CHAPTER VIII
CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Fabrication of drug delivery scaffolds was successfully achieved with both the HA-Gel blends and PBSu-DCH. The as-prepared scaffolds functioned competently in roles of both a physically supportive matrix and a controlled delivery device as being investigated under the condition of bone tissue regeneration in vitro.

Scaffold made of HA-Gel blends was physically delicate since the major components are both hydrogel. Reinforcing with chitin whiskers at a distinct amount seems to individually enhance physical, mechanical or biological properties. Simultaneous improvement of all properties was found to be restricted. High portion of chitin whiskers enhances thermal stability and the resistance to biodegradation, whereas the rather low portion of chitin whiskers encourages tensile strength and compatibility for cell growth. None of any chitin whiskers portion was found to have an obvious effect on the morphology or internal architecture of the obtained scaffolds. The functionality of being an appliance for controlled release of protein can be obtained by incorporating a separate delivery device like the gelatin microspheres into the scaffold in which complex environment and synergistic functions between gelatin microspheres and scaffold could be established and sustained release of bone protein was evidently achieved. Regarding such design, many factors should be concerned particularly type of gelatin and the preparative pH which influences greatly on size of the as-prepared microspheres, surface charge or the zeta potential, swelling ability and encapsulation capability of the crude bone protein. Though sustained release of bone protein was exhibited in the microspheres integrated HA-Gel blend scaffold, the releasing kinetic parameters demonstrated that scaffold played major role of the evidence. Therefore, on the basis of polyion complexation, the ionic interaction between molecules of bone protein and gelatin in the microspheres was not accomplished by direct diffusion of the protein into gelatin microspheres. On the contrary, sustained release of protein as modeled by BSA-Rhod was achieved by directly mix with gelatin during the process of microspheres

preparation, as being investigated with the porous scaffold of PBSu-DCH fabricated by solvent cast and particulate leaching technique.

Scaffold made of PBSu-DCH displayed proper mechanical, physical and biological properties for regenerating bone in dental root socket. All features of the porous PBSu-DCH scaffold rely on its microstructure which can be easily tailored by varying the amount of porogens. Increasing of porogens content leads to the increase of porosity, pore volume, pore size and inter-pore connectivity but induces the decrease of both scaffold's tensile and compressive strength and modulus. The PBSu-DCH scaffold is also potential in being a controlled delivery device. Active substance can be incorporated within its matrix or impregnated through a separate drug carrier like microspheres which need to be securely attached to the scaffold by flexible matrix of HA-Gel as demonstrated in this thesis. Advantage of the latter design is that controlled release of protein can be achieved by tailoring the proportion of HA-Gel matrix which is effective in PBSu-DCH scaffold with either small or large pores sizes. Mechanism of protein release was believed to be the combination of diffusion and dissolution or degradation of the carrier as observed from the releasing kinetic parameters. Based on these results, the salt-leached, porous PBSu-DCH scaffolds serve well as alternative biomaterials for bone tissue regeneration, particularly in dental sockets where load-bearing functionality is of prime concern.

8.2 Recommendations

The study of CBP release from gelatin microspheres integrated HA-Gel scaffold displayed absorption of CBP in the matrix of HA-Gel scaffold as indicated by releasing kinetic parameters. Further study should be conducted on the behavior of such scaffold as a protein carrier through its matrix, in addition to the system of a separate carrier which has been done in this thesis. Furthermore, it is also interesting to study the release characteristic of CBP in case of the direct mix with gelatin during microspheres preparation in order to enhance polyion complexation. For the extreme investigation, bioactivity of such CBP should be inspected as well.

The studies of PBSu-DCH scaffold in this thesis have been restricted to the environment of the use in dental root socket. The further study should be conducted

with purpose of other applications or other areas of the use of which properties and characteristics of scaffold need to be differently modified especially scaffold's mechanical properties, to be able to withstand higher force. The biological potential of PBSu-DCH scaffold in enhancing differentiation of bone cells should also be further confirmed both in vitro and in vivo.