Scientists demonstrated effect of surfactants on living cells

Scientists from Krasnoyarsk and Irkutsk have compared the effects of various types of SURFace-ACTive AgeNTS (surfactants) on luminescent bacteria and enzyme systems (reductase and luciferase) to find out how harmful these surfactants are to living organisms. The proposed method of bioluminescent analysis made it possible to identify the potential toxicity of the studied surfactants for living systems in a short time and demonstrated a higher sensitivity than other bioanalyses.

Surfactants are widely used in the household detergents industry as components of washing powders, liquid detergents, dishwashing liquids and cars. Surfactants are actively used in cosmetics, as well as in industry and medicine. The scientists of Siberian Federal University, being a part of a research team, used an enzyme system consisting of reductase and luciferase enzymes specific to living beings to find out what effect surfactants — in particular, cationic cetyltrimethylammonium bromide (CTAB), nonionic polyoxyethylene 20 sorbitan monooleate (Tween 80) and anionic sodium lauryl sulphate (SLS) have on animals and humans.

> *"We used the protozoan living organisms — bacteria and enzymes isolated from bacteria as indicators to find out how the most common surfactants (for example, the well-known sodium lauryl sulphate) affect their activity. It was important to understand how these substances act on intracellular proteins — after all, the whole cell, which, in essence, is a bacterium, has a natural defence in the form of a cell membrane. But if the defence is breached, then what will happen to the content of the cell?"* said **Irina Torgashina**, co-author of the study, senior researcher at SibFU Laboratory of Bioluminescent Biotechnologies.

According to the researcher, the experiment confirmed what was expected about sodium lauryl sulphate. This surfactant, which creates foam when using shampoos and toothpaste, had the most noticeable effect on the enzyme system — its glow, bright normally, noticeably faded when exposed to a "cosmetic" additive. Meanwhile, the concentrations of surfactants with which the scientists experimented were quite small (from 0.5 to 4 mg/l), which means that the observed effect clearly indicates the toxic effect of sodium lauryl sulphate on living organisms.

> *"We intentionally did not bring the concentration of the studied surfactants to the stage of micellization, when a layer is already forming on the surface of the solution — anyway, in everyday life any detergents are significantly diluted with water. We wanted to find out how surfactants behave in such household quantities, since they get through the drainage system into river arteries and lakes, where they probably have an impact on local ecosystems and the quality of drinking water,"* **Irina Torgashin**a continued.

In addition to the effect that surfactants have on living systems, scientists decided to evaluate the effectiveness of the enzyme system reductase — luciferase (Red + Luc) as an indicator of possible toxicity. It turned out that the analysis with its help takes only 2-3 minutes and has a higher sensitivity than other bioanalyses in toxicological methods. So bioluminescent analysis based on inhibition (quenching) of luminous enzymes can be used as an advanced research tool for assessing the toxicity of surfactants at the molecular level.

> *“Our proposed method of analysis is cheap, fast and does not require complex equipment. It is easy to detect the toxic damaging effect of surfactants on the body with its help but do not expect detailed answers from it, what exactly happens to proteins and living cells — this will have to be found out in the future. But, for example, polyoxyethylene 20 sorbitan monoleate, according to the results of the conducted testing, had no visible effect on either bacteria or the enzyme system. Most likely, it is not particularly toxic in household doses,”* the experts said.

The results of the study, according to the experts, require further clarification and, as of now, can hardly be the basis for a complete cancellation of, for example, sodium lauryl sulphate use. However, the information obtained is a reason for a serious in-depth study of substances that quench bioluminescent test systems.

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