

## Bacteriophage as Feed Supplement for Antibiotic Replacement and Growth Promotion

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Antibiotics are the substances produced by fungus which are used to stop or to kill the growth of another living organism. Antibiotics are used mainly for treatment or prevention of diseases caused by various pathogens. In animal production system antibiotics are used at sub-therapeutic level to enhance the growth i.e., FCR (Feed Conversion Ratio) and increase productivity of the animals. Use of antibiotics as a growth promoter in animal industry was started in 1940s and estimated consumption of about 1,05,596 tons will be reached by the end of 2030 in food animal production. This prolonged and unregulated use may lead to antibiotic resisting 'Superbugs'. The AMR remained [Anti-Microbial Resistance] one of the biggest reasons of serious medical complications as well as deaths in humans. Thus, the dreadful side-effect of extra label and indiscriminate usage of antibiotic led to search of various alternatives to counter the AMR.

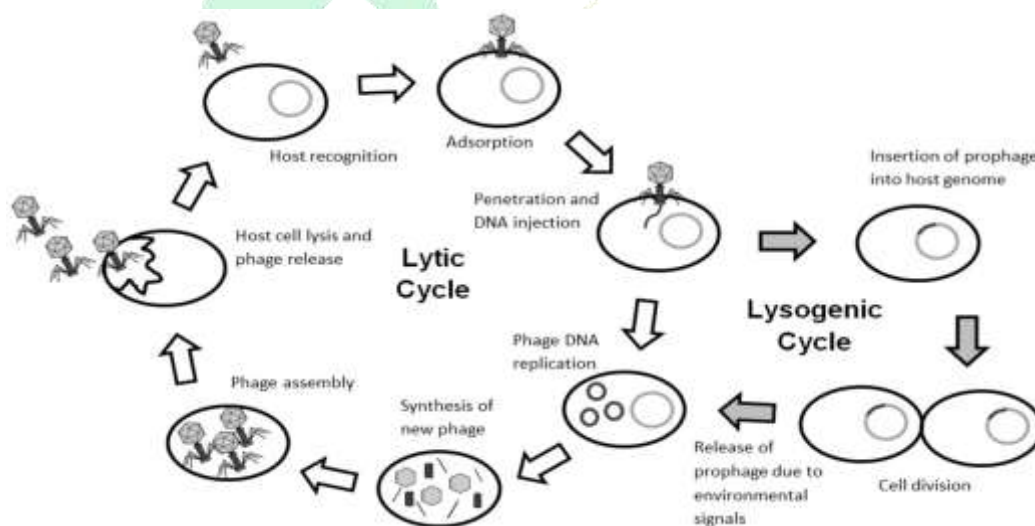
Bacteriophage are viruses that infect and kill the bacteria and replicate only in bacterial cells as they are very host specific. Phages replicate inside the bacterial cell by means of either lytic or lysogenic cycle and kill the host cell by using its genetic material and release own copies. It also inhibits the quorum sensing mechanism and avoids the formations of biofilms, minimizing pathogenicity of the bacteria. Because of this host specificity bacteriophages are emerging as an alternative to antibiotic therapy in animal production industry. Phages also offers plethora of advantages as low production cost, high specificity, used to treat MDR [Multi-Drug Resistance], no-side-effects no-residue and no-withdrawal period for animals. These attributes made phages popular in animal-based enterprises as an alternative to antibiotic growth promoters.

Many studies around the globe have reported the efficacy of phages in poultry and swine and it has been found that they have beneficial effect on egg production, egg albumin, liver weight, feed efficacy, mitigation of pathogenic bacteria and improving gut health in

poultry. For swine phages have reduced the salmonella colonization by 99%, reduced faecal microbial count and improved intestinal health. And because of these positive results many companies are launching their phage product in the market which are gaining popularity in animal feed industry.

In India, biotech industries have contributed for development of phage-based animal supplementation products as:

Thus, inclusion of bacteriophage singular or mixed formulation has shown linear improvement of broiler growth performance, egg laying quality in layers, nutrient digestibility and gut health. These products are effective in achieving more profit by sustainable- organic means and avoiding incidences of AMR, eventually safeguarding public health.



**Figure 1: Replication cycle of bacteriophage**



**Figure 2: Bacteriophage based feed supplements available in India**

**Table 1: Bacteriophage based commercial feed supplements**

Product [Manufacturer]	Target Bacteria	Route
BAFACOL [Proteon Pharmaceuticals]	Against 5 virulent strains of E. coli	oral
BAFASAL+G® [Proteon Pharmaceuticals]	Against 6 virulent strains including Salmonella Enteritidis, Salmonella Typhimurium and Salmonella Gallinarum	oral
BAFASAL® [Proteon Pharmaceuticals]	Against 4 virulent strains including Salmonella Enteritidis and Salmonella Typhimurium infection	oral
SALSHIELD [Aristogen Bioscience]	S.gallinarum, S.pullorum, S.enteritidisS. typhimurium	Spraying or oral
ESHIELD [Aristogen Bioscience]	E. coli and Salmonella.	Spraying or oral
COLISHILED [Aristogen Bioscience]	Phage Cocktail for Pathogenic E. coli.	Spraying or oral

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