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BIODIVERSITY OF MYCELIAL FUNGI IN FRESH WATER IN THE TERRITORY OF THE PARK "MARI CHODRA" OF THE RUSSIAN FEDERATION

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Abstract

Water contaminated with liable to be pathogenic mycelial fungi in tributaries may cause health hazards to animals, birds and humans. The presence of mold fungi in water can be dangerous due to daily contact with water at several points of exposure, such as drinking, showering and swimming in lakes during the summer season. Affections of fungi of the genus Aspergillus, Penicillium, Fusarium, Mucor, Rhizopus cause allergies, opportunistic infections, mycosis and intoxication in living beings. Fresh water bodies, lakes, ponds are a black box for fungal ecology. Microbial organisms of bacteria, viruses, mycelial fungi directly affect agricultural land as well as social forestry. The article presents the results of mycological analysis of fresh water bodies in the territory of the park "Mari Chaudra". We allocated fungi of a sort Trichoderma - 46%, Aspergillus - 27%, Fusarium - 13%, Penicillium - 10%, Mucor - 2%, yeast fungi Candida - 1% and Rodoturulla - 1%. Practical results showed the relationship of natural balance of micelian fungi, ecotoxicants with acid-alkaline balance and aquatic vegetation in water bodies.

Keywords: *karst lakes, ponds, micellae, micelli mushrooms, duckweed, National Park.*

INTRODUCTION

Micellular micromycetes are phylogenetic and functionally diverse omnipresent components of almost all ecosystems on Earth. The aquatic ecosystem stretches from shallow reservoirs, high mountain lakes to the deep ocean. However, little attention has been paid to the habitats of mycelial fungi in aquatic ecosystems, although mildew micacetes play an important role in the organic matter cycle and food network dynamics. In this review, we conceptualize spatio-temporal measurements, biodiversity, functions and organism interactions of mold fungi in structuring aquatic ecosystems (Papadopoulos and Tsihrintzis, 2011; Sims et al., 2013; Mohedano et al., 2019). Today, more relevant developments in water systems are the use of mycelial fungi as a biosorbent for removing heavy metals from waste water (Ansa et al., 2015).

Mycelial fungi became an indispensable family of biosorbents, which are superior to other microorganisms capable of easily producing large biomass, and the ability to perform genetic and morphological manipulations (Sekomo et al., 2012; Mohedano et al., 2012; Dugova et al., 2013; Potekhina et al., 2020).

To study the water space of mycelial fungi, we selected ponds that were subject to natural temperature fluctuations, precipitation and biotic colonization. Nine lakes of the usual forest ecosystem structure were selected: Mushan-Yer, Konan-Yer, Gluchoe, Yalchik, Kichier, Shut'-Yer, Kuzh-Yer, Yergez-Yer, Tot-Yer and karst lake Kozhla-Sola, located in the settlement of the "Mari Chodra" National Park. The lakes have a mixed water supply, namely: melt, rain, river and ground waters of the azonal type, the chemical composition of which is determined not by the peculiarities of surface runoff, but by their origin (Sengupta et al., 2010; Sims and Hu, 2013; Dinh et al., 2020).

The aim of our research was to identify ecotoxicants in fresh water as well as mycological analysis of field isolates.

The research was conducted during the spring-summer period of 2019-2020.

MATERIALS AND METHODS

For the study of fresh water from lakes for mycological analysis and ecotoxicants the ecologically clean object National Park "Mariy Chodra" was chosen. The park is located in the southeastern part of the Republic of Mari El and occupies 36.800 hectares, in the zone of mixed coniferous-broad-leafed forest with boreal and forest-steppe flora elements.

The soil cover in the forest zone of the entire park is sod-podzolic. It is located under coniferous and mixed coniferous-broad-leafed forest with a well-defined grass cover.

For the study samples of water in 10 lakes in the territory of the park in the adjacent 4 forestries Yalchinskiy, Lushmarskiy, Klenovogorskiy, Kerebelyakskiy, of which one lake of karst origin were taken.

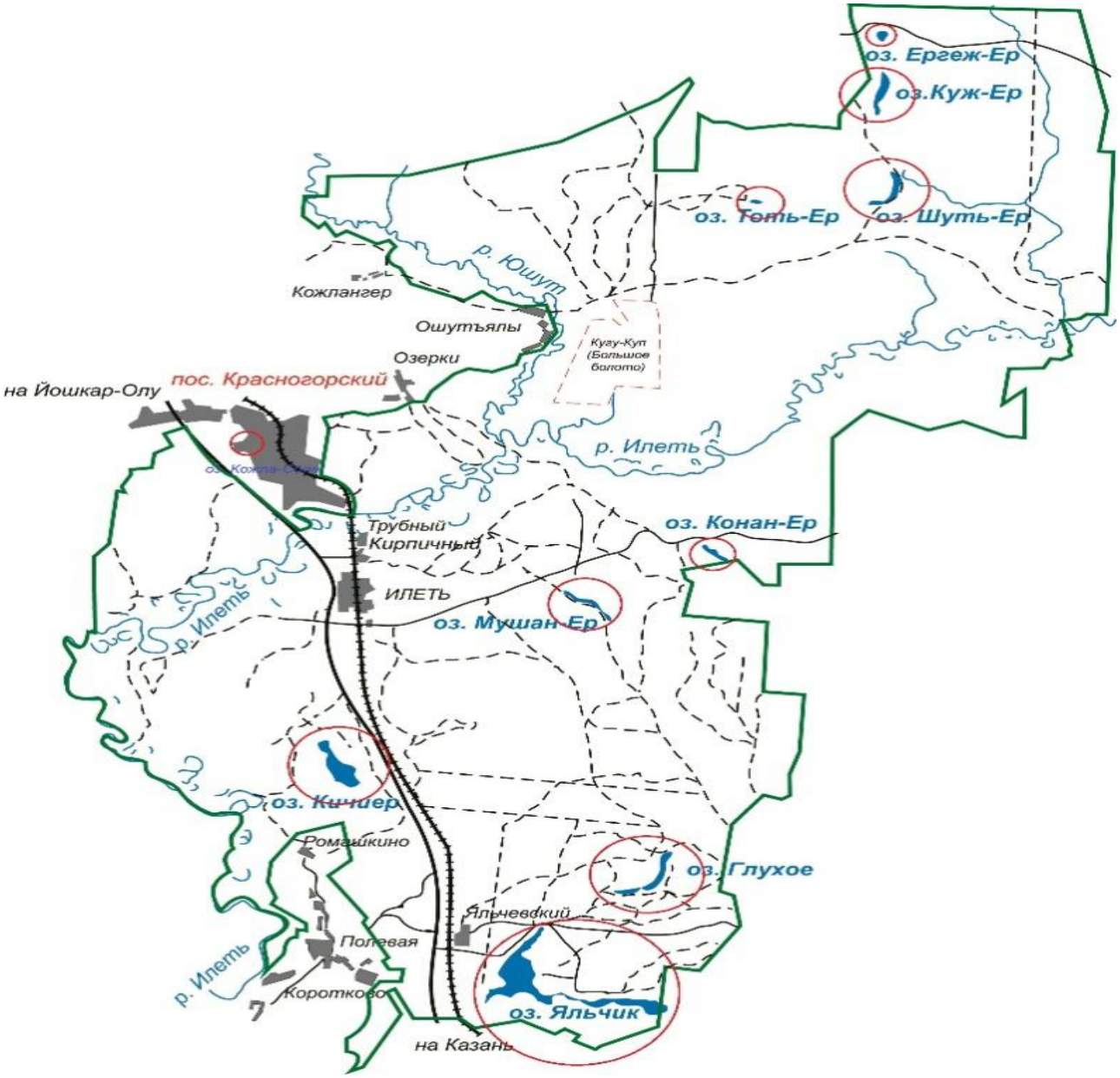


Figure 1. Water sampling in the park area.
1. Mushan-Yer, 2. Konan-Yer, 3. Gluchoe, 4. Yalchik, 5. Kichier, 6 Shut'-er, 7. Kuzh-Yer, 8 Yergezz-Yer, 9. Tot-Yer, 10 Karst lake Kozhla-Sola.

Sampling, transport and storage. Water was taken under aseptic and antiseptic conditions, sterile gloves were used to prevent dust and splashes, and samples were taken on the surface of the pond. Glass containers with a capacity of no more than 0.5 liters were used for water withdrawal, which were tightly sealed with a silicone plug. The selection took place in three repetitions. Before sampling, the glass vessel and plug were flamed with a burning tampon moistened with 96% ethyl alcohol. Water was taken from the surface of the reservoir from a depth of 10 to 30 cm into sterile vessels. During sampling, we took care to leave space between the plug and the water surface of the vessel so that the plug didn't come into contact with water during transportation. Then the samples were cooled to the temperature of - 20^{C}, using a cold battery. Samples were examined within 8 hours of being taken.

Determination of hardness in natural waters. The method is based on the formation of complex compounds of Trilon B with ions of alkaline earth elements. The determination is performed by titration of the sample with Trilon B solution at pH=10 in the presence of an indicator.

Muddy and coloured samples are pre-filtered through an ash-free "blue ribbon" filter.

In a flask with a capacity of 250 cm^3 we put 100 ml (or a smaller volume brought to 100 ml of bidistilled water) of the analyzed water, 5 ml of buffer solution (pH = 10 ± 0.1), 0.05-0.1 g of the dry mixture of the indicator (eryochrome black T with sodium chloride) and titrate with a solution of Trilon B 25 $mmol/dm^3$ to change the equivalent color from red violet to blue with a greenish tint. There are 2 parallel definitions.

To calculate the stiffness, the correction factor (K) to the concentration of Trilon B solution is preliminarily determined using a standard solution of magnesium ions with a concentration of 25 $mmol/dm^3$.

The water hardness is calculated by the formula:

$$H = \underline{M \cdot C \cdot V_{tr}}$$

V_{ws}

where M - the conversion factor equal to $2S_{tr}$ (M=50),
C- correction factor for the concentration of Trilon B solution,
V_{tr} - volume of Trilon B solution used for titration, cm^3,
V_{ws} - volume of water sample taken for analysis, see [3].

Definition of nitrates. The method consists in the interaction of nitrates with sodium salicylic acid in a sulfuric acid medium with the formation of nitrosalicyl salt, painted yellow, and the subsequent photometric determination and calculation of the mass concentration of nitrates in the sample under study.

The interfering effect of turbidity and water color is eliminated by adding 3 ml of aluminum hydroxide suspension to 150 ml of the sample. The sample is thoroughly stirred and after settling, the sludge is filtered out.

Place 10 ml of prepared sample in a porcelain cup, add 1 ml of 0.5% sodium salicylic acid solution and evaporate in a water bath to dry. After cooling, add 1 cm^3 of concentrated sulfuric acid to the dry residue, rub thoroughly with a glass rod and leave for 10 minutes. Then add 10 cm^3 of distilled water and quantitatively transfer to a measuring flask with a capacity of 50 cm^3, add 7 cm^3 40% sodium hydroxide solution, bring the volume of distilled water to the mark and stir. Then, within 10 minutes, the optical density of the analyzed samples is measured using a purple light filter (λ=400 nm) and a cuvette with an optical layer thickness of 30 mm. Distilled water prepared in the same way is used as a blank sample. The mass concentration of nitrates is found on a graduation schedule.

Determination is made in three repetitions.

Determination of nitrites. The essence of the method is the interaction of nitrites with sulfominic acid in the presence of I-naphthylamine to form a red-violet colored compound with subsequent photometric determination and calculation of the mass concentration of nitrites in water samples.

The interfering effect of turbidity and water color is eliminated by adding 3 ml of aluminum hydroxide suspension to 250 ml of the sample. The sample is thoroughly stirred and after settling, the sludge is filtered out.

To 50 cm^3 of the prepared sample (or to a smaller volume diluted with distilled water to 50 cm^3) 2 cm^3 of Griss reagent solution shall be added, stirred and in 40 minutes optical density of the analyzed samples shall be measured using a green light filter (λ=520 nm) and cuvettes with 30 mm thick optical layer. Distilled water prepared in the same way is used as a blank sample. The mass concentration of nitrites is found on a graduation schedule.

The determination is made in three repetitions.

Determination of sulfates. The method is based on measuring the turbidity intensity of water containing sulfate ions in interaction with barium chloride. To stabilize the resulting suspension in the reaction mixture ethylene glycol is introduced, and to reduce solubility - ethyl alcohol is used.

Turbidity is eliminated by filtering the sample, and the effect of opalescers and chromaticity is taken into account by measuring your own optical density, acidic hydrochloric acid.

In 2 tubes make 5 ml of prepared water samples, add 1 drop of hydrochloric acid solution (1:1), stir. Then add 5 cm^3 of sedimentation agent, stir and 30 minutes measure the optical density D in relation to bidistilled water at wavelength 364 nm in 20 mm thick cuvettes. Bidistilled water is prepared in the same way is used as a blank sample.

To take into account the color of the sample, add 1 drop of hydrochloric acid solution (1:1), 5 cm^3 of bidistilled water to the 5 cm^3 sample and measure the optical density. The mass concentration of sulfates is calculated by the formula:

$$X=\frac{D-D_x-D_1}{b}$$

where the D-optical density of the water sample,
D_x-optical density of blank sample,
D_1 - optical density corresponding to the color or danger of water sample,
b - angular coefficient of graduation characteristic, dm^3/mg.

Studies of acid-alkaline balance samples of fresh water bodies were carried out on pH meters.

Determination of the total number of fungi. To determine the total number of water samples, the water was filtered and precipitated. The obtained extracts were separated from plankton and natural particles and sown in 1 ml in Petri dishes on the dense nutrient medium of Capek with bile. Composition of Czapek's nutrient medium with bile: sucrose – 30 g; sodium nitrate – 2 g; monosubstituted potassium phosphate – 1 g; magnesium sulfate – 0.5 g; potassium chloride – 0.5 g; ferrous sulphate iron – 0.01 g; medical bile – 100 ml; distilled water – 1000 ml; agar-agar – 25 g; pH 5.0-5.5. All samples of aqueous suspensions were tested in three repeats, observing aseptic conditions to avoid contamination with field isolates.

Identification of fungi. Mycelial fungi were microscopically identified in primary crops. Pure culture of micromycet was isolated by direct resettlement of grown colonies. With the help of a mycological hook a particle of a mycological fungus was selected, placed on the surface of the nutrient medium in a new Petri dish, incubation was carried out at a temperature of 23^0C. Small sporonated mycelium particles taken by a distillation needle from a cup were placed on a slide glass and a drop of distilled water was added, mycelium was washed with 96% ethyl alcohol with the addition of ice acetic acid. The preparation was covered with cover glass, a microscopic examination was carried out at magnification of x10 and x40, using a Biomed microscope. The determination of fungi was carried out by morphological features, which were compared with the determinant (Watanabe, 2010), as well as with our long-term photocollection of fungi.

Biotesting on the simplest Paramecium caudatum. The total toxicity of isolated fungi was determined by accelerated biotesting on protozoans *P. caudatum.* Water extracts were prepared to extract toxic substances from fungi cultures grown on nutrient media. For this purpose, grown colonies of fungi were removed from the surface of the agar, placed in a tube, crushed to a fungi state, distilled water was added in a ratio of 1:1 by volume, with subsequent shaking for 10 minutes at 160 rpm. The suspension was placed in a refrigerator for 24 hours at 10ºC. Then two drops of the extract were placed on the slide and one drop of liquid medium was added (Lozin-Lozinsky solution: NaCl - 0.01%; KCl - 0.001%; $CaCl_2$ 2-water - 0.001%; $MgCl_2$ 6-water - 0.001%; $NaHCO_3$ - 0.002%) with animalcule. Using the Biomed microscope (x100 magnification) we evaluated the behavior of the paramedics. If the animalcule had not died in 3-5 minutes, they were transferred to a Petri dish on filter paper moistened with water (to prevent drying out) and kept staying under observation. The criterion for determining the sensitivity of parameciums to toxic substances was the time from the onset of exposure to the test extract to the death of protozoa, which was ascertained on the basis of cessation of movement, with further deformation and decomposition. Bio-test results were recorded within 2 hours. When at least part of the parameciums stopped moving during this time, surveillance continued until all the copies died. Biotesting evaluation criteria: toxic – 0-39% survived; slightly toxic – 40-69% survived; non-toxic – 70-100% survived.

The toxicity of an individual fungi isolate was determined by a similar method of biotesting on *P. caudatum.* But in this case, an aqueous extract was prepared from a separate culture of a fungus grown on a nutrient medium. All other stages of the bio-testing and toxicity assessment were conducted as described above.

Biotesting on rabbits. In case the toxicity of a certain fungus isolate was detected by biotesting on *P. caudatum*, additional biotesting was carried out on rabbits using a skin sample (Potekhina et al., 2020).

RESULTS AND DISCUSSION

pH- water balance of fresh water bodies is presented in Table 1.

Table 1. Measurement of pH of water balance and characterization of the sample under study.

Sample name	PH results	Water smell	Water colour	Natural inclusions
Mushan-Yer	6.30±0.02	Slight smell of ooze	mild yellow	plankton particles in sediment, duckweed
Gluchoe	4.69±0.11	Slight smell of ooze	yellow colour	snails, pond snails
Kichier	5.73±0.03	Slight smell of ooze	transparent	-
Konan-Yer	5.18±0.21	Smell of ooze	dark yellow colour	mosquito larvae, ponds, snails
Yalchik	5.0±0.1	Swamp smell	pale yellow	-
Shut'-Yer	5.47±0.08	-	transparent	-
Kuzh-Yer	6.52±0.3	Slight smell of ooze	light yellow	duckweed
Yergezh-Yer	6.48±0.06	Slight smell of ooze	transparent	Duckweed, pond snails
Tot-Yer	6.57±0.01	-	transparent	Duckweed, greens, snails, pond snails
Kozhla-Sola	6.49±0.20	-	transparent	duckweed

According to the results of the received data in lakes Mushan-Yer, Kuzh-Yer, Tot'-Yer, Ergezh-Yer and karst lake Kozhla-Sol pH of water ranged from 6.30±0.02 to 6.52±0.3 that testifies to normal indicators of acid-alkaline balance. Table 2 shows the results of the examined samples for nitrates, nitrites, sulfate and water hardness.

Table 2. results of the examined samples for nitrates, nitrites, sulfate and water hardness.

Sample name	**Indicators**			
	nitrates mg/dm^3	**nitrites mg/dm^3**	**sulfates mg/dm^3**	**stiffness, ^{0} G**
Mushan-Yer	0.84±0.17	< 0.003	24.5±4.9	3.19±0.49
Gluchoe	2.08±0.31	0.006±0.003	< 2.0	1.99±0.30
Kichier	1.32±0.26	0.015±0.008	< 2.0	0.78±0.12
Konan-Yer	2.57±0.39	<0.003	< 2.0	0.68±0.10
Yalchik	3.53±0.53	<0.003	< 2.0	1.83±0.28
Shut'-Yer	2.39±0.36	<0.003	< 2.0	2.34±0.35
Kuzh-Yer	0.83±0.17	<0.003	< 2.0	0.78±0.12
Yergezh-Yer	1.17±0.23	0.020±0.011	< 2.0	4.10±0.62
Tot-Yer	2.22±0.33	<0.003	6.3±1.3	4.40±0.66
Kozhla-Sola	0.47±0.09	0.076±0.038	< 2.0	4.30±0.65

Water samples in the lakes were examined in the ecologically clean zone and did not exceed MPN (maximum permissible norm). In spite of the fact that water hardness in lakes Yergezh-Yer, Tot'-Yer, Kozhla-Sola was 4.10±0.62 - 4.30±0.65, water bodies can be used for fishery purposes.

As a result of the study of total water toxicity in lakes at Paramecium caudatum infusorium, the absence of a pronounced toxic effect was shown. The survival rate of microorganisms in lake samples was 89-99%.

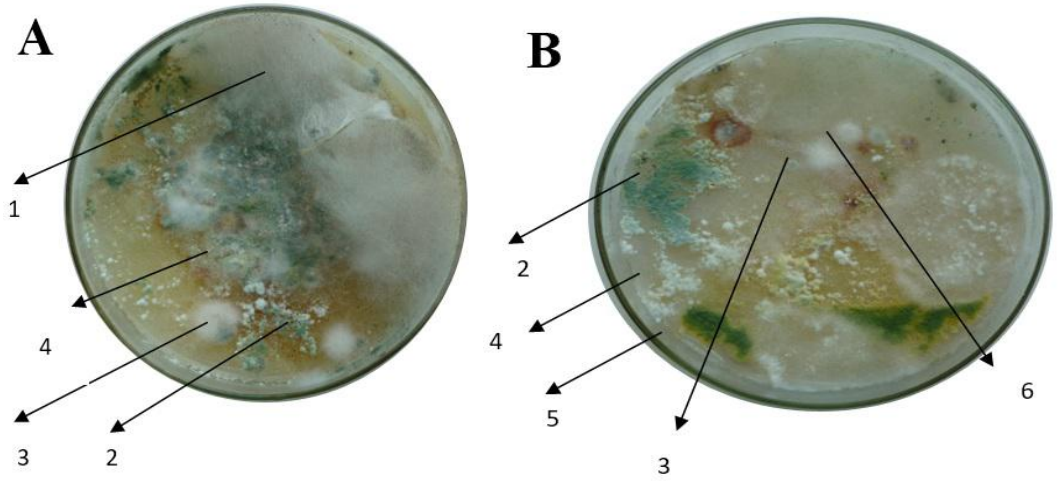
Table 3. Mycological analysis of selected fungi.

Sample name	**Total number**	**Highlighted micromycetes**
Mushan-Yer	12.3x10^3 ±0.10	*Aspergillus flavus* *Fusarium spp.* *Trichoderma veride* *Trichoderma spp.* *Penicillium spp.* *Mucor spp.* *Rodotorula spp.* *Candida spp.* *Yeast fungi*
Gluchoe	10.6x10^3 ±0.12	*Fusarium sporotrichioides* *Fusarium spp.* *Trichoderma veride* *Trichoderma spp.* *Trichoderma asperellum* *Penicillium notatum* *Mucor spp.*
Kichier	12.6x10^3 ±0.15	*A. fumigatus* *F. graminearum* *Fusarium spp.* *Rhizopus nigrican* *Trichoderma veride* *Trichoderma harzianum* *Trichoderma spp.* *Penicillium spp.*

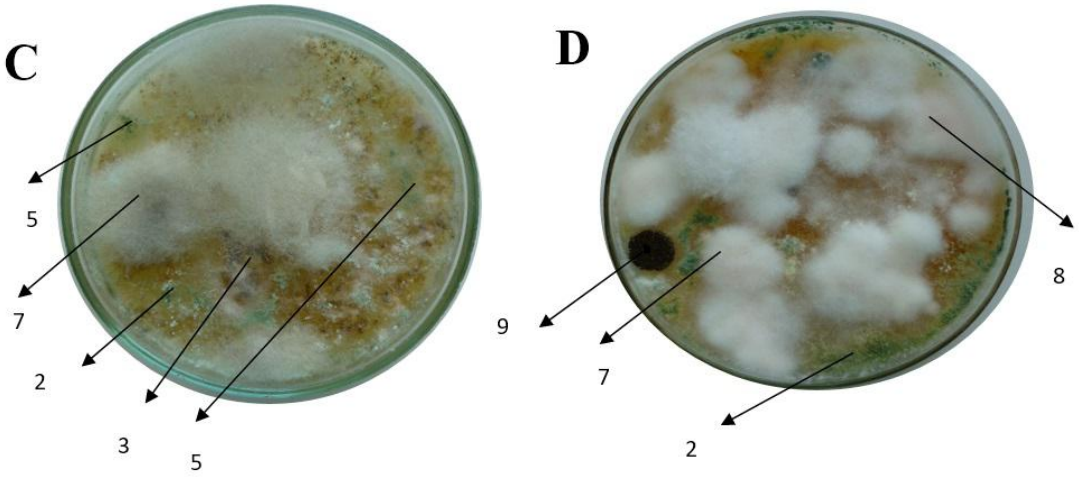
Konan-Yer	$15.1x10^3 \pm 0.41$	*A. flavus* *A. niger* *F. graminearum* *Trichoderma harzianum* *Trichoderma spp.* *Trichoderma asperellum* *Penicillium spp.*
Yalchik	$12.9x10^3 \pm 0.11$	*Fusarium sporotrichioides* *Mucor spp.* *Trichoderma veride* *Trichoderma spp.* *Rhizopus spp.*
Shut'-Yer	$14.3x10^3 \pm 0.06$	*A. ochraceus* *Fusarium graminearum* *Fusarium spp.* *Trichoderma veride* *Trichoderma spp.* *Penicillium notatum* *Mucor spp.*
Kuzh-Yer	$15.6x10^3 \pm 0.33$	*A. flavus* *A. niger* *Fusarium spp.* *Trichoderma veride* *Trichoderma spp.* *Cladosporium spp.* *Mucor spp.* *Yeast fungi*
Yergezh-Yer	$13.9x10^3 \pm 0.19$	*A. niger* *Fusarium sporotrichioides* *Trichoderma veride* *Trichoderma spp.* *Penicillium notatum* *Mucor spp.* *Rdotorula spp.*
Tot-Yer	$15.06x10^3 \pm 0.48$	*A. flavus* *A. fumigatus* *Fusarium spp.* *Trichoderma spp.* *Rdotorula spp.*
Kozhla-Sola	$13.23x10^3 \pm 0.36$	*A. niger* *A. flavus* *A. ochraceus* *Trichoderma harzianum* *Trichoderma spp.* *Trichoderma asperellum* *Rdotorula spp.*

To date, the main role in foreign countries is given to the treatment of fresh waste water bodies, with the use of mycelial fungi genus Trichoderma, duckweed and algae. Due to warm climatic conditions, experiments have shown that algae ponds are more effective than duckweed ponds at removing faecal E. coli due to their high pH value (Sutcliffe et al., 2018).

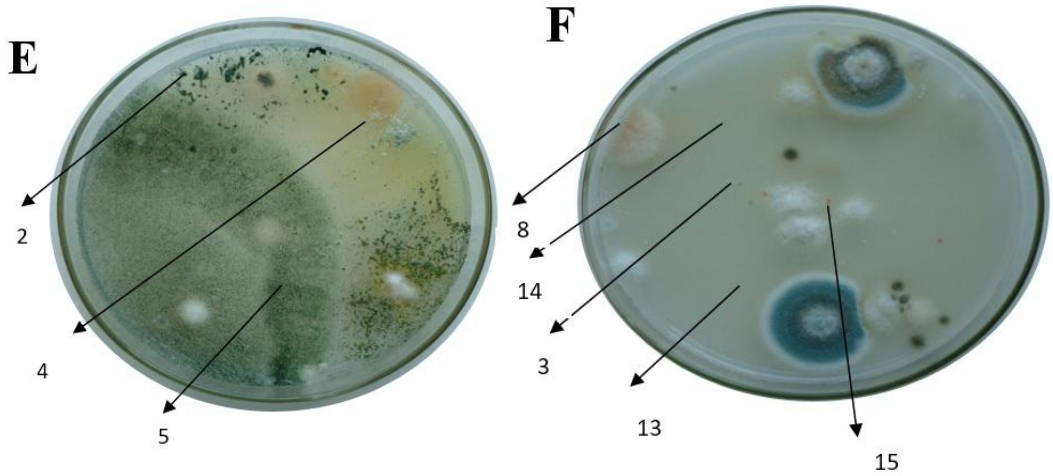
In the course of the conducted mycological analysis it was established that the "Mari Chaudra" National Park can be a model of the natural complex of aquatic ecosystems, taking into account the regularities of the aquatic plant community, the mutual symbiosis of yeast and mycelial fungi (picture).



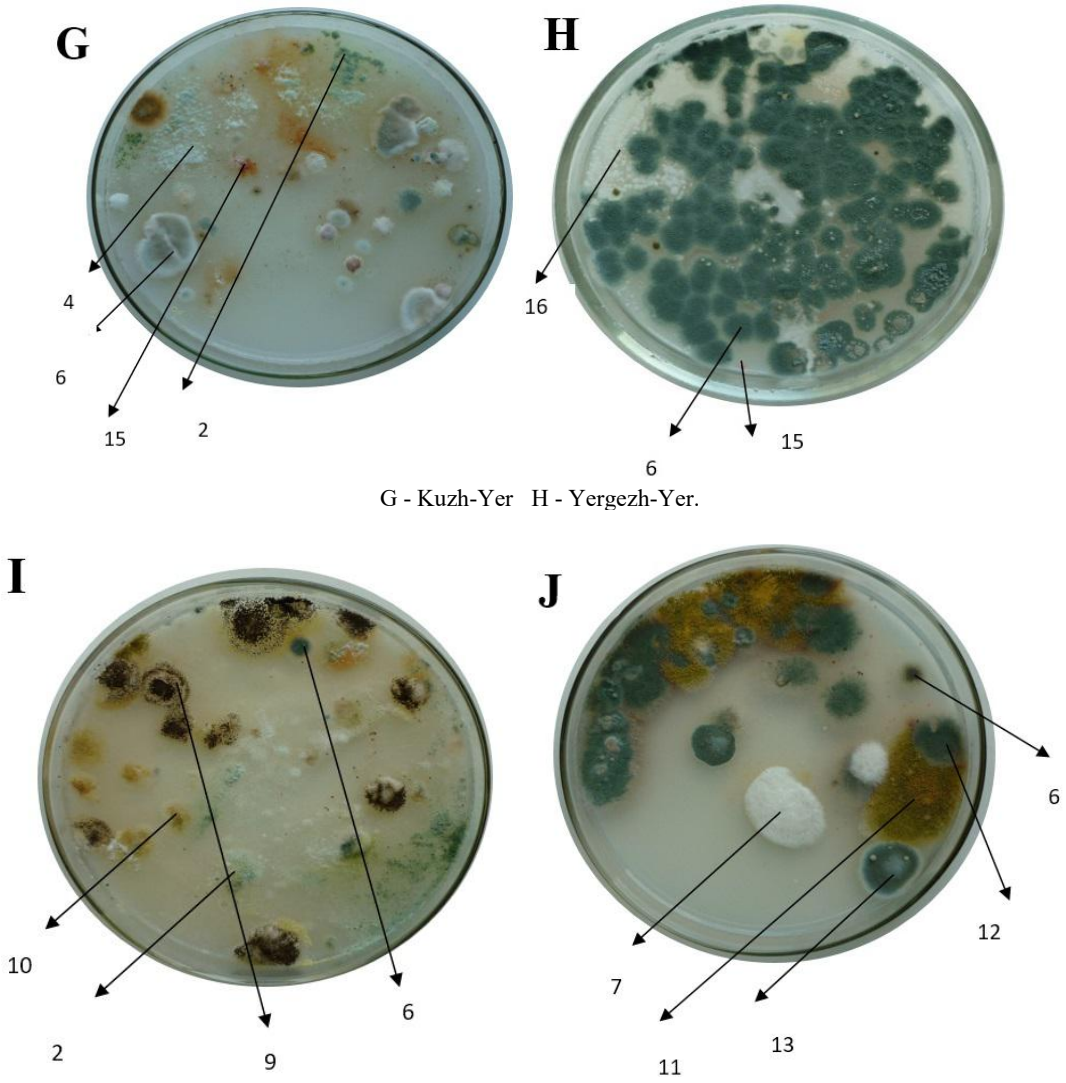
A - Lake Mushan-Yer B - Lake Konan-Yer



C - lake Gluchoe D - Yalchik



E- Kichier F- Shut'-Yer.



G - Kuzh-Yer H - Yergezh-Yer.

I - karst lake Kozhla-Sol. J - Tot'-Yer

Figure. Mycological picture of the water in the lakes in the park area

Highlighted micromycetes in fresh water. *1. Rhizopus spp., 2. Trichoderma veride, 3. Fusarium spp.,4. Trichoderma asperellum, 5. Trichoderma harzianum, 6. Penicillium spp., 7. F. graminearum, 8. Fusarium sporotrichioides 9. A. niger, 10. A. ochraceus, 11. A. flavus, 12. A. fumigatus, 13. Penicillium notatum, 14. Penicillium spp. 15. Rodotorula spp.,16. Candida spp.*

In mycological study, conditionally pathogenic micromycetes of the genus Aspergillus, Fusarium, Cladosporium were isolated. Musty micromycetes of the genus Aspergillus cause aspergillosis, affecting young poultry (chickens, turkeys, geese), and sometimes other farm animals, as well as humans. The fungi of the genus Fusarium (Fusarium sporotrichioides, Fusarium graminearum) form toxic products that can cause mycotoxicosis in humans and animals (Semenov et al., 2016; Semenov et al., 2018; Matrosova et al., 2000).

The analysis revealed that Kozhla-Sol karst lake and Tot'-Yer lake, unlike others, were contaminated with fungi of the genus Aspergillus, species Aspergillus niger, A. ochraceus, A. flavus, A. fumigatus. Fusarium mushrooms were sown in Yalchik lake. Water hardness in lakes (4.10±0.62 - 4.40±0.66) and increased nitrite and nitrate content contributed to the growth of more aggressive Aspergillus field isolates.

The toxicity of opportunistic isolates was assessed by biotesting at P. caudatum infusions (Table 4).

Table 4. Evaluation of the toxicity of fungal isolates by biotesting on *P. caudatum*

Toxic isolates	Exposure time			
	15/	30/	60/	120/
A. niger	90.9%	88.9%	79.5%	59.4%
A.ochraceus	90.3%	88.8%	84.1%	80.1%
A. flavus	89.2%	83.7%	74.5%	60.1%
A. fumigatus	90.1%	88.9%	85.8%	82.4%

Taking into account the fact that the isolated field isolates of *A. niger - 59.4%* and *A. flavus - 60.1%* showed a weakly toxic effect on *P. caudatum infusions*, micromycetes were further tested by skin sampling on rabbits.

The results of biotesting of isolates by skin sample are presented in Table 5.

Table 5. Evaluation of biotesting of toxic fungal isolates in rabbits by skin test

Isolated isolates	The toxicity result		
	24 h	48 h	72 h

A. niger	(++)	(+)	(+)
A.ochraceus	(++)	(-)	(-)
A. flavus	(+)	(+)	(+)
A.fumigatus	(+)	(-)	(-)

The test results showed that the field isolates *A. niger* and *A. ochraceus* showed the second degree of toxicity in the first test 24 hours after rubbing the extract. Field isolates of *A. flavus* and *A. fumigatus* fungi showed the first degree of toxicity in the first 24 hours. After 48-72 hours, the isolates *A. niger* and *A. flavus* on the skin sample of rabbits showed the first degree of redness.

Aspergillus genus fungi can be very aggressive, causing lung diseases, affecting the respiratory tract of birds, animals and humans.

Melt water and wastewater are sources of heavy metal pollution in aquatic ecosystems. In a study of algae and duckweed ponds for waste water, it was assessed that different conditions, temperature, pH, redox potential and dissolved oxygen can lead to different removal efficiencies for heavy metals and prevent greater contamination of mycelial fungi (Sekomo et al., 2012).

During a mycological study of fresh lakes in the Mari "Chaudra Park", a pattern of mycelial and yeast isolates with aquatic plant ecosystems was established. In lakes where there was a frock, the ponds were always sown with *Rodotorula spp.* More than 56% of *Trichoderma* fungi were sown in the majority of forest reservoirs. The mycelial fungi of the genus Trichoderma are used for biological treatment of water, soil and for composting waste and are considered partially responsible for the biological control effect (Harman et al., 2003; Lees-Haley, 2003).

CONCLUSIONS

During the mycological study of lakes in the territory of the park "Mari Chaudra" the total number of fungi was $10.6x10^3 \pm 0.12$ - $15.06x10^3 \pm 0.48$.

Fungi of the genus Aspergillus in the study of lakes made up 27%, more aggressive micromicetes were isolated from lakes Tot-Yer and Kozhla-Sola, given the overestimated content of indicators in water bodies, compared with other lakes in terms of water hardness (4.10 ± 0.62 - 4.40 ± 0.66) and the increased content of nitrites and nitrates for ecologically clean forest area.

Micromycetes of the genus Fusarium were not more than 13%, Penicillium 10%, the smallest amount in the water bodies were mycelial fungi of the genus Mucor, yeast fungi Rodotorula and Candida.

The research work carried out to date is very relevant due to the fact that the risk of increasing anthropogenic load on the environment is increasing daily. Therefore, research on micro- and macrobiological systems colonizing a particular environment is in great demand. It is well known that biological susceptibility of surfaces is closely related to its constituent materials and environmental parameters, the impact of which contributes to the formation of certain biotic communities.

Considering that mycelial fungi of the genus Trichoderma, plants and animals have a conservative mechanism of protection against injuries, in which the production of active forms of oxygen (OAF) and lipid metabolism are important in the natural symbiotic community, mycelial fungi are widely used in the world as biocontrol microorganisms, which are mainly used to control various plant diseases transmitted through soil, water, etc. (Chen et al., 2011; Hernández-Oñate et al., 2012; Bondarenko et al., 2016; Xu et al., 2017). Musty micromycetes are studied in ecosystems in all parts of the world. By studying their properties and migration, we can judge their useful properties as models for a better understanding of biogeographic processes affecting fungi biodiversity. The analysis of lake water of the "Mari Chaudra" park, the obtained information on the biogeography of various species of yeast fungi, as well as fungi of the genus Aspergillus, Fusarium, Penicillium, Cladosporium, Trichoderma indicate some possible processes affecting the distribution and species formation.

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