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A mini review of the importance of bacteriophages in animal health

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***Abstract*— This review talks about the importance of bacteriophages in animal health, highlighting their role as natural predators for bacteria. Bacteriophages, or phage, are viruses that particularly infected the bacterial cells, and provide a promising alternative way instead using traditional antibiotics for treatment bacterial infections, especially now, during the growing antibiotic resistance crisis. The review discuss molecular biology in the stages of bacteriophages, including their life cycle and transition mechanisms, which include both lytic and lysogenic pathways. Medical applications of phase therapy are investigated in the treatment infections of bacteria in livestock and pets, which emphasizes the ability of toned treatments against multi-resistant pathogens. In addition, Bacteriophage use in food security is addressed, their role in controlling food-borne pathogens without compromising favorable microbes. Overall, this review emphasizes the versatile applications of bacteriophages to increase animal health and food safety, and advocate further research and development in this promising region.**

***Keywords* — Bacteriophages, animal health, resistant pathogens, food safety.**

INTRODUCTION

A particular kind of virus called a bacteriophage (sometimes called a phage or BP) targets and infects prokaryotic organisms, such as bacteria and archaea (1). Phages, which are obligate intracellular parasites, have complex relationships with their hosts. It can inhabit bacterial communities and cause changes to their physiology, pathogenicity, diversity, and abundance, thereby modifying and shaping these communities (2). Phages, determined the most prevalent living things in the environment; furthermore, incredibly diverse and fundamentally simple. Between 1031 and 1032 bacteriophages are thought to be present at any given moment, aiding in the control of bacterial populations in natural environments worldwide (3The use of phages and antibiotics, either independently or in combination, in human and animal models has been extensively studied during the past few decades. Additionally, phage–antibiotic synergy—the mechanism by which antibiotics induce bacterial hosts to create phages—has been demonstrated. (4).

Recent studies on phage molecular biology have fueled several biotechnological applications across a variety of fields, including the creation of vaccines, medical administration, bacterial detection systems, novel antibiotic medications to combat antibiotic-resistant bacteria, etc. The usage of bacteriophages is another potential use (5). Taking into consideration to prevent the same error made with antibiotics, which resulted in potential phage resistance (6).

BACTERIOPHAGE LIFE CYCLE

Because they lack their own metabolism, bacteriophages are entirely dependent on the resources of their bacterial hosts to absorb the protein and energy produced in order to multiply (7). typically, bacteriophage replication cycles are separated from their bacterial hosts by four steps: connection, infection, multiplication, and emissions (liberation) (8).

Only when certain receptors are present on the phage's surface can it adhere to the bacterial host cells during the attachment phase. the virus enters the host receptor by random diffusion. because the phage genetic material reaches the host cell via an injection-like process, the infection phase comes after attachment (9). the phage species determines when the multiplication phage starts after infection. it is commonly known that in order to build their phage progeny inside the bacteria, pathogenic bacteriophages require the replication machinery of the bacteria. the synthesis of several copies of those new phages until a critical mass is reached causes the semipermeable membrane of the bacterium to lyse, releasing the new phage progeny to resume the lytic cycle (10). this critical mass is frequently determined by the strain of bacteria infected by the virus, the environment in which the bacteriophage-bacteria interaction occurs, and other factors (11). phage lytic enzymes, often referred to as endolysins or lysins, play a critical role in the degradation of bacterial peptidoglycan during the last stage of the lytic cycle. additionally, certain filamentous-shaped phages can escape the host cell by extruding their cell membranes without causing the host to die (12). however, it has been discovered that lysogenic phages, also referred to as prophages, incorporate the host's genetic material. this is the outcome of a biological process that transfers genetic information vertically to the virus for the daughter phages. viral genes and proteins can also be expressed. instead of integrating into the chromosome inside the host bacteria cells, the lysogenic phage genetic material occasionally stays as a distinct plasmid, allowing it to survive from one bacterial generation to the next (13). induction is an internal or external stresses like chemicals can cause the cycle to alter from lysogenic to lytic (14).

THERAPEUTIC APPLICATIONS

1- Phage Therapy

Bacteriophage treatment, also known as phage therapy, bacteriophage, or phage, refers to a method of treating bacterial illnesses by means of viruses that proliferate within bacterial cells. It is thought to be a potential treatment for illnesses brought on by harmful microorganisms (15). Such treatment should be considered especially during antibiotic-resistance crises, which are brought on by the existence of bacterial strains known as multidrug resistant bacteria (MDR) that are resistant to most, if not all, of the available medicines (16). Particularly, during this area where antibiotic usage had become mostly abused, resulting in a great danger. Infections that mostly affect cattle and rams have been effectively treated using phage therapy (17). Phage can be designed to goal specific bacterial strains, so that the development of special treatment for animals infected with specialized pathogens. Thus, Phage, bacterial host and animal spectacle have a tripartite difference that affects both health and disease states (18).

Phage therapy has been shown to be a successful treatment for bacterial infections in pets, and cattle at multiple levels (19). The ability of bacteriophages to multiply at the site of infection is another benefit. They have little or no negative effects and they are determined harmless to human and animal's host (20). Even if there are still obstacles to overcome, phage therapy integration into clinical practice requires constant research, technical development, and teamwork. This might transform the way bacterial illnesses are treated and help solve the worldwide antibiotic resistance dilemma (21).

2- Commercial Bacteriophage-Based Products for the Removal OF foodborne Zoonotic Pathogens.

Foodborne illness is caused by a variety of factors, including new and emerging pathotypes, persistent contamination, antibiotic resistance, a dynamic environment, and the complexity of food production processes. Common foodborne pathogens including Salmonella, Shiga toxigenic E. coli (STEC), Campylobacter, and Listeria monocytogenes are increasingly being found in both isolated and widespread outbreaks. Preventing financial losses from tainted food product recalls and litigation, as well as improving public health and food safety, depend on controlling human diseases linked to food productsBacteriophages (phages) are an enticing extra weapon in the ongoing search for preventative strategies to improve food safety and public health (22).

Commercial bacteriophage products that have been authorized for use in food security across various nations are steadily growing in quantity. Many commercial companies throughout the world are interested in learning more about the use of bacteriophages as antibacterial tools to combat food-generated infections (23).

CONCLUSION

Bacteriophages play a major importance role in health concern and food safety. Phages are natural predators of bacteria, and therefore represent an attractive alternative way for antibiotics, particularly against antibiotic-resistant strains. They are considered quite useful in both therapeutic and food safety applications due to the ability to selectively target and lyse bacterial pathogens while sparing beneficial microbes. Phage therapies have also been used in livestock and pets as target-specific treatment against multidrug resistant bacteria (MDR). Moreover, phages are utilized for food safety by eliminating foodborne pathogens while preserving beneficial microbes. Additionally, the above discussion on bacteriophages provides a holistic view on their role and potential in animal health. Continued study and advancement in this field are essential in order to completely use of bacteriophages, paving the way for innovative solutions in animal health and beyond.

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