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Development of biotechnical system for automated incorporation of drugs into human erythrocytes

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Introduction: Drug delivery using natural biological carriers, especially erythrocytes, is a rapidly developing field. Such erythrocytes carriers (EC) can act as carriers that prolong the drug's action due to its gradual release from the carrier; as bioreactors with encapsulated enzymes performing the necessary reactions, while remaining inaccessible to the immune system and plasma proteases. To date, erythrocytes have been studied as carriers for a wide range of drugs, however, their use in the clinic is limited mainly by the lack of automated drug encapsulation methods.

Methods: To incorporate biologically active drugs into erythrocytes, an automated unit was developed using the method of hypoosmotic flow dialysis. The installation includes a device for washing cells, a dialyzer, peristaltic pumps, sensors for hematocrit, pressure and the presence of liquid in the conductive lines connecting different units of the installation. The operation of the device is controlled by a specially the developed program, which allows the procedure completely automatically under sterile conditions.

Results: Using the developed automated biotechnical system the asparaginase enzyme, which is used in the treatment of leukemia was incorporated into human erythrocytes. Verification of the obtained EC (n=11) showed the complete sterility of the preparations. The efficiency of enzyme incorporation using the developed setup (the percentage of the enzyme included in erythrocytes) averaged E=22.5±4.4%, and the cell yield (percentage of erythrocytes preserved after the procedure) was equal to C=55.1±4.6%. The relative incorporation efficiency (R=51.8±9.6%) was also evaluated, which is the percentage that the specific activity of the enzyme obtained in erythrocytes is from the maximum possible under given conditions.

Conclusion: The developed automated biotechnical system allows sterile and reproducible incorporation of an enzyme preparation (asparaginase) into human erythrocytes with high efficiency, which exceeds the efficiency of all other currently existing devices for incorporating medicinal compounds into erythrocytes.

Speaker Biography

Anna Suvorova received her master's degree in 2018 from the Bauman Moscow Technical University and is currently a graduate student at the Faculty of Biotechnical Technologies of this university. Her research interests include biotechnology and the development of new instruments for scientific research, in particular, for the creation of new dosage forms for the delivery of medicines.

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