CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

In this research work, ultra-fine poly(L-lactic acid) fiber mats were successfully prepared by electrospinning process under a fixed electric field of 20 kV/18 cm and were developed for transdermal drug delivery system or wound dressing applications. Gallic acid, widely known for its antioxidant, anti-inflammatory, anticarcinogenic, antifungal and antityrosinase activities was added to the neat PLLA solution (10% w/v in 7:3 v/v DCM/DMF) at 40 wt.% (based on the weight of PLLA powder). Both the neat and the gallic acid-containing PLLA solutions were fabricated into ultra-fine fibers by e-spinning process. The obtained fibers were smooth. No evidence of any kind of aggregate was observed on the surface of the gallic acid-loaded PLLA fibers. The water retention behavior of gallic acid-loaded PLLA fiber mats in the acetate buffer, the citrate-phosphate buffer and the normal saline increased with an increase in the submersion time and the property value in the normal saline was the greatest, followed by those in the citrate-phosphate and the acetate buffer solutions, respectively. Almost all of gallic acid contained in the spinning solutions [i.e., 40 wt.% (based on the weight of PLLA powder), which is equivalent to 28.57% (based on the weight of the obtained e-spun fiber mats)] was retained within the obtained fibers (i.e., 86 to 95% on average, measured in three different media). The cumulative release of gallic acid was the greatest in the normal saline, followed by those in the citrate-phosphate and the acetate buffer solutions, respectively. Moreover, the free radical scavenging ability of the as-loaded gallic acid, as determined by the DPPH assay, remained high at 85.4%.

The development of the e-spun fimer mats for cell/tissue culture based on the use of biodegradable and biocompatible synthetic or natural polymers has been emphasized. Notwithstanding, its hydrophobicity often leads to unfavorable cell adhesion and growth. Therefore, the cytocompatibility of PLLA should be improved. These PLLA e-spun fiber mats were used as to immobilize caffeic acid on the surface for the purpose of improving cytocompatibility. The XPS confirmed that

caffeic acid was immobilized in the surface of PLLA e-spun fiber mats, while the water contact angle of the caffeic acid-immobilized PLLA fiber mats were more hydrophilic than these of the neat PLLA fibers. The potential for use of these modified PLLA fiber mats as wound dressings was first assessed by cytotoxicity evaluation with human dermal fibroblasts (HDFa) and mouse fibroblasts (L929), and it was found that both the neat and the modified PLLA e-spun fiber mats released no substances in levels that were harmful to these cells. Among the various modified PLLA fiber mats, the caffeic acid-immobilized PLLA fiber mats showed the greatest ability to support cell attachment and proliferation.

Phyto-chemical substances extract from from the plant *Eupatorium adenophorum* Spreng., commomly used in traditional medicine as antimicrobial activity, were loaded into these gelatin-based matrices in order to enhance the wound healing and antimicrobial property of the dressing. The swelling and weight loss behavior of these hydrogels were depended on the *E.adenophorum* emulsion content. The potential to use the emulsion-containing gelatin hydrogels as wound dressing was assessed on investigation the release characteristics of the as-loaded hydrogels, antimicrobial activity by using agar disk diffusion methods. The result showed that *E. adenophorum* essential oil and the emulsion-loaded inhibited the growth of the test pathogens. With all of the obtained results, it can be concluded that the gelatin-based hydrogels have high potential to be developed as the active wound dressings. In addition, the mangosteen extract-loaded polyacrylonitrile fiber mats were fabricated and demonstrated a convenient procedure and the potential to develop antimicrobial and anti-tuberculosis properties of electrospun fibrous membranes containing *G. mangostana,* which are beneficial in filtration applications for respirator, face mask, and air conditioning filter.

7.2 Recommendations

There are many factors which related to improve wound healing such as antimicrobial and antioxidant properties. In fact, no single herbal substances are suitable for the management of all wounds. In addition, to improve the mechanical

properties and promote wound healing, the development of composite dressing composes of electrospun fiber and hydrogels is challenging.

Besides the chemical methods for the production, the gelatin hydrogels can be also produced by using the radiation technique that can combine the formation and sterilization of the product in a single technological step.

In case of the antioxidant activity studied, given the importance of ROS and reactive nitrogen species in physiology and pathophysiology, it has become essential methods be measured the ROS formation in order to quantify the levels of these molecules in cells and tissue. In addition, the potential for use of the obtained electrospun and hydrogels as wound dressing or skin regeneration applications should be further investigated in vivo or in an animal study.