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DIVERSITY AND INDICATOR VALUE OF THE ARAL MICROALGAE

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Abstract
With the ongoing population growth of the planet and the predicted shortage of food and other raw materials, the search for new available sources of nutrients becomes one of the priority tasks of biological science.
Key words: ecological state of water, bioindication method, algoindication, processing of algal raw materials.

1. Introduction

Aral Sea (Aral, Aral Lake) is a continental brackish-water reservoir located in Central Asia on the territory of Kazakhstan and Uzbekistan with constantly changing sizes and salinity. This reservoir over the history of its existence has undergone three major regressions caused by changes in climatic conditions. The pond from time to time increased or decreased in size and became either freshwater or hyperhaline. In the historical period, fluctuations in the level of the Aral Sea began to depend not only on changes in climatic conditions, but also on human activities, mainly related to irrigation of nearby lands. Changes in salinity led to changes in the composition of aquatic vegetation communities, which were traced from literature data, herbarium materials, and the author's observations.

The first herbarium specimens from the Aral were collected by A.N. Butakov in 1849 (herbarium of the BIN RAS, LE), and then I.G. Borshchov during the first Aral-Caspian expeditions of St. Petersburg Academy of Sciences and the Society of Naturalists in 1858 and 1874. (Alenitsyn, 1874, 1875; Borshchov, 1865, 1877). All known historical, physical-geographical, as well as zoological and botanical data on the Aral Sea were summarized at the beginning of the last century by Acad. L.S. Berg (1908).

The following information on the distribution and productivity of macrophyte communities was obtained during hydrobiological and ichthyological studies carried out in different years on the Aral Sea.

In this regard, the list of species encountered may be, on the one hand, incomplete, and on the other hand, contain species that were incorrectly identified.

The state of water bodies requires special attention due to the exceptional role of water in the national economy, and in the cycle of matter in nature. The ecological state of water and bottom sediments of water bodies has recently become more and more interesting from the point of view of toxicology, since the general tendency of recent times is the active distribution of toxicants in the aquatic environment and their accumulation in bottom sediments. Analytical control of the progressive increase in the number of new chemicals is impossible, moreover, it is complicated by the additivity and synergistic action of most compounds.

Only by biota can it be estimated the total toxic effect of pollutants, which is one of the main causes of the negative consequences of anthropogenic pollution of natural waters (Bakaeva, 2009). Initially, water quality research was based on a bioindication method based on a study of the composition and structure of hydrobiocenoses. Algoindication is an integral part of this methodological approach.

Several thousand species of algae grow in the seas and oceans, of which a little more than 100 species are used by humans for food, as fertilizers, for technical and feed purposes. Algae are rich in trace elements, iodine, vitamins, carbohydrates, proteins, contain antibacterial substances, are able to enhance the anticoagulant properties of blood.

To meet the human needs for algae products, the volume of extraction and processing of algae raw materials should be significantly increased. However, the use of only naturally growing algae cannot fully satisfy the needs of the national economy for products from them.

ISSN- 2394-5125 VOL 7, ISSUE 02, 2020

2. The degradation of the marineandcoastalecosystems

Recently, interest has grown significantly in the biotechnology of microalgae as a source of vitamins and other valuable biologically active compounds used to enrich the diet of humans and animals [1]. The commercial use of microalgae for the extraction of specific chemicals began with Dunaliella salina, cultivated since the 1970s. to obtain β-carotene.

Cultivation of Haematococcus pluvialis Flotow and Crypthecodinium cohnii Seligo was widely used to produce astaxanthin and long chain polyunsaturated fatty acids, respectively [3]. Of the more than 25 thousand microalgae known to date, no more than 15-17 species are used for commercial purposes.

They accumulate in large quantities a variety of biologically active substances and are part of many nutritional supplements. Algae extracts are used in cosmetics and in the production of animal feed. Microalgae strains were isolated for commercial production of polyunsaturated fatty acids: γ-linoleic (S. platensis), arachidonic (Porphyridium cruentum), docosahexanoic (C. cohnii, Schizochytrium sp.), eicopentaenoic (N. oculata, Phaeodactylum tricornutum) as well as pigments (D. salina, H. pluvialis) and phycobiliproteins (S. platensis, P. cruentum) [1-3].

3. Methodology

Field studies were conducted in the spring-summer seasons of 2018–2019. The route method and the trial plot method were used.

In 1976, a simplified technique was proposed that is applicable to natural samples (Gough et al., 1976). When fixing the cells, and at the same time, to remove mucus, it was proposed to use the complex FAA fixative (7: 2: 1: 1 - water: formalin: glacial acetic acid: 95% tyl alcohol).

The systematic position and Latin names of species are verified by electronic resources: (AlgaeBase, WoRMS).

The successful use of microalgae in biotechnology largely depends on the choice of producer and the selection of optimal conditions for its cultivation.

4. Results and discussion

Currently, more than 80% of the harvested algae is grown artificially, and their share is increasing every year.
Marine macrophyte algae are a valuable biological resource and are currently actively used in various industries. For example, in the food industry, algae are used for direct consumption in food and for the production of specific food substances and additives, in pharmaceuticals - for the production of active and auxiliary components of medicines and dietary supplements for enriching the diet, in agriculture - for the production of fertilizers and feed additives.

The value of macroalgae as food products and sources of economically useful substances is determined by their biochemical composition - the content of the main macro- and micronutrients (proteins, amino acids, carbohydrates, minerals), the composition of certain groups of compounds (e.g., fatty acids in brown algae), unique to this systematic group of components (specific polysaccharides - agar and carrageenans in red algae, alginates in brown algae; a unique reserve product of red algae - floridoside).

Microalgae are able to accumulate significant amounts of tocopherols (up to 4 mg / g dry weight). Unlike vegetable oils, in which the amount of α-tocopherol is small, microalgae contain up to 97% of this tocochromanol, which ensures high biological activity of vitamin E extracted from these organisms. Information on the content of tocopherols in eukaryotic microalgae Dunaliella tertiolecta, Nannochloropsis oculata, Isochrysis galbana, Euglena gracilis, Tetraselmis suecica, Diacronema vlkianum, as well as cyanobacteria Spirulina platensis is presented. The accumulation of tocopherols in microalgae depends on the cultivation method.

The greatest amount of tocopherols is synthesized in Euglena gracilis cells during heterotrophic growth. Technological methods such as two-stage cultivation, limiting the nutrient medium for some biogenic elements, and the introduction of exogenous carbon sources are used to increase the yield of α-tocopherol in microalgae.

One of the most interesting taxonomic groups of algae with significant applied potential are representatives of the Rhodophyta department (red algae). Currently, these algae form an important part of the diet of residents of Southeast Asia (Japan, China, the Philippines) and some European countries (Norway, Iceland), where they are consumed and valued on a par with seafood of animal origin.In the process of photosynthesis in cells of golden algae, a special carbohydrate, leukosin, is produced instead of starch.

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At the same time, the applied potential of the red macrophytes of Uzbekistan has not been studied in detail and is very limitedly realized. Russia's share in the global production of algae is less than 1%, and a large part of the production volume falls on the Far East basin. The bulk of the production and consumption of algae falls on the countries of Southeast Asia and the North Atlantic basin [1].
An ecological and geographical analysis of freshwater algae flora was carried out by us using environmental characteristics and data on the distribution of algae cited by several authors (Khursevich, 1976; Kharitonov, 1981; Levadnaya, 1986; Vasilyeva, 1989; Wasser, 1989; Barinova, Medvedeva, 2000) .
Due to the high transparency and shallow water of the Aral Sea, plant communities, most organics were produced by phytobenthos rather than phytoplankton, which made the ecosystem of this reservoir different from the ecosystems of other inland seas. In general, the proportion of phytobenthos biomass reached 90%, while phytoplankton - only 10% (Karpevich, 1975).

Charovy algae accounted for about 75% and green algae - about 13% of the phytobenthos biomass. Other important benthic algae were green algae and red algae (Karpevich, 1975). In 1990 almost all of these species disappeared already in 1995. Currently, the only macroscopic algae in the Great Aral Sea are Cladophora fracta and Vauscheria sp. In the 1950-60s. in phytoplankton, diatoms dominated in the Aral Sea as the dominant species (Zenkevich, 1963).

According to Aladin and Kotov (1989) from 1972 to 1983. most species of brackish-water planktonic algae disappeared from the Aral Sea, including such dominants as blue-green and diatoms. In the 1980s, when salinity reached 24 ppt, not only brackish-water, but also marine euryhaline species of algae began to die out in the Aral Sea (Elmuratov, 1981). In 1999-2002 We noted 159 species of algae in periphyton and 167 species in plankton.

This is approximately half the diversity of phytoplankton noted previously. So, in the 1920s, Kiselev (1927) noted 375 species in the plankton of the Aral Sea, while in the 1960-70s. Pichkil (1981) and Elmuratov (1981) noted 306 and 278 species, respectively. The diversity of phytoplankton in 2002-2005 was stable, but significantly lower than in the previous period. If in 1999-2001 in the Aral Sea, 159 species of algae were recorded; in 2002-2005, only 81 species. Moreover, in each individual year, no more than 60 species were found. Practically only marine and halophilic species remained in the reservoir. Not all noted algae species are truly planktonic.

Due to the shallow water of the sampling sites (2-4 m), a significant number of the noted species of algae are representatives of phytobenthos and periphyton.

5. Conclusion

Long-term monitoring observations of the state of the Aral Sea ecosystem have revealed a significant restructuring of the basic structural and functional relationships. The species composition was depleted, as a result of successive successions of biocenoses, a number of trophic groups and even some parts of food chains were lost, as a result of the transformation of the internal cycle of nutrients, a change in the type of production of primary organic matter took place.

The main changes in the Aral Sea ecosystem under the conditions of the ecological crisis and their consequences are disclosed and summarized in the monograph of N.I. Andreeva (1999), but so far there have been no attempts to identify evolutionary changes in any group of organisms under conditions of such an unprecedented restructuring of the ecosystem.

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