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Application of bacteriocin-producing starter cultures in sourdough (to increase competitiveness), in fermented sausage have been studied during in vitro laboratory fermentations as well as on pilot-scale level.

114 lactococcal strains were isolated from raw milk probes and dairy products and also from powerful drinks: kurunga. Overall, 94 isolated colonies inhibited the growth of test-microorganism *B. coagulans*, twelwe of them displayed the highest activity.

The morphology of the isolated strains demonstrated that the cultures were represented by cocci assembled in pairs or short chains of various lengths (four-seven cells).

Only nine of the isolated 94 strains expressed a broad spectrum of activity against potential food pathogens: *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris, Salmonella gallinarum* and fungi of *Aspergillus, Fusarium, Penicillium* genera, as well as against *Rhodotorula aurantiaca* and *Candida albicans.*

Most effective new bacteriocin-synthesizing strains 194 and K-205 were isolated from raw cow milk and kurunga drink from Buryatia. These strains had high antibiotic activity up to 3600–2700 IU mL^{-1} respectively, as compared with nisin. It was important that bacteriocins produced by these strains had a wide range of activity that made them perspective for further studies.

Treatment of the raw smoked sausages with cultural broth of these strains of *L. lactis* ssp. *lactis* inhibited the spoilage by *E. repens*. After treatment the sausages had longer shelf-life and integrated products correspond to technological and microbiological indexes. The results of this study indicated that the treatment with these lactococci strains can prevent a contamination of raw smoked sausages with mould.

Antifungal activity among natural strains of *L. lactis* is unique property. This strains produced novel antibiotic complex with broad activity spectrum against food-borne pathogens included fungi that was absent in J. Berdy database BNPD.

So, potential applications of cultural broth of these strains in various food fermentations allow to recommend it as potential perspective biopreservatives for preventing fungal spoilage of foodstuffs and edible raw materials.

The highly promising results of these studies underline the important role that functional, bacteriocinogenic LAB strains may play in the food industry as starter cultures, co-cultures, or bioprotective cultures, to improve food quality and safety. In addition, antimicrobial production by probiotic LAB might play a role during in vivo interactions occurring in the human gastrointestinal tract, hence contributing to gut health.

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Algae and invertebrates in the ice of several lakes of the Trans-Baikal region

Ice is a specific living environment of organisms. It has a great impact on living conditions and living activities of plants and animals. Covering the surface of water, ice represents a kind of a floating shield protecting waters from further freezing and preserving the underwater life.

Currently, there is sufficient data collection on development of organisms in the ice sheet of the polar seas such as Chukchi Sea, East Siberian Sea, Kara Sea, White Sea, Sea of Japan and big lakes (Baikal, Karelia coastal area (Tricolor Lake, Sour-Sweet Lake etc.), rivers (Amur River)[1], однако лед малых водоемов и водотоков изучен крайне слабо. For East Siberia, there are materials on invertebrates and algae of Baunt Lake[2].

Since 2009 the studies of organisms of the ice sheet of Arakhlei, Kenon and Doroninsk Lakes have been carried out in Trans-Baikal region (Russia) (Pic. 1).

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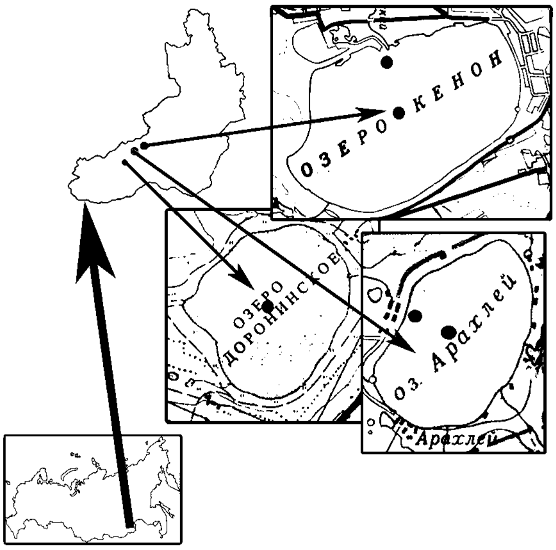
[1] Ilyash L.V., Zhitina L.S. Comparative analysis of species composition of diatom invertebrates in the ice of the seas of Russian Arctic//Journal of general biology. 2009. T. 70. № 2. P. 143–154.;Vinogradov M.E., Melnikov I.A. Ecosystem of arctic shifting ice//Biology of central arctic basin. M.: Nauka, 1980. 260 p.;Obolkina L.A., Bondarenko N.A., Doroshenko L.F., Gorbunova L.A., Molozhavaya O.A. Peculiarities of the ice communities in Baikal//Sustainable development: problems of protected territories and traditional use of the nature in Baikal region. mat. conf. Ulan Ude: Published BNTS SO RAN, 1999. P. 119–120.;Stunzhas P.A. Sapozhnikov F.V. Incredible diatoms//Nature. 2000. № 5. P. 377–385.;Bordonsky G.S., Obolkina L.A., Bondarenko N.A. etc. Ice communities of Baikal Lake//Nature. 2003. № 7. P. 22–23.;Obolkina L.A., Bondarenko N.A., Timoshkin O.A. Ice – the life preserver//First-hand science. 2004. № 1. P. 76–83.;Shkundina F.B. Under0ice and ice communities of the invertebrates//Hydro-biological journal. 1988. T. 24. № 6. P.15–18.;Yuryev D.N. Development of ice periphyton of Amur River in relation to the light factor//Bot. journal. 1988. T. 73. № 11. P. 1546–1551.;Yuryev D.N. River ice as a base for development of plankton invertebrates//Ecological and bio-geochemical studies in the Far East. Vladivostok: Dalnauka, 1996. P. 79–96.;Kondratyeva L.M. Ice as a component of monitoring of pollution of surface waters//Measurement, modeling and information systems as a means of reduction of pollution at town and regional level. ENVIROMIS-2002. Works of international conference, v. 1. Tomsk: 2002. P. 174–179.

[2] Bondarenko N.A., Belykh O.I., Tomberg I.V. etc. Ice dwellers of lakes of Baikal rift zone//mat. IV conference of geo-cryologists of Russia. M.: University, 2011. P. 316–323



Pic. 1. Schematic map of examined lakes in the Trans-Baikal region Locations of sample collection are marked with dots.

The interest in these water bodies is not accidental. The lakes of Ivano-Arakhlei system, particularly the mesotrophic lake of Arakhlei, are currently model sites for the Trans-Baikal region. Kenon Lake is town's fresh water body with anthropogenic load. Doroninsk Lake is a major garden lake in East Siberia. Water salinity of Arakhlei Lake doesn't exceed 200 mg/l, Kenon Lake — 700 mg/l, Doroninsk Lake — about 32 g/l[1]. Kenon and Doroninsk Lakes are closed lakes that are unique due to their morphometric and hydrochemical peculiarities, defining their chemical composition and ice structure. The ice of Arakhlei and Kenon Lakes is monolithic as well as the ice of other fresh water bodies. However, according to A. A. Topolov's works, the ice of Arakhlei Lake contains the most diverse form (defined by biochemical transformations in lake sediments). Their diameter can account for up to 5–10 mm. The April ice of Doroninsk Lake there are three distinct layers: upper — cloudy, whitish; medium — most transparent; lower — porous, yellow and grey. The examination of its chemical composition revealed that its salinity changes, which indicates migration of the solution in the ice sheet. Such solution, caught in the process of ice sheet building-up, is contained in closed cells, pass through capillaries and between ice crystals (in interstitial)[2].

Main characteristics of Arakhlei, Kenon and Doroninsk Lakes are given in Table 1[3].

Hydrographic characteristics of the examined lakes

Characteristic, measuring unit	Lake		
	Arakhlei	Kenon	Doroninsk
Location	Ivano-Arakhlei system, the south of Vitim highland	Closed water body in the west and north-west part of the town of Chita, the interfluve of Ingoda and Chita rivers	Closed water body located 150km to the south-west of the town of Chita, at the bottom of Chitino-Ingoda intermountain basin
Square, km^2	58,2	16	3,7–4,8
Square of hydrographic basin, km^2	256	227	-
Lake length, km	11	5,7	-
Lake width, km	5,3	2,8	-
Maximum depth, m	17	6,8	6,5
Medium depth, м	10,4	4,4	4
Duration of ice formation, days	180–220	180–215	-
Salinity, g/l	0,15–0,16	0,4–0,7	16–32
Water chemical composition	Hydrocarbonate, magnesia, calcium	Hydrocarbonate and sulfate three-component in cations	Chloride, carbonate, sodium
Ice thickness*, m	1,00–1,25 (2010) 0,50–1,03 (210–2011) 0,58–1,36 (2011–2012)	0,66 (December 2011) 1,15 (March 2012)	1,29 (April 2012 г.)
Snow thickness*, m	0,07–0,08 (2010) 0,01–0,16 (210–2011) 0,02–0,06 (2011–2012)	0,08 (in high spots up to 0,12) (December 2011) 0,05 (in high spots up to 0,07) (March 2012)	-

«*» — data of the Laboratory of aquatic ecosystems;
«-» — data not available

[1] Zamana L. V., Bordonsky G. S., Borzenko S. V. etc. Silicon in the ice sheet of Trans-Baikal lakes//Rep.AN. 2005. T. 401. № 2. P. 248–251.

[2] Zamana L. V., Borzenko S. V. Chemical composition and salinity of Doroninsk Lake//Natural resources of trans-Baikal region and problems of geosphere researches: mat. sci. conf. Chita. 2006. P.68–70.

[3] Table drawn on the basis of the material: Biological productivity of Arakhlei Lake (Trans-Baikal region). Novosibirsk: Nauka, 1981. p. 3.;Chechel A. P. Physical-geographical conditions and layer regime of Kenon Lake/A. P. Chechel//Ecology of an urban water body – Novosibirsk: Published by SO RAN, 1998. – P. 5–13.;Borzenko S. V. Zamana L. V. Reconstruction of sulpher species in the brine of Doroninsk Lake (East Trans-Baikal region)//Geochemistry. 2011. № 3. P. 268–276

Method. The selection of the field material was carried out during winter period within the frames of complex project studies. The selection of water and ice cores samples, measurement of hydrologic and meteorological indicators were conducted in 2010, 2010–2011 and 2011–2012 of the researches at Arakhlei Lake central station, as well as in December 2010 and January-April 2011 near the lake shore (3m depth).

In December 2011 and March 2012 the selection of ice cores in Kenon Lake was carried out, as well as in April 2012 in the Lake of Doroninsk. Total 200 samples of algae and invertebrates were taken from the examined lakes.

The method of selection and processing of the samples of ice sheet water are presented in the previous works of the author[1].

Obtained results. Cryophilic flora of Arakhlei, Kenon and Doroninsk Lakes as well as other water bodies and water passages (Baunt Lake, Baikal Lake, Amur River) partially consists of pagons (organisms frozen in the ice) and partially invertebrates of sub-glacial water. However, compared to authentic phytoplankton, the composition of invertebrates of the ice sheet of the examined lakes was poor. Total 25 invertebrate taxons of lower kind (Table 2) were found in the ice interstitial of the lakes in 2010–2012.

Table 2

Taxon composition of invertebrates of the ice interstitial of the examined lakes in 2010–2012

Taxon	Lake		
	Arakhlei	Kenon	Doroninsk
Cyanobacteria *Anabaena* sp.	+	-	-
A. sp. (spore)	+	-	-
OCHROPHYTA *Chrysococcus rufescens* Klebs, 1893	+	-	-
Chromulina sp.	+	-	-
Mallomonas sp.	+	-	-
Asterionella formosa Hassall, 1850	+	-	-
Aulacoseira sp.	+	-	-
Achnanthes sp.	+	-	-
Amphora sp.	-	+	-
Cymbella sp.	-	+	-
Diatoma vulgare Bory, 1824	+	+	-
Fragilaria capucina Desmazières, 1830	+	-	-
F. sp.	-	-	+
Gomphonema sp.	+	-	-
Navicula sp.	-	+	-
Navicula sp.[1]	-	-	+
Puncticulata radiosa (Lemmermann) Håkansson, 2002	+	+	-
EUGLENOZOA *Phacus* sp.	+	-	-
MYZOZOA *Peridinium* sp.	+	-	-
Peridinium sp.[1]	-	+	-
CHLOROPHYTA *Chlamydomonas* sp.	-	-	-
Closteriopsis acicularis (Chodat) J. H. Belcher & Swale, 1962	+	-	-
Monoraphidium contortum (Thuret) Komàrková-Legnerová, 1969	+	-	-
Tetrastrum triangulare (Chodat) Komárek 1974	+	-	-
Scenedesmus arcuatus (Lemm.) Lemmermann 1899	-	+	-

The composition of invertebrates of the Arakhlei ice sheet amounted to 17 taxons referred to 5 groups — Ochrophyta (10), Cyanobacteria (2), Myzozoa (1), Chlorophyta (3) and Euglenozoa (1). In the composition of invertebrates of the ice interstitial of Kenon Lake 8 forms, related to three groups — diatoms, green and dinophysis. It should be noted that cells of such kinds of diatom invertebrates as *Navicula sp., Cymbella sp.* were found mainly destroyed (as separate valves). Whole organisms were present as single kinds. Reconnaissance studies of invertebrates of Doroninsk Lake ice allowed revelation of extreme poorness of their species. In 2012, total 2 forms of diatoms were found in the ice core selected at the central station (see Table 2). All invertebrate forms, found in the ice interstitial of the examined lakes, are not authentic cryobionts, but related to cryophilous kinds.

[1] Tashlykova N. A. Invertebrates of the ice communities of Arakhlei Lake.//Vestnik KrasGAU, 2012. № 1. P. 87–90. Afonina E.Yu., Tashlykova N. A., Intigilova M.Ts., Invertebrates and algae of the ice of Kenon and Doroninsk Lakes (Trans-Baikal region)//Biodiversity and problems of ecology of Amur River region and cross-border territories: mat. region. sci. conf. with int. particip. Khabarovsk: Published DVVGU, 2012. P. 130–134.

Obtained results allow noting that the composition of invertebrates in the ice interstitial of the examined lakes is different. It is defined by their geographical location, morphometric and hydrochemical characteristics. Sørensen coefficient of similarity of the invertebrates for the lakes of Arakhlei and Kenon accounted for 16%. It is a quiet low index. However, the coefficient of similarity of phytoplankton in these lakes is also low and accounts for 40%[1]. When comparing species composition of invertebrates in the ice of Arakhlei, Kenon and Doroninsk Lakes, common species were not found, this is explained by peculiar hydrochemical peculiarities (high salinity) of the waters of the latter.

In the qualitative composition of algae in the ice of Arakhlei and Kenon Lakes, 11 trivial taxons were found, united in 11 species, 6 families, 5 orders, 3 classes and 2 types. In the lake of Arakhlei, 2 kinds of Rotifera and in 4 — Cladocera and Copepoda were found, in the lake of Kenon — in 2 — kinds of cladocerae and copepoda crustacean (Table. 3).

Таблица 3

Species composition of rotifers and crustaceans in the ice interstitial of Arakhlei and Kenon Lakes.

Taxon	Arakhlei Lake	Kenon Lake
ROTIFERA *Keratella cochlearis* (Gosse, 1851)	+	-
Kellicottia longispina (Kellicott, 1879)	+	-
CLADOCERA *Sida crystallina* (Müller, 1776)	+	-
Ceriodaphnia quadrangula (Müller, 1785)	+	+
Daphnia galeata Sars, 1864	+	+
Bosmina longirostris (Müller, 1785)	+	-
COPEPODA *Neutrodiaptomus incongruens* (Poppe, 1888)	-	+
Eudiaptomus graciloides (Lilljeborg, 1888)	+	-
Macrocyclops albidus (Jurine, 1820)	+	-
Cyclops vicinus Uljanin, 1875	+	+
Thermocyclops crassus (Fischer, 1853)	+	-

As Table 3 shows, common species for both water bodies are *D. galeata*, *C. quadrangula* and *C. vicinus*. Mass representatives of the under-ice zooplankton *E. graciloides, D. galeata, C. vicinus* were found in the ice more often than others.

Quantitative development of the invertebrates and algae in the examined lakes was low. Quantity and biomass of the invertebrates in the ice of Arakhlei Lake, except February 2010 (160 thousand kl/l; 1,5 g/m^3), changed from 0,3 to 158 thousand kl/l and from 0,4 to 1500 mg/l in 2010, from 0,2 to 28,6 thousand kl/l and from 0,1 to 98,6 mg/l in 2010–2011, from 0,4 to 33 thousand kl/l and from 0,7 to 1472 mg/l in 2011–2012, consequently. Vertical distribution of the invertebrates in the ice core was nonhomogeneous and mainly concentrated in the lower layers and at the water's edge. High indicators of quantity and biomass of the invertebrates are defined by the development of dinoflagellates in the ice sheet, particularly *Peridinium* sp. In the ice samples, selected by the shore in 2010–2011, diatom and dinofit invertebrates were singularly found in the middle layers of the core. In March 2012, dinoflagellates, found in the ice of the offshore station, were concentrated in the lower layers of the core at the water's edge and created high quantitative indicators — quality 21,6 thousand kl/l, under the biomass of 1,4 g/m$^{3.}$

In the ice samples, selected in Kenon Lake, the invertebrates were mainly concentrated in the upper and middle layers, where their quantity varied from 0,3 to 5 thousand kl/l — in December 2011 and from 0,5 to 1,4 thousand kl/l — in March 2012. *Scenedesmus arcuatus* and *Diatoma vulgare* dominated.

Marked quantitative indicators of the invertebrates in Doroninsk Lake as well as Kenon Lake weren't high and varied from 0,6 to 1,5 thousand kl/l.

Total quantity of algae in the ice core isn't high. Maximum value in Arakhlei Lake reached 5,14 specimen/m^3 in the central part and up to 18,67 thousand specimen/m^3 — in the shore line. Quantity of crustacean in the ice of Kenon Lake varied from 0,1 to 1,15 thousand specimen/m^3 (in December 2011) to 1,25–16,0 thousand specimen/m^3 (in March 2012). During winter period, in the lakes of Arakhlei and Kenon, the crustacean were mainly concentrated upper and lower layers of the ice pole, and in spring at the ice edge, they were almost not found in the surface layers.

Thus, the composition of the invertebrates of the ice sheet of Arakhlei, Kenon and Doroninsk was quite poor and mainly consisted of invertebrates, frozen in the ice and invertebrates of the under-ice water. All forms of invertebrates detected in the ice interstitial of the examined lakes are not authentic cryobionts, but related to cryophilous kinds. Quantitative characteristics of the invertebrates in the ice of examined Doroninsk and Kenon Lakes were low compared to Arakhlei Lake. Maximum quantitative and biomass value in Arakhlei Lake was marked in February 2010–2011, as well as March 2012. Vertical distribution of the invertebrates in the ice core was nonhomogeneous and mainly concentrated in the lower layers and at the water's edge.

The conducted research of algae in the ice revealed that in Arakhlei Lake hydrobionts of the ice sheet, collected in the shore line during winter period, were mainly concentrated in the upper layers and were richer in quantitative and qualitative aspect than the ice, collected in the central part of the water body during spring period, when organisms were found rarely and spread vertically in almost homogeneous manner. In Kenon Lake, the crustaceans were mainly concentrated on the ice surface during winter period and in the lower layer of the ice pole during spring period.

The work was carried out on the topic of «Invertebrates — cryophiles of the ice of salty and fresh water lakes of the Trans-Baikal region, supported by the projects VII.65.2.2 «The role of ice sheets in seasonal hydro-geochemical and biological cycles of small salty and fresh water lakes (on the example of Trans-Baikal region) and № 11-04-98064-р_siberia_a «Estimation of competitive relations between alien species of Elodea canadensis Mich. and aboriginal community of hydrobionts of Kenon Lake (East Trans-Baikal region)».

[1] Ogly Z. P. Phytoplankton of various water ecosystems of the East Trans-Baikal region. Chita: RIK ZabGU, 2011. P.33.