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Physiology and cell viability of new strains destructors of organic pollutants

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INTRODUCTION & AIM

Microbial degradation of anthropogenic pollutants has been a promising area of biotechnology for decades and remains an important issue due to the ever increasing technogenic load, as well as to the economical and environmental advantages of biodegradation.

Phenols are among the most common pollutants, arriving to the surface waters with the waste of oil-processing, slate-processing, wood-chemical, chemicalrecovery industries, etc., as well as with wastes of hydrolysis industry (processing of nonedible plant materials in pulp and paper and textile industries).

The works dealing with the effect of the pollutant on bacterial cells are, however, few.

The goal of the present work was to isolate of new pollutant destruction strains and investigate the effect of pollutants (phenol, its chlorinated derivatives) on survival, morphplogy and ultrastructure of bacterial cells.

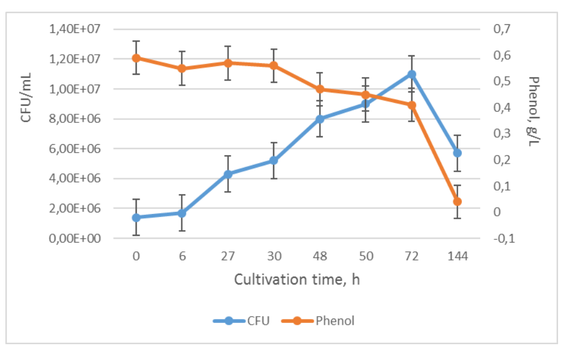

Figure 2. Survival of strain 7Ba growing at 0.5

METHOD

Four strains were isolated from soil (designated SL-1, 2, 3 and SL-4) and 2 - from river sludge (designated as IL-1 and IL-2) (Figure 1). Strain 7Ba was isolated from uncontaminated rhizosphere soil at the Saratov Petroleum Refinery, Saratov, Russia) (Polivtseva et al., 2020).The isolation was carried out by the enrichment culture method on a mineral medium containing phenol at a concentration of 0.5 g/L as the sole source of energy and carbon.

Cell viability was determined by culture-based techniques, determining the colony-forming ability (CFU/mL) on a Colony counter SC6 (Stuart, United Kingdom) after cultivation for 24–36 h at 28°C.

Formation of exopolymers (proteins and extracellular DNA) was also investigated. Protein content in the medium (mg protein/mL) was determined by the Bradford method (Bradford, 1976), with bovine serum albumin as the standard. Quantitative determination of extracellular DNA was carried out by measuring absorption coefficients at 260/280 nm.

RESULTS & DISCUSSION

The pure cultures obtained were tested for their ability to grow on phenol at a concentration of 0.5-2 g/L. The studies showed that strain SL-4 was able to grow on phenol at concentrations up to 2 g/L, strains IL-1, SL-1, SL-2 and SL-3 – up to 1.5 g/L, IL-1 was able to grow on phenol up to 0.5 g/L. The new isolates were further tested for their ability to degrade toluene (50 g/L), pinoxaden (50 g/L), diesel + gasoline mixture, biphenyl and oil. The isolates showed growth on all the substrates used as sole carbon and energy source, except for strains IL-1, IL-2, SL-1 and SL-3, which are incapable of toluene utilization.

The studied strains were also tested for cell viability when growing at high concentrations of phenol and its chlorinated derivatives.

The survival rate of the 7Ba strain. At initial phenol concentration of 0.5 g/L, a gradual increase in the CFU number and phenol consumption occurred, until, after 72 h, phenol was exhausted, and the number of viable cells began to decrease (Figure 2).

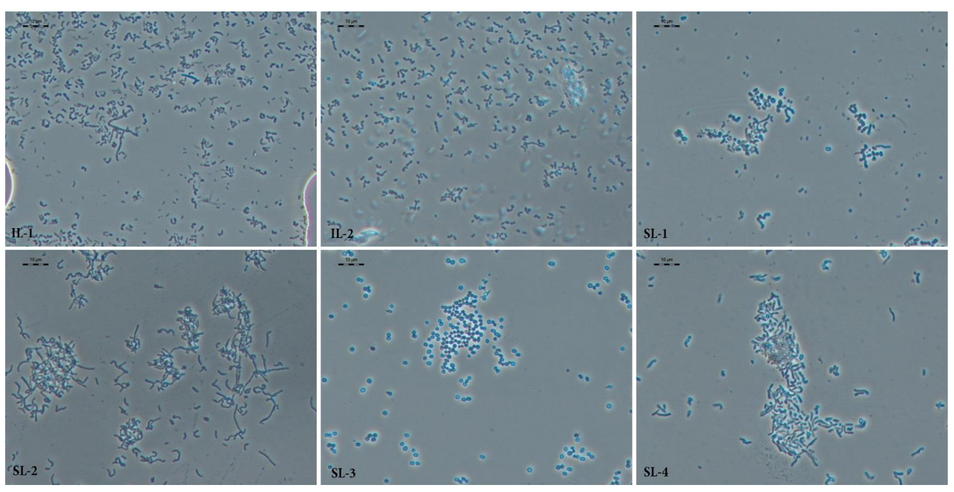

Figure 1. The new strains destructors of organic pollutants. Phase-contrast microscopy. Scale marker length 10 m.

CONCLUSION

The peculiarities of the physiology of isolates and the maintenance of cell viability in unfavorable conditions are important for their further use as a basis for biological products.

FUTURE WORK / REFERENCES

Polivtseva, V.N., Anokhina, T.O., Esikova, T.Z., Solyanikova, I.P., Iminova, L.R., and Borzova, O.V., Evaluation of the biotechnological potential of new bacterial strains capable of phenol degradation, Appl. Biochem. Microbiol., 2020, vol. 56, no. 3, pp. 298−305.