The loading (and subsequent release) of biomolecules is influenced by some key parameters, including composition, synthesis method of MBGs, application type, material form, and size (particles, fibers, paste, etc.). It was observed that the increase of CaO content in the MBG formulation led to the enhancement of loading efficiency and decrease of drug-release rate and burst effect (Zhao et al., 2008b). A possible explanation provided by Zhao et al. (2008b) was that the drug molecule (tetracycline in their study) may be chelated with calcium on the pore wall, which makes it difficult to be released. Xia and Chang (2006) observed a similar trend after comparing the gentamicin loading/release kinetics of two silica-based MBGs: 77S and 58S.

Mesopore size and volume are strongly dependent on the type of surfactant used during MBG synthesis. P123 and F127 are among the block copolymer surfactants selected for this purpose. It was observed that P123-templated MBGs had a higher pore volume and specific surface area compared with F127-derived MBGs. Hence, the former material exhibited a significantly higher drug (metoclopramide)-loading efficiency (47.3%) compared with the latter one (16.6%) (Zhao et al., 2008a). Analogous conclusions were reported by Arcos et al. (2009) in the case of triclosan-loaded P123 or F127-templated MBGs (loading efficiency: 9.7% vs 9.1%); drug uptake could be further improved to 10.7% by using CTA-Br (hexadecyltrimethylammonium bromide) as a structure directing agent.

The form in which the material is produced (e.g., micro- or nanosized glass particles, macroporous scaffolds, fibers, composites, coating, injectable paste) is a third factor influencing the drug-release kinetics of an MBG-based system. In general, it was observed that the drug uptake/release ability depends on the drug access route to the mesopores during the loading phase (Baino et al., 2016a).

Besides being proposed as effective bioactive drug delivery systems, MBGs have also been recently exploited as smart platforms for the controlled release of therapeutic ionic species able to promote, for example, angiogenesis or elicit an antibacterial effect (Wu and Chang, 2014). More details about antibacterial and angiogenetic properties are discussed in Sections 2.3 and 2.4 of the present chapter.

2.3 ANTIBACTERIAL PROPERTIES

Bioactive glasses have been traditionally studied as bone fillers, in the form of dense or porous implants (particles, granules, coatings, fibers, meso-, micro-, or macroporous scaffolds) and their clinical success is mainly related to their bone regeneration properties. However, the success of the implant is not only related to the aptitude of its surface to induce bone healing. There are a variety of concurrent issues that, if well controlled, allow for faster bone regeneration. The adhesion and proliferation of bacteria on implant surfaces is a common adverse event which often leads to biofilm growth and to the development of prosthetic infections (Diefenbeck et al., 2006; Uçkay et al., 2013). This can cause septic