(sensor protein) that regulates the expression of multiple genes important for biofilm formation (Balaban et al. 2007).

In combating mature (established) biofilms, AMPs may promote eradication of the microbial community by dispersing the cells within the biofilm after degradation of the extracellular matrix or may promote eradication by killing the cells associated with the biofilm after penetration into the extracellular matrix (Jorge et al. 2012; Di Luca et al. 2014).

20.3.2 Bacteriophage Therapy Anti-Biofilm

Bacteriophages or phages are obligate parasites that propagate in bacterial hosts and can be classified according to their life cycles, lytic or lysogenic (Maciejewska et al. 2018). For infection of a bacterial cell to occur, a phage will adhere to the surface of the host cell and then inject the viral DNA into the bacterium. Subsequently, the replication strategy will depend on whether the phage is virulent or tempered (Salmond and Fineran 2015).

Virulent phages are only able to replicate via the lytic cycle, a process involving the production of viral progeny and their release from lysis of the infected cell. In contrast, the temperate phages may enter the lytic cycle or form an association with the host, called lysogeny. During lysogeny, the viral genome is termed the prophagy and has its replication in conjunction with the host DNA. Already under stress conditions, the prophages can leave the lysogenic state and produce more virion, with subsequent release from lysis of the host cell, which results in bacterial death (Young 2013; Roach and Donovan 2015; Salmond and Fineran 2015).

Phages have been used for the treatment of bacterial infections for more than 50 years; however the appearance of strains resistant to multiple antibiotics has made this type of therapy revitalized (Wu et al. 2015). In addition, the occurrence of pathogenic bacterial strains capable of forming biofilms drew more attention to the investigation of this type of therapy, thus emerging as a valuable alternative for the treatment of bacterial infections, mainly those caused by biofilm (Hughes and Webber 2017).

In the treatment of infections associated with pathogenic biofilms, phages have unique properties that offer some advantages: they are highly specific and nontoxic, do not affect the normal microbiota, and have the capacity to improve conventional treatment (Yang et al. 2012; Casey et al. 2018).

Several experimental and clinical studies have demonstrated the effectiveness of the use of phages as well as proteins derived from phages, especially enzymes, in the fight against pathogenic biofilms (Szafrański et al. 2017). In this context, Sutherland and co-workers (2004) evidenced in their work that some phages can carry on their surface very specific enzymes that promote the degradation of the bacterial polysaccharides, promoting the destruction of the integrity of the biofilms. Son and co-workers (2010) characterized in their study