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The role of microorganisms isolated from some river waters of Azerbaijan in bioremediation

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ABSTRACT

The article presents the results of research conducted on water and silt samples taken from river waters located in the southern region of Azerbaijan. Microbiological and physicochemical analyses were performed on the samples, and it was determined that the temperature ranged between 6 and 28 °C, pH between 6.9 and 8.6, and dissolved oxygen between 4.5 and 11.2 mg/L, depending on the season.The number of saprotrophic bacteria in the water samples ranged from 2 to 42 million cells/ml, while in the silt samples, it ranged from 1 to 6 million cells/ml.The highest indicator was observed here, as Lenkeranchay is exposed to excessive anthropogenic impacts throughout the year. Cellulose degrading aerobic bacteria showed 46–236 cells/ml and anaerobic bacteria showed 14–545 cells/ml in 1 ml of water.The micromycetes isolated from the studied river waters represent 2 divisions, 6 classes, 8 orders, 9 families, 12 genera and 33 species. Of these, 28 species of micromycetes belong to the division Ascomycota, while 5 species belong to the division *Zygomycota*. If we quantify the obtained micromycetes, the division Ascomycota represents 84.8% and the division *Zygomycota* 15.2%. The role of the identified micromycete strains in the biodegradation of cellulose was determined and it was found that Trichoderma viride and Aspergillus terreus species were more active in the biodegradation process. Cellulose-degrading bacteria and micromycetes were found to completely degrade filter paper and cotton residues within 10-30 days. The results of the research provide important information on the health of river ecosystems and the protection and conservation of water resources.

Keywords: river ecosystem, cellulose decomposer, aerobic and anaerobic microorganisms, micromycetes, bioremediation.

INTRODUCTION

Clean water plays a crucial role in maintaining the ecological balance and biodiversity of aquatic ecosystems. Pollution of aquatic ecosystems adversely affects the life activities of all living organisms that inhabit them, sometimes leading to a reduction in biodiversity and sometimes to its complete disappearance (Veliev et al., 2013). Water pollution comes from many sources, including domestic, industrial and agricultural waste, energy production, heavy industry, automobiles and the transport of oil and oil products and etc (Babashli et al., 2022). Inadequate management of industrial and agricultural wastewater, i.e., its direct discharge into water basins without treatment, means that the drinking water of hundreds of millions of people is dangerously or chemically contaminated. According to the World Health Organization report, 2.2 billion people lack access to safe water services, and 144 million people rely on contaminated water sources. By 2025, 50% of the world's population is expected to live in regions with water scarcity, and this figure is expected to increase in some regions due to recent climate change and population growth (UN-Water, 2021).

The continuous discharge of untreated wastewater into water basins creates a number of problems related to the supply of clean water to cities and villages. Water pollution problems arise mainly from the discharge of wastewater into aquatic ecosystems, with this leading to eutrophication. Eutrophication can cause oxygen loss by stimulating excessive growth of algae. This can lead to various changes in the populations of aquatic systems. Pollutants pose serious risks to human health, livestock and all hydrobionts living in aquatic ecosystems. Pollutants include organic and inorganic compounds, heavy metals, industrial and domestic waste (Babashli et al., 2023).

As we know, water basins have the ability to self-clean, a process that converts organic and partly inorganic substances into harmless compounds through physical, chemical, and biological methods. All hydrobionts contribute to the self-cleaning of water basins, with bacteria and fungi playing an important role in this process. The nutritional versatility of microorganisms can also be exploited for the biodegradation of pollutants. This process, called bioremediation, is the ability not only to collect and store pollutants, but also to break them down and convert them into less toxic or non-toxic compounds, i.e., simpler compounds. Biological agents, including bacteria, archaea, and fungi, are used as bioremediators to clean up environmental pollutants (Strong et al., 2008). The effectiveness of bioremediation depends on biotic and abiotic factors, including the concentration of pollutants and the effect of microorganisms (bacteria, micromycetes) on them (Tang et al., 2007; Endeshaw et al., 2017).

Recently, freshwater scarcity and the pollution of existing water basins have become widespread issues and a priority area of research. The increase in the world's population and the critical demand for water have become a universal issue and have made solving the problem even more urgent. The sustainable development of human society depends largely on the efficient use of natural resources, including groundwater and surface freshwater resources. As we have mentioned, one of the most urgent problems of the modern age is the reliable supply of water to the population and various economic sectors. Considering that Azerbaijan is also among the countries with limited fresh water resources, it becomes clear how urgent the issue is for our country (Imanov and Alekberov, 2017).

Recently there has been a decline in available water resources, particularly due to climate change. In our country, water resources are organised at the expense of surface water and groundwater. However, more than 70% of our country's freshwater resources are formed by transboundary rivers, as a result, the water supply in many regions is deteriorating sharply. This directly affects the food supply of the population and the ecological security of the regions. Water pollution by organic and inorganic pollutants is a pressing problem, and attempts to remove these elements are the subject of research in various studies (Udod et al., 2014; Korshunova et al., 2019).

The aim of the research is to monitor the ecological situation in the Astarachay, Lankaranchay, Vilashchay, Boladichay, Bolgarchay and Veravulchay rivers located in the southern region of Azerbaijan and subject to anthropogenic impact, to study and identify saprotrophic bacteria, micromycetes and their role in the bioremediation of river waters.

MATERIAL AND METHODS

The Astarachay, Lankaranchay, Vilashchay, Boladichay, Bolgarchay, and Veravulchay rivers, located in the southern region of Azerbaijan and influenced by anthropogenic activities were selected as the focus of the study. The hypothesis of the research includes the possibility of using saprotrophic bacteria and micromycetes in the bioremediation of river waters located in the southern region of Azerbaijan. To achieve this goal, both classical and modern methods widely used by microbiologists were employed during the research. The method of selecting permanent stations was used for sampling, and samples were collected seasonally. The purity of the reagents used for analysis, as well as the accuracy of the measurement devices, served as the basis for obtaining reliable data. The repeatability of the samples taken was at least four times, and the results were processed statistically. To ensure the validity of the experimental results, the formula $S/M = P \leq 0.05$ was considered fundamental. To study the hydrobiological and microbiological status of the river waters, water and silt samples were collected and analyzed. The quantitative and qualitative diversity of microorganisms, biotic and abiotic factors, saprotrophic bacteria, cellulose-degrading bacteria, micromycetes, and their role in the river ecosystem were studied and analysed in the collected samples. Initially, samples were collected from designated stations in the coastal zone and physicochemical measurements of the water were carried out. Water temperature (°C) was measured with a mercury thermometer, pH (pH-200) and dissolved oxygen (MW 600 dissolved oxygen (mgL^{-1})) on-site with an analyzer. The amounts of biogenic elements (nitrite, nitrate, ammonium ions, and phosphate) were determined using a photometer.

Saprotrophic bacteria were isolated using the dilution method and cultured by deep inoculation on meaty peptone agar medium. Their morphological and cultural characteristics were studied. Cellulose-degrading microorganisms were cultured on selective nutrient media to promote the growth of those capable of degrading cellulose. Aerobic cellulose-degrading bacteria were cultured in Hutchinson solid and liquid nutrient media, and anaerobic cellulose-degrading bacteria were cultured on Omelyansky nutrient media using the deep seeding method and counted according to the appropriate method. Water samples for micromycetes were collected in sterile plastic containers, and plant and insect remains were collected in sterile polyethylene bags. The samples were cultured in laboratory conditions using the attraction method on SDA (sabouraud dextrose agar), YEPD (yeast extract peptone dextrose) media and incubated for 3–7 days. A study was conducted over a period of one month to determine the cellulase activity of the identified active strains. Commonly found fungal species were used for the study. Hutchinson's nutrient medium was used to determine the cellulose activity of the isolated active strains, and the studies were conducted in flasks. Ashless filters were used as the only carbon source (Hasanova et al., 2023).

RESULTS AND DISCUSSION

Determination of physicalchemical properties of river waters located in the southern region of Azerbaijan

Studying the physicochemical properties of rivers is essential for understanding river ecosystems, assessing their sustainability, and evaluating the impact of human activities, climate change, and other environmental factors. Therefore, during the study, the influence of the physicochemical properties of water and biogenic elements on microorganisms (bacteria and micromycetes) in spatio-temporal dynamics was investigated. As can be seen from Table 1, the water temperature

Table 1. The physico-chemical properties of water in the studied river waters of the Lankaran natural region

Rivers	Winter	Spring	Summer	Autumn
Temperature indicator (t °C)				
Astarachay	6–6.5	15–17	27–28	15–16
Lankaranchay	6.5–7.2	16–16.5	25–27	13–14.3
Vilashchay	7–7.6	17–18	24.5–26	16–16.5
Veravulchay	7–8	17–19	24–27	11.7–12
Boladichay	7.9–8	16.5–18	25–26	15–17
Bolgarchayar	6.5–6.8	16–17.5	22–24	15.5–18
Dissolved oxygen indicator (mg/L)				
Astarachay	7.4–8	5.5–6.5	4.5–5	6.5–7
Lankaranchay	9.1–9.5	8–9.5	4.8–5.3	9.7–10.1
Vileshchay	8–8.5	8.5–9.0	7.8–8.5	9.9–11.2
Veravulchay	9–10.9	9.5–10.5	6.7–7	8–8.1
Boladichay	7.9–8.2	8.9–9.2	7.8–8.4	9.1–10.3
Bolgarchay	8–8.5	8–8.5	8–8.9	9.3–10.2
pH-indicator				
Astarachay	7.1–7.3	7.2–7.5	7.9–8.4	7–7.2
Lankaranchay	6.9–7.1	7–7.3	7.8–8.0	7.1–7.4
Vileshchay	7.5–8.2	7.2–8.1	8–8.3	7.5–7.9
Veravulchay	7.6–7.9	7.5–8.6	7.9–8.3	7–7.9
Boladichay	7.6–8	7.8–8.2	8.2–8.6	7.2–7.6
Bolgarchay	7.7–8	7.3–7.5	7.5–7.6	7–7.1

in the studied river waters was 6–8 °C in winter, 15–19 °C in spring, 24–28 °C in summer, and 12–18 °C in autumn. Water temperature directly affects the amount of oxygen. Usually, as temperature increases, the ability of water to dissolve oxygen decreases. This happens because the water molecules move faster, which causes oxygen molecules to separate from the water and rise to the surface, reducing the amount of dissolved oxygen. In addition, cold water can dissolve oxygen better because the bonds between water molecules are tighter and more stable. Hot water increases the movement of the molecules and causes the oxygen to separate from water. Rising temperatures can make it more difficult for living organisms to obtain oxygen. Therefore, oxygen deficiency can occur in ecosystems under thermal stress. Oxygen dissolved in water affects the life activity of various organisms in river ecosystems. Dissolved oxygen in water plays an important role in biological treatment processes in rivers. Oxygen is used by bacteria and microorganisms to break down organic matter, which helps to keep the river clean and improve water quality. As can be seen from Table 1, the amount of dissolved oxygen in the studied rivers was 7.4–10.9 mg/L in winter, 5.5–10.5 mg/L in spring, 4.5–8.9 mg/L in summer, and 6.5–11.2 mg/L in autumn. In general, water in rivers and flowing water environments is considered to be of high quality and suitable for biodiversity if the optimal dissolved oxygen content in the water is 8–10 mg/L. In polluted and oxygen-deficient waters, the oxygen content is <3 mg/L (Ridanović et al., 2010). Table 1 also presents the spatial-temporal dynamics of pH indicators in the studied river waters. Changes in the pH of river waters can occur as a result of natural phenomena, anthropogenic factors, biological processes and climate changes. Changes in pH can adversely affect water quality and ecosystem health. A pH in the range of 6.5 to 8.5 is ideal for aquatic ecosystems, while a pH below 5.5 and above 8.5 can be unfavourable and even fatal by disturbing the balance of gases and minerals in the water (Qiao et al., 2016). Monitoring and managing the pH status of water bodies is necessary to maintain ecosystem sustainability and prevent environmental disasters. As shown in Table 1, the highest pH values are 8.6 in Veravulchay during spring and 8.6 in Boladichay during summer.

Biogenic elements, which are key physicochemical parameters of water, play a fundamental role in the growth and activity of microorganisms. The concentrations of biogenic elements—nitrite, nitrate, ammonium ions, and phosphate—were measured in water samples collected from the rivers we studied.

As shown in Table 2 the ion content of biogenic elements in the studied river waters varies with the season (rainfall, flooding), the areas it flows

Table 2. The result of chemical analysis in the studied river waters (mg/L)

Season	The name of the component	1	2	3	4	5	6
Spring	Nitrite	0.01	0.02	0.03	0.00	0.02	0.02
	Nitrate	0.56	0.76	0.36	0.40	0.40	0.30
	Ammonium	0.05	0.04	0.15	0.03	0.07	0.10
	Phosphate	0.01	0.06	0.01	0.01	0.02	0.02
Summer	Nitrite	0.00	0.00	0.01	0.00	0.00	0.01
	Nitrate	0.48	0.65	0.30	0.32	0.38	0.20
	Ammonium	0.20	0.08	0.25	0.06	0.12	0.40
	Phosphate	0.00	0.02	0.01	0.00	0.00	0.01
Autumn	Nitrite	0.02	0.03	0.06	0.01	0.04	0.02
	Nitrate	0.70	0.85	0.45	0.60	0.50	0.48
	Ammonium	1.50	0.10	0.40	0.10	0.18	0.35
	Phosphate	0.01	0.04	0.03	0.01	0.01	0.02
Winter	Nitrite	0.02	0.03	0.06	0.01	0.04	0.05
	Nitrate	0.40	0.65	0.40	0.40	0.35	0.30
	Ammonium	0.50	0.10	0.30	0.09	0.14	0.44
	Phosphate	0.01	0.03	0.03	0.01	0.01	0.05

Note: 1 – Astarachay, 2 – Lankaranchay, 3 – Vileshchay, 4 – Veravulchay, 5 – Boladichay, 6 – Bolgarchay.

through (direct discharge of household waste into the rivers), and the amount of substrate in the watercourse. In summer the concentration of these ions decreases, while in autumn these indicators increase, which is associated with the decomposition of the components. Microorganisms, which are the subject of research, participate in the main processes of nitrogen circulation in the aquatic ecosystem – depolymerisation of nitrogen compounds, ammonification, nitrification, reduction of oxidised forms. Biogenic elements in the studied river waters showed relatively high results in spring and autumn. This is due to the pollution of river waters with domestic waste, as well as abundant rainfall and richness in organic matter.

Isolation of saprotrophic bacteria and micromycetes, determination of their number and species composition

Saprotrophic bacteria are microorganisms that break down organic matter and mineralise waste in ecosystems. We measured the amount of saprotrophic bacteria in samples collected from the water and silt layers of the rivers studied. To assess the ecological status of river waters in the southern region of Azerbaijan, saprotrophic bacteria and micromycetes in the water and silt layers and their role in river waters were studied. As can be seen from Figure 1, the lowest indicator of saprotrophic bacteria in Astarachay was observed in autumn. In Lankaranchay, this indicator was high in almost all seasons, which was linked to excessive anthropogenic influence throughout the year. In Veravulchay, the amount of saprophytic bacteria was almost evenly distributed along the stream, but an increase was observed towards the mouth. In Boladychay, the amount of saprophytes was lower than in the other rivers studied. The amount of saprotrophic bacteria in Vilashchai was higher in the summer, which was associated with the enrichment of the river with organic substrates of allochthonous origin. Although the amount of saprotrophic bacteria is lower in the upper reaches of Bulgarchai, the middle and lower reaches of the river are more exposed to allochthonous pollution. The amount of saprotrophic bacteria was determined in the silt samples

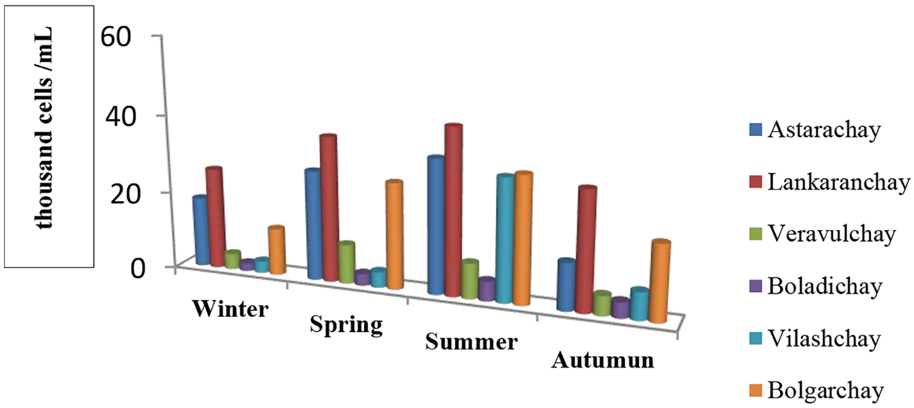

Figure 1. Amount of saprotrophic bacteria in the studied river waters (thousand/mL)

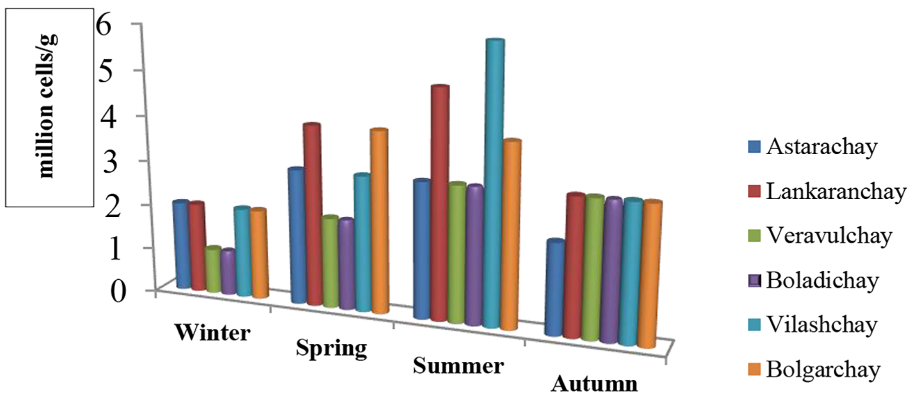

Figure 2. Amount of saprotrophic bacteria in the soil in the studied rivers (mln/gr)

collected from the investigated river waters. The results are presented in Figure 2.

As can be seen in Figure 2, the amount of saprotrophic bacteria in the sludge samples was also studied and the highest amount of saprotrophic bacteria was found in Vilashchay in summer and the lowest amount was found in Veravulchay and Boladichay in winter.

As mentioned, besides bacteria, micromycetes are also involved in the decomposition of plant remains in river waters. The participation of micromycetes in biological processes in aquatic ecosystems is associated with the presence of powerful enzyme systems. In the first stage of the study, the species composition of micromycetes involved in the formation of the mycobiota in the analysed river waters was determined. The results revealed that micromycetes are present in every river ecosystem, but the species contributing to the mycobiota vary across ecosystems, both in terms of number and species composition.

Data on 33 species of micromycetes isolated from water, plant and insect remains taken from the river waters we studied are listed in Table 3.

As can be seen from Table 3, the 33 species of micromycetes isolated from the studied river waters represent 2 division, 6 classes, 8 orders, 9 families, and 12 genera. Of the micromycetes recorded during the study, 28 species belonged to *Ascomycota* and 5 species to *Zygomycota*. Quantitatively, *Ascomycota* and *Zygomycota* accounted for 84.8% and 15.2%, respectively, of the total number of micromycetes recorded.

The micromycetes that play a role in the formation of the mycobiota of each of the investigated river waters were identified according to their species and genus composition. According to the results obtained, although the micromycetes in the studied river waters differed in terms of species and genus composition, the genera *Aspergillus* and *Penicillium* were dominant in all the studied river waters (Figure 3).

Micromycetes are organisms that can change their activity and species richness in aquatic environments due to a wide range of environmental factors. A graph illustrating the relationship between aquatic micromycetes and factors such as water temperature (°C), pH, and dissolved oxygen was constructed during the research process.

When the dependence of aquatic micromycetes on water temperature (°C), pH, and dissolved oxygen was plotted (Figure 3), it was found that the highest seasonal species richness of micromycetes occurred in the autumn. This is because river waters in the fall are rich in optimal temperatures and substrates required for the development of micromycetes.

This is due to the optimal temperature of river waters and the abundance of substrates that support the growth of micromycetes.

Determination of the role of bacteria and micromycetes in cellulose degradation

It is known that cellulose is a complex polysaccharide that is difficult to break down, and that bacteria and some fungi play a role in the breakdown of these high-molecular compounds. Under aerobic conditions, the decomposition of cellulose is mainly carried out by three large groups of microorganisms (*Cytophaga*, *Cellulomona,* and *Clostridium*), while under anaerobic conditions,

Table 3. Taxonomic structure of micromycetes recorded during research

Division	Class	Order	Family	Genus (number of species)
Zygomycota	*Mucoromycetes*	*Mucorales*	*Mucoraceae*	*Mucor* (4)
				Rhizopus (1)
Ascomycota	*Eurotiomcetes*	*Eurotiales*	*Asperegillaceae*	*Aspergillus* (9) *Penisillium* (7)
	Sordariomycetes	*Hypocreales*	*Nectriaceae*	*Fusarium* (3)
			Hypocreaceae	*Trichoderma* (2) *Acremonium* (1)
		Sphaeriales	*Chaetomiaceae*	*Chaetomium* (1)
	Dothideomycetes	*Capnodiales*	*Davidiellaceae*	*Cladosporium* (2)
		Pleosporales	*Pleosporaceae*	*Alternaria* (1)
	Saccharomycetes	*Saccharo-mycetales*	*Saccharo-Mycetaceae*	*Candida* (1)
	Sordariomycetes	*Microascales*	*Microscaceae*	*Scopulariopsis* (1)

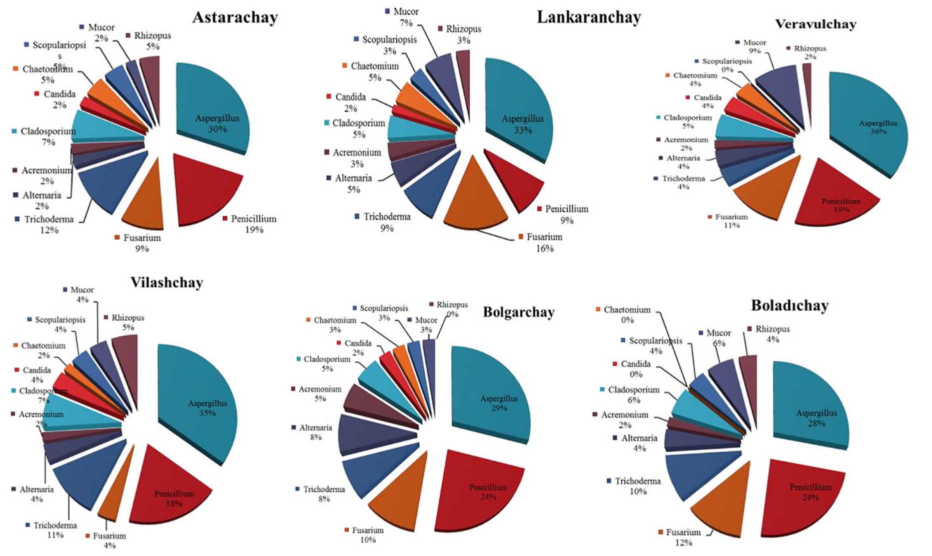

Figure 3. *Micromycetes* involved in the formation of the mycobiota in the studied river waters

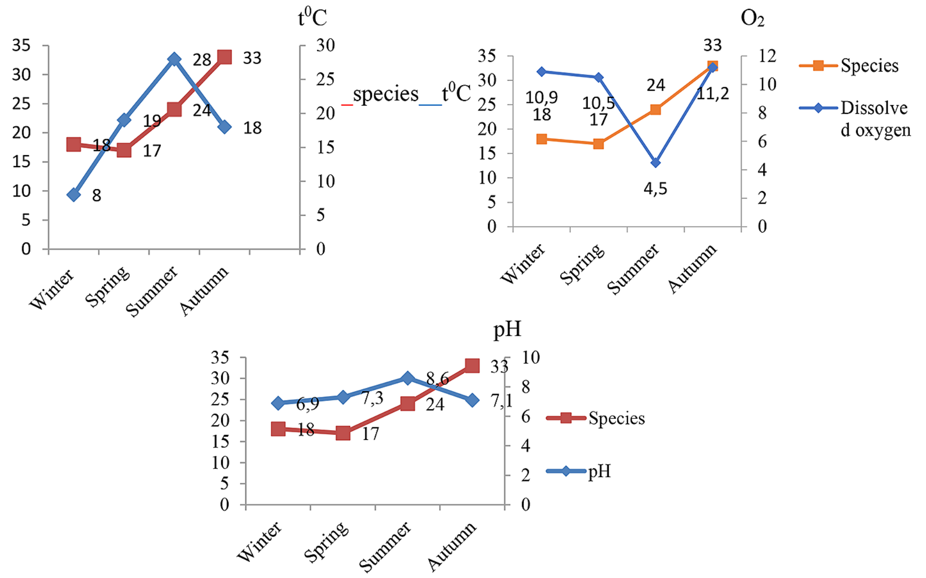

Figure 4. Dependence of micromycetes on water t°C, pH and dissolved oxygen (mg/L)

mesophilic and thermophilic *Clostridia* participate in the decomposition of cellulose. Fungi (*Aspergillus*, *Trichoderma* and *Penicillium*) have an important role in the degradation of cellulose under aerobic conditions. We studied the numerical dynamics of the distribution of cellulose-decomposing aerobic and anaerobic bacteria by season in the river waters (Hasanova et al., 2023).

Table 4 shows the numerical dynamics of the seasonal distribution of aerobic and anaerobic cellulose-degrading bacteria in river waters. In winter, spring, and autumn, aerobic bacteria predominate, whereas in summer, anaerobic bacteria are more dominant, this trend was more pronounced in Vilashchay. The more intensive development of anaerobic bacteria in Vilashchay is mainly due to the vegetation along the river channels and the occurrence of aquatic blooms during the summer. The mouth of the Vilashchay is the Small Gizylagach Bay of the Caspian Sea, 50% of its area is covered with higher plants, and anaerobiosis is often observed in the bay during the warm months of the year (Huseynov et al., 2016). The failure of the canals connecting the bay to the sea, along with the complete reduction in water flow in the rivers, has resulted in a general stagnation of water in the basin. This situation has caused a significant oxygen deficiency both in the bay

Table 4. Seasonal distribution of aerobic and anaerobic cellulose degrading bacteria in the studied rivers (in 1 mL of water cells/mL)

Stations	Winter		Spring		Summer		Autumun	
	Aerobic	Anaerobic	Aerobic	Anaerobic	Aerobic	Anaerobic	Aerobic	Anaerobic
Astarachay	72	24	136	62	236	147	157	82
Lankaranchay	65	23	123	71	215	235	134	71
Veravulchay	46	19	125	69	187	195	142	76
Boladichay	56	14	120	52	190	186	132	63
Vilashchay	78	26	142	78	85	415	160	75
Bulgarchay	61	22	112	64	98	99	154	78

and in the rivers that feed it with fresh water. It is concluded that the development and formation of anaerobic cellulose-degrading bacteria are influenced by the oxygen regime of the environment (Varnaitė et al., 2008).

The development and formation processes of anaerobic cellulose-degrading bacteria are influenced by the oxygen regime of the environment. Figure 5 shows a graph of the oxygen dependence of aerobic and anaerobic cellulose-degrading bacteria in the Vilashchay.

As shown in the graph of the oxygen dependence of aerobic and anaerobic cellulose-degrading bacteria in Vilashchay (Figure 5), the maximum growth of anaerobic bacteria in the summer is inversely proportional to the amount of dissolved oxygen in the water. It is known that during the warmer months of the year, microbiological processes in water bodies intensify, the flow of water into the basin decreases, and stagnation occurs. This leads to an increase in water temperature, acceleration of microbiological processes, and increased consumption of dissolved oxygen in the water. As a result, the amount of oxygen dissolved in water is sharply reduced, the development of aerobic microorganisms is weakened and the development of anaerobic microorganisms is increased.

We determined the role of active micromycete strains isolated from water and plant residues in the biodegradation of cellulose in the river waters we studied (Figure 6).

The results obtained when studying the role of active micromycete strains isolated from river water, water and plant residues in the biodegradation of cellulose (Figure 6) showed that T. viridi and A. terreus had the highest biodegradation efficiency, while A. fumigatus had the lowest. Thus, migratory micromycetes strains found in water have the ability to biodegrade organic matter. As a result of the research, it was found that active strains of bacteria and micromycetes isolated from the southern waters of Azerbaijan effectively degrade cellulose-containing plant residues as well as cellulose-containing organic matter in industrial and domestic wastes.

Cellulose-degrading microorganisms predominate over other groups of microorganisms

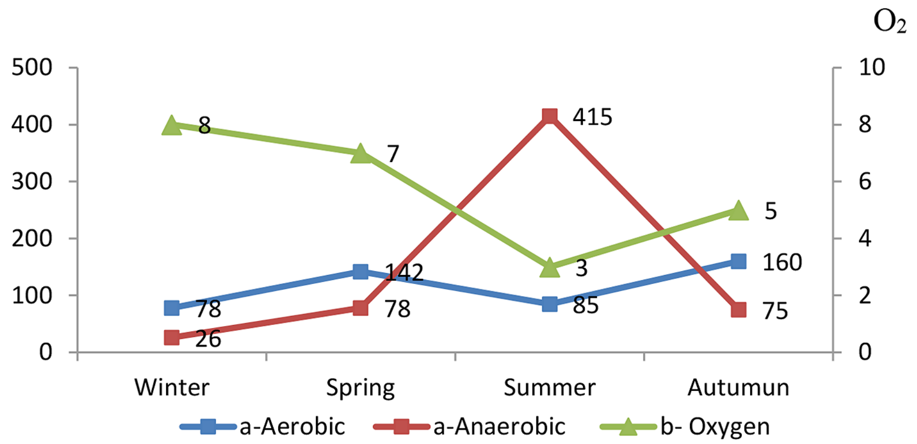

Figure 5. Changes in the dependence of aerobic and anaerobic cellulose degrading bacteria on the amount of oxygen in Vilashchay according to seasons (in water)

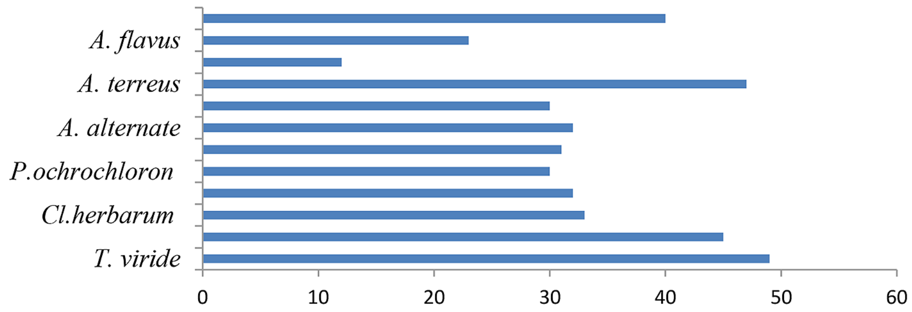

Figure 6. The role of micromycetes in cellulose biodegradation

in the rivers we studied, indicating that the rivers are more contaminated with cellulose-containing substances (Hasanova, 2024). This type of biodegradation helps maintain ecological balance, and manage waste.

CONCLUSIONS

As a result of the research, it was concluded that the physicochemical properties, microbiological, and mycological indicators of river waters vary depending on the season, the area through which the river passes, and the amount of substrate in the watercourse, all of which have a significant effect on microorganisms. The water temperature in the studied river waters varied between 6–28 °C, dissolved oxygen 4.5–11.2 mg/L, pH 6.9–8.6, the amount of biogenic elements nitrite 0.00–0.06 mg/L, nitrate 0.20–0.85 mg/L, ammonium 0.05–1.50 mg/L, and phosphate concentration 0.00–0.06 mg/L.

Saprotrophic bacteria were analysed to determine the degree of pollution and putrefaction of river waters. It was found that these indicators in water varied between 2–26 cells/ml in winter, 3–37 cells/ml in spring, 5–42 cells/ml in summer, and 4–30 cells/ml in autumn. In silt, these indicators were higher, ranging from 1 to 6 cells/ml. The highest value was observed in Vilashchay during the summer. The systematics of 33 species of micromycetes isolated from the studied river waters were determined, representing 2 divisions, 6 classes, 8 orders, 9 families, and 12 genera. During the study, 28 species of micromycetes were recorded as belonging to the *Ascomycota* division, and 5 species to the *Zygomycota* division.

The role of active micromycetes strains, aerobic and anaerobic bacteria separated from water and plant residues from the investigated river waters in the biodegradation of cellulose was investigated. During biodegradation, it was determined that *T. viridi* and *A. terreus* showed the highest results, while *A. fumigatus* showed the lowest results. High levels of both aerobic and anaerobic cellulose-degrading bacteria were observed in the Vilashchay throughout all seasons. The maximum number of anaerobic bacteria in Vilashchay during the summer months is likely due to the low levels of dissolved oxygen in the water. In order for the decomposition of cellulose to proceed intensively and rapidly, it was necessary to create a basis for the development of aerobic microbiota in rivers. For this purpose, wastewater should be discharged into rivers after treatment, river mouths should be cleaned and the flow of river water should be restored.

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