CHAPTER V

CONCLUSION AND RECOMMENDATION

V.1. Conclusion

Variables of concentration and temperature of NCC synthesis process through acid hydrolysis have been studied. The optimum variables condition in acid hydrolysis are 60%wt of sulfuric acid and 30˚C of temperature.

NCC from *Cerbera manghas* characterization have been done by FTIR and SEM as shown in the literature. NCC-chitosan composite was suitable for amoxicillin drug delivery system. In the adsorption process, three types of composite ratio reached equilibrium quantity of drug in three hour. The increase of chitosan amount in the composite decreased its adsorption capability. Whilst the increase of chitosan delayed desorption rate of the drug until 9.5 hours.

V.2. Recommendation

NCC-Chitosan composites have been shown suitable for amoxicillin drug carrier. Although, the amount of drug adsorbed and desorbed at each equilibrium state are still low. Further research and characterization of NCC-Chitosan composite are recommended to increase the adsorption capabilities and to characterize the muco-adhesivity of the composite in human intestines.

REFERENCES

AKHLAGHI, S. P., BERRY, R. C. & TAM, K. C. 2013. Surface modification of cellulose nanocrystal with chitosan oligosaccharide for drug delivery applications. *Cellulose,* 20**,** 1747-1764.

BODDU, V. M., ABBURI, K., RANDOLPH, A. J. & SMITH, E. D. 2008. Removal of Copper (II) and Nickel (II) Ions from Aqueous Solutions by a Composite Chitosan Biosorbent. *Separation Science and Technology,* 43**,** 1365-1381.

DE MESQUITA, J. P., DONNICI, C. L. & PEREIRA, F. V. 2010. Biobased nanocomposites from layer-by-layer assembly of cellulose nanowhiskers with chitosan. *Biomacromolecules,* 11**,** 473-80.

ELAZZOUZI-HAFRAOUI, S., NISHIYAMA, Y., DUBREUIL, F., PUTAUX, J.-L. & ROCHAS, C. 2008. The Shape and Size Distribution of Crystalline Nanoparticles Prepared by Acid Hydrolysis of Native Cellulose. *Biomacromolecules,* 9**,** 57-65.

GONG, K., DARR, J. A. & REHMAN, I. U. 2006. Supercritical fluid assisted impregnation of indomethacin into chitosan thermosets for controlled release applications. *Int J Pharm,* 315**,** 93-8.

HABIBI, Y., LUCIA, L. A. & ROJAS, O. J. 2010. Cellulose Nanocrystals: Chemistry, Self-Assembly, and Applications. *Chemical Reviews,* 110**,** 3479-3500.

HANDOKO, T., SUHANDJAJA, G. & MULJANA, H. 2012. HIDROLISIS SERAT SELULOSA DALAM BUAH BINTARO SEBAGAI SUMBER BAHAN BAKU BIOETANOL. *Jurnal Teknik Kimia Indonesia,* 11**,** 26-33.

HASHIN, Z. 1983. Analysis of Composite Materials -- A Survey. *Journal of Applied Mechanics,* 50**,** 481-505.

HO, Y. S. & MCKAY, G. 1999. Comparative sorption kinetic studies of dye and aromatic compounds onto fly ash. *Journal of Environmental Science and Health, Part A,* 34**,** 1179-1204.

IGUCHI, M., YAMANAKA, S. & BUDHIONO, A. 2000. Bacterial cellulose—a masterpiece of nature’s arts. *Materials Science,* 35**,** 261-270.

JACKSON, J. K., LETCHFORD, K., WASSERMAN, B. Z., YE, L., HAMAD, W. Y. & BURT, H. M. 2011. The use of nanocrystalline cellulose for the binding and controlled release of drugs. *Int J Nanomedicine,* 6**,** 321-30.

KAETSU, L., YOSHIDA, M., ASANO, M., YAMANAKA, H., IMAI, K., YUASA, H., MASHIMO, T., SUZUKI, K., KATAKAI, R. & OYA, M. 1987. BIODEGRADABLE IMPLANT COMPOSITES FOR LOCAL THERAPY. *journal of Controlled Release,* 6**,** 249-263.

LAM, E., MALE, K. B., CHONG, J. H., LEUNG, A. C. & LUONG, J. H. 2012. Applications of functionalized and nanoparticle-modified nanocrystalline cellulose. *Trends Biotechnol,* 30**,** 283-90.

MANDAL, A. & CHAKRABARTY, D. 2011. Isolation of nanocellulose from waste sugarcane bagasse (SCB) and its characterization. *Carbohydrate Polymers,* 86**,** 1291-1299.

PAVALOIU, R.D., STOICA, A., STROESCU, M. & DOBRE, T. 2014. Controlled release of amoxicillin from bacterial cellulose membranes. *Central European Journal of Chemistry* 12**,** 962-967.

PETER, M. G. 1995. Applications and Environmental Aspects of Chitin and Chitosan. *Journal of Macromolecular Science, Part A,* 32**,** 629-640.

PLACKETT, D. V., JACKSO, K. L. J. K. & BURT, H. M. 2014. A review of nanocellulose as a novel vehicle for drug delivery. *Nordic Pulp & Paper Researh Journal,* 19**,** 105-118.

SUI, K., LI, Y., LIU, R., ZHANG, Y., ZHAO, X., LIANG, H. & XIA, Y. 2012. Biocomposite fiber of calcium alginate/multi-walled carbon nanotubes with enhanced adsorption properties for ionic dyes. *Carbohydr Polym,* 90**,** 399-406.

WAN NGAH, W. S., TEONG, L. C. & HANAFIAH, M. A. K. M. 2011. Adsorption of dyes and heavy metal ions by chitosan composites: A review. *Carbohydrate Polymers,* 83**,** 1446-1456.

ZAHEDMANESH, H., MACKLE, J. N., SELLBORN, A., DROTZ, K., BODIN, A., GATENHOLM, P. & LALLY, C. 2011. Bacterial cellulose as a potential vascular graft: Mechanical characterization and constitutive model development. *J Biomed Mater Res B Appl Biomater,* 97**,** 105-13.

ZIMMERMANN, T., BORDEANU, N. & STRUB, E. 2010. Properties of nanofibrillated cellulose from different raw materials and its reinforcement potential. *Carbohydrate Polymers,* 79**,** 1086-1093.