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ISOLATION OF MICROBIAL CONSORTIA FROM POLYETHYLENE FILMS SURFACE

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Introduction

Nowadays, polyethylene-based plastic materials are widely used for packaging products, in construction, transport, medicine. Low-density polyethylene (LDPE, PE-LD), the main material for the production of disposable bags, the most widespread type of plastic packaging, accumulates and pollutes the environment. According to legislative changes, in the Republic of Moldova, polyethylene bags will be gradually withdrawn from circulation, but still LDPE will remain for a long time the main cause of persistent environmental pollution. In the year 2022, almost 100 thousand tons of plastic materials were imported. During the last 10 years analyzed, the amount of plastic materials has registered a constant increase, with an average of 4% annually. The recycling rate of plastic waste in the Republic of Moldova is only three percent. Evaluating the ability of microorganisms to transform or detoxify organic compounds is a recognized trend in the development of environmental decontamination biotechnologies. Microorganisms participate both in the degradation of synthetic and natural polymers. Thus, polymeric materials represent a potential source of carbon and energy for heterotrophic microorganisms, bacteria and fungi.

The aim of this work is the characterization of the microbial consortium isolated from storage soil polluted with low density polyethylene.

Materials and methods

The soil was collected from the landfill, located near the village of Slobozia-Dușca, the Criuleni district, the Republic of Moldova. LDPE films were placed in the soil amended with mono- and dipotassium and diammonium phosphates within six months, and then were placed to flasks with liquid mineral salt medium MSM (pH 6.0) and cultivated under continuous stirring conditions at 28°C. After 30 days of cultivation, cultures were inoculated on MSM 2 (pH 5.5) and MSM 4 (pH 6.5) liquid media, through enrichment techniques. Enrichment cultures were prepared by adding 10 mL water sample to 90 mL (MSM). As a growth inducer in the media was added glucose, in a concentration of 0.1%. To the culture media was added LDPE in the form of films and cultivation was continue for 270 days.

Samples from the enrichment culture were serially diluted and plated onto MSM agar, nutrient agar, and Czapek medium. The plates were incubating at 28°C for 7-

10 days. Growing colonies were selected and streaked successively onto the same media for purification. The isolates were examined for their Gram reaction, endospore formation, and characteristics of a colony, such as color, colony form, margin, surface, and elevation. The morphological peculiarities of the microorganisms were studied under an optical microscope Optica® Microscopes B-510 PH, Italy. The LDPE degradation was determined by Fourier-transform infrared spectroscopy (FTIR).

Results and conclusions

The number of microorganisms in consortia, cultivated on MSM 2 medium (pH 5.5), obtained after LDPE incubation varied from 0.93×10^6 to 34.87×10^6 CFU/ml. The titer of microorganisms in consortia, cultivated on MSM 4 (pH 6.5) medium, obtained after LDPE incubation varied from 2.0×10^6 to 99.73×10^6 CFU/ml, in experimental variant 4, grown on MSM 4 medium (pH 6.5). This was due to the large number of bacteria in this consortium, up to 95% of the population. All consortia cultivated on MSM 2 and 4 had a mixed composition.

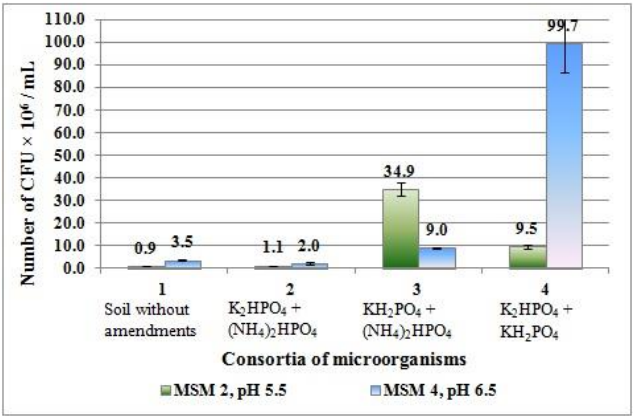

Fig. 1. Number of microorganisms, in CFU/mL, in consortia isolated from the surface of LDPE films, extracted from the soil with different amendments, and cultivated on mineral salt media.

The analysis of the LDPE films by the FTIR method showed that the microorganisms, which populated the surface of the LDPE samples, cause physical changes, observed on the absorption spectra of the films, such as the appearance of some absorption bands (891, 879, and 802 cm^{-1}), or their splitting (2988, 2971 cm^{-1}).

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