CHAPTER VIII
CONCLUSIONS AND RECOMMENDATIONS

Silk fibroin is biocompatible and biodegradable, and promote cell adhesion and growth. These characteristics of silk fibroin are important prerequisite properties for being used as tissue-engineering scaffolds; however, the use of silk fibroin as biomaterials alone cannot always be expected to be able to restore the morphological and physiological archetype of the desired tissue. In this present dissertation, it was focused on two possible approaches to develop silk fibroin-based biomaterials in the context of tissue engineering, i.e. (i) enhancement of the biological and physical functions of silk fibroin by blending/incorporating chitin derivatives, and (ii) the use of silk fibroin as a carrier matrix to delivery the bioactive agents.

In the case of (i), after crosslinking, the presence of CM-chitin in the blend improved both biodegradability and swelling ability of silk fibroin. Although the presence of CM-chitin did not directly affected the β-sheet structure of silk fibroin after methanol treatment, the content and hydrophobic nature of the blend were decreased as CM-chitin content increased. By the use of chitin whisker as a nanofiller, the incorporation of chitin whisker into the silk fibroin matrix not only promoted the dimensional stability but also enhanced the mechanical properties of the silk fibroin scaffolds. Moreover, the nanocomposite scaffolds exhibited the absence of the cytotoxicity as well as the promotion of cell spreading. Thus, all of these results might indicate the potential utility of this nanocomposite system for further exploration as a scaffolding material.

In the case of (ii), in order to use silk fibroin as a carrier matrix in tissue engineering applications, the charge characteristic of silk fibroin must be firstly investigated because this characteristic play an important role in controlled-release of bioactive agent such as growth factor. By varying the pH values of sorption and release media as well as using a various types of model compounds, the charge characteristic of silk fibroin shows pH-dependent properties. The strong interaction was observed when the charges of dye and silk fibroin were opposite. Not only did the charge of the fibroin chains influence the sorption and release of the charged dyes, but their hydrophobicity also affected sorption and release.

After the charge characteristic of silk fibroin has been understood, the potential use of silk fiborin as growth factor releasing scaffold would be further investigated using bFGF as a model compound. The study was conducted both *in vitro* and *in vivo*. As indicated by results above, the high affinity between silk fibroin and bFGF was based on the electrostatic interaction due to their opposite charge at a physiological pH. Under *in vitro* enzymatic degradation condition, the primary factors that governed the release profile of bFGF from the silk fibroin scaffolds were the dispersion (along the depth of the scaffold's wall) of bFGF existing in the carrier and the degradability of the scaffold. Although the bioactivity of bFGF upon *in vivo* release should be further evaluated, the sustainable release of bFGF *in vivo* might enhance the efficacy of bFGF.

Recommendation of future work was based on the successful improvement of the silk fibroin by blending with CM-chitin. This higher degradation may be applied for soft tissue such as skin. Thus, the fibroblast reponses to this blend should be further evaluated. The excellent dimensional stability and mechanical properties of the chitin whisker-reinforced silk fibroin nanocomposite scaffold may be suited for high load-bearing tissues like bone or cartilage. The nanocomposite scaffold should be further evaluated in terms of cell response using osteoblasts/chondrocytes for bone/cartilage tissue engineering.

Due to the sustainable release of bFGF by the silk fibroin scaffolds, the controlled release of bFGF may benefit for promoting the morphogenesis and organogenesis either *in vivo* regeneration of defect or *in vitro* culture of celluar construct. Thus, the incorportion of bFGF into the silk fibroin scaffold should be further investigated in terms of *in vivo* tissue regeneration or *in vitro* culture of celluar construct for bone/cartilage tissue engineering.