҢ ӘСЕРІ**

**Аннотация.** Қазіргі таңда ғимараттар мен құрылыстарды қоршаған ортаның агрессивті химиялық және биологиялық әсерінен қорғау мәселесі өте өзекті болып келеді. Микробиологиялық коррозия темірбетон конструкцияларының сенімділігі мен ұзақ мерзімділігіне ықпал ететін маңызды фактор болып табылады. Осыған байланысты, құрылыстар конструкциясы мен ғимараттарды агрессивті биологиялық әсерден қорғау мәселесі өте өзекті. Зерттеудің мақсаты коррозиялық-қауіпті микроорганизмдердің дамуына сополимерлер мен мыс сульфаттарының негізіндегі биоцидтердің әсерін зерттеу болып табылады. Мыс сульфаты тионды және сульфатредуцирлеуші бактерияларды (СРБ) азайтуға қарсы ең аз тиімді ингибиторлық әрекетке ие екендігі анықталды. 1% концентрация қосылған кезде зерттелген бактериялардың өсуі баяулады. Әртүрлі молярлық құрамды сополимерлер анағұрлым белсенділік көрсетті. Олардың СРБ және тионды бактерияларды баяулату әсері 0,1-0,5% концентрациясында орын алды. Олардың әсеріне ең сезімтал *T. ferrooxidans* және СРБ болды. Гетеротрофты бактериялар мен жіпшумақты саңырауқұлақтарда сыналған қосылыстар тек 1% концентрацияда бактерицидтік әсерге ие болды. Мыс сульфаты микромицеттер мен ашытқыларға қатысты тиімді болғанымен, олардың өсуінің баяулауы тиісінше 1% және 0,5% концентрация кезінде байқалды.

**Түйін сөздер:** биокоррозия, коррозиялық-қауіпті микроорганизмдер, тионды және сульфатредуцирлеуші бактериялар, гетеротрофты микроорганизмдер, биоцидтер.

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**APPROBATION OF ACCELERATED BIOTECHNOLOGICAL  
PRODUCTION OF ELITE SEED POTATOES FOR ENSURING  
SEED INDUSTRY IN THE REPUBLIC OF KAZAKHSTAN**

**Abstract.** Production of healthy seed mini-tubers is the basis for obtaining high-quality potato seed material. The technology of pilot production of elite seed potatoes on a small scale has been developed and tested (approved) in order to accelerate the production of domestic potato seed material. The prospects of this technology application are shown with use/availability of modern greenhouse complexes at the first stages of the technological process of “super-superelite” category of minituber material production. Virus free plants-regenerants of domestic high-yielding “Aksor” cultivar were obtained from a small number of tubers and propagated with the use of micrograftage method. Minitubers for the production of super-superelite seed material were obtained from the regenerant plants under conditions of closed (isolated) soil/ground in the first year. In the second year of the project superelite potato seeds were obtained from super-superelite minituber material under field conditions and were transferred to the elite seed-growing farms for further production of seeds of “elite” category in the third year of the project implementation.

Features of this technology consist in a continuous process of obtaining healthy test-tube plants (*in vitro*) and minitubers within 3 years. Conducting regular excavation of tuber material during the cultivation of plants in the greenhouse leads to an increase in the amount of minitubers harvest from one generation, as well as to cyclical production of super-superelite material 2 times a year. Results are the following: reduction of the period of elite seeds production to 3 years, a low demand for production areas, a slowdown in the norms of seed material consumption and a high coefficient of its reproduction.

**Key words:** potato, *in vitro* cultures, virus free plants-regenerants, microclonal propagation, potato original seeds, minitubers, potato elite seed material.

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**АПРОБАЦИЯ УСКОРЕННОГО БИОТЕХНОЛОГИЧЕСКОГО  
ПРОИЗВОДСТВА ЭЛИТНОГО СЕМЕННОГО КАРТОФЕЛЯ  
ДЛЯ ОБЕСПЕЧЕНИЯ СЕМЕНОВОДСТВА  
В РЕСПУБЛИКЕ КАЗАХСТАН**

**Аннотация.** Производство оздоровленных семенных мини-клубней является основой для получения высококачественного семенного материала картофеля. Для ускоренного получения отечественного семенного материала картофеля разработана и апробирована технология пилотного производства элитного



семенного картофеля в малых промышленных масштабах. Показана перспективность ее применения при наличии современных тепличных комплексов на первых этапах технологического процесса получения миниклубневого материала категории «суперсуперэлита». Из небольшого числа клубней получены и размножены методом микрочеренкования безвирусные растения-регенеранты отечественного высокоурожайного сорта картофеля «Аксор». Из растений-регенерантов в условиях закрытого грунта в первый год получены миниклубни для производства супер-суперэлитного семенного материала. Из клубневого материала супер-суперэлита на второй год в полевых условиях получены суперэлитные семена картофеля и переданы в элит-семхоз для производства семян категории «элита» уже на третий год выполнения проекта.

Особенности данной технологии заключаются в непрерывном процессе получения оздоровленных пробирочных растений (*in vitro*) и миниклубней в течение 3-х лет. Проведение регулярной выемки клубневого материала во время культивирования растений в теплице приводит к увеличению количества урожая миниклубней с одного поколения, а также циклическому получению супер-суперэлитного материала 2 раза в год. Результатами являются сокращение сроков производства элитных семян до 3 лет, низкая потребность в производственных площадях, снижение норм расхода семенного материала и высокий коэффициент его размножения.

**Ключевые слова:** картофель, культуры *in vitro*, безвирусные растения – регенеранты, микроклональное размножение, оригинальные семена картофеля, миниклубни, элитный семенной материал картофеля.

Картофель является важнейшей продовольственной, технической и кормовой культурой. Также, являясь самым важным и значимым в мире растительным источником пищевой энергии, витаминов, минеральных веществ и антиоксидантов среди незлаковых растений, картофель представляет собой уникальный продукт для здорового питания. Клубни картофеля содержат в среднем 76–78 % воды, 17–19 % крахмала, 1–2 % белков, примерно 1 % минеральных веществ и витамины [1]. В Казахстане приоритетным направлением его применения служит производство картофеля для обеспечения продовольственной безопасности нынешнего и будущих поколений страны. За последние несколько лет производство картофеля в стране по рентабельности является одним из наиболее перспективных отраслей сельского хозяйства (от 50% до 300%) [2].

Однако вопрос производства высококачественного семенного материала на сегодняшний день остается одним из наиболее острых в этой отрасли по ряду причин. Семеноводческие хозяйства по производству оригинального и элитного семенного материала картофеля имеются не во всех регионах республики и не покрывают всех потребностей картофелевыращивающих хозяйств высококачественными семенами местных сортов, так как большая часть территории нашей страны не пригодна для возделывания картофеля ввиду сложных природно-климатических условий [3]. В настоящее время на территории Казахстана под выращиванием картофеля занято более чем 190 тыс. га земельных ресурсов и основными регионами, в которых отмечен наибольший валовый сбор картофеля являются Алматинская, Южно-Казахстанская, Павлодарская, Жамбылская и Северо-Казахстанская области [4]. При ежегодном собственном производстве картофеля, ориентированном только на внутренний рынок, нужды потребителей покрываются всего на 50 - 60%, а остальной объем рынка занимает привозной картофель самого разного качества из России, Киргизии, Китая и Пакистана [5,6]. Нехватка качественного исходного посадочного материала отечественных сортов картофеля в стране вызывает необходимость ввоза семян картофеля сортов зарубежной селекции, которые не адаптированы к местным природно - климатическим условиям, теряют свои качественные характеристики, становятся восприимчивыми к болезням, вследствие чего снижается урожайность и дальнейшее воспроизводство становится нецелесообразным. [7].

Таким образом, для повышения эффективности картофелеводства в республике необходима организация высокотехнологичной и рентабельной системы безвирусного семеноводства картофеля.

Существующая схема производства семенного картофеля категорий «суперэлита» и «элита» традиционным способом требует от 4 до 6 лет, при этом выращиваемый в полевых условиях семенной картофель подвергается высокому риску заражения вирусными и бактериальными болезнями, что в значительной мере снижает его качество и сроки использования в дальнейших репродукциях.

При использовании новой схемы ускоренного получения оздоровленного семенного элитного материала на биотехнологической основе значительно сокращается риск заражения миниклуб-

нового материала за счет его культивирования в тепличном комплексе, а также сокращаются сроки производства элитного семенного материала картофеля на один год.

В лаборатории биоинженерии растений разработана схема ускоренного получения оздоровленного семенного элитного материала, основанная на том, что в первый год из небольшого числа клубней методом микрочеренкования получают и размножают безвирусные растения-регенеранты отечественного высокоурожайного сорта картофеля и миниклубни → на второй год в условиях закрытого и открытого грунта получают миниклубни, супер-суперэлитный и суперэлитный семенной материал → на третий год из клубневого материала суперэлиты в полевых условиях получают элитные семена картофеля, которые передают в элитсемхоз для дальнейшего производства семенного картофеля.

Пилотное биотехнологическое производство безвирусной элитной семенной продукции картофеля отечественных сортов на базе, разработанной в лаборатории технологии культивирования, позволило опытным путем произвести оценку рентабельности данной технологии, выявить слабые и сильные стороны данной схемы семенного производства, а также оценить перспективность такого подхода для решения проблемы обеспечения картофелевыращивающих фермерских и крестьянских хозяйств элитным семенным материалом отечественных сортов картофеля.

Клоновый отбор исходного клубневого материала картофеля, выгонку меристемного материала и получение оздоровленных пробирочных растений в условиях *in vitro* проводили на каждом повторяющемся цикле в течение каждого года.

В качестве исходного клубневого материала картофеля выбран картофель отечественного сорта «Аксор», урожая 2015 г., полученного от оригинатора сорта Казахского института картофелеводства и овощеводства. Картофель сорта «Аксор» - относительно жаростойкий и засухоустойчивый, среднеспелый, среднеурожайный. Производственный потенциал урожайности находится в пределах 55 т/га. Содержание крахмала 18 %. Относительно устойчив к заболеваниям, универсального назначения [8].

Первичные пробирочные растения-регенеранты получали методом вычленения апикальных меристем из здоровых, стерилизованных клубней картофеля в сочетании с термотерапией [9]. Апикальные меристемы помещали на универсальную среду Мурасиге и Скуга (МС) и культивировали в помещении с контролируемым световым и температурным режимом [10,11] (рисунок 1).



Рисунок 1 – Получение пробирочных растений из апикальной меристемы картофеля

Микроклональное размножение первичных пробирочных растений картофеля проводили стандартным способом микрочеренкования [12].

Пробирочные растения-регенеранты картофеля проверяли на инфицированность вирусами PVY, PVM, PRVL с помощью диагностических наборов для определения вирусов картофеля. Оценку результатов ИФА осуществляли на фотометре при длине волны 450 нм. В результате тестирования обнаружено отсутствие вирусной инфекции в 19 из 21 партий (по 15 образцов) пробирочных растений картофеля. Партии пораженных растений, показавшие наличие М вируса картофеля, уничтожены.

Здоровые растения тиражировали для перевода в условия *ex vitro* и получения миниклубней картофеля в закрытом грунте. На первом этапе получено 350 первичных пробирочных растений картофеля сорта «Аксор» из 19 линий. На второй и третий год в условиях *in vitro* получено 252 первичных пробирочных растения из 21 линии и 800 первичных пробирочных растений, из 7 линий картофеля сорта «Аксор» соответственно.

На первом этапе укоренения и адаптации к естественному световому и температурному режиму, растения-регенеранты картофеля пересаживали в индивидуальные пластиковые стаканчики с автоклавированной почвенной смесью (торф - земля - песок в соотношении 1:1:0,1). Растения отмывали питательной MS средой, пересаживали в асептическую почву и помещали в светокультуральную климатическую комнату с 18-ти часовым световым днем, влажностью 70%, освещением 3000-5000 люкс и температурой: днев. + 25<sup>0</sup>С / ночн. + 22<sup>0</sup>С. Полив осуществляли по мере подсыхания грунта модифицированным питательным раствором Кноппа для нормального роста и развития растений.

Второй адаптационный этап культивирования проводили через 3 недели после высадки пробирочных растений в грунт. Влажность воздуха в климатической комнате снижали до 56%, температурный режим оставался прежним, полив растений осуществляли дважды в неделю. Процент выживших растений картофеля на данном этапе составил 92% от количества растений, прошедших первый этап адаптации. Адаптированные пробирочные растения картофеля сорта «Аксор» переданы в элитно-семеноводческое крестьянское хозяйство «Оркен» для получения оригинальных семян.

*Получение миниклубней (оригинальных семян) картофеля.* В первый год из пробирочных растений в элитно-семеноводческом крестьянском хозяйстве «Оркен» в ходе выращивания в закрытом грунте получен урожай миниклубневого материала картофеля сорта «Аксор» в количестве в количестве 5 400 шт., что составило 270 кг.

На второй год из 2500 оздоровленных пробирочных растений в тепличном комплексе к/х «Оркен» в зимний период получен урожай миниклубневого материала картофеля сорта «Аксор» в количестве 2000 шт.

Для непрерывного цикла получения миниклубней все адаптированные пробирочные растения картофеля в весенний период следующего года высаживали в открытый грунт.

Таким образом, на второй год реализации проекта, из новой партии 5000 оздоровленных пробирочных растений в условиях теплицы и поля получено 90 кг миниклубневого материала картофеля, на третий год - 52 кг миниклубней (рисунок 2).



Рисунок 2 – Урожай миниклубней сорта «Аксор»

*Производство супер-суперэлитного семенного материала из оригинальных семян в условиях теплицы.* В первый год реализации проекта из 2500 оздоровленных пробирочных растений в полевых условиях к/х «Оркен» получен миниклубневый материал картофеля, который находился на хранении с октября по декабрь. За время хранения миниклубневого материала за счет естественной убыли из 5400 шт. миниклубней жизнеспособность сохранили около 3500 миниклубней картофеля.

В январе второго года миниклубневый семенной материал картофеля был помещен на проращивание при температуре  $+18^{\circ} + 20^{\circ}\text{C}$  в течение 14 дней и высажен в тепличном комплексе элитселекционного хозяйства «Оркен» для получения суперсуперэлитного семенного материала картофеля сорта «Аксор». В ходе культивирования растений в теплице в зимний период проведены все необходимые агротехнические мероприятия, собран урожай суперсуперэлитного картофеля в количестве 150 кг и помещен на краткосрочное хранение для дальнейшей высадки в весенний период.

*Производство «суперсуперэлитного» семенного материала из оригинальных семян в условиях поля на второй и третий год.* На второй год реализации проекта в открытый грунт высадили 2000 миниклубней картофеля сорта «Аксор», полученных в теплице в зимний период. На третий год в полевые условия высадили 81 кг миниклубней картофеля. В ходе культивирования растений в полевых условиях проводили все необходимые агротехнические мероприятия по уходу за растениями. Урожай семенного картофеля категории «суперсуперэлитита» собирали во второй декаде октября второго и третьего года (рисунок 3). Осенью второго года реализации проекта получено 480 кг суперсуперэлитного материала картофеля, что составляет примерно 80% от исходно ожидаемого урожая. Семенной картофель категории суперсуперэлитита помещали на хранение и последующую высадку весной.

Осенью третьего года собрано 1000 кг картофеля категории «суперсуперэлитита», что составляет примерно 100% от исходно ожидаемого урожая. Семенной картофель категории «суперсуперэлитита» помещен в к/х «Оркен» на хранение и анализ качества полученного семенного картофеля.



Рисунок 3 – Семенной картофель категории «суперсуперэлитита» сорта «Аксор»

Получение семенного материала категории «суперэлитита» в полевых условиях и передача элитселекционным хозяйствам Алматинской области для производства элитных семян и оценки его качества

На второй год с учетом неблагоприятных весенних погодных условий в открытый грунт высадили 150 кг семенного материала категории «суперсуперэлитита» сорта «Аксор». На третий год в полевых условиях высадили 432 кг семенного материала «суперсуперэлитита» сорта «Аксор», урожая предыдущего года.

Сбор урожая картофеля проводили во второй декаде октября второго года и в 3–4 декаде октября третьего года (рисунок 4).

На второй год получен урожай – 315 кг картофеля категории суперэлитита сорта «Аксор» и помещен на хранение в элитно-семеноводческое крестьянское хозяйство «Оркен». На третий год урожай картофеля категории «суперэлитита» составил порядка 4 000 кг. Семенной материал категории «суперэлитита» передан собственнику элитно-семеноводческого крестьянского хозяйства «Оркен» для дальнейшего производства элитных семян и оценки его качества.

*Получение элитного семенного материала.* С учетом негативных весенних погодных условий семенной материал картофеля категории «суперэлитита» в количестве 283 кг высажен в полевые условия на территории крестьянского хозяйства «Оркен». В ходе культивирования растений в полевых условиях проводились все необходимые агротехнические мероприятия по уходу за растениями и в первой декаде октября произведен сбор урожая семенного материала картофеля сорта «Аксор» категории «элитита» в количестве 5000 кг. Семенной материал категории «элитита»





Рисунок 4 – Сбор урожая картофеля категории суперэлита

передан собственнику элитно-семеноводческого крестьянского хозяйства «Оркен» для дальнейшего производства элитных семян и оценки его качества.

Разработанная и апробированная новая схема ускоренного биотехнологического получения оздоровленного семенного элитного материала показала возможность сокращения сроков производства семенного материала категории «элита» до трех лет и получения миниклубневого и супер-суперэлитного семенного материала картофеля в зимний период в условиях теплицы.

Ключевыми факторами успешной реализации апробируемой схемы производства являются наличие эффективно работающего тепличного комплекса для культивирования пробирочных и взрослых растений первого поколения. Результаты первого года показали успешность применяемых биотехнологических методов для получения и тиражирования в промышленных масштабах оздоровленных пробирочных растений-регенерантов. Результаты второго года также показали перспективность применения культивирования растений в тепличном комплексе для получения семенного материала миниклубней и суперсуперэлита. Эффективность технологии получения семенного материала на третий год - получено семенного материала категории «элита» - 5 тонн (100%), «суперэлита» - 4 тонны (80%), «суперсуперэлита» - 1 тонна (100%) и оригинального семенного материала (миниклубни) - 1800 шт. - 52 кг (2%).

Таким образом, полученные результаты показали перспективность применения данной ускоренной технологии для производства элитного семенного картофеля с учетом выявленных слабых мест (недостаточности финансирования и влияния климатических факторов), что позволит в дальнейшем предположить возможность внедрения данной технологии в производство.

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**ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ ТҰҚЫМ ӨНДІРІСІН ҚАМТАМАСЫЗ ЕТУ  
МАҚСАТЫНДА ЭЛИТТІ ТҰҚЫМДЫҚ КАРТОПТЫҢ BIOTEХНОЛОГИЯЛЫҚ ӨНДІРІСІНІҢ  
ЖЫЛДАМДАТЫЛҒАН АПРОБАЦИЯСЫ**

**Аннотация.** Сауықтырылған тұқымдық мини-түйнектерді өндіру картоптың жоғары сапалы тұқымдық материалын алудың негізі болып табылады. Картоптың тұқымдық отандық материалын жылдамдата алу үшін азғана өндірістік масштабта элиталық тұқымдық картоптың пилоттық өндіріс технологиясы жасап шығарылды және қабылданды. Бұл технологияны жаңа заманға сай жылыжай құрылғылары болған жағдайда «суперсуперэлита» категориясына жататын минутүйнектік материалды алудың технологиялық процесінің бірінші сатысында пайдаланудың болашағы бар екендігі көрсетілді. Түйнектің азғана мөлшерінен микрокалемшелеу әдісімен картоптың отандық өнімділігі жоғары «Аксор» сортының сауықтырылған регенерант-өсімдіктері алынды және көбейтілді. Бірінші жылы регенерант-өсімдіктерден жабық топырақ жағдайында супер-суперэлиталық тұқымдық материал алу үшін минутүйнектер алынды. Екінші жылы егістік жағдайында супер-суперэлитаның тұқымдық материалдарынан картоптың суперэлиталық тұқымы алынды және элиталық тұқым шаруашылығы жобасының үшінші жылдық жобасына өндіруге «элита» категориясына жататын тұқым берілді.

Бұл технологияның ерекшелігі сауықтырылған пробиркалық өсімдік (*in vitro*) пен минутүйнектерді 3 жыл бойы үздіксіз алуға негізделген. Жылыжайда өсімдікті өсіру кезінде түйнектік материалды жүйелі түрде қазып алу. Бір ұрпақтан минутүйнектердің өнімінің санының артуы. Супер-суперэлиталық материалды жылына екі рет алу мүмкіндігі. Элиталық тұқым өндіру уақытының 3 жылға дейін қысқаруы, өндіріс аумағының қажеттілігінің азаюуы, тұқымдық материалдың шығынының төмендеуі және оны көбейту коэффициентінің жоғары болуы осы технологияның нәтижелері болып табылады.

**Түйін сөздер:** картоп, *in vitro* өскен клеткалар, сауықтырылған регенерант-өсімдік, микроклондау арқылы көбейту, картоптың бастапқы тұқымы, мини түйнек, картоптың элиталық тұқымдық материалы.

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## NEWS

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### **THE FREQUENCY AND IMPACT OF PREMENSTRUAL SYNDROME ON THE QUALITY OF LIFE OF MEDICAL STUDENTS IN ALMATY**

**Abstract.** Data on the frequency and severity of premenstrual syndrome (PMS) range from 30 to 95%. According to US statistics, 70 to 90% of US women of reproductive age experience some manifestations of PMS; severe forms are registered in 5-8% of women; every third woman has a decrease in her quality of life [1]. According to M. Steiner (2000), PMS is recorded in more than 75% of Canadian women [2], and in Japanese women this percentage reaches 95% with severe symptoms of PMS reported by 1.2% [3].

Some of recent studies have established a significant prevalence of PMS in young girls. N. Nisar (2008) in her study reports that 51% of students were diagnosed with PMS, 5.8% experienced premenstrual dysphoric disorder (PMDD) [4]. According to the study by G. Pinar (2011), the incidence of PMS among students was 72.1% [5].

Many women report that premenstrual symptoms have a significant negative impact on their daily lives, they experience deterioration of various social and individual functions, such as a reduced working capacity, social activity and family relationships, including the sexual sphere.

**Keywords:** premenstrual syndrome, quality of life, frequency and severity of premenstrual syndrome, premenstrual dysphoric disorder.

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### **ЧАСТОТА ПРЕДМЕНСТРУАЛЬНОГО СИНДРОМА И ЕГО ВЛИЯНИЕ НА КАЧЕСТВО ЖИЗНИ СТУДЕНТОК МЕДИЦИНСКИХ УНИВЕРСИТЕТОВ г. АЛМАТЫ**

**Аннотация.** Данные о частоте и тяжести предменструального синдрома (ПМС) колеблются в широких пределах – от 30 до 95%. Согласно статистики США, в стране от 70 до 90% женщин репродуктивного возраста испытывают те или иные проявления ПМС, тяжелые формы зарегистрированы у 5-8% женщин, у каждой третьей отмечается снижение качества жизни [1]. В Канаде, по данным М. Steiner (2000), ПМС фиксируется более чем у 75% женщин [2], а у жительниц Японии этот показатель достигает 95%, тяжелая степень симптомов ПМС выявлена у 1,2% японских женщин [3].

В ряде последних исследований установлена значительная распространенность ПМС у молодых девушек. В исследовании N. Nisar (2008) у 51% студенток был установлен диагноз ПМС, у 5,8% - клиника расценена как предменструальное дисфорическое расстройство (ПМДР)[4]. В исследовании G. Pinar (2011) распространенность ПМС среди студентов составила 72,1 % [5].

У многих женщин предменструальные признаки оказывают существенное отрицательное воздействие на их повседневную жизнь, отмечается нарушение различных социальных и индивидуальных функций - снижение работоспособности, социальной активности и взаимоотношений в семье, включая сексуальную сферу.

**Ключевые слова:** предменструальный синдром, качество жизни, частота и тяжесть предменструального синдрома, предменструальное дисфорическое расстройство.

**Введение.** ПМС – «предменструальный синдром» или «синдром предменструального напряжения» – это состояние, которое характеризуется различными циклически повторяющимися симптомами (физическими, эмоциональными, поведенческими и познавательными), которые развиваются во второй фазе менструального цикла и исчезают вскоре после начала менструации [6]. В ряде исследований показано, что ПМС развивается чаще у женщин, занимающихся умственным трудом, у пациенток с синдромом вегетативной дистонии, а также в 4 раза чаще наблюдается у женщин с дефицитом массы тела. Данный синдром может возникать под воздействием различных факторов, обусловленных физическим или умственным перенапряжением, профессиональными проблемами, социальной незащищенностью, хроническим эмоциональным стрессом. [7]. При изучении влияния ПМС на качество жизни выявлено следующее: увеличиваются прогулы, снижается производительность труда, качество профессиональной деятельности. Негативное влияние на социальные отношения ведет к ухудшению межличностных отношений на рабочем месте. Исследования, проведенные среди студенток медицинского вуза в университете Урмия (Иран) в 2014 году, ПМС выявили в 39,4 % случаев. Оценка качества жизни была низкой в более чем в половине случаев, особенно в психотических и социальных компотентах. Результаты данного исследования показывает, что ПМС отрицательно влияет на некоторые домены качества жизни.

**Материалы и методы исследования.** В рамках исследования проведено анонимное анкетирование студенток медицинских университетов г. Алматы по 2-м анкетам одновременно. Анкета по выявлению ПМС разработана исследователями. Оценка качества жизни проводилась по опроснику SF-36 (The Short Form-36). SF-36 относится к неспецифическим опросникам для оценки качества жизни, он широко распространен в США и странах Европы при проведении научных исследований. Он может применяться как у здоровых, так и больных людей и является «золотым» стандартом исследования качества жизни. Анкетирование проводилось на добровольной основе. Материалом для проведения исследования послужили данные, полученные в результате анкетирования по специально разработанной и апробированной анкете 1500 студенток. Дизайн исследования соответствовал критериям одномоментного клинического исследования, анкетирование проводилось в течение 2-х месяцев. Численность сформированной выборки - 2061, из них 561 анкет, что составило 27,2%, оказались неправильно заполненными, многие графы остались пустыми, не корректно заполнены пункты по качеству жизни.

**Результаты собственных исследований.** Средний возраст опрошенных составил  $24 \pm 4,3$  года. Все студентки, вошедшие в исследование, были жителями Республики Казахстан. Условия проживания всех студенток было удовлетворительным. Состояло в браке 28,0%, при этом половая жизнь была у 54,0% респондентов. Структура применяемых методов контрацепции среди респондентов, живущих половой жизнью выглядело следующим образом: комбинированные оральные контрацептивы -  $26,0 \pm 5,2\%$ , презервативы -  $48,1 \pm 4,3\%$ , внутриматочные спирали -  $10,0 \pm 5,7\%$ , не применяли методы контрацепции -  $15,9 \pm 5,6\%$ . Отсутствие методов контрацепции у 15,9% девушек, живущих половой жизнью, низкий уровень использования эффективных современных методов предохранения от нежелательной беременности послужили причиной производства аборта у 13,0% респондентов исследуемой группы. Экстрагенитальные заболевания в анамнезе у изучаемой группы студенток зарегистрированы у 38,8%. Причем на каждую студентку данной группы пришлось по 3,3 различных экстрагенитальных заболеваний.



Наиболее частыми симптомами, сопровождающие менструации в исследуемой группе студенток, была раздражительность и плохое настроение в  $58,0 \pm 2,2\%$  и  $59,5 \pm 2,2\%$  случаев. В  $34,5 \pm 2,1\%$  случаев раздражительность переходила в агрессивность. Достаточно часто наблюдалось вздутие живота ( $41,0 \pm 2,2\%$ ), тошнота ( $20,0 \pm 1,8\%$ ) и рвота ( $11,0 \pm 1,4\%$ ). Каждая третья студентка испытывала нагрубание и боли в молочных железах ( $32,5 \pm 2,1\%$  и  $32,0 \pm 2,1\%$ ). Нередко респонденты отмечали появление головной боли ( $30,5 \pm 2,1\%$ ), реже жаловались на боли за грудиной ( $7,5 \pm 1,2\%$ ) и изменения уровня артериального давления ( $14,5 \pm 1,6\%$ ). Выраженность симптомов заставило  $39,5\%$  студенток для облегчения состояния, использовать обезболивающие средства. Нарушение работоспособности, пропуск занятий во время менструации отметили  $34,5\%$  студенток. Несмотря на выраженность симптомов во время менструации, пропуски занятий, за медицинской помощью обратились только  $12,4\%$  студенток. Результаты исследования по частоте ПМС, показали, что  $57,4 \pm 1,6\%$  студенток не испытывали изменений в состоянии здоровья или испытывали единичные симптомы, ПМС у  $36,0 \pm 2,14\%$  респондентов, а самая тяжелая форма зарегистрирована у  $6,6 \pm 1,11\%$  (таблица №1).

Таблица 1 – Частота предменструального синдрома и предменструального дисфорического расстройства среди респондентов исследуемой группы

Нет симптомов или единичные симптомы предменструального синдрома		Предменструальный синдром		Предменструальное дисфорическое расстройство			
abc	%	abc	%	abc	%		
8	1	57,4	$1,6$	540	$36,0 \pm 2,1$	99	$6,6 \pm 1,1$

Наши исследования показали, что наличие экстрагенитальных заболеваний у студенток значительно повлияли на частоту ПМС и ПМДР. Так, частота ПМС у студенток с ЭГЗ составила  $63.9 \pm 3.4\%$ , у здоровых без ЭГЗ данный показатель оказался  $18,3 \pm 4.83\%$  ( $P < 0,05$ ) (таблица №2).

Таблица 2 – Частота предменструального синдрома и предменструального дисфорического расстройства в зависимости от наличия ЭГЗ среди респондентов исследуемой группы

Нет симптомов или единичные симптомы предменструального синдрома		Предменструальный синдром		Предменструальное дисфорическое расстройство	
с ЭГЗ	без ЭГЗ	с ЭГЗ	без ЭГЗ	с ЭГЗ	без ЭГЗ
%	%	%	%	%	%
$23,3 \pm 1,7$	$79,1 \pm 1,3$	$63.9 \pm 3.4^*$	$18.3 \pm 4.8$	$12.8 \pm 2.3^*$	$2.6 \pm 0.9$

\* $p < 0.05$  статистическая достоверная разница в частоте собственно ПМС и ПМДР среди респондентов с ЭГЗ в сравнении с группой респондентов без ЭГЗ.

Статистически достоверная разница была и в частоте самой тяжелой формы ПМДР. В группе с ЭГЗ частота ПМДР  $12,8 \pm 2,3\%$ , без ЭГЗ  $2,6 \pm 0,9\%$  ( $P < 0,05$ ). Возможно, значительное колебание частоты ПМДР по данным различных авторов от  $5,8\%$  до  $36,1\%$ , связано с тем, что в исследуемых группах не учитывалось наличие или отсутствие экстрагенитальных заболеваний.

Из 810 студенток, живущих половой жизнью, современные методы контрацепции использовали только 210, что составило  $25,9\%$ . Сравнение частоты различных проявлений ПМС в двух группах студенток показало значительное влияние приема КОК на течение данного синдрома. Так, в группе респондентов, применявших комбинированные оральные контрацептивы, отмечена статистически достоверная разница в проявлении практически всех симптомов, кроме агрессивности.

Понятие качества жизни - это индивидуальная способность к функционированию в обществе (трудовая, общественная деятельность, семейная жизнь), а также как комплекс физических, эмоциональных, психических и интеллектуальных характеристик человека. Результаты опросника SF-36 представляются в виде оценок в баллах по 8 шкалам, составленных таким образом, что более высокая оценка указывает на более высокий уровень качества жизни. У студенток-медиков без ПМС показатели физического функционирования (PF- $87,4 \pm 1,6$ ), ролевого функционирования, обусловленное физическим состоянием (RP- $84,2 \pm 2,4$ ) интенсивности боли (BP- $84,0 \pm 1,9$ ), ролевого

Таблица 3 – Частота различных симптомов сопровождающих период менструации в зависимости от используемого метода контрацепции среди респондентов исследуемой группы

Симптомы	Пользуются контрацепцией (КОК) N=210		Не применяют методы контрацепции или применяют другие методы (ВМС, барьерный метод) N=600		P
	абс	%	абс	%	
Раздражительность	189	40,3±5,8	279	59,7±3,4	<0,01
Плаксивость	72	34,7±5,6	135	65,3±3,3	<0,001
Обидчивость	87	26,6±5,2	240	73,4±3,1	<0,001
Плохое настроение	129	26,8±5,2	351	73,2±3,1	<0,001
Агрессивность	141	50,5±5,9	138	49,5±3,5	>0,05
Онемение рук	24	28,5±5,3	60	71,5±3,1	<0,001
Сонливость	78	32,5±5,5	162	67,5±3,3	<0,001
Забывчивость	27	26,4±5,2	93	73,6±3,1	<0,001
Отек лица, век, ног	12	12,9±2,0	81	87,1±2,3	<0,001
Боли в молочных железах	57	22,0±4,9	201	78±2,9	<0,001
Нагрубание молочных желез	48	18,1±4,6	216	81,9±2,7	<0,001
Вздутие живота	138	41,8±5,8	192	58,2±3,4	<0,001
Головные боли	69	28,8±5,4	177	71,2±3,2	<0,001
Тошнота	51	31,4±5,5	111	68,6±3,2	<0,001
Рвота	12	14,2±4,1	72	85,8±2,4	<0,001
Изменение уровня АД	27	23,0±5,0	90	77,0±2,9	<0,001
Боли за грудиной	12	19,0±4,6	51	81,0±2,7	<0,001
Сердцебиения	33	29,7±5,4	78	70,3±3,2	<0,001
Ознобы	42	34,1±5,6	81	65,9±3,3	<0,001

функционирования, обусловленное эмоциональным состоянием (RE-84,2±2,6), не имеют ярких деформаций и находятся примерно в равной степени компрессии. В группе женщин без ПМС среднее значение шкалы общего состояния здоровья составляет -71,9±1,6, с ПМС 64,4±2,0 ( $p<0,05$ ). Среди респондентов с ПМС чаще встречались экстрагенитальные заболевания, которые влияли на общее состояние здоровья. В нашей группе исследуемых среднее значение данного показателя социального функционирования составляет 76,3±1,8 без ПМС и 73,2±1,9 с ПМС. Шкала психического здоровья студенток-медиков находится на уровне 67,0±1,6 без ПМС и 60,0±1,5 с ПМС. При сравнительной оценке показателей опросника MOS SF-36 получены данные: в группе женщин с ПМС все 8 шкал имеют тенденцию к снижению. Отмечается значительное снижение в шкале ролевого функционирования, которое обусловлено физическим состоянием (RP -68,9±4,2).

#### Выводы:

1. Частота ПМС среди студенток медицинских университетов г. Алматы составляет 36,0±2,14%, а самая тяжелая форма - 6,6±1,11%.
2. Наличие экстрагенитальных заболеваний значительно увеличивает частоту предменструального синдрома у студенток в 3 раза (с 18,3±4,8% в 63,9±3,4%), а предменструального дисфорического расстройства в 5 раз (с 2,6±0,9% в 12,8±2,3%).
3. Использование комбинированных оральных контрацептивов снижает частоту всех симптомов предменструального синдрома.
4. Предменструальный синдром отрицательно влияет на качество жизни студенток. В группе женщин с ПМС все 8 шкал качества жизни имеют тенденцию к снижению.

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**АЛМАТЫ ҚАЛАСЫ МЕДИЦИНАЛЫҚ УНИВЕРСИТЕТТЕРІНІҢ  
СТУДЕНТТЕРІНДЕ ЕТЕККІРАЛДЫ СИНДРОМЫНЫҢ ЖИЛІГІ  
ЖӘНЕ ОНЫҢ СТУДЕНТТЕР ӨМІР САПАСЫНА ӘСЕРІ**

**Аннотация.** Етеккіралды синдромының жиілігі туралы деректер кең шегінде ауытқиды – 30%-дан бастап 90%-ға дейін жетеді. АҚШ статистикалық деректеріне сәйкес репродуктивті жастағы әйелдердің 70-90 пайызы етеккіралды синдромының көріністерінен зардап шегеді, ал 5-8 пайыз әйелдер бұл сырқаттың ауыр түріне шалдыққан, ал әр үшінші әйел өмір сапасының төмендегенін айтады. М. Steiner (2000) деректері бойынша Канадада 75 пайыз әйел етеккіралды синдромына шалдыққан, Жапонияда болса 95 пайыз әйелдер бұл аурумен сырқат, соның ішінде 1,2 пайызы ауыр түрімен ауырады.

Бір қатар зерттеулерде етеккіралды синдромының жас қыздар арасында жиі таралғаны туралы көрсетілген. Мысалы В. N. Nisar (2008) деректері бойынша бұл синдром 51 пайыз студенттерде бар, ал 5,8 пайыз студент қыздар етеккіралды дисфориялық бұзылыстарынан зардап шегеді. G. Pinar (2011) зерттеуі бойынша етеккіралды синдромы жиілігі 72,1 пайызды құрайды.

Көптеген әйелдерде етеккіралды синдромы белгілері олардың күнделікті өміріне, әлеуметтік және жеке қызметтерінің бұзылуына, жұмыс істеу қабілетіне, жанұядағы қарым-қатынасына, жыныстық өміріне елеулі теріс әсер етеді.

**Түйін сөздер:** етеккіралды синдромы, өмір сүру сапасы, етеккіралды синдромы жиілігі мен ауырлығы, етеккіралды дисфориялық бұзылыстары.

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**MANAGING THE MEDICAL SERVICES QUALITY  
IN MARKETING ACTIVITIES OF OHI FUND AND  
MEDICAL ORGANIZATIONS  
IN THE REPUBLIC OF KAZAKHSTAN**

**Abstract.** The present article contains the description of the content analysis of the Republic of Kazakhstan Public Health Ministry issued statutory and regulatory acts on implementation of the quality management system over the period of health care organizations work with the Obligatory Health Insurance Fund since 2018. The issue is relevant because of the need to improve efficiency of the marketing interaction of the Obligatory Health Insurance Fund (OHIF) with medical organizations (MO) in achievement of the goals and objectives set in the Governmental programs for improvement of availability and quality of medical services in new conditions of the health care market players interaction. The objective of this study is to analyze the legislative and statutory acts on health care services quality management and the role of the OHI Fund in interaction with medical organizations. The methods of content-analysis of the Republic of Kazakhstan Public Health Ministry issued legislative and statutory acts, the Law on the Obligatory Health Insurance (OHI) in the Republic of Kazakhstan, orders for procurement of medical services and expert opinion on the primary medical documentation were used. The results of assessment of the expert examination of inpatient medical records revealed the need for revision of many aspects effective in the medical services quality control system adopted in the Republic of Kazakhstan as a part of transfer from quality control to quality management. The conducted expert examination of the legislative and statutory acts and inpatient records allowed us to make a conclusion that the expert activity on the part of the internal audit service, department's head, deputy head of a medical organization is far from being sufficient in the conditions of heightened requirements to the medical services quality. Medical organizations need to use total analysis, i.e. they need to analyze all aspects of medical services quality (structure and process) and not only the final result in the form of the patients' complaints or mortality. This requires involvement by the process owners (doctors, paramedical personnel) in the quality management process in order for them to monitor the process indicators in the course of their professional duties discharge. It is exactly the stages of structure and process analysis where the defect prevention mechanisms are used.

**Key words:** medical services quality management, social marketing, obligatory health insurance fund, expert assessment, defects.

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## УПРАВЛЕНИЕ КАЧЕСТВОМ МЕДИЦИНСКИХ УСЛУГ В МАРКЕТИНГОВОЙ ДЕЯТЕЛЬНОСТИ ФОНДА ОМС И МЕДИЦИНСКИХ ОРГАНИЗАЦИЙ В РЕСПУБЛИКЕ КАЗАХСТАН

**Аннотация.** В статье проведен контент анализ законодательно-нормативных актов МЗРК по внедрению системы управления качеством в период работы медицинских организаций с Фондом обязательного социального медицинского страхования с 2018 года. Актуальность проблемы обусловлена необходимостью повышения эффективности маркетингового взаимодействия Фонда обязательного медицинского социального страхования (ФОМС) и медицинских организаций (МО) в достижении поставленных в Государственных программах целей и задач по повышению доступности и качества медицинских услуг в новых условиях взаимодействия участников рынка медицинских услуг. Цель исследования – анализ законодательно-нормативных актов по управлению качеством медицинских услуг и роли Фонда ОМС при взаимодействии с медицинскими организациями. Использованы методы контент анализа законодательно-нормативных актов МЗ РК, Закона об ОСМС в РК, Приказы по закупу медицинских услуг, экспертная оценка первичной медицинской документации. Результаты исследования экспертной оценки медицинских карт стационарных больных показали необходимость пересмотра многих аспектов действующей в РК системы контроля качества медицинских услуг в медицинских организациях в плане перехода от контроля к управлению качеством. Проведенная нами экспертная оценка НПА и карт стационарного больного позволяет сделать заключение, что экспертная деятельность только со стороны Службы внутреннего аудита, заведующего отделением, заместителя руководителя медицинской организации в новых условиях повышения требований в качестве медицинских услуг крайне недостаточно. Медицинским организациям необходимо перейти к тотальному анализу, т.е. нужно анализировать все аспекты качества медицинских услуг (структуру и процесс), а не только конечный результат в виде жалоб пациентов или же летальности. Для этого необходимо вовлечь в управление качеством владельцев процесса (врачей, средний медицинский персонал), чтобы они при выполнении профессиональных обязанностей осуществляли мониторинг индикаторов процесса. Именно на этапах анализа структуры и процесса заложены механизмы предупреждения дефектов лечебной деятельности.

**Ключевые слова:** управление качеством медицинских услуг, социальный маркетинг, фонд обязательного медицинского страхования, экспертная оценка, дефекты.

**Актуальность проблемы:** обусловлена необходимостью повышения эффективности маркетингового взаимодействия Фонда обязательного медицинского социального страхования (ФОМС) и медицинских организаций (МО) в достижении поставленных в Государственных программах целей и задач по повышению доступности и качества медицинских услуг в новых условиях взаимодействия участников рынка медицинских услуг [1]. Известно, что с 2018 года медицинские организации, оказывающие гарантированный объем бесплатной медицинской помощи (ГОВМП) переходят в новый более жесткий формат работы – это заключение договоров с ФОМС на оказание ГОВМП и выполнение требований ФОМС к качеству медицинских услуг. В соответствии с законодательно-нормативной базой, принятой в 2015-2017 гг. ФОМС определен как единственный оператор и закупщик медицинских услуг с января 2018 года [2-3]. На наш взгляд, эффективность достижения поставленных целей и задач возможна лишь с применением методов и инструментов социального маркетинга в деятельности МО, включая такие как онкологические диспансеры, кардиологические центры, амбулаторно-поликлинические организации и другие [2-3]. По определению Ф. Котлера социальным маркетингом является социальный процесс, который направлен на удовлетворение желаний и потребностей физических и юридических лиц с помощью органи-

зации свободного конкурентного обмена услугами и товарами, которые представляют определенную ценность для потребителя [4-5]. Полное внедрение новой Модели здравоохранения – система Обязательного социального медицинского страхования начнется с 2020 года.

**Цель.** Провести анализ законодательно-нормативных актов (за последние годы 2015-2017 гг.) и требований ФОМС к качеству медицинских услуг, и разработать рекомендаций по переходу от контроля к управлению качеством медицинских услуг на уровне медицинских организаций.

**Методы исследования.** Контент анализ законодательно-нормативной документации (ЗНА) по внедрению системы ОСМС в РК, анализ требований Фонда ОМС на этапах контроля качества деятельности МО, анализ положений договора закупа медицинских услуг, анализ ЗНА в системе государственного контроля качества медицинских услуг, анализ Руководств по аккредитации МО, анализ стандартных организационных процедур по управлению качеством медицинских услуг. Также нами использован метод экспертных оценок медицинских карт стационарного больного нескольких медицинских организаций, и проведен анализ Протоколов лечения (ИБС и рака молочной железы) в соответствии с чек- листами Фонда ОСМС по контролю качества.

**Результаты и обсуждение.** Проведенный контент-анализ ЗНА по соблюдению договорных обязательств показал, что с нового года будут повышены требования к медицинским организациям (МО). Во первых, усиливается конкурентная среда на рынке медицинских услуг, так в реестре медицинских организаций при ФОМС зарегистрированы более 1500 поставщиков, среди них более 45% - это частные медицинские организации. Во вторых, утверждены новые Правила закупа медицинских услуг и Правила выбора поставщика услуг по оказанию гарантированного объема бесплатной медицинской помощи и возмещения его затрат [6, 7]. Фонд ОМС обязан проводить мониторинг исполнения субъектами здравоохранения договорных обязательств по качеству и объему медицинской помощи, оказанной потребителям медицинских услуг; рассматривать жалобы и обращения граждан и организаций здравоохранения по вопросам оказания медицинской помощи, осуществлять мониторинг исполнения условий договора закупа услуг путем посещения субъекта здравоохранения.

Первый этап контроля качества будет проводиться Фондом по индикаторам соответствия стандартам (например аккредитации). Контроль будет проводиться ежемесячно, перед оплатой. Второй этап контроля будет проводиться после заключения договора и включает ряд критериев экспертизу объемов, качества пролеченных случаев, экспертизу назначения лекарственных средств, обследования и мониторинг индикаторов конечного результата деятельности медицинской организации. Параметры оценки качества по схеме ФОМС будут включать: обеспечение безопасности пациента, клиническую эффективность, экономическую эффективность и достижение целевых показателей. По результатам проверок ФОМС будет формировать базу данных по медицинским организациям, имеющих положительные и отрицательные рейтинги, что будет влиять на заключение договоров на следующий год.

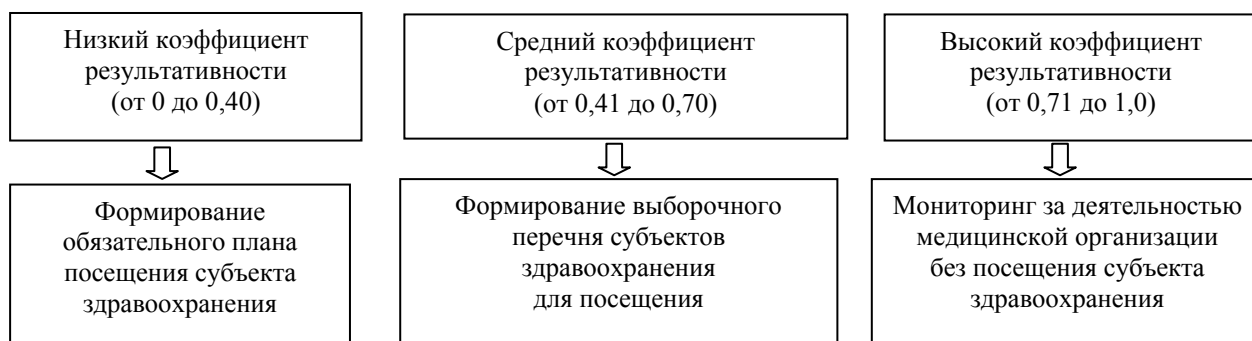
Экспертная часть контроля направлена на контроль по чек-листам к Акту о результатах мониторинга качества и объемов оказанных медицинских услуг (приведены критерии амбулаторно-поликлинической помощи):

- 1) результаты оценки качества сбора анамнеза (5 критериев);
- 2) результаты оценки правильности и точности постановки клинического диагноза (7 критериев);
- 3) выявленные ятрогении и результаты оценки ятрогений (6 критериев);
- 4) результаты оценки качества диагностики (6 критериев);
- 5) результаты оценки своевременности и качества консультаций профильных специалистов (6 критериев);
- 6) результаты оценки качества диспансерных мероприятий (10 критериев); 7) Результаты оценки качества профилактических мероприятий за детьми до 5 лет (10 критериев);
- 8) результаты оценки качества профилактических мероприятий за беременными женщинами (8 критериев);
- 9) результаты оценки качества лечебных мероприятий;
- 10) результаты оценки достигнутого результата лечебно-профилактических мероприятий (6 критериев);

- 11) результаты оценки исходов лечения (5 исходов);
- 12) результаты оценки качества ведения медицинской документации (10 критериев);
- 13) Результаты оценки корректности ввода данных медицинской карты в АИС (6 критериев).

При контроле будут выявляться дефекты лечебно-диагностического процесса, ниже указаны проценты удержания при подтверждении обнаруженных дефектов. Кроме контроля качества будут определены дефекты оказания медицинских услуг по 3-м группам с детализацией обнаруженных дефектов (превышение установленной длительности ожидания КДУ, жалобы пациентов, необоснованное отклонение лечебно-диагностических мероприятий от стандартов в области здравоохранения, не соблюдение стандартов диспансеризации, иммуно-профилактики, случаи не обеспечения или нерегулярного обеспечения лекарственными средствами и ИМН для бесплатного обеспечения населения в рамках ГОБМП на амбулаторном уровне с определенными заболеваниями, необоснованное направление на госпитализацию с процентами удержания от 0,10% до 0,50% в зависимости от кода дефекта. Самыми грозными дефектами являются обнаруженные дефекты с кодами 3.1-3.4. Случаи необоснованного проведения (удорожания, увеличения, отклонения) медицинских услуг, осуществляемой в форме консультативно-диагностической помощи, подлежит снятию от 50%-до 100% от стоимости услуг.

При оценке рисков деятельности медицинских организаций (поставщиков) Фонд ОМС будет проводить распределение медицинских организаций по зонам риска, с формированием планов обязательного посещения субъектов здравоохранения. Ниже приведена схема:



Экспертный анализ первичной медицинской документации стационарных организаций г. Алматы: всего в экспертной оценке были проработаны 30 карт стационарного больного, был проведен ретроспективный анализ за 2016-2017 гг. Нами были использованы критерии по чек-листам, которые прилагаются к Акту экспертной оценки:

- 1) результаты оценки качества сбора анамнеза (5 критериев);
- 2) результаты оценки правильности и точности постановки клинического диагноза (7 критериев);
- 3) результаты оценки качества диагностики (6 критериев);
- 4) результаты оценки своевременности и качества консультаций профильных специалистов (6 критериев).

#### **Результаты экспертной оценки и обнаружения дефектов лечения:**

1. При экспертной оценке карт стационарного больного отмечено, что не возможно разобрать почерк врачей, не читабельный текст, особенно в листах назначений (80% карт стационарного больного).

2. Много дефектов по листам назначений: не указаны масса и рост тела пациента, нет расчета дозировок при назначении сильно-действующих медикаментов, не указаны даты и время проведения инъекций и внутривенных вмешательств (90% карт стационарного больного).

3. Дефекты по Листу наблюдений: небрежное заполнение, диагноз указан в сокращенной форме, не в соответствии с требованиями к формулировке диагноза (80% карт).

4. Информированное согласие пациента – в сокращенной форме (50%).

5. При оформлении первичной документации – карта стационарного больного – не полный и не качественный сбор жалоб, анамнеза жизни и анамнеза заболеваний, заполнение дневников

ежедневного осмотра пациента и почти во всех картах стационарного больного – это компьютерный шаблонный текст (90% карт).

6. Заключительный диагноз, почти во всех картах (80% карт стационарного больного) формулировка не соответствует требованиям МКБ-10. Нарушены сроки постановки Заключительного диагноза (в 65% картах стационарного больного).

7. Диагноз при поступлении, диагноз после осмотра лечащего врача, диагноз после осмотра заведующего отделением сформулирован с нарушениями требований МКБ-10, в 70% случаев имеет трафаретную формулировку, и ставится под вопросом.

8. Также отмечены нарушения Протоколов лечения в длительности пребывания пациентов, в 35% случаев пациентов.

9. Отмечается во многих картах стационарного больного шаблонное оформление осмотра и опроса пациентов, сбора анамнеза жизни, анамнеза заболевания.

#### **Заключение:**

1. В связи с возрастающей ролью контроля качества медицинской помощи со стороны ФОМС, Комитета по контролю медицинской и фармацевтической деятельности МЗРК устанавливаются новые требования к медицинским организациям. Необходимо провести реорганизацию службы внутреннего аудита и разделить функции по клиническому аудиту и по аудиту организационных процессов. На наш взгляд клинический аудит касается непосредственно владельцев процессов (врачей и среднего медицинского персонала) и заведующих отделений, а аудит организационных процессов – это задача руководителя и заместителей руководителя.

2. Учитывая проведенный нами анализ выполнения требований со стороны ФОМС и требований договоров закупки медицинских услуг можно отметить, что только контроль конечного результата, проводимый в настоящее время повсеместно на уровне медицинских организаций службой внутреннего аудита будет не достаточным, поскольку он ориентирован только на конечный результат (жалобы пациентов и другие), т.е. при анализе качества на уровне медицинских организаций упускаются самые важные этапы лечебно-диагностического процесса, не анализируется структура и сам процесс лечения. Проведенный нами анализ научных данных позволяет сделать заключение, что именно на этапах анализа структуры и процесса заложены механизмы предупреждения дефектов лечебно-диагностического процесса. Клинический аудит надо проводить в соответствии с триадой А. Донабедиана (анализ структуры, процесса, результата).

3. В процесс экспертизы качества вовлечены только работники службы внутреннего аудита, а владельцы процессов (врачи, средний медицинский персонал) не принимают участия. Поэтому необходимо разработать единые подходы и алгоритм перехода от контроля конечного результата клинических процессов (жалоб, летальности) к управлению качеством медицинских услуг с разработкой индикаторов процессного анализа, показателей входа в процесс и промежуточных показателей процесса, которые должны быть определены для предупреждения дефектов лечебно-диагностического процесса. Только вовлечение в процесс клинического аудита самих владельцев процесса сможет помочь снизить число дефектов и таким образом сохранить финансирование медицинской организации и избежать штрафных санкций со стороны ФОМС.

#### **Практические рекомендации:**

1. Проводить мониторинг исполнения договоров на постоянной основе в медицинской организации, за основу взять индикаторы контроля качества первого и второго этапов при заключении договора, индикаторы дефектов оказания медицинских услуг;

2. Перестроить работу службы внутреннего аудита, отойти от контроля конечного результата, и перейти к разработке карт процессов, предупреждающих и корректирующих действий на уровне лечебно-диагностического процесса, т.е. к управлению качеством, необходимо проводить ежемесячный анализ и мониторинг индикаторов, указанных в Актах о результатах мониторинга качества и объемов в чек-листах;

3. Провести тренинги и семинары с врачами и средним медицинским персоналом по индикаторам экспертной оценки, дефектам, а также по разработке предупреждающих и корректирующих действий;

4. Своевременно выявлять дефекты лечебно-диагностического процесса и разработать систему документов по предупреждению;



5. Перейти от контроля качества к управлению качеством на основе интегрированной оценки качества медицинских услуг по схеме А. Донабедиана, проводить анализ процессов на основе трех компонентов (структуры, процесса и результата) в ежедневной деятельности врачей;

6. Провести семинары и обучение по заполнению медицинской документации, правильной постановке диагноза в соответствии с МКБ-10.

7. Придать статус врачам, как владельцам лечебно-диагностических процессов в процессное управление и процессный анализ, начать работу по стандартизации Протоколов лечения. В целях адаптации Протоколов необходимо создание карт процессов на основе Протоколов лечения, не нарушая требования Протоколов, утвержденных МЗРК, так как повышение качества медицинских услуг возможно только через стандартизацию процессов оказания медицинских услуг.

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#### ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ МЕДИЦИНАЛЫҚ ҚОРЫ МЕДИЦИНАЛЫҚ ҰЙЫМДАРЫНЫҢ МАРКЕТИНГІ ҚЫЗМЕТІНДЕГІ МЕДИЦИНАЛЫҚ ҚЫЗМЕТТЕРДІ САПАСЫН БАСҚАРУ

**Аннотация.** Мақалада заңнамалық және нормативтік мазмұны талдау 2018 жылы міндетті әлеуметтік медициналық сақтандыру жүйесінің іргетасы медициналық ұйымдардың кезеңінде сапаны басқарудың жүзеге асыру үшін Қазақстан Республикасы Денсаулық сақтау министрлігі әрекет етеді. Медициналық қызметтер нарығына қатысушылардың өзара іс-қимыл, жаңа жағдайында медициналық қызметтердің қол жетімділігі мен сапасын арттыру үшін мемлекеттік бағдарламасы мақсаттары мен міндеттеріне қол жеткізу міндетті медициналық сақтандыруға және әлеуметтік денсаулық сақтау ұйымдарының маркетингтік өзара іс-қимыл қорының тиімділігін арттыру қажеттілігіне байланысты проблемалар өзектілігі. Зерттеудің мақсаты медициналық қызмет сапасын басқару бойынша заңнамалық және нормативтік актілерді талдау және Медициналық сақтандыру қорының медициналық ұйымдармен өзара әрекеттесудегі ролі болып табылады. Заңнамалық және нормативтік актілерді талдау әдістемесі, медициналық құжаттардың сараптамалық бағасы пайдаланылды. ауруханаға науқастарды медициналық жазбаларды сараптама нәтижелері сапасын басқару үшін бақылау қозғалатын медициналық ұйымдарда медициналық қызметтердің сапасын бақылау Қазақстан жүйесінде жұмыс істейтін көптеген аспектілерін қайта қарау қажеттігін көрсетті. Медициналық қызметтің сапасына қойылатын талаптарды арттырудың жаңа жағдайларында медициналық ұйымның ішкі аудит қызметі сапаны басқару үшін жеткіліксіз. Медициналық ұйымдар толық талдау жасауға көшу керек, яғни. Сіз науқастардың шағымдары түрінде, немесе өлімі денсаулық сақтау қызметтеріне (құрылымы және технологиялық) сапасы ғана емес, түпкі нәтижеге барлық аспектілерін талдау қажет. Ол үшін кәсіптік міндеттерді орындаған кезде процесстің көрсеткіштерін қадағалау үшін процесстің иелерін (дәрігерлерді, медбикелерді) сапа менеджментіне тарту қажет. Медициналық қызметтегі ақаулардың алдын-алу механизмдері құрылымы мен процесін талдау сатысында тұр.

**Түйін сөздер:** медициналық қызмет сапасын басқару, әлеуметтік маркетинг, міндетті медициналық сақтандыру, сараптамалық бағалау, кемшіліктер.

## ЮБИЛЕЙНЫЕ ДАТЫ

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### ЛИДИИ ЯКОВЛЕВНЕ КУРОЧКИНОЙ 90 ЛЕТ



6 февраля 2018 г. исполнилось 90 лет со дня рождения Лидии Яковлевны Курочкиной –доктора биологических наук, профессора, выдающегося геоботаника, эколога, картографа Казахстана, хорошо известного в СНГ и дальнем зарубежье. Л.Я. Курочкина окончила Казахский Пединститут им. Абая и аспирантуру в Институте ботаники АН КазССР. Кандидатская диссертация была посвящена пастбищам пустыни Кызылкум (1953), докторская степень присвоена за монографическую работу «Псаммофильная растительность пустынь Казахстана (1975).

Сфера научных интересов Лидии Яковлевны охватывает широкий круг проблем: взаимосвязь растительности с почвами, рельефом, климатом; полнота использования ресурсов окружающей среды; биоразнообразие на видовом, ценотическом и экосистемном уровнях; районирование и классификация; природная и антропогенная динамика растительности; картографирование и определение функциональной значимости растительности и экосистем и др. Научно-производственную значимость имеют рекомендации по природопользованию, пастбищные кадастры, карты устойчивости, экологических ограничений и охранных мероприятий. Л.Я.Курочкина – один из первых исследователей проблем опустынивания, стояла у истоков мониторинга усыхания Аральского моря, является последователем теоретических разработок академика Б.А.Быкова о доминантах растительного покрова, конассоциациях, классификации экосистем, структурно-функциональной организации растительных сообществ. В руководстве стационарными исследованиями (1965-1990 гг.), лабораторией экологии и охраны растительности Института ботаники (1976-1993 гг.), Международными курсами по экологии пастбищ (ГКНТ-ЮНЕП) проявился организаторский талант Л.Я. Курочкиной. Лидия Яковлевна подготовила 12 кандидатов и 2 докторов наук. Результат плодотворной научной деятельности - более 250 статей и 16 монографий. Крупнейшим достижением в деятельности по проекту ГЭФ «Глобально значимые водно-болотные угодья Казахстана» стала разработка концептуальной базы экосистемного подхода.

Л.Я. Курочкина участвовала в разработке Национальных программ по борьбе с опустыниванием, по сохранению биоразнообразия, Каспийской экологической программы. Лидия Яковлевна является международным экспертом ООН по опустыниванию. Опыт изучения проблем

опустынивания получил свое отражение в 3 томе монографии «Республика Казахстан» и на карте в Национальном Атласе, изданных в 2010 году. Итогом многолетнего труда стала монография в соавторстве с Г.Б. Макулбековой «Природно-антропогенное опустынивание растительности Казахстана», которая ожидает своего опубликования. Богатый опыт изучения пастбищных экосистем оказался востребованным при выполнении грантового проекта в зональных пустынях Северного Приаралья (2015-2017 гг.), где Лидия Яковлевна стала разработчиком серии карт и рекомендаций по стабилизации устойчивого функционирования и нормативного природопользования. Лидия Яковлевна продолжает активно публиковаться. В одной из последних статей в журнале «Aridecosystems» (Springer) поднимается вопрос об определении тенденций дестабилизации окружающей среды и риска потери биоразнообразия на уровне экосистем и зональных растительных формаций. Обсуждение продолжается в другой публикации по оценке значимости зональных формаций как барьеров по предотвращению процессов опустынивания. Эти работы выполняют важную методическую роль для мониторинга опустынивания. Статья по истории геоботаники в Казахстане подвела итоги за период с начала XX столетия и определила перспективы фундаментальной науки.

Сердечно поздравляем Лидию Яковлевну со славным юбилеем, желаем доброго здоровья, долгих лет жизни, творческих успехов и новых публикаций.

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МАЗМҰНЫ

**Биология**

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