

MAMMOTH MICROFLORA PRESERVED IN YAKUTIAN PERMAFROST

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In the proposed research we present living bacteria of Pleistocene age identified from microfloral elements related with mammoth fauna (e.g., Neustroev, 2007, 2010; Tarabukina et al., 2010). Microbiological studies of paleomicroflora extracted from Mokhsunuokhsk and Yukagir mammoths, Oimyakon and Khroma young mammoths and Kolyma woolly rhinoceros, the young mammoth of Yuka, the Yukagir horse and the Yukagir bison all preserved in permafrost, allow identification of a unique bacteria of the genus *Bacillus*, which not only survived (for 18-30 thousands of years), but retained the ability to produce biologically active substances. The results are as amazing as the preserved remains of fossil animals themselves.

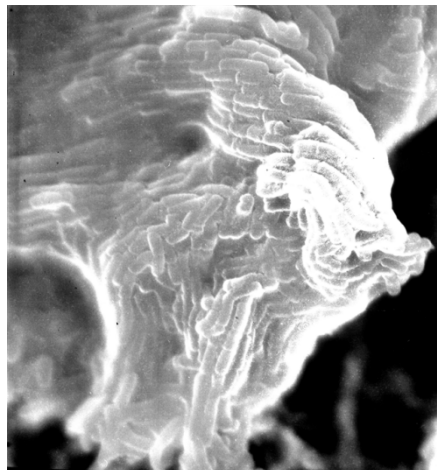
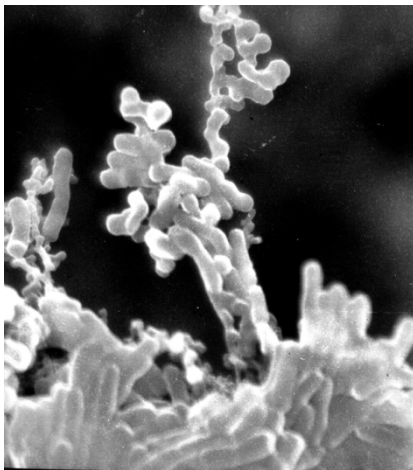
The microbiological studies on soft tissues of Mokhsunuokhsk and Yukagir mammoths, Oimyakon and Khroma young mammoths, Kolyma woolly rhino, young mammoth of Yuka, and Yukagir horses and bison allow isolating 43 strains of microorganisms, including 26 strains of bacteria assigned to the genus *Bacillus*. According to biochemical, and physiological properties they are attributed to the species: *Bac. megatherium*, *Bac. subtilis*, *Bac. alvei*, *Bac. pumilis*, *Bac. brevis*, *Bac. popillae*, *Bac. steurothermophilus*, and *Bac. circulans*.



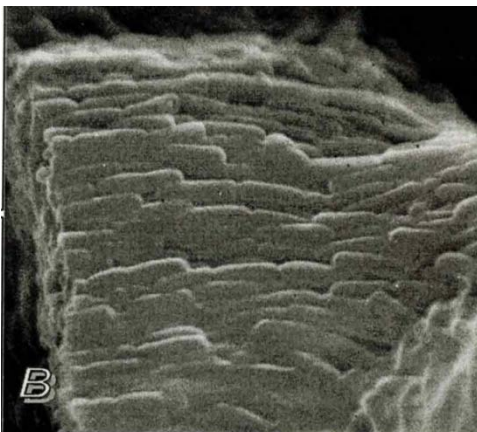
Research of population of Bacillus bacteria sort allocated from the animals' fossil, are carried out with use of methods of scanning electronic microscopy (SEM).

Cells in such "plaits" are incorporated by intercellular matrix. On a surface can be formed the cover, its formation depends on conditions and a stage of development of cells in a population.

Fragment of a population
B. megaterium (MPB, 24 hours). EM x 6000



B.subtilis Kolyma 7/2к (24 h) SEM, x 6000



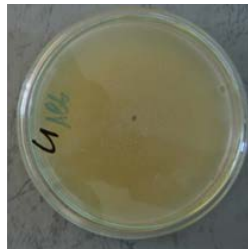
It is important to note, that formation of spores can begin in the cells of non-separated chains therefore after spores germination and its exit out of a parent cell the general skeleton uniting mature spores is formed.

Thus, are formed the plaits compact congestions including spores, the residues of extra-cellular elements of intercellular matrix, covers and detritus of cells. It is, probably, extreme stability and long survival rate (20-30 thousand years), allocated in this case out of the animals' fossil, sporogenetical bacteria to extreme conditions of an environment which is caused not only a structure of spore, but also additional

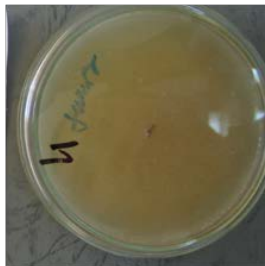
protection as the generated covers allowing spores to exist in structure of a uniform population also explains.

Fragment of a population B. megaterium (MPA, 24 hours). x 10 000.

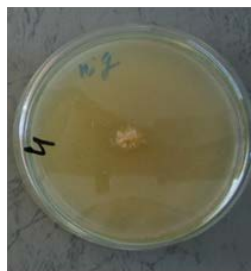
All strains of bacteria Bacillus isolated from the mammoth and rhinoceros have varying degrees of antagonistic properties in relation to pathogenic and conditionally pathogenic microorganisms: Salmonella, Ecsherihea, Shigella, Stafylococcus, Streptococcus, Brucellosis, Tuberculosis and microscopic fungi as Aspergillus, Penicillium, Alternaria.



Alt.alternata



Asp. fumigatus



Asp.niger



Pen. citrinum

In the available literature we have not found messages about antagonistic activity of microbial communities that have kept long viability in permafrost soils (bed-rocks). Therefore, the received results allow concluding, that we for the first time determined a phenomenon of the expressed antagonistic activity of microbes of pleistocene age in attitude to pathogenic and toxigenic microorganisms. Basically the strains of bacteria, allocated out of fossil animals are antibiotic – resistance.

According to the results of our research, we can conclude a high antagonistic activity of strains of the isolated bacteria of the genus *Bacillus* in relation to opportunistic and pathogenic microorganisms, including toxigenic fungi. It should be noted that in the Pleistocene paleomicroflora there is no putrefactive microorganisms. The obtained results of microbiological research and observations suggest that strains of antagonist-bacteria of *Bacillus* dominating in paleomicroflora contribute to the preservation of soft tissues of mammoth fauna representatives, preserved in permafrost. The study allowed for the first time to certify and deposit strains of bacteria *Bacillus subtilis* «Kolyma-7/2K» and *Bacillus subtilis* «Oimyakon-6/1», extracted from the Kolyma woolly rhinos and the Oimyakon young mammoth in the collection of microorganisms of the Russian Research Institute of Agricultural Microbiology (St. Petersburg, 2010) for further modern biotechnological studies.

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