

## **CHAPTER V**

### **CONCLUSION**

#### **V.1. Conclusion**

1. Synthesis of mesoporous silica nanoparticles modified with alginate has been done, this was confirmed by FTIR.
2. Modified MSN with alginate can released the curcumin optimally at pH 7.4.
3. The result of release profile showed higher concentration of alginate and greater ratio of MSN and APTES made the release profile become slow.
4. The best composition of modified MSN for deliver curcumin was sample with ratio of MSN and APTES 1.2 mg : 3.0 ml and alginate concentration of 1 mg/ml.

#### **V.2. Recommendation**

In the process of modification MSN, to drying the product faster than usual, it should be moved to another place with a larger surface, because if it is only left in the place with small surface area at room temperature, it will make drying process become longer

## REFERENCES

- AbouAitah, K. E. A., et al. (2016). "pH-controlled Release System for Curcumin based on Functionalized Dendritic Mesoporous Silica Nanoparticles." *Journal of Nanomedicine & Nanotechnology* **7**.
- Bansal, S.S., M. Goel, F. Aqil, M.V. Vadhanam and R.C. Gupta. "Advanced Drug-Delivery Systems of Curcumin for Cancer Chemoprevention." *Cancer Prev Res (Phila)*, (2012): 1158-1171.
- Daemi, H., & Barikani, M. (2012). Synthesis and characterization of calcium alginate nanoparticles, sodium homopolymannuronate salt and its calcium nanoparticles. *Scientia Iranica*, *19*(6), 2023-2028.
- Gary-Bobo, M., Hocine, O., Brevet, D., Maynadier, M., Raehm, L., Richester, S., Durand, J. O. (2012). Cancer therapy improvement with mesoporous silica nanoparticles combining targeting, drug delivery and PDT. *International Journal of Pharmaceutics*, *423*, 509-515.
- Grabovac V, Bernkop-Schnurch A. Development and in vitro evaluation of surface modified poly(lactide-co-glycolide) nanoparticles with chitosan-4-thiobutylamidine. *Drug Dev Ind Pharm*. 2007;*33*:767–774.
- Han, Y. & Ying, J. Y. 2005. Generalized Fluorocarbon-Surfactant-Mediated Synthesis of Nanoparticles with Various Mesoporous Structures. *Angewandte Chemie*, 292-296.
- Hartono, S. B., Gu, W., Kleitz, F., Liu, J., He, L. Z., Middelberg, A. P. J., Yu, C. Z., Lu, G. Q. & Qiao, S. Z. 2012. Poly-L-lysine Functionalized Large Pore Cubic Mesostructured Silica Nanoparticles as Biocompatible Carriers for Gene Delivery. *ACS NANO*, *6*, 2104-2117.
- Hartono, S. B., Hadisoewignyo, L., Yang, Y., Meka, A. K., Antaresti, & Yu, C. Z. (2016). Amine functionalized cubic mesoporous silica nanoparticles as an oral delivery system for curcumin bioavailability enhancement. *Nanotechnology*.
- Hassan, A. S., Sapin, A., Lamprecht, A., Emond, E., El Ghazouani, F., & Maincent, P. (2009). Composite microparticles with in vivo reduction of the burst release effect. *European Journal of Pharmaceutics and Biopharmaceutics*, *73*, 337-334.
- Hu, L., Sun, C., Song, A., Chang, D., Zheng, X., Gao, Y., Jiang, T. & Wang, S. 2014. Alginate encapsulated mesoporous silica nanospheres as a sustained drug delivery system for the poorly water-soluble drug indomethacin. *Asian Journal of Pharmaceutical Sciences*, *9*, 183-190.

- Jambhrunkar, S., Karmakar, S., Papat, A., Yu, M. H. & Yu, C. Z. 2013. Mesoporous Silica Nanoparticles Enhance the Cytotoxicity of Curcumin. *RSC Advances*, 4, 709-712.
- Kurayama, F., Suzuki, S., Bahadur, N. M., Furusawa, T., Ota, H., Sato, M. & Suzuki, N. 2012. Preparation of aminosilane–alginate hybrid microcapsules and their use for enzyme encapsulation. *Journal of Material Chemistry*, 22, 15405-15411.
- Lao, C.D., M.T. Ruffin IV, D. Nomolle, D.D. Heath, S.I. Murray, J.M. Bailey, M.E. Boggs, J. Crowell, C.L. Rock and D.E. Brenner. "Dose Escalation of a Curcuminoid Formulation." *BMC Complementary and Alternative Medicine*, (2006)
- Liu, J., Qiao, S. Z., Budi Hartono, S. & Lu, G. Q. 2010. Monodisperse yolk-shell nanoparticles with a hierarchical porous structure for delivery vehicles and nanoreactors. *Angew Chem Int Ed Engl*, 49, 4981-5.
- Liu, L., Yao, W., Rao, Y., Lu, X. & Gao, J. 2017. pH-Responsive carriers for oral drug delivery: challenges and opportunities of current platforms. *Drug Deliv*, 24, 569-581
- Lv, Y. J., Li, J. J., Chen, H. L., Bai, Y., & Zhang, L. K. (2017). Glycyrrhetic acid-functionalized mesoporous silica nanoparticles as hepatocellular carcinoma-targeted drug carrier. *Int J Nanomedicine*, 12, 4361-4370.
- Manzano, M., Aina, V., Areán, C. O., Balas, F., Cauda, V., Colilla, M., Delgado, M. R. & Vallet-Regí, M. 2008. Studies on MCM-41 mesoporous silica for drug delivery: Effect of particle morphology and amine functionalization. *Chemical Engineering Journal*, 137, 30-37.
- Mchugh, J., 2003, A Guide To Seaweed Industry, Food and Agric. Org. of the Un, Rome
- Meiyanto, E. 1999. Kurkumin sebagai obat kanker: Menelusuri mekanisme aksi. *Majalah Farmasi Indonesia* 10 (4): 224-236.
- Muhlen, A. Z., Schwarz, C., & Mehnert, W. (1998). Solid lipid nanoparticles (SLN) for controlled drug delivery Drug release and release mechanism. *European Journal of Pharmaceutics and Biopharmaceutics*, 45, 149-155.
- Nurrochmad, A. (2004). "Pandangan baru kurkumin dan aktivasinya sebagai antikanker." *Biofarmasi*: 75-80.
- Petchsomrit, A., Sermkaew, N., & Wiwattanapatapee, R. (2017). Alginate-Based Composite Sponges as Gastroretentive Carriers for Curcumin-Loaded Self-Microemulsifying Drug Delivery Systems. 85(1).

- Purba, E.R. and M. Martosupono. "Kurkumin Sebagai Senyawa Antioksidan." *Prosiding Seminar Nasional Sains dan Pendidikan Sains IV 3*, (2009): 607-621.
- Rahimi, H.R., R. Nedaenia, A.S. Shamloo, S. Nikdoust and R.K. Oskuee. "Novel Delivery System for Natural Products : Nano-Curcumin Formulation." *Avicenna Journal of phytomedicine*, (2016): 383-398.
- Rukmana, R. 1994. Kunyit. Penerbit: Kanisius, Yogyakarta.
- Remant, B. K. C., & Xu, P. S. (2012). Multicompartment Intracellular Self-Expanding Nanogel for Targeted Delivery of Drug Cocktail *ADVANCED MATERIAL*.
- Saif, B., C.L. Wang, D. Chuan and S.M. Shuang. "Synthesis and Characterization of Fe<sub>3</sub>O<sub>4</sub> Coated on Aptes as Carriers for Morin-Anticancer Drug." *Journal of biomaterials and Nanobiotechnology* 6, (2015): 267-275.
- Sun, L.Z., Y.Z. Wang, T.Y. Jiang, X. Zheng, H.H. Zhang, J. Sun, C.S. Sun and S.L. Wang. "Novel Chitosan-Functionalized Spherical Nanosilica Matrix as an Oral Sustained Drug Delivery System for Poorly Water-Soluble Drug Carvedilol." *ACS Applied Materials & Interfaces*, (2012): 103-113.
- Tang, F. Q., Li, L. L., & Chen, D. (2012). Mesoporous Silica Nanoparticles: Synthesis, Biocompatibility and Drug Delivery. *ADVANCED MATERIAL*, 1504-1534.
- Tiwari, G., Tiwari, R., Sriwastawa, B., Bhati, L., Pandey, S., Pandey, P., & Bannerjee, S. K. (2012). Drug delivery system: An updated review. *Int J Pharm Investig*, 2 - 11.
- Tønnesen, H.H. and J. Karlsen. "Alginate in Drug Delivery System." *Drug Development and Industrial Pharmacy*, (2002): 621-630.
- Yanzhuo Zhang, J. W., Xiayou Bai, Tongying Jiang, Qiang Zhang and Siling Wang (2012). "Mesoporous Silica Nanoparticles for Increasing the Oral Bioavailability and Permeation of Poorly Water Soluble Drugs " *Molecular Pharmaceutics* 9.