Abstract

Bacteria belonging to family *Enterobacteriaceae* such as *Salmonella* and *Escherichia coli* in the natural environment form biofilms, i.e. spatial multicellular structures of microorganisms adhered to abiotic solid surfaces or the surface of cells of higher organisms. Apart from adhesion to the substrate, function of biofilm is protection of microorganisms against adverse external factors, including antimicrobial agents. This feature of biofilm results in difficulties in bacterial combating

Bacteriophages are viruses capable of multiplying within bacterial cells. Due to the ability to infect only bacteria cells belonging to one species or even a single strain of bacteria, they can be used against very specific group of microorganisms. Bacteriophages are mentioned as a method of combating bacteria of food origin, especially pathogens, whose source is food, showing the ability to create sessile forms, so phages can be used to remove bacteria from these structures formed on food and on devices used in the food production process and to combat bacteria dangerous to humans, including highly resistant to chemotherapeutic agents.

Salmonella Enteritidis in humans causes salmonelosis, one of the most common zoonotic diseases. The main source of infection by this pathogen is the consumption of contaminated food, mostly contaminated poultry products such as meat and eggs. *Salmonella* is able to survive on poultry farms, plant surfaces and on the surfaces of machinery in the food production industry due to its ability to form a biofilm. The aim of this study was to use the UPWr_S1-5 bacteriophages and the UPWr_S134 bacteriophage cocktail to eradicate *Salmonella* Enteritidis biofilm formed in *in vitro* and *in vivo* conditions on surfaces such as polypropylene, steel or lettuce leaves.

In this study a significant effectiveness of both single UPWr_S1-5 bacteriophages and a cocktail of bacteriophages in combating the biofilm formed by *Salmonella* Enteritidis on the surface of polypropylene, stainless steel and the surface of lettuce leaves was indicated. In addition, the effectiveness of these bacteriophages in combating biofilms has been demonstrated even at significant dilutions of their suspensions.

The next stage of the research was the use of the UPWr_S134 bacteriophage cocktail to combat the biofilm formed by *Salmonella* on poultry drinkers in laboratory conditions and to eliminate these pathogens from the multispecies biofilm present on poultry drinkers during chicken breeding. *In vitro* studies have shown a consistent reduction in the number of pathogens present on the surface of the drinkers. Hovever, in farming conditions, the complete elimination

of *Salmonella* from the biofilm present on the poultry drinkers was demonstrated. This indicates a great application potential of the UPWr_S134 bacteriophage cocktail in the poultry industry.

Avian pathogenic *Escherichia coli* (APEC) posess the ability to infect chickens, causing colibacillosis, a disease syndrome that is a significant threat to the health and life of not only poultry, but also could be a potential source of antibiotic resistance genes that can be transferred to human pathogens, also for human health . These pathogens are the source of significant economic losses in the production industry. Like *Salmonella*, avian pathogenic *E. coli* is able to form a biofilm, which results in its increased ability to survive on poultry farms, plant surfaces, machine surfaces and poultry carcasses. The aim of this study was to use UPWr_E1-4 bacteriophages and a bacteriophage cocktail UPWr_E124 to combat APEC strain in biofilm formed on the surface of polypropylene, steel, lettuce leaves and poultry meat.

The effectiveness of the UPWr_E1-4 bacteriophage and the UPWr_E124 bacteriophage cocktail in combating the biofilm created by avian pathogenic *E. coli* on biotic and abiotic surfaces was demonstrated. The results of analyzes of the use of suspensions of these bacteriophages in preventing the development of these pathogens on the surface of poultry meat in refrigeration conditions additionally indicate the potential application of UPWr_E1-4 bacteriophages in limiting the growth of *Escherichia coli* on the surface of stored meat.

The results obtained in this study indicate the possibility of effective use of the UPWr_S1-5 and UPWr_E1-4 bacteriophages in combating the biofilm formed by two pathogenic bacteria: *Salmonella* Enteritidis and *Escherichia coli*, respectively.