

## **BAB V**

### **KESIMPULAN & SARAN**

#### **V.1. Kesimpulan**

Dapat disimpulkan dari hasil percobaan yang ada, bahwa :

- Pembuatan *Mesoporous silica nanoparticle* jenis IBN-2 menggunakan bahan seperti surfaktan F127 dan FC4, untuk bahan dasar silikanya digunakan TEOS. Sedangkan, untuk memperbesar pori-pori dari IBN-2 digunakan TMB.
- Dari kedua metode yang dilakukan, metode kedua lebih menunjukkan perbedaan yang signifikan dari ketiga pH yang berbeda dibandingkan dengan metode pertama.
- Dengan konsentrasi kitosan 0,05% dihasilkan persen kumulatif kurkumin tertinggi sekitar 6,8% pada pH 2,5.

#### **V.2. Saran**

Pada proses modifikasi MSN dengan menggunakan kitosan, untuk mendapatkan hasil yang maksimal sebaiknya dikeringkan dengan menggunakan cawan petri untuk membantu pelarut lebih mudah menguap, dikarenakan jika hanya dibiarkan pada udara terbuka namun tempat yang digunakan luas permukaan tidak cukup besar, dibutuhkan proses pengeringan yang terlalu lama.

## DAFTAR PUSTAKA

- Aggarwal., Bharat, B., Kumar, A., Manoj, S., Shishodia, S. & Aggarwal, M. S. 2005. Curcumin Derived from Turmeric (*Curcuma longa*): a Spice for All Seasons. 349-387.
- Ambrogi, V., Perioli, L., Marmottini, F., Giovagnoli, S., Esposito, M. & Rossi, C. 2007. Improvement of dissolution rate of piroxicam by inclusion into MCM-41 mesoporous silicate. *Eur J Pharm Sci*, 32, 216-22.
- Ansel, H. C. 2005. Pengantar Bentuk Sediaan Farmasi. IV ed. Jakarta: UI Press.
- Carmona, D., Balas, F. & Santamaria, J. 2014. Pore ordering and surface properties of FDU-12 and SBA-15 mesoporous materials and their relation to drug loading and release in aqueous environments. *Materials Research Bulletin*, 59, 311-322.
- Epstein, J., Sanderson, I. R. & Macdonald, T. T. 2010. Curcumin as a therapeutic agent: the evidence from in vitro, animal and human studies. *Br J Nutr*, 103, 1545-57.
- Fagundes, L. B., Sousa, T. G. F., Sousa, A., Silva, V. V. & Sousa, E. M. B. 2006. SBA-15-collagen hybrid material for drug delivery applications. *Journal of Non-Crystalline Solids*, 352, 3496-3501.
- Geetha K, Athira, Alummoottil, N. & Jyothi. 2014. Preparation and Characterization of Curcumin Loaded Cassava Starch Nanoparticle With Improved Cellular Absorption. *Innovare Academic Sciences*, 6, 171-176.
- George, M. & Abraham, T. E. 2006. Polyionic hydrocolloids for the intestinal delivery of protein drugs: alginate and chitosan--a review. *J Control Release*, 114, 1-14.
- Han, Y. & Ying, J. Y. 2005. Generalized Fluorocarbon-Surfactant-Mediated Synthesis of Nanoparticles with Various Mesoporous Structures. *Angewandte Chemie*, 117, 292-296.
- Hartono, S. B., Hadisoewignyo, L., Yang, Y., Meka, A. K., Antaresti & Yu, C. 2016. Amine functionalized cubic mesoporous silica nanoparticles as an oral delivery system for curcumin bioavailability enhancement. *Nanotechnology*, 27, 505605.
- Heikkila, T., Salonen, J., Tuura, J., Hamdy, M. S., Mul, G., Kumar, N., Salmi, T., Murzin, D. Y., Laitinen, L., Kaukonen, A. M., Hirvonen, J. & Lehto, V. P. 2007. Mesoporous silica material TUD-1 as a drug delivery system. *Int J Pharm*, 331, 133-8.
- 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.
- Jain, K. K. 2008. Drug Delivery System. *Methods in Molecular Biology*, 437, 1-49.
- Jambhrunkar, S., Karmakar, S., Popat, A., Yu, M. & Yua, C. 2013. Mesoporous Silica Nanoparticles Enhance the Cytotoxicity of Curcumin. 1-11.
- Li, F., Li, J., Wen, X., Zhou, S., Tong, X., Su, P., Li, H. & Shi, D. 2009. Anti-tumor activity of paclitaxel-loaded chitosan nanoparticles: An in vitro study. *Materials Science and Engineering: C*, 29, 2392-2397.
- Limnell, T., Santos, H. A., Makila, E., Heikkila, T., Salonen, J., Murzin, D. Y., Kumar, N., Laaksonen, T., Peltonen, L. & Hirvonen, J. 2011. Drug delivery formulations of ordered and nonordered mesoporous silica: comparison of three drug loading methods. *J Pharm Sci*, 100, 3294-3306.
- Lin, C. X., Qiao, S. Z., Yu, C. Z., Ismadji, S. & Lu, G. Q. 2009. Periodic mesoporous silica and organosilica with controlled morphologies as carriers for drug release. *Microporous and Mesoporous Materials*, 117, 213-219.
- 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.
- 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.
- Nguyen, T. P. B., Lee, J.-W., Shim, W. G. & Moon, H. 2008. Synthesis of functionalized SBA-15 with ordered large pore size and its adsorption properties of BSA. *Microporous and Mesoporous Materials*, 110, 560-569.
- Nugroho, A. E., Yuniarti, N., Estyastono, E. P., Supardjan. & Hakim, L. 2006. Penetapan Aktivitas Antioksidan Dehidrozingeron Melalui Penangkapan Radikal Hidroksi Dengan Metode Deoksiribosa. *Majalah Farmasi Indonesia*, 17(3), 116-122.

- Remant, B. K. C. & Xu, P. 2012. Multicompartment Intracellular Self-Expanding Nanogel for Targeted Delivery of Drug Cocktail. *Advance Material*.
- Shen, L. & Ji, H. F. 2012. The pharmacology of curcumin: is it the degradation products? *Trends Mol Med*, 18, 138-44.
- Silva, M.L., S., R.C., C., Braga, V.L., M., Fook, M.O., C., Raposo, H., L., Carvalho & Canedo, E. L. 2012. Infrared Spectroscopy - Materials Science, Engineering and Technology. *Application of Infrared Spectroscopy to Analysis of Chitosan/Clay Nanocomposites*, 43-62.
- Slowing, II, Vivero-Escoto, J. L., Wu, C. W. & Lin, V. S. 2008. Mesoporous silica nanoparticles as controlled release drug delivery and gene transfection carriers. *Adv Drug Deliv Rev*, 60, 1278-88.
- Sousa, A., Souza, K. C. & Sousa, E. M. 2008. Mesoporous silica/apatite nanocomposite: special synthesis route to control local drug delivery. *Acta Biomater*, 4, 671-9.
- Sun, L., Wang, Y., Jiang, T., Zheng, X., Zhang, J., Sun, J., Sun, C. & Wang, S. 2013. Novel chitosan-functionalized spherical nanosilica matrix as an oral sustained drug delivery system for poorly water-soluble drug carvedilol. *ACS Appl Mater Interfaces*, 5, 103-13.
- Suteewong, T., Sai, H., Bradbury, M., Estroff, L. A., Gruner, S. M. & Wiesner, U. 2012. Synthesis and Formation Mechanism of Aminated Mesoporous Silica Nanoparticles. *Chemistry of Materials*, 24, 3895-3905.
- Vadia, N. & Rajputb, S. 2011. Mesoporous Material, MCM41: A New Drug Carrier. *Asian Journal of Pharmaceutical and Clinical Research*, 4, 44-53.
- Vllasaliu, D., Exposito-Harris, R., Heras, A., Casettari, L., Garnett, M., Illum, L. & Stolnik, S. 2010. Tight junction modulation by chitosan nanoparticles: comparison with chitosan solution. *Int J Pharm*, 400, 183-93.
- Xu, W., Gao, Q., Xu, Y., Wu, D., Sun, Y., Shen, W. & Deng, F. 2009. Controllable release of ibuprofen from size-adjustable and surface hydrophobic mesoporous silica spheres. *Powder Technology*, 191, 13-20.