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**Тұжырым**

Бидай дәнінің алейрон қабаттарының КДГ ферменттерінің белсенділігінің фитогормондар арқылы реттелетіндігі көрсетілді. КДГ ферментінің белсенді күйге көшуіне ГҚ тікелей әсер етеді деп болжауға болады. Ал оның табиғи антогонисті абсциз қышқылы бұл модельдік жүйеде керісінше, КДГ белсенділігін тежеуге бағытталған. Сонымен қатар,аталмыш фермент белсенділігі уақытқа қатысты реттеліп отырады.

**Summary**

For the first time we showed ROS generating activity of xanthine dehydrogenase in aleuronic layer of wheat grain. According to the data activity this enzyme is under regulation of phytohormones. One of primary effects of GA in aleuronic layer is the activation of xanthine dehydrogenase. The enzyme is always in active form in presence of GA. Action of ABA is directed on slowing down activation effect of GA on early steps.

**Homziak J.**

## THE NEED FOR AQUATIC RESOURCES MANAGEMENT PROGRAMS IN KAZAKH UNIVERSITIES

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**Abstract:** Kazakhstan is an arid country with limited water resources. These resources are critical for both economic development and for the conservation of the countries natural resources, aquatic and terrestrial. While some of the waters have been damaged in past development, Kazakhstan has begun to make the effort to reverse these trends, from reducing pollution burdens to waterways, to promoting sustainable water use policies, to restoration of the Aral Sea. The responsibility for carrying out these ambitious programs will fall to the students of today. There is an urgent need to increase the knowledge of university students in Kazakhstan about the structure and organization of aquatic, inland marine and associated coastal ecosystems, and to promote their conservation, restoration and sustainable use. Students who have this knowledge area key resource in the sustainable development of Kazakhstan. They form the cadre of future environmental scientists, resource agency staff, teachers, and leaders of business, community and volunteer organizations that will ensure that sustainable development guides the future of Kazakhstan.

**Context and Need:** Sustainable and science based resource utilization in aquatic and coastal ecosystems in Kazakhstan are articulated in the national conservation strategy, which also lays out how it may be achieved: [1]

- “Preparation of a cadastre of water reservoirs of the Republic determining the significance of its biological resources;
- Provision for complex utilization of biological resources of water eco-systems (on the basis of the cadastre assessment);
- Conducting systematic research on the identification of bioresource reserves and exploitation standards;
- Isolation of reservation plots of the water-coastal eco-systems;
- Conservation of native, especially endemic species within an eco-system”.

Education and training in ecology is a priority for Kazakhstan in its transition to sustainable resources management. These efforts to increase of environmental knowledge have begun. Teachers are receiving training to include environmental education elements in pre-university programs. Of particular importance is the “...training of specialists ...to participate in implementation of the scientific, technical and educational programs on... ecology problems and ... in carrying out... managerial activities...” [2].

There is a tremendous need for improved understanding of aquatic ecosystems and resources in Kazakhstan. Kazakhstan has about 30,000 km² of inland waters, with 107 species of fish and an undetermined number of marine and aquatic invertebrates [3]. Kazakhstan contains a large part of the huge west/Central Asian endorhetic basin that includes the Caspian and the two largest lakes in Central Asia – the Aral Sea and Lake Balkash. Such isolated aquatic ecosystems systems, in arid climates, frequently harbor a high degree of endemism [4]. The coastal areas also form important but vulnerable ecosystems. Some important Kazakh examples [5] are the tugai forests in the Ili-Balkash region, the coastal desert along the northern and eastern shores of the Caspian Sea, and the fresh and salt lake marshes of the Naurzum and Korgalzhyn State Nature Reserves.

Freshwater wetlands in Kazakhstan, including lakes and wetlands, comprise a key stopover point and cross-roads for millions of migrating waterfowl on multiple trans-continental flyways. They also provide critical nesting habitat for waterfowl. Steppe lakes of Kazakhstan are affected by dramatic seasonal changes in hydrology, chemistry and biology.

The diverse flora and fauna of the lakes and their wetlands has evolved through complex wetting/drying cycles, and are of considerable scientific interest. IUCN's evaluation [6] stated that the wetlands of Northern and western Kazakhstan to be are of international importance. Two lake complexes in Kazakhstan have been designated as RAMSAR sites [7].

Any discussion of the importance of aquatic ecosystems in Kazakhstan must include the lakes and wetlands of the Volga and Ural River deltas on the Caspian Sea. The Volga Delta is one of Eurasia's largest and most productive delta systems, one of the world's most productive areas for fish, and critical habitat for multiple threatened species. The Volga delta is the key to the long-term functioning of the Caspian Sea. The Ural Delta is also an important area for fishery production and critical habitat for economically important and threatened fish species. Both deltas are critically important for migratory water birds.

Both aquatic and coastal ecosystems in Kazakhstan are under threat. Dam construction for electricity and irrigation, large withdrawals of water for irrigation, oil and gas exploitation, deforestation, inadequately managed fisheries, and point and non-point pollution from agriculture, industry and urban development all pose serious threats.

A focal point of the water resources management facing Kazakhstan is the Illi-Balkash basin and Lake Balkash. The basin drains into Lake Balkash via seven rivers [8], primarily the Ili River, which brings the majority of the riparian inflow; others, such as the Karatal, provide both surface and subsurface flow. The Ili is fed from precipitation (largely vernal snowmelt) from the mountains of China's Xinjiang region. The lake currently covers 16,400 $km^2$ (6,300 sq mi), but, like the Aral Sea, it is shrinking because of the diversion of water from the rivers that feed it. The lake is divided by a strait into two distinct parts: the western part is fresh water, while the eastern half is saline. The largest city in the lake area is also named Balkhash, with about 66,000 residents. Major industrial activities in the area are mining, ore processing and fishing.

The water resources situation is critical in the basin, with degradation of all aquatic, coastal and terrestrial ecosystems [9]. Water levels in Lake Balkhash, an endorhetic basin reservoir, are unstable because of increasing demand for water withdrawals in Kazakhstan and China, which share the basin. Since 1970, water diversion to fill the Kapchagay Reservoir resulted in a 2/3 decrease in the supply to the lake from Ili River, with a drop in lake level of approximately 15.6 cm/year, much larger than previous natural declines. China also consumes 14.5 $km^3$ of water per year from Ili River, with a planned increase by 3.6 times [10]. Dropping lake levels have resulted in the loss of 11 of the 16 wetland-lake systems around the lake, and the desertification of about 1/3 of the basin [11]. Salt dust is generated in the dried areas, contributing Asian dust storms, increasing the soil salinity and adversely influencing the climate.

Emissions from mining and smelting, mostly at the Balkhash Mining and Metallurgy Plant, are also major contributors to the degradation of the lake and basin. It is estimated that emissions deposit 150+ mt of copper, 140 mt of zinc and 125+ MT of lead on the surface of the lake. Contamination of Balkhash originates not only locally, but is also brought by inflow of polluted water from China [12].

As the quantity of water withdrawn from the Illi River by local demand and China increases, water quality degradation accelerates because impairments from agriculture, industry, mining and municipal water uses stay the dame or increases. Further, the glacier resources that are the principal sources of water in the Illi-Balkash basin are rapidly decreasing, both due to climate change and on the growing development pressures in the mountain headwaters regions.

The report recognizes that the main challenge is to develop an integrated ecosystem based management plan that considers impacts of development of water resources on fishing and agriculture-based local economies, urban and industrial development, their water supply needs, ecosystem health, predicted climactic variations and the demands of transboundary coordination and resource management. Unfortunately, the capacity to develop and implement such a plant is lacking.

There is a broad need to strengthen the national capacity for environmental assessment, to properly plan for sustainable development and use of the county's natural resources, and the guide the restoration and remediation of damaged ecosystems in the country. Kazakhstan's Ambassador to the United Nations provided a succinct summary of why there is such a need for a strong national environmental assessment program: "Kazakhstan faces major environmental problems as a result of the policies pursued during the Soviet period, which failed to account the cost of land, water, and air degradation, and led to an overuse of natural resources. Centrally planned practices associated with extensive production schemes in massive industrial and chemical complexes have polluted the air, soil, and water. Urban environment has also been polluted from coal-burning power plants, lack of forest cover or vegetation and hazardous wastes." [13].

The Government of Kazakhstan adopted a National Environmental Strategy aimed at reducing environmental pollution and natural resource degradation. In 1998 the Government also developed a National Environmental Action Plan, which proposes a number of priority policy reforms and investment projects to address the urgent environmental concerns. The major policy issues proposed include environmental legislation and regulation, environmental management, promotion of cleaner technology, human resources development, and capacity building for monitoring and enforcement. This course is intended to help meet the needs of the NEAP, to improve environmental planning and management, and strengthen capacity for municipal, national and regional sustainable development strategies.

**Needs and Expected outcomes:** To counter and reverse these threats requires a broad understanding of the systems that are affected and how human activities can disrupt and change them. The education and training of university-level and graduate students is essential to improve understanding and management of Kazakhstan's unique environment overall, and of its fragile aquatic, marine and related coastal ecosystems. An understanding of the structure and function of aquatic and coastal ecosystems is essential in changing the way resources are managed, restored and sustainably utilized.

Kazakhstan has one of the smallest available water resources among CIS countries. Kazakhstan's coastal and aquatic ecosystems have been recognized as important for economic development, for the quality of life of residents, and for the conservation of the rich biodiversity of the country. Breaking with the past, when management was based on maximizing yield from the exploitation of natural resources, Kazakhstan is adopting sustainable development to ensure that "…the diversity of the animal and vegetable world that Kazakhstan possesses shall not be lost." [14].

An example is the new approach to fisheries management, from managing the resource just for fishing and fish harvest, to conservation and sustainable use of the aquatic ecosystem. Fisheries are an important resource: commercial fish landings total about 36,100 MT annually, mainly from the lower Ural River and the Bukhtarma reservoir; in 2001 about 59% and 25% respectively. The remainder came from Lake Balkhash, the Alakol lakes group and large reservoirs – Bukhtarma, Kapshagay, Shulba, Shardara and others [15]. Sustainable fisheries management depends upon a broad understanding of aquatic ecology and limnology by all stakeholders, from fishery managers and economic planners, to local officials, fishers and the general public.

Other water resources and land use regulations are also under review to better conserve, protect, and restore vulnerable aquatic and coastal ecosystems from development, water extraction, pollutant discharges and overexploitation. Using only maximum economic gain as the only guide for aquatic resources management is a simplistic, one-sided approach. A water body does not have a single use and managing it for multiple purposes requires a primary understanding of how aquatic ecosystems function. Only by understanding the structure and function of aquatic and coastal ecosystems, and the impact of extraction and manipulation, can an effective management program be developed. This need for understanding ecosystems is not limited to nature conservation agencies and organizations alone, but is critical for other competing sectors to understand as well - energy, agriculture, regional planning, economic development, water dependent industry, urban development, and tourism. It is only when there is a shared understanding of all of these attributes can there be an integrated approach that balances sustainable resources use with economic development needs and conservation.

Kazakhstan has been a leader in the region in restoration ecology for damaged aquatic ecosystems. The recognition that it is in the economic interest of local government, business and residents has made the restoration of the aquatic biological resources possible. The ability to restore biological resources is an important condition for their conservation. An understanding of the ecology of lakes, inland seas and their coastal areas and wetlands is essential for successful restoration efforts, several of which are already underway.

An important subset of restoration efforts is the management of important fish stocks through restocking, reservoir management and habitat management to create conditions favorable for the survival and growth of the target species. Management can be directed at restoring and maintaining commercially valuable species, or threatened or endangered fish populations. Critical to successful fisheries management is an understanding of the dynamics of aquatic ecosystems to create appropriate conditions for restoration to succeed.

An understanding of the underlying ecological structure of aquatic and coastal ecosystems equally important to develop effective tools to meet management objectives in the face of competing uses, be it for commercial fisheries, restoration ecology, or the conservation of threatened or endangered species or critical habitat. Managers and decision makers need to understand the ecological structure and function of the aquatic communities they are working with in order to develop and enforce standards for the use of the resources. Key among these decisions is designating areas, or "zoning", of aquatic and coastal habitat by type and degree/intensity of use. This can range from emphasis on non-aquatic resources (oil and gas industry, transport, mining, etc.) to multiple use (e.g. sustainable fisheries or "green" hydroelectric production), to varying degrees of protection.

The current approach, based on the protection or management of individual species while otherwise permitting the exploitation of coastal and aquatic resources needs to be revised. This approach, the protection of one species while ignoring the reminder of the ecosystem, is inevitably followed by impacts on other species and overall ecosystem function. It may even lead to unpredicted and undesirable outcomes, for example the unexpected impacts of protection of beaver in the basin of the Ural River [16].

Protected coastal, aquatic and marine reserves play an important role in the conservation, restoration and sustainable use of these important resources. Creation and management of limited use areas defined by ecosystem, not by individual species, provide the opportunity for restoration of natural links and functions throughout the entire coastal/water body. Aquatic ecosystem restoration efforts, planned and already underway, need to be guided by informed decision making. These can only be successful if mangers and decision makers have an understanding of the ecosystem goals the restoration is to achieve.

All of these efforts, in management of aquatic resources, pollution prevention, restoration, sustainable use or aquatic and littoral resources, all require an understanding of ecosystem level management, an understanding of the interlinked aquatic and coastal ecosystem as a whole.

Additional resources are needed to further the objectives of increased environmental education in Kazakhstan. As identified in the national biodiversity strategy and action plan (p. 96) : "…ecological education, enlightenment and bringing up of all groups of population irrespectively the age or professional orientation in the field of conservation and the balanced use of the biological diversity. "The plan further identifies "Water and coastal eco-systems (as) …notable for their sufficient distinctness…" to warrant specialized efforts to improve their understanding. These efforts are to be directed at students seeking specialist Bachelors and Masters Degrees at public universities and academic institutions specializing in ecology, conservation biology environmental protection, and environmental assessment and monitoring.

There is also a concomitant need to train current specialists, those with an established knowledge of environmental protection issues, about conservation, sustainable development and use of biological diversity. Equally important, there is a need to train teachers of the pre-college level and to develop curricula in aquatic and coastal environmental education, conservation and the sustainable use of biological diversity at the pre-university level. This is to better prepare youth to enter the university to seek their degrees in aquatic resource management and conservation.

This approach will contribute to the national mandate to prepare and train specialists to strengthen environmental protection and improve natural resources management, particularly in the critical field of aquatic resources management.

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**Тұжырым**

Қазақстан – шектелген су ресурстары бар шөл далалы мемлекет. Бұл ресурстар экологиялық даму ретінде де, табиғи ресурстарды сақтау мүмкіндігін де анықтайды. Сонда да кейбір судың қайнар көздері зардап шеккен. Қазақстанда су магистралдарының ластауын төмендету, Арал теңізін қайта қалпына келтіру және де суды тиімді пайдалану саясаттары жүзеге асырылуда. Мұндай шамданушы мәселелерді орындауға жауапкершілік қазіргі студенттерге жүктелген. Судың, ішкі және жағалауындағы экожүйелерінің құрылымы мен ұйымдастырылуы және оларды сақтау, қалпына келтіру және тиімді пайдалануы жайында Қазақстан университеттерінде оқитын студенттердің білімін жоғарылату қажеттігі туындап отыр. Қазақстанның өркендеуінде мұндай білімді алған студенттер негізгі ресурстарды дұрыс пайдаланады. Олар болашақ эколог мамандарының кадрларын, табиғи ресурстарды қолдану құрылымдарын, Қазақстанның даму келешегінде негізгі роль ойнайтын бизнес, қоғам және мекемелердің жетекшілері мен оқытушыларын қалыптастырады

**Резюме**

Казахстан – пустынная страна с ограниченными водными ресурсами. Эти ресурсы определяют как экологическое развитие, так и возможность сохранения природных ресурсов. Хотя некоторые источники воды пострадали в прошлом, Казахстан делает усилия восстановить их, начиная с уменьшения загрязнения водных магистралей, и, кончая установлением политики использования вод и восстановлением Аральского моря. Ответственность за выполнение этих амбициозных задач ляжет на сегодняшних студентов. Это влечёт острую необходимость в повышении знаний студентов университетов Казахстана о структуре и организации водной, внутренней и прибрежной экосистем, и методах их сохранения, восстановления и разумного использования. Студенты, получившие эти знания, будут способствовать использованию ключевого ресурса для развития Казахстана. Они сформируют кадры будущих специалистов экологов, структур по использованию природных ресурсов, преподавателей и руководителей бизнеса, общества и организаций, которые сыграют ведущую роль в будущем развитии Казахстана.