alone, without endolysins, compromises the cell membrane, but is unable to destabilize the cell wall. Thus, peptidoglycan destruction, mediated by the holin-exported endolysin, is necessary for complete cell lysis.

19.5.4 Concerns About the Application of Phage to Treat Bacteria

There are some major concerns about phage therapy, phage selection, preparation, and storage. The emergence of bacterial resistance to phage is another concern of phage therapy. Although apparently innocuous, to defend the genome against parasitic DNA and to maintain fidelity of the genomes in stable ecologies, a mechanism known as clustered regularly interspaced short palindromic repeats (CRISPR) found in a wide range of bacteria is a crucial component of the immune systems of bacteria. If a viral infection threatens a bacterial cell, the CRISPR system can prevent the attack by destroying the genome of the invading virus. The CRISPR systems provide a type of defense in prokaryotes, conferring resistance to plasmid uptake and phage infections, and a barrier to horizontal gene transfer. This immunity depends on the presence of specific target-derived spacer sequences, the intervening repeat palindromes short and highly conserved, and nuclease activity encoded by the *cas* genes. Since the CRISPR system is reactive to the environment, it might play a critical role in the adaptation of the host to its surroundings and explain the persistence of particular bacterial strains in ecosystems where phages are present.

19.6 Therapy with Essential Oils

Essential oils are biologically active organic compounds produced as secondary metabolites in plants and are an intermediate or final product, produced by plants, being synthesized in different plant organs, such as sprouts, flowers, leaves, husks, branches, seeds, fruits, roots, wood, or barks. They are complex hydrophobic and volatile liquids containing alkaloids, phenols and polyphenols, flavonoids, quinones, tannins, coumarins, terpenes, lecithins, polypeptides, and saponins synthesized by different metabolic routes. They are obtained through water/steam distillation, hydrodistillation, cold pressing, extraction by solvents, and supercritical fluid extraction (clean, nontoxic, and non-residual technology producing high-quality products) often used in pharmaceutical, food, and cosmetic industry.

Essential oils have distinct biological properties, such as anti-inflammatory, soothing and sedative, digestive, antimicrobial, antiviral, antiparasitic, antioxidative, and cytotoxic properties. They have been used for thousands of years for their curative potential. Diseases such as respiratory and intestinal infections and wounds were previously treated with essential oils. In Eastern and Western civilizations, knowledge on the benefits and traditions were