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CONTENTS

BIOLOGICAL SCIENCES

Абдуллаева Н.Ф., Гусейнова Н.Ф., Абдуллаева Н.А.
ВЛИЯНИЕ СОЛЕЙ ЖЕЛЧНЫХ КИСЛОТ И ФЕНОЛА НА ЖИЗНЕСПОСОБНОСТЬ МОЛОЧНОКИСЛЫХ МИКРООРГАНИЗМОВ İN VİTRO 3
Abdullayeva N.F., Huseynova N.F., Abdullayeva N.A.
THE EFFECT OF BILE SALTS AND PHENOL ON THE VIABILITY OF LACTIC ACID MICROORGANISMS IN VITRO 3

AGRICULTURAL SCIENCES

Амонс С.Е.
БІОЛОГІЧНИЙ ЗАХИСТ РОСЛИН ЯК ОДИН ІЗ ЧИННИКІВ ПОДАЛЬШОГО РОЗВИТКУ ОРГАНІЧНОГО ЗЕМЛЕРОБСТВА В УКРАЇНІ 5
Amons S.E.
BIOLOGICAL PROTECTION OF PLANTS AS ONE OF THE FACTORS OF FURTHER DEVELOPMENT OF ORGANIC AGRICULTURE IN UKRAINE 5

Akhmetchina T. A.
INFLUENCE OF THE TYPE OF FEEDING ON THE MILK PRODUCTIVITY AND METABOLIC PROCESSES OF DAIRY COWS 12

Голубенко Т..
ВЛИЯНИЕ ПОРОДНОСТИ НА РОСТ, РАЗВИТИЕ И ПРОДУКТИВНЫЕ КАЧЕСТВА ТЕЛЯТ 16
Golubenko T.L.
INFLUENCE OF BREEDS ON GROWTH, DEVELOPMENT AND PRODUCTIVE QUALITY OF CALFS 16

Gutsol G. V.
INTENSITY OF AGGRESSION OF AGRICULTURAL LAND BY HEAVY METALS WITHIN THE FRESH-STEPPE FOREST BANK 26

Кучерявий В.П., Льотка Г.І., Кучерява М.Ф.
МОРФОЛОГІЧНІ ПОКАЗНИКИ КРОВІ МОЛОДНЯКУ ШИНШИЛ ПРИ РІЗНИХ СИСТЕМАХ УТРИМАННЯ 32
Kucheriavyi V.P., Lotka H.I., Kucheriava M.F.
MORPHOLOGICAL BLOOD PARAMETERS OF YOUNG CHINCHILLAS UNDER DIFFERENT HOUSING SYSTEMS 32

Паламарчук І.
ФЕНОЛОГІЧНІ ФАЗИ РОЗВИТКУ БУРЯКУ СТОЛОВОГО ЗАЛЕЖНО ВІД СОРТУ ТА ВОДОУТРИМУВАЛЬНИХ ГРАНУЛ 36
Palamarchuk I.
PHENOLOGICAL PHASES OF DEVELOPMENT OF TABLE BEETS DEPENDING ON THE VARIETY AND WATER-CONTAINING GRANULES 36

Prokopchuk V., Pantsyreva H., Mazur K.
REPRODUCTIVE ABILITY ROSA L. IN LANDSCAPING PODILLYA OF UKRAINE 42

Рудська Н.О.
ЕФЕКТИВНІСТЬ СИСТЕМИ ЗАХИСТУ ПОСІВІВ КУКУРУДЗИ ВІД БУР'ЯНІВ ЗА РІЗНИХ СПОСОБІВ ОБРОБІТКУ ГРУНТУ В УМОВАХ ЛІСОСТЕПУ ПРАВОБЕРЕЖНОГО УКРАЇНИ 47
Rudska N.O.
EFFICIENCY OF THE SYSTEM OF PROTECTION OF MAIZE CROPS FROM WEEDS IN DIFFERENT METHODS OF SOIL TREATMENT IN THE CONDITIONS OF THE RIGH BANK FOREST- STEPPE OF UKRAINE 47

Biliavtseva V.
METHODS OF WASTEWATER TREATMENT WITH THE HELP OF AQUATIC ORGANISMS. 54

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METHODS OF WASTEWATER TREATMENT WITH THE HELP OF AQUATIC ORGANISMS.

Abstract.
One of the promising areas for the introduction of innovative water treatment technologies is the use of biological methods. In this case, the aquatic environment is not made of uncharacteristic substances, technological processes mimic natural, the efficiency of which is enhanced by tens and hundreds of times by a special organization of biological processes.

Almost 80% of Ukraine's drinking water supply is provided by surface water. Pools and rivers, according to the hygienic classification of water bodies according to the degree of pollution, can be classified as polluted and highly polluted. The composition of treatment facilities and water treatment technologies have not actually changed in recent years.

Keywords: *aquatic organisms, plankton, water, organisms, purification*

Topicality.

The uncontrolled rapid development of water mains (largely blue-green hydrogen) is a clear example of the treatment of contaminated surface waters in the waters of Ukraine. Due to the pollution of the hydrosphere of human products - compounds of phosphorus and nitrogen, algae received unfavorable conditions for development.

As a result of the construction of artificial reservoirs on the rivers of Ukraine, the number of shallow areas that are well warmed by the sun has increased. Algae cause significant damage to the environment at the stage of extinction, creating secondary pollution (release of toxic substances into the air and into the aquatic environment), but at the same time absorbing pollution contribute to water purification.

Analysis of recent research and publications.

A large number of studies have been devoted to the treatment of polluted wastewater with the use of aquatic organisms.

Hydrobionts are salt and freshwater organisms that live permanently (obligatorily) or temporarily (optionally) in the aquatic environment [9]. Many of them have adapted to living in a variety of conditions over millions of years of evolution.

A large number of researchers have studied the factors influencing the development of coenobacteria on the example of cyanobacteria from the genera Anabaena, Aphanizomenon, Cylindrospermopsin, Nodularia, Lyngbya, Oscillatoria, Microcystis, Planktothrix [17].

Among other factors that shape the conditions for the development of cyanobacteria, they focused in their research on salinity, temperature, pH, lighting, hydrodynamics of the environment.

Depending on the way of staying and moving in the respective layers of the aquatic environment, the following main ecological groups are distinguished among aquatic organisms: nekton, plankton and benthos.

Nekton (nektos - floating) - large animals that move actively and are able to overcome long distances and strong currents: fish, squid, pinnipeds, whales. Necton in freshwater includes both amphibians and many insects [13,15].

Plankton (planktos - wandering) - a set of plants (phytoplankton: diatoms, green and blue-green algae, etc.) and small animals (zooplankton: small crustaceans, winged mollusks, finfish, jellyfish, some worms), which are not capable of active movement and resistance to currents, but live at different depths.

The larvae of animals, forming a special group - neuston, belong to the plankton. This is a "temporary" population of the upper layer of water, represented by various animals (ten-legged, barnacles and oars, crustaceans, echinoderms, polychaetes, fish, mollusks, etc.) in the larval stage, which is passively floating [8,16].

Mollusks are non-segmented secondary cavity invertebrates. All mollusks have a foot, which is an ointment structure that provides movement. Squid and octopus differ from other species of mollusks in that their limbs have turned into tentacles, which they use not only for movement. The body of mollusks is covered with a skin fold - a mantle. A mantle cavity is formed between this fold and the torso. Due to glandular cells, most of them form a protective shell. Mollusks, compared to roundworms, have a complicated digestive system (the presence of digestive glands: salivary and liver), and blood (formed a central pulsating organ - the heart). A well-developed respiratory system is represented by gills or lungs.

Most of these animals are heterosexual, some are hermaphrodites. Like roundworms, mollusks often go through a larval stage, but unlike worms, their adults are not segmented. All mollusks play an important role in nature and human life: they are objects of fishing, clean ponds, are a food base for aquatic animals.

Epineiston includes organisms that live on top of the surface film, those below - to hyponeuston. Growing larvae move to the lower layers of the pelageal. Above the neuston are organisms in which the upper part of the body grows above the water, and the lower - in the water (duckweed - Lemna, siphonophores, etc.) - is a Pleistocene [1,4].

For many aquatic inhabitants, including the main food for baleen whales (Myatcoceti), plankton acting as food is important in the trophic relationships of the biosphere [17, 18].

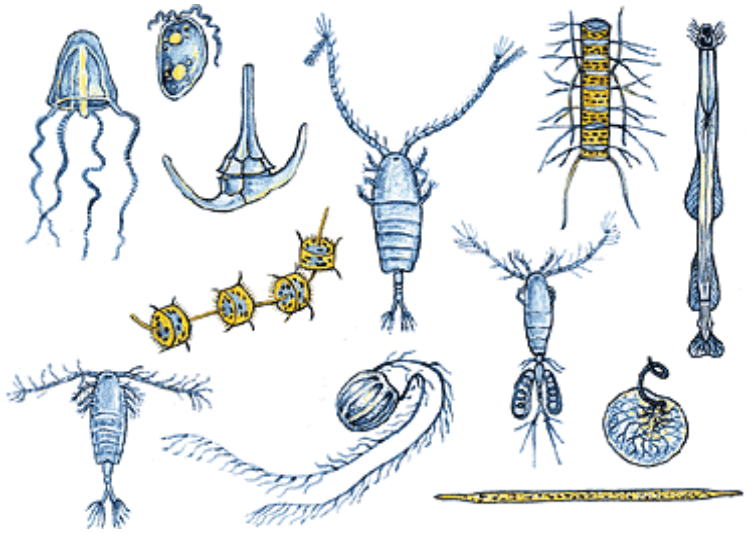

Figure. 1 Benthos

Benthos (benthos - depth) - bottom aquatic organisms. Benthos are mainly animals that lead an attached lifestyle or move slowly over short distances (zoobenthos: foraminifera, some fish, sponges, intestinal caterpillars, worms, brachiopods, ascidians, etc.), more numerous in shallow water, where benthos belongs to and plants (phytobenthos: diatoms, green, brown, red algae, bacteria).

Phytobenthos is absent at depths where there is no light. Kamka (zoster), rupee - are flowering plants found near the coast. Rocky areas of the bottom are the richest in phytobenthos. Less rich and diverse than in the sea - zoobenthos in lakes, it is formed by the simplest, crustaceans, worms, mollusks, insect larvae.

Phytobenthos of lakes is formed by free-floating diatoms, green and blue-green algae; brown and red algae are absent [19]. Rooted coastal plants in lakes form distinct zones, the species composition and appearance of which are consistent with the environmental conditions in the land-water border zone.

In the water near the shore grow hydrophytes - semi-submerged plants (arrow, specimens, reeds, hornbeam, sedges). They are replaced by gidatophytes - plants immersed in water, but with floating leaves (lotus, duckweed, jugs, water nut) and - then - completely immersed (rdesnik, elodeya, chara). Hydatophytes include plants that float on the surface (duckweed, water hyacinth) [16].

Figure 2 Phytobenthos

Elodeya Representatives of the genus Elodeya (Elodea) are often called "water plague", and rightly so. These perennial aquatic plants belong to the waterfowl family. Their characteristic feature is unpretentiousness and intensive growth. When exposed to favorable conditions, Elodea grows so rapidly that it can displace the local aquatic flora. There are cases when dense thickets of Elodea interfered with navigation [1].

Figure 3. Elodeya

The optimum temperature for the growth of most species is 17-24 ° C. Too low a water temperature slows down the growth of Elodea. Parameters such as hardness and acidity, almost do not play a role in the care of Elodea. The main thing is not to observe sharp drops, as a result of which Elodea can drop leaves. If there is enough organic matter in the aquarium, Elodea can do without additional feeding [3]. Elodea propagated vegetatively - by cuttings of the stem. It is desirable that the cuttings were at least 20 cm in size. Under favorable conditions, it is possible to observe the flowering of Elodea. It should be noted that Elodea is a dioecious plant, male and female flowers are located on different plants. But on the European continent spread only females, so pollination and seed formation does not occur.

Chara is one of the most highly organized genera of higher algae. The name is Greek. hara - joy, beauty. There are more than 400 species of choral, the flora of Ukraine has 38 species. These are macroscopic algae, outwardly similar to some terrestrial plants (horsetails, anthocerotovidnye). The height of their thalamus is usually 20-30 cm, but can reach 1-2 m, lateral branches of limited growth. Green chloroplasts contain chlorophylls a and b, as well as lycopene. Starch accumulates as a reserve substance. For vegetative algae is characterized by vegetative and sexual reproduction.

Duckweed - perennial herbaceous planktonic monocotyledonous flowering plant of the Lemnaceae family. One of the most common representatives of the higher aquatic vegetation of freshwater ecosystems of all continents except Antarctica. The plant is also common in Ukraine, undemanding to growing conditions, able to survive under ice. The plant multiplies rapidly both in polluted water (farm and municipal effluents, fish ponds, reservoirs of thermal power plants) and in clean reservoirs with low-flowing or stagnant water (lakes, ponds, reservoirs, canals, rivers). R.m. has a high biological productivity (1–3 kg of green mass per 1 m ²), is used as a bioindicator of environmental pollution in water treatment systems [7,13].

In the people duckweed was added to soups, brewed instead of tea. Modern nutritionists argue that R.m. contains the optimal balance of nutrients, and is advised to add it to food fresh or dried.

Figure 4 Eichhornia, (water hyacinth)

Water hyacinth - Eichhornia (water hyacinth) belongs to the family Pontederievye, which has about 30 species of flowering algae. Eihorn was first discovered in tropical South African forests, where it abundantly covered the surface of local warm water. If the plant is provided with appropriate conditions as in the native tropics, it very quickly forms continuous thickets on the water, covering it with large floating leaves. But, the main thing that attracts attention eichhornia is the flowering period, when large flowers blooming in the green thickets, resembling the shape of hyacinths.

In regions with warm tropical climates eichhornia from time to time brings a lot of inconvenience to locals. In warm humid weather, it grows strongly in ponds, lakes and floodplains, stopping the movement of water, impeding transport, threatening populations of animals, fish and other plants. If the water in which the eichhornia grows is constantly restless, the petioles of the leaves will be thick. If the pond is quiet or you grow the plant in an aquarium, the cuttings will be long and slender [5,11].

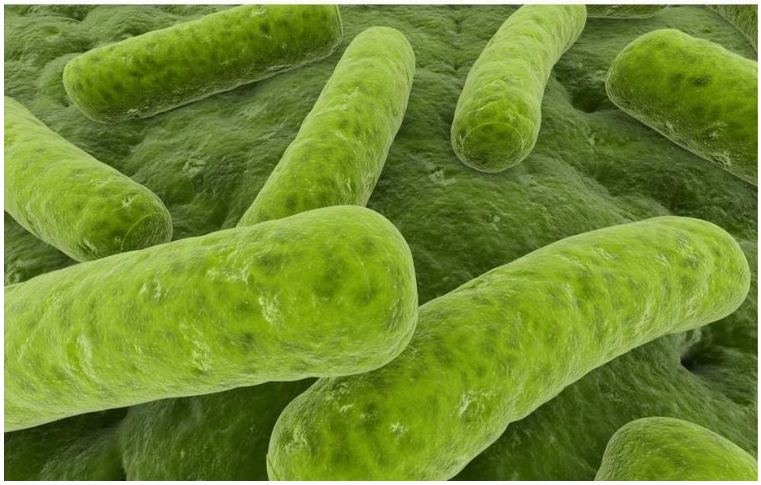

Figure 5. Nitrospira moscoviensis

Common forms of aquatic organisms include species, the increase in the number of which under certain conditions becomes explosive in reservoirs, and their biomass is beginning to significantly exceed that, compared with competing species.

At the level of the kingdoms of wildlife, aquatic organisms are representatives of Virabiota, Bacteriobiota, Phytobiota, Mycobiota, Zoobiota. They belong to different taxa and taxonomic groups in the modern system of the organic world.

Microalgae and bacteria. Bacteria (Bacteriobiota) - a kingdom of microscopic, mostly unicellular, prokaryotic organisms, which are characterized by the presence of a cell wall, cytoplasm with organelles, various specific inclusions, the absence of mitochondria and chloroplasts, decorated nucleus.

The size of bacterial cells usually does not exceed a few micrometers, occasionally reaching 20 μm (average 0.1–1.0 μm). According to the physiology of nutrition, heterotrophs and autotrophs (photo- and chemotrophs) are distinguished among bacteria, and aerobes and anaerobes are distinguished by the type of respiration.

Many species of pathogenic (pathogenic) bacteria cause diseases in humans, animals and plants. Some bacteria can exchange genetic information, which is the so-called process of horizontal gene transfer [13]. Both fresh and marine waters can house certain types of bacteria.

An example is the bacterium Nitrospira moscoviensis (Fig. 5). Some exist only in fresh hydroecosystems. Studies have established the prevalence of such groups of bacteria in freshwater bodies as α-, β-, and γ-proteobacteria . A high content of δ-

proteobacteria was found in the sediments of both fresh and marine water bodies [15].

Because cyanobacteria are photosynthetic and aquatic (mostly planktonic) microorganisms, they are often referred to as "blue-green algae" (SZV). Cyanobacteria do not need vitamins to survive and develop. They can use phosphorus compounds and micronutrients such as iron, sulfur, zinc, copper, manganese, cobalt, molybdenum, as well as nitrates or ammonia as a source of nitrogen.

Most of their species are phototrophs, but some filamentous species can grow in the dark using some carbohydrates (glucose or sucrose) as a source of energy. The complex of interrelated, mostly abiotic factors constitutes the optimal conditions for the development of cyanobacteria.

Plants (Phytobiota) - the kingdom of eukaryotic autotrophic (photosynthetic) single- or multicellular organisms; one of the main groups of the organic world on Earth. According to the morpho-anatomical structure and complexity of functioning, plants are divided into lower with undifferentiated body - thalamus (algae, some mosses, lichens) and higher, whose body is differentiated into root, stem, leaves.

On spores (moss, horsetail, plauno- and fern-like) and seeds (naked and angiosperms), in turn, are divided into higher plants [11]. There are about 500 thousand species of modern plants that play an extremely important role in nature: they create favorable living conditions for animals and humans, form the flora and vegetation of the Earth, as they are the primary producers of organic matter.

Algae (Rhodobionta et Phycobionta) is a group of divisions of lower (ivory) unicellular, multicellular and colonial autotrophic, chlorophyll-bearing plants from two subkingdoms of plants. More than 35,000 species are known, most of which are obligate aquatic organisms. Algae are organisms that grow rapidly in inexpensive environments and play an important ecological role due to photosynthesis, but are sensitive to environmental factors. Algae are organisms that grow rapidly in inexpensive environments and play an important ecological role due to photosynthesis, but are sensitive to environmental factors. As a result, algae are widely used in environmental studies as a means of testing water toxicity and are used in the testing of wastewater, including landfill filtrates (table 1.) [8].

Microalgae are present in landfill filtrates, after some pre-treatment or dilution of these filtrates, but mainly in small-scale experiments, while several species of algae have been studied for biological treatment of landfill effluents in large open ponds and drains. Growing algae in landfill filtrates can solve a dual task - to make algae biomass for energy and bioproducts production and to restore low-quality landfill effluents for recycling and reuse. Microalgae should be considered as a promising and fairly stable addition to complex technologies for purification of leachate [3,7].

Table 1.

Classification of microalgae by Anders, Ralph, Levin

Відділ (тип хлорофілу)	Class	Genus
Rhodophyta («a» + «d»	*Rhodophyceae*	*Bangia, Chondrus, Corallina, Gelidium, Palmaria, Gracilaria, Porphyra, Rhodymenia et al.*
Chromophyta («a» + «c»)	*Bacillariophyceae*	*Cyclotella, Thalassiosira, Bacillaria, Navicula, Nitzschia et al.*
	Chrysophyceae	*Chrysamoeba, Chrysocapsa, Lagynion,Ochromonas. Bicosoeca, Chrysochromulina et al.*
	Phaeophyceae	*Ascophyllum, Ectocarpus, Fucus, Laminaria, Macrocystis, Postelsia, Sargassum et al.*
	Raphidophyceae	*Chattonella, Gonyostomum, Heterosigma, Psammamonas, Vacuolaria et al.*
	Xanthophyceae	*Botrydium, Bumilleriopsis, Tribonema,Vaucheria et al.*
	Cryptophyceae	*Chilomonas, Cryptomonas, Falcomonas, Plagioselmis, Rhinomonas, Teleaulax etal.*
	Dinophyceae	*Ceratium, Dinophysis, Gonyaulax, Gymnodinium, Noctiluca, Peridinium et al.*
Chlorophyta («a» + «b»)	*Chlorophyceae*	*Chlamydomonas, Chlorella, Dunaliella, Oedogonium, Desmidium, Volvox, Acetabularia, Caulerpa, Monostroma et al.*
	Prasinophyceae	*Micromonas, Ostreococcus, Pyramimonas et al.*
	Charophyceae	*Chara et al.*
Euglenophyta	*Euglenophyceae*	*Colacium, Euglena, Eutreptiella, Phacus et al.*

Higher aquatic plants (macrophytes) - a group of orders of mostly monocotyledonous (Liliopsida) subkingdom

Embriobionta - the most highly organized deciduous plants, the ontogeny of which occurs in the aquatic environmenthydrophytes (Fig. 1.6) and gidatophytes.

In freshwater biohydrocenoses and marine ecosystems, the interaction of aquatic plants with bacteria is important for a number of environmental processes that occur (including water self-purification, nitrogen fixation, denitrification, ammonia oxidation, etc.) [6,12].

Mushrooms. Fungi (Mycobiota) - a kingdom of heterotrophic, eukaryotic organisms (about 100 thousand species distributed throughout the globe). They feed on organic substances osmotically (adsorbent nutrition), getting them from inanimate substrate - saprotrophs, or from living organisms - parasites [4,18].

Figure 6. Oomycota

Oomycota – This is a large ecological group, which includes representatives of all classes of fungi. They live in reservoirs - oceans and seas, rivers and lakes, swamps, thermal springs. Aquatic ecosystems are the oldest on Earth. Therefore, they have preserved and thrived the oldest groups of fungi: chitridiomycetes, oomycetes. This is a large ecological group, which includes representatives of all classes of fungi. They live in reservoirs - oceans and seas, rivers and lakes, swamps, thermal springs. Aquatic ecosystems are the oldest on Earth. Therefore, they have preserved and thrived the oldest groups of fungi: chitridiomycetes, oomycetes.

Aquatic fungi are in relatively more stable living conditions than terrestrial ones: water cools slowly and heats up slowly, it dissolves well and removes various products of aquatic life, protects them from direct sunlight. Thus, aquatic organisms do not experience sharp fluctuations in the main environmental factors - temperature, mineral and gas composition. He main criterion for distinguishing this group is living in an aquatic environment, where fungi perform the following functions:

- decomposition of organic residues;
- parasitism on plants and animals;
- participation in symbiotrophic associations with other organisms;
- participation in various biogenic fouling.

By origin, aquatic fungi can be divided into two subgroups:

1) primordial (appeared in the aquatic environment and remained in it);

2) re-aquatic (during evolution they migrated to land, and then returned to the aquatic environment). The second subgroup includes aquatic hyphomycetes, many ascomycetes and basidiomycetes.

Forming mycorrhiza, some species of fungi are in symbiosis with algae (lichens) and woody plants. The vegetative body consists of a system of thin branched hyphae, mycelium. Fungal cells are mono-, di- or multinucleate. The cell wall of hyphae is dense, 80-90% consists of polysaccharides, the main of which in the vast majority of fungi is chitin, and in oomycetes - cellulose.

Forming mycorrhiza, some species of fungi are in symbiosis with algae (lichens) and woody plants. The vegetative body consists of a system of thin branched hyphae, mycelium (mycelium). Fungal cells are mono-, di- or multinucleate. The cell wall of hyphae is dense, 80-90% consists of polysaccharides, the main of which in the vast majority of fungi is chitin, and in oomycetes - cellulose. The ability to form fruiting bodies that develop from vegetative mycelium is an important feature of higher fungi 32 (marsupials and basidiomycetes). Reproduction - asexual (vegetative) and sexual. Some fungi also know budding (yeast) [4].

Division of fungi into divisions: true fungi (Eumycota), aquatic fungi (Oomycota), mucous membranes (Myxomycota) and lichens (Lichenes). Fungi are dominated by terrestrial microorganisms, but there are some species that are common in aquatic ecosystems [14, 17].

Fungi play an important role in the destruction of organic matter in marine and freshwater ecosystems. They are involved in the degradation of virtually all organic substrates, including lignin, chitin, keratin and other hard-to-reach compounds that are poorly degraded by bacteria.

Coastal-aquatic vegetation belongs to the category of difficult to decompose organic matter. In addition, the reservoir gets a large amount of leaf fall of trees and shrubs that grow along the shores. It is on plant remains (algae and tree leaves) are often found saprotrophic fungi [2,15].

Bacteria, actinomycetes, and invertebrates take part in the decomposition of such organic matter, but the main role in this process belongs to fungi, primarily fungi, which decompose ligninocellulose complexes (E.A Kuznetsov).

As a rule, between fungi and bacteria during the decomposition of organic matter there is a fairly clear sequence. Fungi dominate at the initial stage of decomposition of organic substances containing cellulose, and bacteria replace them at the final stage of the destruction process.

Most aquatic fungi develop on living and dead plants - these are periphyton and benthic organisms. At the same time, some fungi are parasites of plants and animals. Many fungi have planktonic stages in their development. In addition, mushrooms are a complete food for many aquatic organisms - from protozoa to fish. There is a complex relationship between algae and periphyton, which includes fungi. Interactions of mac-

rophytes and fungi are multifaceted. Plants secrete organic compounds into the environment, which are used by periphyton bacteria, fungi, algae and invertebrates.

Mushrooms, in turn, produce biologically active substances for general use, which are disposed of by plants. Apparently, this interaction is similar to the relationship of fungus and algae in lichen. Aquatic plants, both living and dead, are constantly exposed to saprotrophic and parasitic fungi.

It is now generally accepted that fungi are a heterogeneous group of lower chlorophyll-free organisms. Mushrooms in a broad sense mean not only the actual fungi from the kingdom of Fungi (with 5 divisions - Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota and the combined division of Deuteromycota), but also fungal organisms.

The high degree of contamination increases the destructive power of parasitic fungi. Not the last role in this process belongs to usual saprotrophic fungi which together with parasitic fungi infect live plants.

In reservoirs used for fish farming (ponds, some cooling reservoirs), the share of saprotrophic species with a short development cycle is growing among fungi: chitridium fungi Rhizophydium pollinis-pini, Phlyctochytrium papillatum, heterocontigolipidium.

The parasitic properties of fungi are used to combat the overgrowth of water by macrophytes. Thus, the deuteromycete fungus Cercospora rodmanii is widely used as a means of biological control of water hyacinth (Eichhornia crassipes).

Lichens are a group of symbiotic organisms numbering more than 20 thousand species. The body of the lichen - the elephant consists of a fungus and algae that live in symbiosis as a whole organism. It is formed by intertwined threads of the mycelium, between which are unicellular green algae. The threads of the lichen fungus absorb water and minerals dissolved in it, and organic matter is formed in the cells of green algae.

Algae that are part of the lichen's body, separated from the fungus, can usually exist on their own. The fungus cannot live apart from algae. Lichens reproduce mainly by pieces of frost, as well as special groups of cells of the fungus and algae, which are formed in large numbers inside his body.

Under the pressure of increased mass, the body of the lichen is torn, groups of cells are carried by wind and rain.

Animals (Zoobiota) - the kingdom of heterotrophic unicellular or multicellular organisms. The absence of cellulose cell wall is characteristic of the cells of all animals except the integuments. In the process of evolution, the structure and functions of multicellular animals became more complicated: there were tissues, organs and their systems, devices that ensure the stability of the internal environment (homeostasis); developed special complex forms of behavior and so on. There are about 1.5 million species of animals that exist today, including more than 1 million insects. Many representatives of invertebrates (protozoa, intestinal, mollusks, arthropods, etc.) and vertebrates (chordates) belong to the primary and secondary aquatic organisms [6,18].

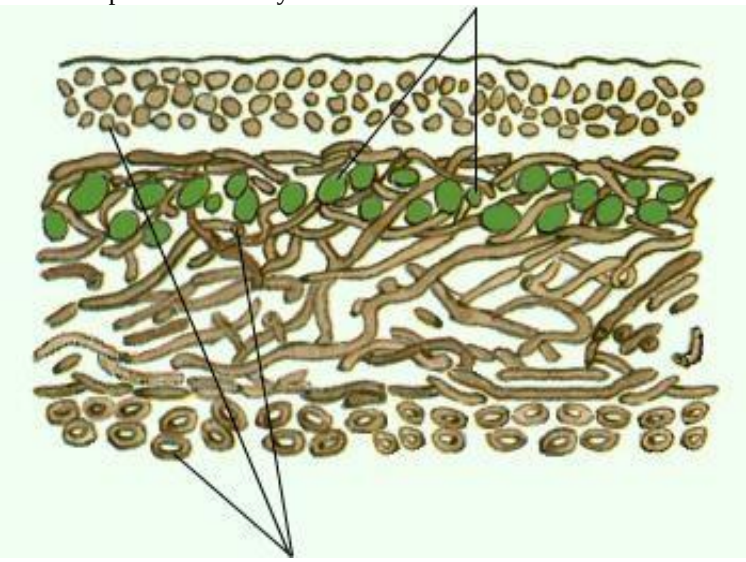

Figure7. Lichens

Protozoa - a type of unicellular animals (size 2−200 mm), whose body consists of cytoplasm (divided into ectoplasm and endoplasm), pseudopodia (temporary formations of ectoplasm) and located in the endoplasm of the nucleus and organelles, which are divided into five classes : sarcoids, rhizopods, radiolarians, sunflowers and zoomastigines [7,20].

The cell of the protozoan, like any eukaryotic cell, has whole-cell organelles. In the cytoplasm of protozoa there are two layers: outer - ectoplasm and inner - endoplasm. In addition, the protozoa have organelles characteristic only of them: movements (pseudopods, flagella, cilia), digestion (digestive vacuoles, in the ciliate - cell mouth, pharynx), secretion and osmoregulation (contractile vacuoles).

The cell of unicellular animals contains one (amoeba, euglena) or several (ciliates) nuclei. The vast majority of unicellular organisms have the ability to move. With the help of temporary protrusions of the cytoplasm - false legs (pseudolegs) move the simplest, devoid of a dense cell membrane (amoeba). The flagella (euglena green) and cilia (ciliate-shoe) promote the rapid movement of unicellular organisms.

Figure 8. Freshwater benthic amoeba of silt deposits Mastigamoeba aspera (Pelobiontida, Sarcodina)

The simplest are distributed around the globe. These include free-living and parasitic species. According to the peculiarities of the structure, unicellular organisms are divided into several types: Carcodus, Spores, Infusoria. Feeding mainly on microorganisms and organic residues, the protozoa include them in the general process of circulation of substances in the biosphere. They themselves are food for some crustaceans, mollusks, fish fry. Their role in self-cleaning of reservoirs is noticeable [3,16].

With the help of digestive vacuoles, excretion and gas exchange - through the contractile vacuoles or the surface of the body is digestion. Propagated mostly by division. Under adverse conditions, they are able to form cysts. More than 30 thousand species (in Ukraine - about 1.5 thousand) are distributed worldwide.

Among the methods of wastewater treatment, biological treatment methods play an important role. Biological methods of domestic wastewater treatment (and their mixtures) from organic substances are based on the use of microorganisms that use these compounds as nutrients and energy sources .

The different types of aquatic organisms used for wastewater treatment include: activated sludge (aerobic biomicrocenosis), various bacteria (anaerobic biomicrocenoses), microalgae, aquatic plants, higher plants (in artificially constructed wetlands). The optimal values of temperature and pH and the need for an oxygen source are presented in table 2.

Table 2.

Optimal values of temperature, pH and air sources

	pH	The presence of oxygen	Temperature, °C
Aerobic biomicrocenosis	6,5-7,5	+	20-40
Anaerobic biomicrocenosis	6,5-8,5	-	25-35
Microalgae	6,0-6,5	+	23-25
Aquatic plants	6,0-6,8	+	16-20
Higher plants	6,5-8,5	+	08- 25

Organic compounds in polluted effluents undergo destructive decomposition due to oxidation in aerobic and reduction processes with the formation of methane in anaerobic treatment .

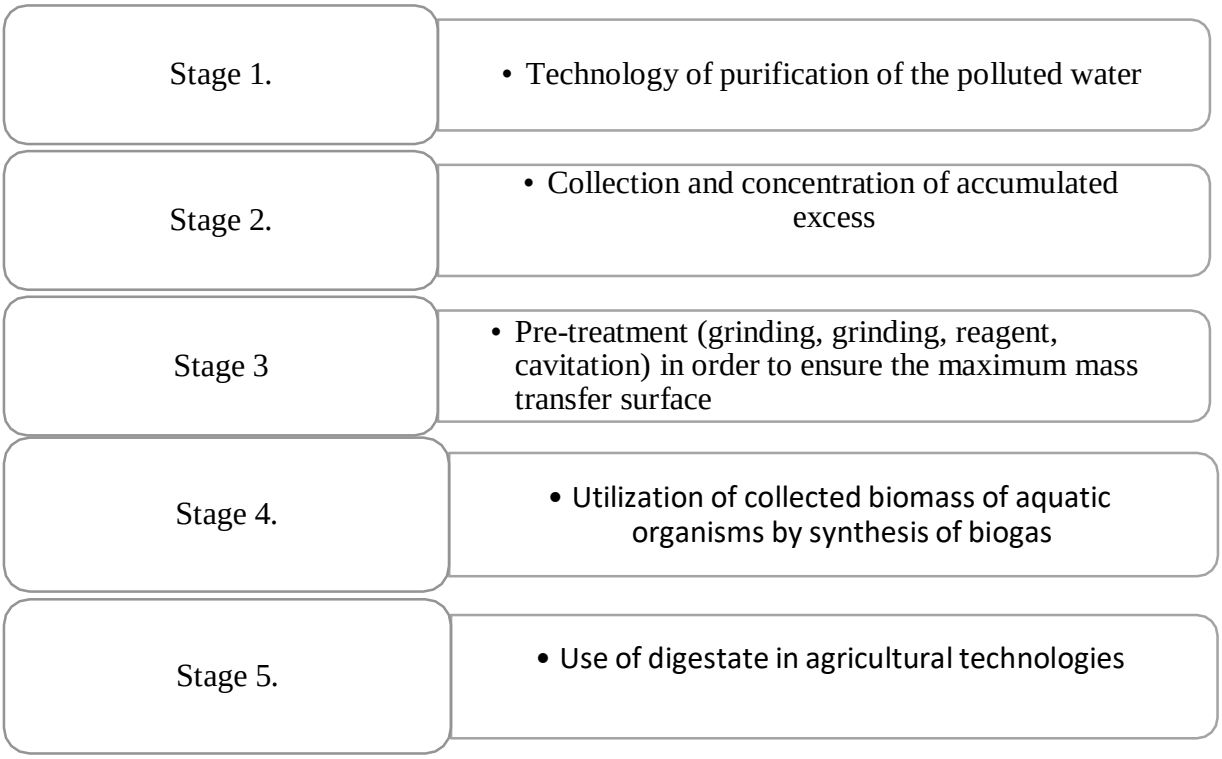

Figure 9. Life cycle of aquatic organisms

CONCLUSIONS

Wastewater treatment is the destruction or removal of certain substances, disinfection and removal of pathogens.

There is a wide variety of cleaning methods, which can be divided into the following main groups according to the main principles used:

Mechanical. They are based on the procedures of filtering, filtering, settling, inertial separation. Allow to separate insoluble impurities. In terms of cost, mechanical cleaning methods are among the cheapest methods.

Chemical. They are used to separate soluble inorganic impurities from wastewater. When treating wastewater with reagents, they are neutralized, decolorized and disinfected. In the process of dry cleaning can accumulate a large amount of sludge.

Physico-chemical. The processes of coagulation, oxidation, sorption, extraction, electrolysis, ion exchange purification, reverse osmosis are used. This is a high-performance cleaning method with a high cost. Allows to clear sewage of fine and coarsely dispersed particles, and also the dissolved connections.

Biological. These methods are based on the use of microorganisms that absorb wastewater pollutants. Biofilters with a thin bacterial film, biological ponds with microorganisms, aerotanks with activated sludge, with bacteria and microorganisms are applied.

Combined methods are often used, which use different cleaning methods in several stages. The use of one or another method depends on the concentration and harmfulness of impurities.

Depending on whether the components of pollutants are removed from wastewater, all treatment methods can be divided into regenerative and destructive.

Destructive methods of industrial wastewater treatment are used, which involve the destruction of harmful impurities or their transfer to non-toxic products, and regenerative, based on the production and disposal of impurities from wastewater.

The method of biological wastewater treatment is based on the ability of microorganisms to use various substances contained in wastewater as a source of nutrition in the process of life. Thus microorganisms release water from pollution.

There are many modern methods that can treat wastewater. The use of some of them depends on the composition of contaminants in the water, its further use and the released substances. However, the use of at least one of them is a legal and moral obligation of every business entity. Because we all need to remember that we depend on the environment and harming it will come back to us three times over.

Fungi are present in all biological communities, taking an active part in their lives, are in close contact with all organisms inhabiting them, participate in the general biological cycle of substances.

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