

BAB 5

KESIMPULAN DAN SARAN

5.1 Kesimpulan

1. Variasi konsentrasi glukomanan dan PVA secara signifikan memengaruhi karakteristik fisikokimia hidrogel berbasis sekretom sel punca, meliputi viskositas, daya sebar, waktu kering, kemampuan *swelling*, dan daya absorpsi air.
2. Formula hidrogel yang optimum diperoleh dari kombinasi glukomanan 2,3% dan PVA 8,4%
3. Berdasarkan hasil evaluasi, formula hidrogel berbasis sekretom sel punca yang telah dioptimasi menunjukkan mutu fisik yang stabil, homogen, pH yang sesuai serta memiliki elastisitas dan kemampuan menyerap air yang tinggi.

5.2 Saran

1. Untuk penelitian lanjutan, disarankan dilakukan uji efektivitas biologis secara *in vivo* pada model luka eksisi untuk membuktikan kemampuan hidrogel berbasis sekretom sel punca.
2. Perlu uji stabilitas fisik, kimia dan mikrobiologi jangka panjang terhadap formula optimum untuk memastikan kestabilan sediaan selama proses penyimpanan.
3. Untuk mengembangkan kearah aplikasi klinik, perlu dilakukan pengujian iritasi pada kulit.

DAFTAR PUSTAKA

- Alkilani, A.Z.,(2023). Topical drug delivery: Recent advances and future trends. *Frontiers in Pharmacology*, 14, 1333986.
- Alves, A., Miguel, S. P., Araujo, A. R. T. S., & Jes, D.,(2020). Xanthan Gum konjac glucomannan blend hydrogel. *Polymers*, 12(99), 1–15.
- Chen, Y., Xie, X., Zheng, Z., Chen, F., & Li, X. (2018), Hydrogels for skin wound healing: An in-depth review. *Journal of Materials Chemistry B*, 6(20), 3219-3231
- Chu, D. T., Nguyen, T. T., Tien, N. L. B., Tran, D. K., Jeong, J. H., Anh, P. G.,& Truong, D. T.,(2020). Recent progress of stem cell therapy in wound healing and hair regeneration. *International Journal of Molecular Sciences*, 21(3), 902.
- D. R. Barleany, (2023) “Hydrogel Preparation from Shrimp Shell-Based Chitosan: The Degree of Crosslinking and Swelling Study,” ASEAN J. Chem. Eng., vol. 23, no. 1, pp. 28–39,
- Dipiro JT, Yee GC, Posey LM., Haines ST, Nolin TD, Ellingrod V. (2020). *Pharmacotherapy a pathophysiologic approach 11th ed.* New York: The McGraw-Hill Companies
- Dzobo, Kevin. (2021). *Multipotent Human Mesenchymal Stem/Stromal Cells: An Updated Review on Historical Background, Recent Trends and Advances in their Clinical Applications.* 10.20944/preprints 202103. 0373.v1.
- El-Kased, R. F., Amer, R. I., Attia, D., & Elmazar, M. M. (2017). Honey-based hydrogel: In vitro and comparative in vivo evaluation for burn wound healing. *Scientific Reports*, 7(1), 1–11.
- Guo, J.,(2021). Hydrogel-based therapies for wound healing: A review of recent advances. *Materials Science & Engineering C*, 122, 111925.
- Guttner, G.C., Werner, S., Barrandon, Y., & Longaker, M.T., (2008), wound repair and regeneration. *Nature*, 453(7193), 314-321
- Hadisoewignyo L. dan Fudholi A., (2013), Sediaan Solida, Pustaka Pelajar, Yogyakarta.

- Hassan, W., Zhang, X., & Li, F. (2021). Thermosensitivity and biostability of stem cell-derived exosomes: Implications for regenerative medicine. *Cells*, 10(6), 1392.
- Ho, T. T., Nguyen, T. T., Tran, T. T., & Nguyen, D. H. (2022). Smart Hydrogels for Biomedical Applications: Recent Advances. *Gels*, 8(9), 568.
- Hu, M. S.(2018). Stem cell-based therapies for skin regeneration and wound healing. *Burns & Trauma*, 6(1), 4.
- I. Setiawan, N. Y. Lindawati, and B. Amalia, “Formulasi dan Uji Antiinflamasi Sediaan Hidrogel Ekstrak Jahe Merah,” *Media Farm. Indones.*, vol. 13, no. 1, pp. 1330–1334, 2016.
- Jaya kumar R.P. 2011. *Biomaterial Based On Chitin and Chitosan in Wound Dressing Application*.
- Karande, P., & Mitragotri, S. (2017). Enhancement of transdermal drug delivery via synergistic action of chemicals. *Advanced Drug Delivery Reviews*, 123, 62–79.
- Kusuma, G. D., Carthew, J., Lim, R., & Frith, J. E. (2020). Effect of temperature on the viability, secretome and regenerative capacity of mesenchymal stem cells. *Scientific Reports*, 10, 11002.
- Li, J., Chen, J., & Kirsner, R. (2007). Pathophysiology of acute wound healing. *Clinics in Dermatology*, 25(1), 9–18.
- Liu, Y., Meng, H., Qian, Z., Fan, Y., & Wang, D. A. (2023). Secretome-integrated hydrogel wound dressings for enhanced tissue regeneration. *Bioactive Materials*, 20, 536–550.
- Lv, Q., Wu, M. and Shen, Y., 2019. Enhanced swelling ratio and water retention capacity for novel super-absorbent hydrogel. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 583, p.123972.
- Mao, A. S., Shin, J. W., & Mooney, D. J. (2021). Effects of mechanical and chemical properties of hydrogels on stem cell behavior. *Advanced Materials*, 33(2), 2004059.
- Martin, Y.H., Lali, F.V. & Metcalfe, A.D., 2016, Modelling wound healing, in *wound healing biomaterials*. Vol 1. Elsevier, pp 151-170.

- Marwah, H., Garg, T., Goyal, A. K., & Rath, G. (2016). Permeation enhancer strategies in transdermal drug delivery. *Drug Delivery*, 23(2), 564–578.
- Nurrohmach, B., (2012), ‘Optimasi Filming Agent Polivinil Alkohol dan Humektan Gliserin dalam Formula Gel Masker Peel Off Antiacne Ekstrak Daun Kemangi (*Ocimum sanctum* L.) Aplikasi dengan Desain Faktorial’, *Skripsi, Fakultas Farmasi, Universitas Sanata Dharma, Yogyakarta*.
- Nurudhin, A., Werdiningsih, Y., Prabowo, N.A. & Sunarso, I., (2024). *Potensi terapeutik sekretom sel punca mesenkimal pada osteoarthritis lutut*. Surakarta: Tahta media group
- Pratiwi Dyah Indriyani, Tyas Prasetyaningrum, and Lisa Adhani, “Pembuatan Sediaan Gel Dari Ekstrak Herba Pegagan (*Centella asiatica* L. Urban) Sebagai Obat Luka Sayat,” *PENDIPA J. Sci. Educ.*, vol. 7, no. 2, pp. 259–264, 2023.
- Pratiwi, A. R. (2024, November 6). Pengembangan Secretome ProSTEM untuk Hasil Terapi Lebih Efektif. PT ProdiaStemCellIndonesia.<https://prostem.co.id/pengembangan-secretome-prostem-untuk-hasil-terapi-lebih-efektif/>
- Rowe, R.C., Sheskey, P.J. and Quinn, M.E., eds., 2009. Handbook of Pharmaceutical Excipients. 8th ed. London: *Pharmaceutical Press*.
- Santi., 2018, Peranan sel punca dalam penyembuhan luka, *CDK-264*, 45(5), pp. 373–379
- Setiawati, R., & Sukmawati, A. (2019). Karakterisasi Fisik dan Aktivitas Antioksidan Masker Wajah Gel Pell Off Yang Mengandung Sari Buah Naga (*Hylocerus polyrhizus*). *Pharmacon: Jurnal Farmasi Indonesia*, 15(2), 65–74.
- Shahbuddin, M., Bullock, A. J., Macneil, S., & Rimmer, S. (2014). Glucomannan-poly (N-vinyl pyrrolidinone) bicomponent hydrogels for wound healing. *Journal of Materials Chemistry B*, 2(6), 727–738.
- Sievers, J., Sperlich, K., Stahnke, T., Kreiner, C., Eickner, T., Martin, H., Guthoff, R. F., Schünemann, M., Bohn, S., & Stachs, O. (2021). Determination of hydrogel swelling factors by two established and a novel non-contact continuous method. *Journal of Applied Polymer Science*, 138(18).

- Tewary M, Shakiba N, Zandstra PW. Stem cell bioengineering: building from stem cell biology. *Nat Rev Genet* 2018;19(10):595-614.
- Tristem Medika Indonesia, n.d., Terapi berbasis protein. Diakses 15 Mei 2025.
- Vo, T.S., Vo, T.T.B.C., Tran, T.T. and Pham, N.D., 2022. Enhancement of water absorption capacity and compressibility of hydrogel sponges prepared from gelatin/chitosan matrix with different polyols. *Progress in Natural Science: Materials International*, 32(1), pp.54-62.
- Wahyuni, D. F., Mustary, M., Syafruddin, S., & Deviyanti, D. (2022). Formulasi Masker Gel Peel off Dari Kulit Pisang Ambon (Musa Paradisiaca Var): Peel off Mask Formulation from Ambon Banana Peel (Musa Paradisiacavar). *Jurnal Sains Dan Kesehatan*, 4(1), 48-55.
- Wang, P.-H., Huang, B.-S., Horng, H.-C., Yeh, C.-C., & Chen, Y.-J. (2018). Wound healing. *Journal of the Chinese Medical Association*, 81(2), 94–101.
- Wang, X., He, W., Huang, H., Han, J., Wang, R., Li, H., Long, Y., Wang, G., & Han, X. (2024). Recent Advances in Hydrogel Technology in Delivering Mesenchymal Stem Cell for Osteoarthritis Therapy. *Biomolecules*, 14(7), 858.
- Wasitaatmadja, SM., 2016, Anatomi kulit., in Djuanda, A., Hamzah, M. & Aisah, S.(eds.) *Ilmu penyakit kulit dan kelamin*. 5th ed. Jakarta: Fakultas kedokteran Universitas Indonesia, p.3
- Xu, X. (2010). Preparation and properties of konjac glucomannan/PVA blend films. *Carbohydrate Polymers*, 81(2), 305–308.
- Yang, D., Yuan, Y., Wang, L., Wang, X., Mu, R., Pang, J., Xiao, J., & Zheng, Y. (2017). A review on konjac glucomannan gels: Microstructure and application. *International Journal of Molecular Sciences*, 18(11).
- Yang, J., Vittori, N., Wang, W., Shi, Y. C., Hoefflinger, J. L., Miller, M. J., & Pan, Y. (2017). Molecular weight distribution and fermentation of mechanically pre-treated konjac enzymatic hydrolysates. *Carbohydrate Polymers*, 159, 58–65.
- Zakrzewski W, Dobrzynski M, Szymonowicz M, Rybak Z. Stem cells: past, present, and future. *Stem Cell Res Ther* 2019;10(1):68.

- Zhang, C., Liu, K., He, Y., Chang, R., Guan, F. and Yao, M., 2023. A multifunctional hydrogel dressing with high tensile and adhesive strength for infected skin wound healing in joint regions. *Journal of Materials Chemistry B*, 11(46), pp.11135-11149.
- Zhou, N., Zheng, S., Xie, W., Cao, G., Wang, L., & Pang, J., 2022, Konjac glucomannan: A review of structure, physicochemical properties, and wound dressing applications. In *Journal of Applied Polymer Science* (Vol. 139, Issue 11). John Wiley and Sons Inc
- Zhou, S., Hokugo, A., McClendon, M., Zahng., Z., Bakshi, R., Wang, L., Segovia, L. A., Rezzadeh, K., Stupp, S.I., Jarrahy, R. Bioactive peptide amphiphile nanofiber gels enhance burn wound healing. *Burns* 2019, 45, 1112–1121
- Zsikó, S., Csányi, E., Kovács, A., Budai-Szűcs, M., Gácsi, A., & Berkó, S. (2019). Methods to evaluate skin penetration in vitro. *Scientia Pharmaceutica*, 87(3), 19.