Kuznietsova O. O.
National Aviation University, Kyiv

Yeast and *E. Coli* expression systems for the production of insulin

In the world, the number of patients with diabetes mellitus is increasing every year. Therefore, meeting the patients with diabetes need for insulin is an urgent issue. In the past, all people with diabetes used bovine or porcine insulin. Currently, most patients with diabetes use human insulin, that is, insulin that is chemically similar to the insulin produced by the human pancreas. Gene technologies are used in the production of human insulin. With the help of gene technologies, the gene responsible for the synthesis (production) of human insulin is inserted, for example, into yeast cells or bacteria.

In the production of recombinant human insulin, *Escherichia coli* is most often used as a producer with the best technical and economic indicators [1].

The advantages of *E. coli* as an expression system are as follows: simple nutritional needs of the producer, which can be satisfied by simple and cheap nutrient media of a defined composition; simple cultivation conditions; ease of genome manipulation compared to other microorganisms; high growth rate; cultivation with high cell density; ease of scaling and good knowledge of genetic, molecular biological, biochemical and physiological properties of *E. coli*.

However, the production of recombinant proteins using *E. coli* has a number of disadvantages, namely: the inability to carry out complex post-translational modifications; formation of improperly folded or aggregated protein; formation of the target protein in the form of inclusion bodies.

The yeast expression system can also be used to produce heterogeneous proteins. At the same time, yeast is characterized by the presence of some post-translational modifications.

Most often, the yeast *Saccharomyces cerevisiae* is used to produce recombinant human insulin. The genetics and metabolism of *Saccharomyces cerevisiae* are well studied. This type of yeast is characterized by rapid culture growth, a relatively high yield of the target product, low cost of the fermentation process, and protein secretion into the growth medium. Research is also being conducted on the possibility of using *Pichia pastoris* to obtain recombinant human insulin [2].

The production of recombinant insulin from transgenic plants is also of interest [3]. Plant cells are eukaryotes and their mechanisms of post-translational modifications are more similar to human ones.

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