The results demonstrated that the high rate of adsorption is beneficial for colonization but it impairs production and emigration. Therefore, the low adsorption rate is more advantageous under biofilms (Gallet et al. 2009).

In the study by Kelly et al., a cocktail of phages modified to break down biofilms was developed to prevent the formation of *S. aureus* pathogenic biofilm, as well as to reduce the density of this same established biofilm. The results demonstrated that the cocktail was capable of inhibiting biofilm formation and reducing the density of the established biofilm of the aforementioned bacterium in a time-dependent manner (Kelly et al. 2012). In another study, Tinoco and co-workers(2016) modified genes of the tempered phage φE11, by genetic engineering, whose purpose was to render it incapable of lysogeny and to extend the range of host strains within the target bacterial species. From these modifications, the efficacy of the same was evaluated in the degradation of two strains of *E. faecalis* (sensitive and resistant to vancomycin). As a result, the modified phage demonstrated a significant reduction in the biofilm biomass of *E. faecalis* from both strains tested (Tinoco et al. 2016).

In summary, the development of new phages appears to bring even more advantages to the bacteriophage therapy associated with the combat of pathogenic biofilms.

20.3.3 Nanotechnology Applied to the Treatment of Pathogenic Biofilms

Over the last decade, different approaches based on nanoparticles, with specific physicochemical properties for antimicrobial activities, have been described in several studies (Kim 2016), mainly in relation to the inhibition, control, or eradication of infections related to pathogenic biofilms, either on biotic or abiotic surfaces as medical devices (Ramasamy and Lee 2016).

Pathogenic biofilm infections, as mentioned, have limitations in treatment with conventional antimicrobial agents. In this sense, nanoparticles as drug carriers, specifically antimicrobials, appear as an advantageous strategy, since they may be able to protect antimicrobial agents from enzymatic inactivation (Han et al. 2017). They may also be able to prevent electrostatic binding to biofilm matrix components, such as DNA or polysaccharides, and may release antimicrobial agents locally in an efficient, controlled, and safe manner for the reduction of systemic side effects, as well as optimization of antimicrobial efficacy (Han et al. 2017). Thus, nanoparticles as carriers can improve the bioavailability and the targeted delivery of antimicrobials (De Jong and Borm 2008). In this context, many biocompatible and biodegradable nanoparticles have been used as carriers of antimicrobials against pathogenic biofilms (Kim 2016), including liposomal nanoparticles (Zhang et al. 2010).

Liposomes consist of small spherical vesicles composed of a phospholipid bilayer that may be produced from nontoxic phospholipids (e.g. cholesterol),