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CORRELATION ANALYSIS OF INDICATORS OF ANTAGONISTIC ACTIVITY OF *STREPTOMYCES SP.* ONU 64

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Abstract. *A study of the antagonistic activity of actinomycete strains isolated from the bottom sediments of the Black Sea was conducted. Strain Streptomyces sp. ONU 64 showed the maximum antagonistic activity against conditionally pathogenic indicator strains. Correlation analysis showed the existence of a linear relationship between the manifestation of antagonistic activity of this strain and the composition of nutrient media used for preliminary cultivation.*

Keywords: *antagonistic activity, correlation analysis.*

Introduction. The search for previously unknown microbial strains is an effective approach for obtaining new biologically active substances [1]. However, in addition, there is a problem of obtaining the maximum amount of the active substances, that is, optimizing the cultivation conditions of the producer strain and the technology of obtaining the active substances. The solution of this scientific and practical task is implemented using statistical data processing [2, 3]. A "natural" measurement associations between variables in biological systems is the correlation coefficient. The purpose of this work was carried out in the process of study the antagonistic activity of *Streptomyces sp.* ONU 64, isolated from the bottom sediments of the Black Sea, correlation analysis of the dependences of the level of antagonistic activity and the composition of nutrient media used for preliminary cultivation of the strain. The revealed correlational dependences are planned to be used in the future for mathematical modeling and optimization of the conditions of cultivation of the strain.

Materials and methods. To study the antagonistic activity of strain *Streptomyces sp.* ONU 64, it was grown superficially on agar nutrient media of varying composition. Antagonistic activity was determined on LB medium (0.7% agar) using the block method. To carry out statistical analysis, we used the R 4.3.3 program and additional packages "corrplot", "RColorBrewer", "cluster" and "fastcluster" [Principal Component …., Introduction to Color Palettes…., fastcluster: Fast Hierarchical…., An Introduction to corrplot] [4, 5].

Results and discussion. It was shown that the manifestation of antagonistic activity of the strain *Streptomyces sp.* ONU 64 depends on many factors and, above all, is determined by the antagonist strain, the indicator strain, and the composition of the medium used.

The studied strain showed a high level of antagonistic activity against the indicator strains (Table 1). The maximum manifestation of antagonistic activity was recorded when using Gause 2, SCA and 79 media.

Table 1

Antagonistic activity of *Streptomyces sp.* ONU 64, after cultivation on different media, against indicator strains

Nutrient media	Growth inhibition zone, mm				
	Bacillus subtilis ATCC 6633	*Escherichia coli* ATCC 25922	*Pseudomonas putida KT 2440*	*Candida albicans* ATCC 18804	*Kucoria rhizophila* DSM 348
media 10	0,0±0,0	0,0±0,0	0,0±0,0	8.0±0.9	0,0±0,0
media 15	0,0±0,0	0,0±0,0	0,0±0,0	0,0±0,0	0,0±0,0
media Gause 2	0,0±0,0	8.0±0.4	7,0±0.8	10.0±0.9	7.5±0,3
media Gause 1	6.0±0.9	0,0±0,0	0,0±0,0	10.0±0.7	6.5±0,8
media SCA	5.0±0.2	6.0±0.3	3,0±0.5	0,0±0,0	4.5±0,4
media 79	7.5±0.2	9.0±0.5	8,0±0.5	8.0±0.5	10.0±0,9

A correlation analysis between indicators of the antagonistic activity of the strain *Streptomyces sp*. ONU 64 against indicator strains and components of the nutrient medium was conducted. It was shown that the presence of a nitrogen source in the medium in the form of $(NH_4)_2SO_4$ (r=0.42) and Hottinger's broth (r=0.48), peptone (r=0.46) and casein (r=0.37) contributes to inhibition of the growth of the *Bacillus subtilis* ATCC 6633 strain. Ammonium nitrate (NH_4NO_3), yeast extract and calcium carbonate ($CaCO_3$), on the contrary, reduced the antagonistic activity of this strain against *B. subtilis* ATCC 6633 (Fig. 1).

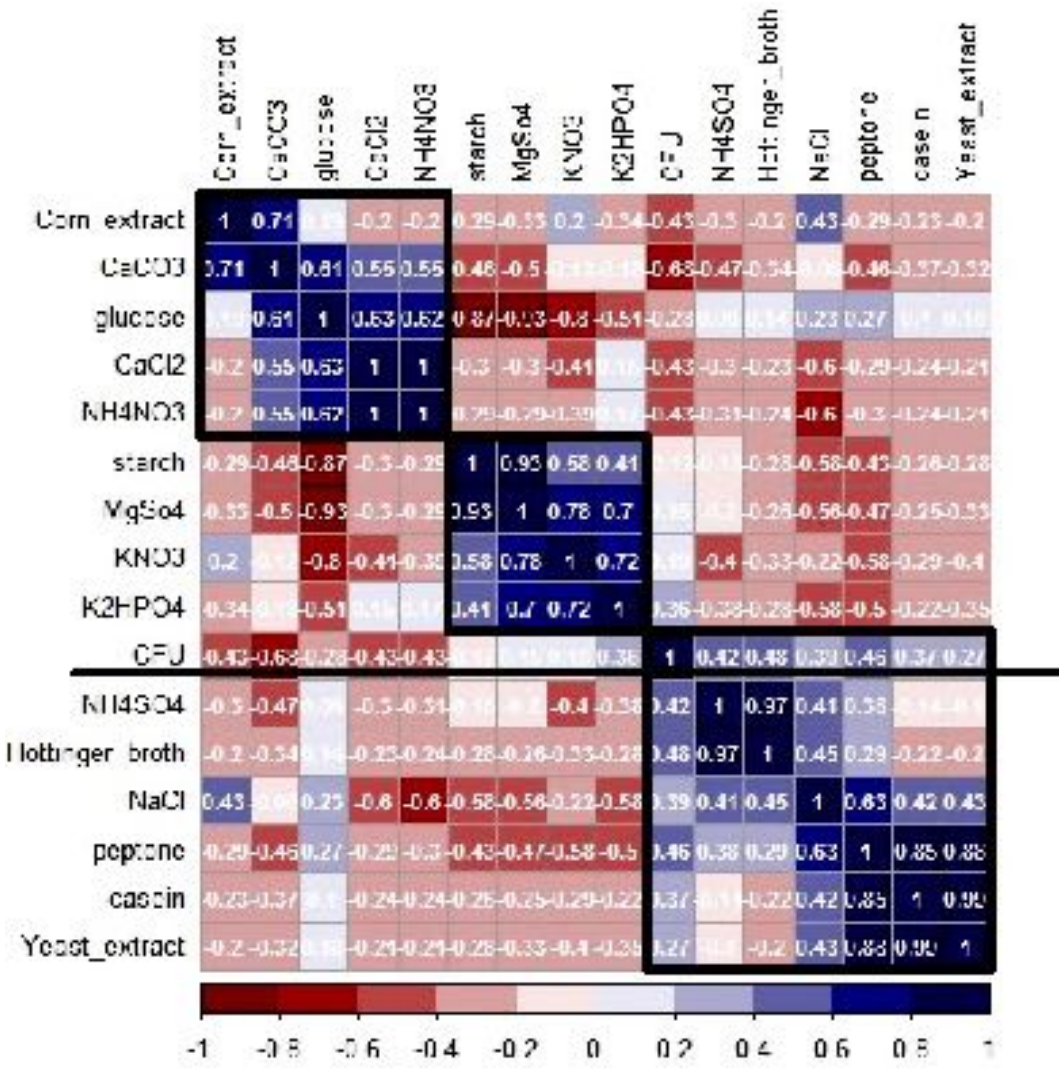

Fig. 1. Graphic representation of the correlation analysis between the composition of the nutrient medium and the indicator of the antagonistic activity of the strain *Streptomyces sp.* ONU 64 against *Bacillus subtilis* ATCC 6633 (CFU – indicator of antagonistic activity)

The manifestation of the antagonistic activity of the strain S*treptomyces sp.* ONU 64 against *Candida albicans* ATCC 18804, *Escherichia coli* ATCC 25922, *Pseudomonas putida* KT 2440 and *Kucoria rhizophila* DSM 348 was positively influenced by the following factors - potassium phosphate (r=0.41), water-soluble starch (r=0.51) and magnesium sulfate (r= 0.52) (Fig. 2).

However, organic extracts (corn extract, yeast extract) and casein, which act as sources of nitrogen, proteins and amino acids, inhibited the antimicrobial activity of S*treptomyces sp.* ONU 64 against these indicator strains (Fig. 2).

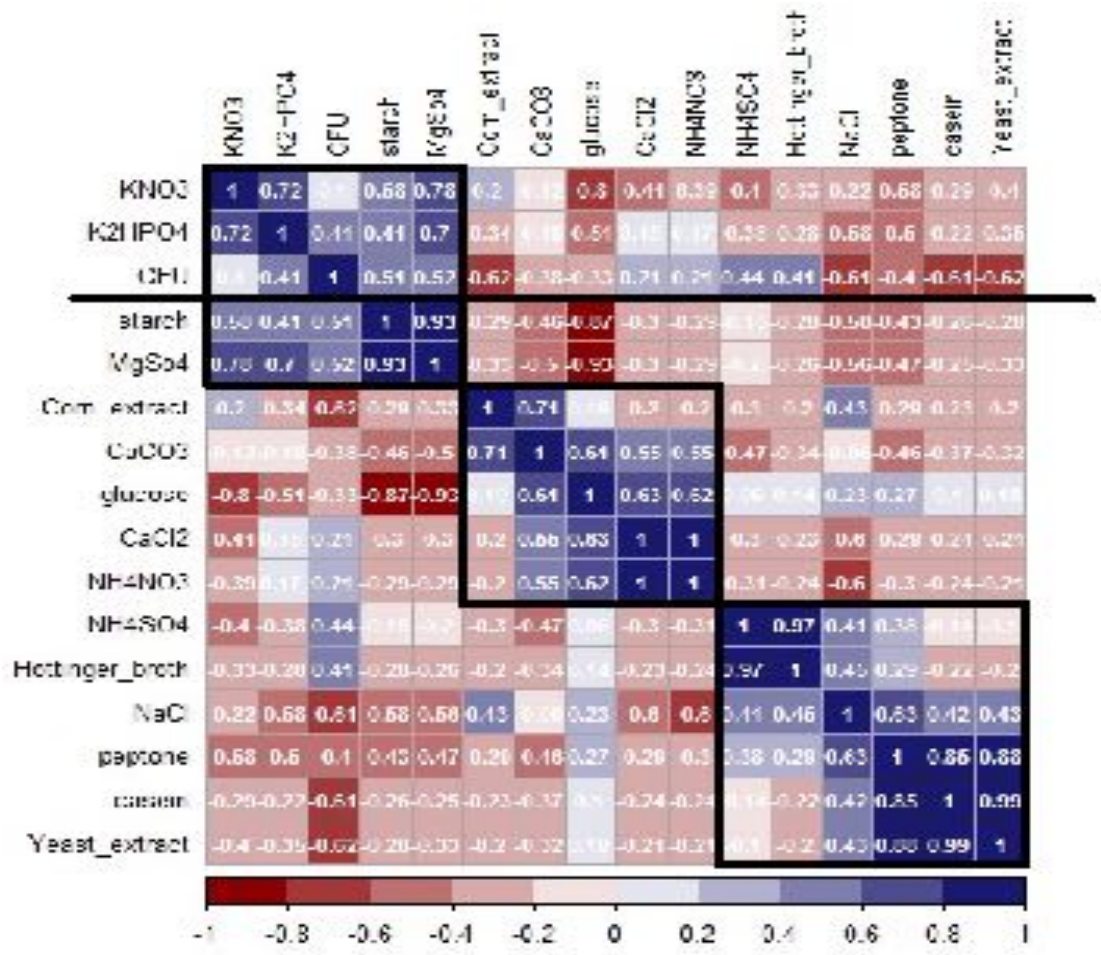

Fig. 2. Graphic representation of the correlation analysis between the composition of the nutrient medium and the indicator of the antagonistic activity of the strain *Streptomyces sp*. ONU 64 against *Candida albicans* ATCC 18804 (CFU – indicator of antagonistic activity)

Conclusions

1. Strain *Streptomyces sp.* ONU 64 showed high antagonistic activity against all opportunistic strains of the indicators. Its activity against *Candida albicans* ATCC 18804 should be noted in particular

2. The highest level of antagonistic activity was registered with the previous cultivation of the strain *Streptomyces sp.* ONU 64 on Gauze 2, SCA and 79 nutrient media.

3. Correlation analysis showed the linear dependence between the presence of combinations of nitrogen sources in the nutrient media and the antagonistic activity of the strain. The presence of glucose, corn extract, and yeast extract more often inhibits the antagonistic activity of *Streptomyces sp.* ONU 64.

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КОРЕЛЯЦІЙНИЙ АНАЛІЗ ПОКАЗНИКІВ АНТАГОНІСТИЧНОЇ АКТИВНОСТІ ШТАМУ *STREPTOMYCES SP.* ONU 64

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Анотація. *Проведено дослідження антагоністичної активності штамів актиноміцетів, ізольованих з донних відкладень Чорного моря. Штам 64 проявив максимальну антагоністичну активність по відношенню до умовно-патогенних штамів індикаторів. Кореляційний аналіз показав наявність лінійної залежності між проявом антагоністичної активності цього штаму та складом поживних середовищ, використаних для попереднього культивування.*

Ключові слова: *антагоністична активність, кореляційний аналіз.*

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