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Biological methods for the assessment degree pollution of water objects by hydrobionts faunistic structure

The article provides information about the effectiveness of biological methods of determining the degree of saprobity of water bodies in species composition of aquatic organisms that inhabit aquatic ecosystems data. The species composition of the reservoir depends on many natural factors: the magnitude of the soil particles, the flow velocity of water, temperature, amount of dissolved oxygen. Fast flowing water contains more oxygen than slow current or standing. That's why in rivers with strong currents, inhabit oxygen-demanding invertebrates. The more pollution, the more changes its species composition. Result in characterization of the different biological methods of assessing water pollution. Also this article are consider of the advantages and disadvantages of these methods. Noted that the method Pantla-Bukk modification Sladecek is a convenient method when saprobiological analysis. Saprobiological analysis being the most important element in the control of pollution of surface waters and bottom sediments, allows you to: to assess the quality of surface waters and bottom sediments as habitat the organisms inhabiting the ponds and watercourses; to determine the aggregate effect of the combined effects of pollutants; set the direction and the change of water biocenoses in terms of environmental pollution; to determine the ecological status of water bodies and ecological consequences of contamination.

Keywords: biological methods of assessment of water pollution, bioindication, aquatic organisms, water saprobity in terms of periphyton, water saprobity for a few major zoobenthos taxa, biotic index of Woodiwiss, Goodnight-Watley index, modified oligochaetic index (E.A. Parele), Mayer index.

The quality of water in natural sources is determined by the presence in it of substances of inorganic and organic origin, as well as microorganisms and characterize the various physical, chemical, bacteriological and biological indicators. When assessing the quality of environmental water requirements can be very different and depend on the purpose of the water.

Despite the importance of chemical, physical and other tests, providing basic information on the concentration of various pollutants and physical changes and biological assessment of environmental quality is a priority for two reasons. First, only the biological assessment provides the possibility of the integral characteristics of the quality of the environment, under a variety of influences. Second, this assessment characterizes the health of the environment, its suitability for wildlife and humans. One of the important directions in bioindicative studies is the study of aquatic invertebrates as feature status indicators of the aquatic environment.

Biological methods for their correct and skilled use are highly sensitive. There are many systems biological analysis of water and determination of their quality by hydrobiological indicators, the choice of which depends on the conditions of work and objectives. It is clear that biological observations of any kind always need to know what types and how many are part of the natural community. Conclusion on the state of waters to the time of the observations can often be made by comparing the data obtained is free from contamination in a water body and water bodies of the alleged contamination. In this case, for the conclusions and reasons of those more features than the full species composition of aquatic organisms in both the compared items.

Biological assessment methods are a description of the status of aquatic ecosystems on plant and animal population reservoir. Learn about the different types of the population of the water – periphyton, benthos, plankton, nekton etc.

Biological indicators to determine the presence or absence of water indicator organisms on the surface (plankton) in the strata (neuston) of water or located at the bottom of the pond, the shores and on the surface of underwater objects (benthos) that are sensitive to specific contaminants.

Biological measuring method of water pollution is part of the directions, which was called bioindication and biotesting. Vindicate is the assessment of the natural condition of the environment by using present living organisms. The bioassay — method of laboratory assessment of river water quality according to the reactions of test organisms with a known and identifiable characteristics. Biological object (test body) in the bioassay is actually used as an analytical tool.

Bioindication can be done at all levels of the organization of the living: biological macromolecules, cells, tissues and organs, organisms, populations and communities [1, 2].

Criteria for selection of bio-indicators: quick response, reliability (error is less than 20%), simplicity and ever-present in the nature of a living object. The bioassay based on the detection of the total toxicity to the test organism from all components of pollution and, thus, allows you to quickly assess whether the analysed sample is contaminated or not [3–7].

Specialists of many countries for the monitoring of rivers using benthic macroinvertebrates, to assess the impact of water quality by a number of anthropogenic contaminants.

Classification using benthic macroinvertebrates does not provide a complete picture of all environmental, artificial and natural contaminants that occur in flowing waters. There is also no uniform classification of rivers, which are suitable for all geographical areas. However, for rivers that cross national borders, the need for classification there.

The essence of the classification of the rivers of the International organization for standardization (ISO) is to compare between the behavior of benthic macroinvertebrates in clean conditions and in the observed environment. ISO recommended five classes of water quality (Table 1) [8].

Table 1

Biological classification of rivers

Quality Classification of benthic macroinvertebrates	Feature
High	Natural behavior of benthic macroinvertebrates
Good	Not affected the biological community
Mediocre	Several injured biological community
Poor	Moderately affected biological communities
Poor badly	Damaged biological community — an extreme reaction to the anthropogenic pollution

With this type of classification taking into account natural variability in biological associations.

Assessment of saprobity of the water in condition of periphyton. In Hydrobiology under saprobity understand the ability of organisms to live at high content of organic substances in the environment. Saprobity is a function of the needs of the organism in organic food and sustainability arising from the decomposition of organic compounds toxic substances: H_2S, CO_2, NH_3, H+, organic acids.

The hydrobiological indicators of the quality of greatest use is made of so-called index of saprobity of water bodies, which is calculated based on the individual characteristics of saprobity of species represented in various aquatic communities (phytoplankton, periphyton) [9].

Polisaprobic area contains many persistent organic substances and products of their anaerobic decomposition. Photosynthesis is not. Deficiency of O_2, is performed on oxidation. In the water — hydrogen sulfide and methane. At the bottom of a lot of detritus, are recovery processes; iron in the form of FeS. Black silt with the smell of hydrogen sulfide. Many saprophytic microflora, heterotrophic organisms: filamentous and sulfur bacteria, bacterial zooglea; protozoa –cilliates, oligochaetes, algae Polutoma.

Alpha mesosaprobic — starts aerobic decomposition of organic matter, produces ammonia, CO_2, little O2, hydrogen sulfide, methane — no. Iron in the form of nitrous and oxide. Are the redox processes. Gray slime. Predominate bacterial zooglea, euglena, Chlamydomonas, larvae of chironomid.

Beta mesosaprobic — mineralization has occurred. The number of saprophytes. The O_2 content varies depending on the time of day. Yellow slime, are oxidative processes. A lot of detritus, algae blooms (phytoplankton), diatoms and green algae, the hornwort. A lot of corneous, ciliates, worms, molluscs, the larvae of hironomid. There are crustaceans, fish, but their number is small.

Oligosaprobic — pure water. Flowering does not happen, the content of O_2 and CO_2 does not fluctuate. Detritus is small. Benthos is small. There is some seaweed of the genus Melozira, rotifers, Daphnia, larvae of stoneflies, mayflies, clams, sturgeon, etc.

It is established that in fact a number of oligosaprobic – mesosaprobic – polysaprobic increase not only the specific resistance to organic pollutants and their consequences, as the lack of oxygen, but their ability to exist under different environmental conditions.

This provision significantly extends the use saprobiological analysis. Therefore, the term «saprobity» recently used when talking about the General degree of pollution. To estimate the total pollution of surface water in modern situations, for example in case of toxic contamination or man-made salinity increase, the use of only one saprobiological of analysis is no longer sufficient.

Zones of saprobity on the indicative organisms. R. Kolkwitz and M. Marsson were not only pioneers in the creation of a system of indicative organisms for evaluating the degree of saprobity of waters, but also gave lists of indicator species characteristic of each zone [10]. Further, throughout the twentieth century, accumulated a bibliography, expanding and clarifying the species table of the coefficients of saprobity.

G.I. Dolgov and Ya.Ya. Nikitinskii [11], summarizing the experience of domestic and foreign researchers have made some changes in the lists Kolkwitz–Marsson. These lists in abbreviated form lead V.I. Zhadin and A.G. Rodina [12] conducted an audit of the system Kolkwitz–Marsson and published a catalogue of examples of types describing the environmental conditions in which these species occur.

In the available bibliography, the most visible is the fundamental work of V. Sladecek [13], containing the most complete list, which includes about 2000 species and synthesized the results of studies of Sladecek [14], N.V. Smirnov [15] and other researchers. Versions of lists of indicator species are given in collections published in Unified methods for the research of the water quality [16], the pointer A.V. Makrushin [17], etc. Additions and modification of the system of indicators of saprobity of waters offered in the works of L.A. Kutikova [18], V.N. Nikulina [19], T.V. Khlebovich [20], N.P. Finogenova [21], A.G. Okhapkin and G.V. Kuzmin [22], E.V. Pastukhova [23], I.K. Toderash [24], E.V. Balushkina [25].

The results of the biological analysis presented in the form of lists of indicators, always, to a greater or lesser number of contain types attributable to different zones of saprobity, which complicates a clear assessment of water quality. Using bioindicators for the purposes of monitoring is not a modern concept. It was noted by Pliny the Elder (AD 23–79) that «the value of living organisms as indicators of specific sets of environmental conditions» was seen in Germany 2000 years ago where grazing wild animals selected specific pastures. Biomonitoring has been the subject of research and controversy ever since [26]. Today biomonitoring systems commonly measure the presence of one or more types of plants and animals and compare the resultant figures with a prescribed and tested index in order to assess the degree of pollution or to track, and sometimes to predict, changes in the biotic integrity of a system [27]. To assess the water quality of reservoirs and streams affected by anthropogenic impact developed a variety of methods: chemical, biological, physical (organoleptic), bacteriological and radiation [28].

To assess the saprobity of water for the organisms of the periphyton most convenient, fast and reliable method is Pantla and Bukka modification Sladecek. This method takes into account the relative frequency of occurrence (abundance) of aquatic organisms h and their indicator significance s (Saprobity valence). For the statistical significance of research results requires that the sample contained at least 12 indicator species with total frequency of occurrence (abundance) h is equal to 30.

$$S = (\sum(sh))/(\sum h). \quad (1)$$

The saprobity index indicates to the nearest 0.01. For xenosaprobic area, it is in the range of 0-0. 50 — very clean; oligosaprobic — 0,51–1,50 — clean; beta mesosaprobic — 1,51–2,50 — moderately contaminated; alpha mesosaprobic — 2,51–3,50 — heavily contaminated; polysaprobic — 3,51–4,00 — very contaminated [29].

Methods of evaluation of water quality based on the application of certain major groups of zoobenthos: the Method of large groups is widely used in the practice of hydrobiological monitoring due to the simplicity of calculation, the absence of time-consuming taxonomic definitions. Theoretical basis and precondition for the universality of the method is widespread used of taxa in the waterbodies of different types with different levels of pollution. Such groups are oligochaetes and chironomid larvae.

In his research E.V. Balushkina proposed to evaluate the water pollution on the ratio of the number of representatives of different subfamilies of chironomids using the index:

$$K = (a_r+0{,}5a_{Ch})/a_0, \quad (2)$$

where: a_r, a_{Ch} and a_0 support values for the subfamilies Tanypodinae, Chironomae, Orthocladiinae.

Auxiliary values are calculated by the sum of the number N of each of the subfamilies expressed in percentage of the total number of chironomids and item 10, in other words, $\alpha=N+10$. Empirically chosen the number 10 limits the limits of the possible values, determining the optimum ratio of the gradation index, and the degree of sensitivity.

The effect of relative numbers of individuals of the subfamily Chironominae is reduced by half on the grounds that in the purest waters relative abundance Orthocladiinae + Diamesinae was close to 100% (excluding Jaroslavich forms), in the most dirty relative abundance Tanypodinae also was 100%. The tendency of the same increase in the relative amount of Chironominae the extent of contamination is expressed to a lesser extent, and their indicator value in General lower, which is reflected in the reduction. The index values K from 0,136 to 1.08 characterize of clean water; 1,08–6,5 — moderately polluted; 6,5–9,0 — contaminated; 9,0–11 — dirty.

Biotic index Woodiwiss. This method of assessment is suitable only for investigation of the rivers of the temperate zones and is not suitable for lakes and ponds. The assessment of the rivers is 15-point scale. The method uses an indicator called the biotic index Woodiwiss. It is determined by a special table.

To assess the status of water bodies by the method of Woodiwiss, you need to:

1) figure out which indicator (indicative) groups are present in the studied reservoir;

2) you then need to assess the overall diversity of benthic organisms. To determine the number of groups of benthic organisms in the sample. When using the method of Woodiwiss for «group» is accepted any kind of flatworms, molluscs, leeches, crustaceans, water mites, stoneflies, lacewing, beetles, any kind of larvae of other insects. Determining the number of groups in the sample, find the corresponding column in the Table 2;

3) at the intersection of row and column in a special table to find the index of Woodiwiss. Its value varies from 0 to 15 and is measured in points. The condition of the reservoir is defined as follows: 0–2 points — very strong pollution (5–7 grade), the water community is in a very depressed condition; 3–5 points — a significant contamination (4–5 grade); 6–7 points — slight pollution of pond (grade 3 quality); 8–10 points and above — a clean river (1–2 grade).

Table 2

The working scale for the determination of biological index

Representative organisms	Species diversity	Biotic index according to the presence of thirds «groups»				
		0-1	2-5	6-10	11-15	16 <
The larva of stoneflies (Plecoptera)	More than one type only one type	- -	7 6	8 7	9 8	10 9
The larvae of mayflies (Ephemeroptera)	More than one type only one type	- -	6 5	7 6	8 7	9 8
Caddisworms (Trichoptera)	More than one type only one type	- -	5 4	6 5	7 6	8 7
Gammarids (Gammarus)	The above types do not exist	3	4	5	6	7
Water louse (Asellus aquaticus)	-//-	2	3	4	5	6
Tubificidae and (red) wiggler of Chironomidae	-//-	1	2	3	4	-
All of the above groups do not exist	Can be present some species are not exacting to oxygen	0	1	2	-	-

According to the biotic index Woodiwiss, with increasing level of water pollution is a change of species composition of benthic organisms. As a result, that is the withering away of the indicator group have reached the limit of tolerance [19, 20, 22, 30].

Index Goodnight-Watley. This simple but effective method of bioindication is used only to determine contamination of the reservoir organic matter. To determine the values oligochaetes index only good materials dredging samples [30–32].

The value of the index and is equal to the ratio of the amount detected in the sample of Oligochaeta (oligochaetes) to the total number of organisms (including the worms) in percent by the formula:

a=N_Oligochaeta/N_(of all organisms) *100%. (3)

The degree of water pollution with organic matter is given in the Table 3.

The classic version oligochaetes index (OI) was first proposed by Goodnight and Watley in 1961 the OI is calculated as the ratio of Oligochaeta to the total number of organisms in the sample. This river is considered good, if OI is less than 60%, questionable in OI in the range of 60–80%, the river is heavily polluted, if OI is greater than 80%. In terms of the generalized index is judged on the degree of eutrophication of the reservoir.

Table 3

Oligogenic index Goodnight–Watley

The index%	Degree of pollution of water	Quality classroom
Less than 30	No pollution	1–2
30–60	Slight Moderate	2–3
60–70	Significantly	3–4
70–80	heavily polluted	4–5
More than 80	Strong	5–6

E.A. Parele applied OI for the small rivers of Latvia, Rangiroa it in accordance with the classification of water quality S. M. Dracheva. Based on the values of the modified OI, called the coefficient D, Parele was allocated to six groups in the studied watercourses: very clean and 0.01 to 0.16 (or 1–16%); clean — 0,17–0,33 (17–33%); moderate — 0,34–0,50 (34–50%); contaminated — 0,51–0,67 (51–67%); dirty – 0,68–0,84 (68–84%); very dirty — 0,85–1 (over 85%).

For large rivers is well established in Parele is another method based on the ratio of the number of Oligochaeta collection tubificids to the total number of all Oligochaeta:

$$D=t/O, \quad (4)$$

where t — the number of Tubificidae; O — the number of Oligochaeta (Oligochaeta).

The D2 values for rivers of Latvia were selected: highly polluted water (0,8–1,0); contaminated (0,55–0,79); slightly polluted (0,3–0,54); relatively clean (less than 0.3). In small fast flowing streams with diverse benthic fauna is proposed to use the coefficient D1 is the ratio of Tubificidae and the entire benthos in the sample. When D1=0,01–0,16 — very clean water; 0,17–0,33 — clean; 0,34–0,50 — lightly soiled; 0,51–0,67 — contaminated; 0,68–0,84 — dirty; 0,85–1,0 — very dirty.

Index Mayer. The most simple method of biological indication. This method is suitable for all types of water bodies. It is more simple and has a great advantage — it is not necessary to identify invertebrates accurate. The method is based on the fact that different groups of aquatic invertebrates are confined to water bodies with some degree of contamination. The organisms — indicators relates to one of the three sections is presented in Table 4.

Table 4

Index Mayer

The inhabitants of the clear waters, X	Organisms average sensitivity, Y	Inhabitants of polluted water, Z
The larva of stoneflies (Plecoptera) The larvae of mayflies (Ephemeroptera) Caddisworms (Trichoptera) Larvae Sialidae Bivalvia	Gammarids (Gammarus) Astacus astacus The larvae of dragonflies The larvae of Tipulidae Planorbidae Viviparidae	larvae of chironomids Hirudinea water louse (Asellus aquaticus) Lymnaeidae The larvae of Simuliidae Oligochaetes

It should be noted which are given in the table groups found in the samples. The number of groups of the first partition must be multiplied by 3, the number of groups from the second section 2 and third section from — 1.

The resulting figures stack up:

$$X*3+Y*2+Z*1=S \quad (5)$$

The value of the sum S (in points) assess the degree of contamination of water bodies: more than 22 points — the pond clean and has a grade 1 quality; 17–21 points — 2 quality class; 11–16 points — moderate contamination, 3 class quality; less 11 — the reservoir is dirty, 4–7 class quality.

The simplicity and versatility of the method of Mayer gives the ability to quickly assess the status of the investigated water body. The accuracy of the method is low. But if conduct studies of water quality regularly for some time and compare the results to see which side changes the status of the water body.

The analysis of methods of bioindication, evaluation of surface water pollution the major advantages and disadvantages Table 5.

Table 5

Characterization methods of biological assessment of water pollution

Name	Benefits	Disadvantages
Saprobity water on the periphyton indicators	Set in the species composition of indicator organisms living in water	The adaptation of organisms to the existence under various environmental conditions (eurybiontic)
Saprobity water for individual groups of zoobenthos	Widespread groups: chironomid larvae (mosquitoes - chironomids) and Oligochaeta (oligochaetes)	It is characteristic of the aqueous medium for a period of time and does not assess at the time of the study. To obtain reliable data, usually, the sampler should be in the river at least four weeks. When this point is conducted in each of at least three repeated extractions.
Biotic Index Woodiwiss	Considered part of the sequence of disappearance of groups of indicator organisms with increasing pollution.	Not suitable for lakes and ponds. It is necessary to find out which are indicator organisms in the study watercourse, depending on the sensitivity to contamination. There is a change of species structure of benthic organisms as the level of water contamination, hence, there is a death of indicator group. Suitable in the coastal zone, where benthic fauna is diverse
Index Goodnight-Watley	It used to determine the reservoir pollution by organic substances	Used for the analysis of materials only bottom grab samples. It should be understood that changes in the sediments occur more slowly than changes in the water quality of the aqueous medium
Modified oligochaetic index (E.A. Parele)	Based on Certain families of oligochaetes to the total number of oligochaetes.	It used only for the major rivers in the conditions of the Russian Plain. Index D1use for small rivers with fast current and diverse flora. Index D2 for rivers and reservoirs with unfavorable oxygen regime and poor composition of oligochaetes.
Index Mayer	Suitable for all types of reservoirs. Used indicator organism, sensitive to different water environment conditions (the inhabitants of the clean water, the organisms average sensitivity and the inhabitants of polluted water).	The accuracy is low.

All of these methods of bioindication are widely used for assessment of the anthropogenic impacts the ecological communities of on the land and aquatic ecosystems. Under any adverse conditions the diversity of species in the natural ecosystems is reduced, and the number of resistant species increases.

In addition, methods of bioindication methods have common disadvantages:

- the size of most organisms has a well-pronounced seasonality, and weather-dependent;
- for most methods require skilled specialists to identify species of living organisms. Along with bioindication methods you need to use and the method of bioassay for the identification and evaluation of factors (including toxic) environment on the organism, its separate function or system of organisms.

Currently, methods of bioindication and biotesting no commonly accepted system of biological analysis and there are no requirements which must be met for this system [32].

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Гидробионттардың фаунистикалық құрамы бойынша су нысандардың ластану деңгейін аңықтау үшін биологиялық бағалау әдістері

Мақалада суда тұратын ағзалардың түрлік құрамы бойынша су экожүйелерінің органикалық ластану дәрежесін аңықтауға арналған биологиялық бағалау әдістері туралы мәліметтер берілген. Су объектілерінің түрлік құрамы көптеген табиғи факторларға байланысты. Мысалы, топырақ бөлшектердің шамасы су ағысының жылдамдылығы, температурасы, еріген оттегі санына тәуелді. Тез ағымдағы су құрамына қарағанда, баяу ағымдағы және тұрған суда оттегі азырақ. Сондықтан тез ағымдарда талғампаз-оттек омыртқасыздар мекендейді. Гидробионттардың түрлік құрамы ластануы күштірек мекендерде көбірек өзгереді. Сонымен қатар авторлар әр түрлі су ластанудың биологиялық бағалау әдістерін сипаттаған. Сол әдістердің артықшылықтары мен кемшіліктері туралы деректер айтылған. Атап өтілгендей, сапробиологиялық талдау кезінде Сладечек түріндегі Пантле-Букктың әдісі ыңғайлы болып табылады. Сапробиологиялық талдау — үсті суларының және су түбі шөгінділері ластанудың ең маңызды бақылау жүйесінің элементі. Осы талдау су айдындар мен ағын суларда ағза мекендеген тіршілік ету ортасы ретінде жер үсті суларының және түптік шөгінділердің сапасын бағалайтын тәсілі; жиынтық әсері-аралас әсерінің ластаушы заттарды аныктайтын тәсілі; табиғи ортаның ластану жағдайында су биоценоздардың бағыт пен өзгертуін орнататын тәсілі; су объектілерінің ластану кезіндегі экологиялық жағдайы мен экологиялық салдарларын аңықтайтын тәсілі болып табылады.

Кілт сөздер: су ластануын бағалайтын биологиялық әдістер, биоиндикация, гидробионттар, перифитон көрсеткіштері арқылы аңықтайтын су ластануы, зообентостың жеке үлкен таксондар арқылы аңықтайтын су ластануы, Вудивисс биотикалық индексі, Гуднайт-Уотлей индексі, Өзгертілген олигохеттік индексі (Э.А. Пареле), Майер индексі.

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Биологические методы оценки степени загрязненности водных объектов по фаунистическому составу гидробионтов

В статье приведены сведения об эффективности методики определения степени сапробности водных объектов по видовому составу гидробионтов, населяющих данные водные экосистемы. Видовой состав водоема зависит от многих природных факторов: величины грунтовых частиц, скорости течения воды, температуры, количества растворенного кислорода. Отмечено, что быстротекущая вода содержит больше кислорода, чем медленно текущая или стоячая, вот почему в реках с сильным течением обитают требовательные к кислороду беспозвоночные. Чем сильнее загрязнение, тем больше изменяется видовой состав. Охарактеризованы различные биологические методы оценки загрязнения вод. Выделены преимущества и недостатки данных методов. Показано, что метод Пантле-Букка в модификации Сладечека является удобным методом при сапробиологическом анализе. Подчеркнуто, что сапробиологический анализ, будучи важнейшим элементом системы контроля загрязнения поверхностных вод и донных отложений, позволяет: оценивать качество поверхностных вод и донных отложений как среды обитания организмов, населяющих водоемы и водотоки; определять совокупный эффект комбинированного воздействия загрязняющих веществ; устанавливать направления и изменения водных биоценозов в условиях загрязнения природной среды; определять экологическое состояние водных объектов и экологические последствия их загрязнения.

Ключевые слова: биологические методы оценки загрязнения вод, биоиндикация, гидробионты, сапробность воды по показателям перифитона, сапробность воды по отдельным крупным таксонам зообентоса, биотический индекс Вудивисса, индекс Гуднайта-Уотлея, модифицированный олигохетный индекс (Э.А. Пареле), индекс Майера.

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К ботаническим и фитохимическим исследованиям *Rheum tataricum* L. из Южного Прибалхашья

В статье приведены результаты комплексных ботанико-фитохимических исследований надземной части казахстанского вида *Rheum tataricum* L. Впервые проведен фитохимический анализ стеблей и листьев ревеня татарского, произрастающего на территории Балхашского района Алматинской области, определены показатели доброкачественности растительного сырья, установлено содержание макро- и микроэлементов. Экспериментально доказано, что доминирующими компонентами биологически активных веществ изучаемого вида являются флавоноидные гликозиды, эфиры катехинов, гидролизуемые дубильные вещества, полисахариды, аминокислоты, стероидные алкалоиды. Выявлены отличия в количественном содержании основных групп первичных и вторичных метаболитов ревеня татарского в зависимости от фазы вегетации растения. Начаты ботанические исследования по современной оценке сырьевой базы ревеня татарского в Южном Прибалхашье (в долине р. Или).

Ключевые слова: Rheum tataricum L., Южное Прибалхашье, ботанические исследования, фитохимический анализ, вегетативная фаза растения.

Для разработки научных основ сбалансированного и бережного использования растительных ресурсов пустынных территорий Прибалхашья необходимым и ключевым элементом является ботанико-фитохимическое изучение востребованных сырьевых растений региона в пределах долин рек Или и Каратал, поскольку именно эта часть региона наиболее освоена в хозяйственном отношении и трансформация растительных сообществ, как в количественном, так и в качественном отношении, здесь наиболее ощутима [1, 2]. В связи с этим актуальны имеющие научную и практическую значимость современные ботанические и фитохимические исследования хозяйственно-ценных растений Прибалхашья, в том числе видов р. ревень *Rheum* L., которые могут восполнить существующий пробел и положат начало систематическим ресурсным исследованиям полезных растений на всей территории Республики Казахстан.

Казахстанские виды рода *Rheum* L. перспективны для всестороннего изучения как высокоэффективные дикорастущие танидоносы, имеющие сырьевые запасы и опыт применения в народной медицине, потенциальные источники сырья для получения фитопрепаратов противовоспалительного, вяжущего, слабительного, кровоостанавливающего, противоопухолевого и другого действия [3, 4].

Обзор современного состояния изученности казахстанских видов рода ревеня показал, что наиболее известным представителем р. *Rheum* L. является культивируемый в странах ближнего и дальнего зарубежья ревень дланевидный (р. тангутский) *Rheum palmatum* L., возделываемый как официальное лекарственное растение, на основе которого созданы фитопрепараты слабительного, желчегонного, вяжущего, спазмолитического действия [4]. Из 9 видов ревеня, произрастающих во флоре Казахстана, не менее 7(8) обладают лекарственными свойствами, два из них — *Rheum altaicum* Losinsk и *Rh. Wittrockii* Lundstr. — занесены в «Красную книгу Казахстана» [5]. Интродукционными исследованиями были охвачены 4 казахстанских вида — *Rheum compactum* (син. *Rh. altaicum*), *Rh. maximowiczii* Losinsk. — в Алтайском ботаническом саду, *Rh. tataricum* и *Rh. wittrockii* — в Главном ботаническом саду. Причем *Rh. tataricum* довольно успешно растёт в наших условиях, но цветет и плодоносит нерегулярно, характеризуется индексом успешности интродукции (ИУИ) = 4. Это связано с тем, что в предгорной зоне хр. Заилийский Алатау интродукция видов с узкой экологической амплитудой (психрофиты, галофиты, гигрофиты), к которым относится ревень татарский, возможна только при создании соответствующих эдафических условий [6]. В химическом плане представители рода *Rheum* L. изучались на кафедре химии природных соединений КазНУ им. аль-Фараби под руководством профессора, д.х.н. Т.К. Чумбалова. У *Rheum tataricum* L. в подземной части было отмечено высокое содержание дубильных веществ, катехинов и флавоноидов, которые были выделены и идентифицированы [7–11]. В результате ресурсоведческих исследований, предпринятых в 60–80-е