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COPPER-RESISTANT MICROORGANISMS ISOLATED FROM ANTARCTIC ISLAND GALINDES

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Abstract. The copper-resistant microorganisms were isolated from soils of Antarctic island Galindes. It was shown that these microorganisms can grow on the medium with concentration of Cu^{2+} ions 1000–3000 ppm.
Key words: resistance to high concentrations of copper, Antarctic microorganisms.

Антарктические медьрезистентные микроорганизмы острова Галиндез. Н.А.Матвеева, А.А.Таширева, А.Б.Таширев.
Изучены микробные ценозы антарктического острова Галиндез и выделены культуры микроорганизмов, которые могут расти на среде с содержанием ионов меди до 1000-3000 мг/л.

Антарктичні мідьрезистентні мікроорганізми острова Галіндез. Н.А.Матвєєва, Г.О.Таширева, О.Б.Таширев.
Досліджено мікробні ценози антарктичного острова Галіндез та виділено культури мікроорганізмів, що ростуть на середовищі зі вмістом іонів міді 1000 -3000 мг/л.

Introduction

Islands of Argentine archipelago including Antarctic island Galindes consist of magmatic rocks, that contain high concentrations of the heavy metals. Because of the physics, chemical and biological destruction this metals move to the environment. The high maintenance of the toxic heavy metals, including copper, can be result of the appearance of Cu^{2+}-resistant microorganisms. The objective of our study was to find microorganisms resistant to high concentrations of Cu^{2+} in soils of Antarctic island Galindes.

Materials and methods

Getting samples

Samples of soil were selected on Antarctic island in 2002 year. They were frozen and stored under the temperature –25° C.

Inoculate preparation

1 g of sample was homogenized and suspended into 100 ml of sterile saline solution (0.9% NaCl) and vigorously shaken for 2 hour. 20 µl of suspension were put in Petri dishes on the MPA media surface with the Cu^{2+} concentration 200-3000 ppm.

Preparation of Cu^{2+} solution

For preparation of Cu^{2+} solution we used chemical pure $CuSO_4$ and suspended it in sterile distillate water. Solution was sterilized by boiling 30 min., than cooled to 25°C and added to nutrient medium to final concentration 200-3000 ppm of Cu^{2+}.

Results and discussions

Cooper is the chemical element which is present in soils in microquantities [5]. It is necessary in a small quantities for the formation and function of ferments, vitamins and antibiotics in microbial cells. [1]. Increasing of cooper concentration in nutrient medium cause growth inhibition and in high concentration is lethal for the most soil microorganisms [2]. So, ions of Cu^{2+} that is a toxic heavy metal can stimulate growth of soil microorganisms in a small concentration and can inhibit the growth in high concentrations [4]. Concentration that is more than 3 ppm Cu^{2+} is the lethal concentrations for soil microorganisms [3].

Investigation of microorganisms isolated from Antarctic islands conducted during many years but the cooper-resistant microorganisms was not discover. The objective of our study was to find Cu^{2+}-resistant microorganisms in soils of Antarctic island Galindes which can grow on the medium with concentration more than 1000 ppm Cu^{2+}.

In order to investigate the growth of Antarctic islands microorganisms the 20 µl of suspension were put in Petri dishes on the MPA media surface without the Cu^{2+} (control). It has been shown that there are 4 types of colonies: a) small yellow 1-2 mm; b) white prominent 3-4 mm; c) large, plane with wavy border near 30 mm; d) small pink 1-2 mm (table 1).

Table 1.

Growth the microorganisms on the MPA medium

Types of colonies	Color	Shape	Diameter, mm	Border
1	yellow	round	1-2	even
2	white	round	3-4	even
3	white	plane	till 30	wavy
4	pink	round	1-2	even

The colonies of type 2 (white prominent) appeared at first, their quantity was till 300 per dish. Then appeared small yellow, large plane with wavy border and small pink colonies (Fig. 1) (Fig. 1-3 see color paste).

In order to discover the cooper-resistant microorganisms the 20 µl of suspension were put in Petri dishes on the MPA medium surface with the Cu^{2+} concentration 200-1000 ppm. It has been shown that there are 4 types of colonies: 1)small yellow 1-2 mm; 2) white prominent 3-4 mm; 3) large, plane with wavy border near 30 mm; 4) small pink 1-2 mm (tabl.2, fig. 2).

Table 2.

Growth of microorganisms on the MPA medium with 200-1000 ppm Cu^{2+}

Types of colonies	Color	Shape	Diameter, mm	Border
1	yellow	round	1-2	even
2	white	round	3-4	even
3	white	plane	till 30	wavy
4	pink	round	1-2	even

Investigation have been shown that in Antarctic soil there are the cooper-resistant microorganisms and concentrations up to 1000 ppm Cu^{2+} don't inhibit their growth. The quantity of cooper-resistant (to 1000 ppm Cu^{2+}) microorganisms was $1 \cdot 10^6$ cells per 1 g of soil.

During the cultivation 9 selected strains were found their ability to grow under the cooper concentration 1000-3000 ppm (Table. 3).

Strains ХЧ, Х7, ХП, ХБ were able to grow on the medium supplemented Cu^{2+} 2000 ppm, strain Х7 –3000 ppm of cooper. Such concentration is 1000 times higher then the lethal for the major part soil microorganisms.

The concentration up to 800 ppm had no influence on the growth of cooper-resistant microorganisms (Fig.3). This testifies that there are the adaptation mechanisms, which neutralize toxic cooper influence on the microbial cells.

Table 3.

Resistance of strains ХЧ, Х7, ХП, ХБ at Cu^{2+} concentration up to 3000 ppm.

	0	200	600	1000	1500	2000	2500	3000
ХЧ	+	+	+	+	+	+	+	-
Х7	+	+	+	+	+	+	+	+
ХП	+	+	+	+	+	+	-	-
ХБ	+	+	+	+	+	+	-	-

Conclusion

The copper- super resistant microorganisms were found in soils of Antarctic island Galindes. It was shown that these microorganisms can grow on the media with the ions Cu^{2+} concentration 1000-3000 ppm which is in 1000 times higher then the lethal for the most soil microorganisms. Such resistance can be the result of the high cooper concentration in Antarctic soils.

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