Adhesion of hydrophobic *Rhodococcus* bacteria to the hexadecane-water interface

Ekaterina Rubtsova,1* Maria Kuyukina1,2, Irena Ivshina,1,2
Anton Kazakov2 and Igor Makarikhin2

1Institute of Ecology and Genetics of Microorganisms, Russian Academy of Sciences, 13 Golev Street, 614081 Perm, Russia
2Perm State University, 15 Bukirev Street, 614990 Perm, Russia
*E-mail: rev85@rambler.ru

Microbial adhesion to the oil-water interface is an important factor in biodegradation of hydrocarbons that enhances cellular uptake and metabolism of these water insoluble compounds. Hydrophobic bacteria spontaneously adhere to oil-water interfaces and modify their mechanical properties. Bacteria of the genus *Rhodococcus* are of increasing fundamental and biotechnological interests due to their diverse metabolic activities and the important role in petroleum degradation in the environment [1]. Using the MA TH test (Microbial Adhesion To Hydrocarbons) we have studied *Rhodococcus* cell hydrophobicity and adherence to *n*-alkanes (C₆-C₁₆), technical hydrocarbon mixtures (machine oil, diesel fuel, kerosene) and food (olive, corn, sunflower) oils. It was found that rhodococci possess considerable (52-98%) adhesive activity to liquid hydrocarbons owing to their high cell surface hydrophobicity. Particularly, the adhesion degree of *Rhodococcus* cells to *n*-alkanes and technical hydrocarbons reached 91-98%, and it correlated with their high emulsifying activity (E₂₄=60-63%) towards these substances. Interestingly, *Rhodococcus* cells did not detach from the oil-water interface even after vigorous shaking; therefore, the adhesion of rhodococci to hydrocarbons appears to be irreversible.

Using the Nuoy ring tensiometer, thermodynamic properties (dynamic interfacial and surface tension, work of adhesion) of *Rhodococcus* cells adsorbed at the *n*-hexadecane-water interface were determined. We have found that bacterial accumulation at the interface had a pronounced effect on the interfacial tension, which decreased from 58.4 mN/m (for the *n*-hexadecane-water system) to the values lower than 50 mN/m. A strong positive correlation (r=0.94, p<0.05) was found between the initial bacterial cell concentration in the water phase and the dynamic decrease in the interfacial tension values. The data obtained suggest that hydrophobic bacterial cells, e.g. *Rhodococcus* cells can act as surface-active agents when accumulated in the oil-water interface. It is known that rhodococci produce cell-bound biosurfactants when grown in hydrocarbon-containing media [2]. However, in our experiments, the resting (non-growing) cells were used to exclude the effect of biosurfactant.

Research was funded by the RAS Program “Molecular and Cell Biology” and the Russian President Program for Leading Scientific School Support (grant 4112.2008.4).