INNOVATIVE APPROACHES AND PROSPECTS OF NEW-GENERATION ANTIBIOTICS

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Relevance.

Antibiotics are widely used as an effective means of combating bacterial infections. They possess the ability to either destroy bacterial microorganisms (bactericidal effect) or inhibit their growth (bacteriostatic effect).

However, in recent years, the increasing prevalence of antibiotic-resistant bacteria has posed a serious threat to their effectiveness. Therefore, studying the factors contributing to the formation of antibiotic resistance, particularly the role and mechanisms of pathogenic microorganisms in this process, is of great scientific and practical importance.

Objective.

To investigate the direct and indirect influence of pathogenic microorganisms on the development of bacterial resistance to antibiotics.

Materials and Methods.

In 2024, the World Health Organization (WHO) updated its list of bacterial pathogens capable of developing antibiotic resistance. Among them are *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *E. coli*. Data from 2020 to 2025 were collected and analyzed from PubMed and Google Scholar databases.

Results.

The discovery of antibiotics marked a revolutionary breakthrough in the field of medicine.

Their widespread use drastically reduced mortality from infectious diseases. Millions of lives worldwide have been saved, and modern medicine has gained the ability to effectively treat dangerous infections.

Studies show that clinically significant bacterial pathogens such as *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *E. coli* frequently cause peritonitis and urinary tract infections. Consequently, the need for new antibiotics capable of combating these pathogens is steadily increasing.

One promising candidate is darobactin, a natural antibiotic that binds to proteins in bacterial cell membranes, disrupting vital functions and ultimately leading to cell death. Recent studies led by Rolf Müller and Jennifer Herrmann demonstrated the high efficacy of the genetically modified derivative Darobactin D22. Laboratory and animal model experiments confirmed its ability to inhibit the growth of multidrug-resistant microorganisms.

In the first stage of the study, the effect of D22 was evaluated on zebrafish embryos infected with *Acinetobacter baumannii*.

Results showed that D22 effectively eliminated the infection, exhibiting a therapeutic effect comparable to that of ciprofloxacin, a commonly used antibiotic.

These findings highlight the potential of D22 in treating complex bacterial infections.

In the next stage, D22 was tested on laboratory mice experimentally infected with *Pseudomonas* and *E. coli*. Administration of D22 demonstrated significant antibacterial activity, reducing signs of inflammation, stabilizing vital parameters, and decreasing pathogen load. The study revealed that parenteral administration of D22 was particularly effective in treating bacterial infections.

These studies once again confirm one of the most pressing problems related to antibiotics – the growing resistance of bacteria. Misuse of antibiotics, particularly self-medication, contributes significantly to resistance development. As a result, the effectiveness of existing antibiotics decreases, complicating infection treatment.

The rising threat of bacterial resistance underscores the urgent need for the discovery and development of new antibiotic compounds. Researchers are actively working to create new molecules, more effective drug formulations, and innovative methods of combating infections.

The high efficacy of D22 highlights its potential as a promising approach in this direction.

Conclusion.

The findings demonstrate that antibiotics remain the primary therapeutic tool in treating bacterial infections. However, preserving their effectiveness directly depends on rational and responsible use. The misuse of antibiotics accelerates resistance development, creating serious obstacles to effective treatment.

Therefore, developing new antibiotic compounds, introducing targeted and individualized therapeutic approaches, and seeking innovative strategies to fight infections are among the key priorities of modern medicine. These measures not only help preserve the long-term therapeutic efficacy of existing antibiotics but also provide a foundation for shaping new treatment strategies.