

BAB 5

KESIMPULAN DAN SARAN

5.1 Kesimpulan

1. Peningkatan konsentrasi ekstrak kering kulit jeruk lemon (*Citrus limon* L.) (5%, 7,5%, 10%) mempengaruhi hasil uji efektivitas dan mutu fisik sediaan yaitu menurunkan nilai pH, meningkatkan viskositas dan daya lekat serta menurunkan nilai daya sebar.
2. Formula dengan konsentrasi 10% ekstrak kulit jeruk lemon (formula III) memberikan efektivitas daya hambat antibakteri tertinggi, memenuhi spesifikasi uji mutu fisik, dan stabilitas sediaan yang baik.

5.2 Saran

Pada penelitian selanjutnya disarankan untuk mengembangkan sediaan gel ini menjadi produk komersial, termasuk uji klinis yang lebih luas untuk memastikan keamanan dan efektivitasnya pada berbagai tipe kulit.

DAFTAR PUSTAKA

- Abubakar, A.R. and Haque, M. 2020, Preparation of medicinal plants: basic extraction and fractionation procedures for experimental purposes, *Journal of Pharmacy & BioAllied Sciences*, **12(1)**: 1–10.
- Adamski, Z., Porowska, J.G., Sobkowska, D., Kaszuba, K., and Czajkowski, R. 2021, Acne – therapeutic challenges to the cooperation between a dermatologist and a cosmetologist, *Advances in Dermatology and Allergology*, **38(1)**: 21–31.
- Agustiani, F.R.T., Sjahid, L.R. and Nursal, F.K. 2022, Kajian literatur : peranan berbagai jenis polimer sebagai *gelling agent* terhadap sifat fisik sediaan gel, *Majalah Farmasetika*, **7(4)**: 270–282.
- Ahad, L.Z., Wahyuni, R. and Umar, S. 2020, Formulation and evaluation of plant extract gels as anti-acne: review article, *World Journal of Pharmacy and Pharmaceutical Sciences*, **9(12)**: 212–224.
- Alnabati, N.A., Al-hejin, A.M., Noor, O.S., Ahmed, M.M.M., Zeid, M.A., and Mleeh, N.T. 2021, The antibacterial activity of four Saudi medicinal plants against clinical isolates of *Propionibacterium acnes*, *Biotechnology and Biotechnological Equipment*, **35(1)**: 415.
- Amengialue, O.O., Oviasogie, E. F., Omoigberale, M. N. O., Omoregie, B. O. and Okoro, T. C. 2016, Evaluation of antimicrobial potential and phytochemical screening of *citrus lemon*, *European Journal of Advanced Research in Biological and Life Sciences*, **4(2)**: 35–42.
- Badola, A., Goyal, M. and Baluni, S. 2021, Gels and jellies a recent technology in semisolids: a review, *World Journal of Pharmaceutical Research*, **10(10)**: 461–472.
- Bakhrushina, E.O., Anuriva, M.N.,Zalvany, M.S., Demina, N.B., Bardakov, A.I., Krasnyuk, I.I. 2022, Dermatologic gels spreadability measuring methods comparative study, *International Journal of Applied Pharmaceutics*, **14(1)**: 164–168.
- Barnes, T.M., Mijaljica, D., townley, J.P., Spada, F. Ian, P.H. 2021, Vehicles for drug delivery and cosmetic moisturizers: Review and comparison, *Pharmaceutics*, **13(12)**: 1–18.
- Bellavite, P. and Donzelli, A. 2020, Hesperidin and SARS-CoV-2: new light on the healthy function of citrus fruits, *Antioxidants*, **9(8)**: 1–18.

- Bhatia, V. and Joyasar, A. 2020, Development of polyherbal anti acne gel formulation, *Journal of Pharmacognosy and Phytochemistry*, **9(2)**: 248–255.
- Bhuyan, C., Saha, D. and Rabha, B. 2021, A brief review on topical gels as drug delivery system, *Journal of Pharmaceutical Research International*, **33(47)**: 344–357.
- Brah, A.S., Armah, F.A., Obuah, C., Akwetey, S.A., and Adokoh, C.K. 2023, Toxicity and therapeutic applications of citrus essential oils (CEOs): a review, *International Journal of Food Properties*, **26(1)**: 301–326.
- Butturini, F. and Fernández, J.J. 2022, Citrus science: learn with limonene safety notes, *The European Journal For Science Teachers*, **(58)**: 1-5.
- Carli, B., 2020, *Cosmetic Formulation a Beginners Guide*, 7th ed, Institute of Personal Care Science, Coolum Beach Queensland.
- Carrer, V., Alonso, C., Pont, M., Zanuy, M., Cordoba, M., Espinosa, S., Barba, C., Oliver, M.A., and Marti, M. 2020, Effect of propylene glycol on the skin penetration of drugs, *Archives of Dermatological Research*, **312(5)**.
- Chandra, S., Sodiya, N. and Patil, S. 2022, A review on herbal gel face wash with scrub, *International Journal of Research in Engineering and Science (IJRES)*, **10(6)**: 19–30.
- Chellathurai, B.J., Anburuse, R., Alyami, M.H., Sellappan, M., Bayan, M.F., Chandrasekaran, B., Chidambaram, K., and Rahamathulla, M. 2023, Development of a polyherbal topical gel for the treatment of acne, *Gels*, **9(2)**: 1–14.
- Chilicka, K., Urbińska, I.D., Szyguła, R., Asanova, B., and Nowicka, D. 2022, Microbiome and probiotics in *acne vulgaris*—a narrative review, *Life*, **12(3)**: 1-5.
- Choi, S.S., Lee, S.H. and Lee, K.A. 2022, A comparative study of hesperetin, hesperidin and hesperidin glucoside: antioxidant, anti-inflammatory, and antibacterial activities in vitro, *Antioxidants*, **11(8)**: 14.
- Dantas, M.G.B., Reis, S.A.G.B., Damasceno, C.M.D., Rolim, L.A., Rolim-Neto, P.J., Carvalho, F.O., Quintans-Junior, L.J., da Silva Almeida, J.R.G. 2016, Development and evaluation of stability of a gel

- formulation containing the monoterpene borneol, *The Scientific World Journal*, 1-12.
- Dayan, N. 2017, *Handbook of Formulating Dermal Applications*, Scrivener, Beverly
- Departemen Kesehatan RI. 2000, *Parameter Standar Umum Ekstrak Tumbuhan Obat*, Departemen Kesehatan Republik Indonesia, Jakarta.
- El-Kholany, E., El-Deeb, A. and Elsheikh, D. 2022, Impact of lemon peel extract utilization on the biological values of Labneh during storage, *Egyptian Journal of Agricultural Research*, **100(4)**: 555–565.
- Gala, M., Aich, B., Bhureddy, S., Muchhala, S., Veligandla, K.C., Rathod, R., Samal, A.R., Choudhury, A.A., Kotak, B., Sethi, S., Joshi, P., Shrivastava, A. 2023, Skin moisturizing and anti-acne effect of acne moisturizer in healthy adult subjects with mild-to-moderate acne-an open label, single arm clinical study, *Cosmoderma*, **3(85)**: 1–2.
- Garg, A., Aggarwal. D., Garg, S. and Singla, A.K. 2002, Spreading of semisolid formulations, *Pharmaceutical Technology*.
- González-Mondragón, E.A., Ganoza-Granados, L.D.C., Toledo-Bahena, M.E., Valencia-Herrera, A.M., Abdala-Duarte, M.R., Camargo-Sánchez, K.A., and Mena-Cedillos, C.A. 2022, Acne and diet: a review of pathogenic mechanisms, *Boletín Medico del Hospital Infantil de Mexico*, **79(2)**: 83–90.
- Gonzalez-Pastor, R., Carrera-Pacheco, S.E., Zúñiga-Miranda, J., Rodríguez-Pólit, C., Mayorga-Ramos, A., Guamán, L.P., and Barba-Ostria, C. 2023, Current landscape of methods to evaluate antimicrobial activity of natural extracts, *Molecules*, **28(3)**: 3–4.
- Goswami, M. 2022, A brief review on topical drug delivery system and gel, *International Journal of Pharmaceutical Research and Applications*, **7(1)**: 271–276.
- Greenwood, D., Finch, R.G., Whitley, R.J., Norrby, S.R. 2010, *Antimicrobial and Chemotherapy*, 10th ed, Mc Graw Hill Company, USA.
- Gupta, A., Jeyakumar, E. and Lawrence, R. 2021, Journey of limonene as an antimicrobial agent, *Journal of Pure and Applied Microbiology*, **15(3)**: 1094–1110.
- Hasanah, R.L., Rianto, Y. and Riana, D. 2022, Identification of acne vulgaris type in facial acne images using GLCM feature extraction and

- extreme learning machine algorithm, *Journal of Sciences and Technology* , **15(2)**: 204–214.
- Harahap, I.S., Halimatussakdiah dan Amna, U. 2021, Skrining fitokimia ekstrak daun jeruk lemon (*Citrus limon* L.) dari kota Langsa, Aceh, *Jurnal Kimia Sains dan Terapan* , **3(1)**: 19–19.
- Hariadi, H., Wahyono, T., Darniadi, S., Maulana, H., Nurhadi, B., Amien, S., Karuniawan, A., Khan, A.A., Aziz, T., Alasmari, A.F. 2024, Effect of maltodextrin concentration and drying temperature on the physicochemical characteristics of Sacha inchi (*Plukenetia volubilis*) extract powder, *Italian Journal of Food Science*, **36(2)**: 74–82.
- Karim, R., Nahar, K., Zohora, F.T., Monarul Islam, Md., Bhuiyan, R.H., Jahan, M.S., Shaikh, M.A.A. 2022, Pectin from lemon and mango peel: Extraction, characterisation and application in biodegradable film, *Carbohydrate Polymer Technologies and Applications*, **4**: 2.
- Kementrian Kesehatan RI. 2017, *Farmakope Herbal Indonesia II*, Kementrian Kesehatan Republik Indonesia, Jakarta.
- Kis, N., Gunnarsson, M., Berko, S., Sparr, E. 2022, The effects of glycols on molecular mobility, structure, and permeability in stratum corneum, *Journal of Controlled Release*, **343**: 755–764.
- Szczykutowicz, M.K., Szopa, A. and Ekiert, H. 2020, *Citrus limon* (lemon) phenomenon—a review of the chemistry, pharmacological properties, applications in the modern pharmaceutical, food, and cosmetics industries, and biotechnological studies, *Plants*, **9(1)**: 1–20
- Kurokawa, I., Layton, A.M. and Ogawa, R. 2021, Updated treatment for acne: targeted therapy based on pathogenesis, *Dermatology and Therapy*, **11**: 1129–1139.
- Ladaniya, M.S. 2008, *Citrus Fruit Biology Technology And Evaluation*, Elsevier, London.
- Lieberman, H.A., Rieger, M.M. and Banker, G.S. 1996, Pharmaceutical Dosage Forms: Disperse System, 2th ed, Marcel Dekker, New York.
- Lubrizol, 2009, Neutralizing carbopol®* and pemulenTM* polymers in aqueous and hydroalcohols systems, *Technical Data Sheet*.

- Lukić, M., Pantelić, I. and Savić, S.D. 2021, Towards optimal pH of the skin and topical formulations: from the current state of the art to tailored products, *Cosmetics*, **8(3)**: 1–18.
- Marjoni, R. dan Saifuddin, I.R. 2022, *Konsep-Konsep Dasar Farmakognosi & Fitokimia*, Pustaka Baru Press, Yogyakarta.
- Mayslich, C., Grange, P.A. and Dupin, N. 2021, *Cutibacterium acnes* as an opportunistic pathogen: an update of Its virulence-associated factors, *Microorganisms*, **9(303)**: 1–15.
- Menon, A., Stojceska, V. and Tassou, S.A. 2020, A systematic review on the recent advances of the energy efficiency improvements in non-conventional food drying technologies, *Trends in Food Science and Technology*, **100**: 70–71.
- Meryem, S., Mohamed, D., Nour-eddine, C. and Faouzi, E. 2023, Chemical composition, antibacterial and antioxidant properties of three Moroccan citrus peel essential oils, *Scientific African*, **20**: 1-7.
- Metta, S., Amir, K.M., Lakshmi, M.S., Devi, P., Shruthi, K. 2023, A review: pharmaceutical gels and its types with prominence role of its drug delivery systems, *International Journal of Research and Analytical Reviews*, **10(2)**: 686–701.
- Mistry, J. and Notman, R. 2024, Mechanisms of the drug penetration enhancer propylene glycol interacting with skin lipid membranes, *Journal of Physical Chemistry B*, **128(16)**: 3885–3897.
- Mujdalipah, S., Brilianty, S.L., and Yosita, L. 2020, Pengaruh konsentrasi pelarut pada proses ekstraksi minyak atsiri dan jenis kulit lemon lokal (*Citrus limon* (L.) Burm.f.) terhadap rendemen minyak atsiri dan karakteristik sensori sabun cair, *Edufortech*, **5(1)**: 15–26.
- Nurhaslina, C.R., Bacho, S.A. and Mustapa, A.N. 2022, Review on drying methods for herbal plants, *Materials Today Proceedings*, **63(1)**: 122-139.
- Nurzyńska-Wierdak, R., Pietrasik, D. and Walasek-Janusz, M. 2023, Essential oils in the treatment of various types of acne—a review, *Plants*, **12(1)**: 1-12
- Nusa, I.M. 2020, Karakteristik teh hijau daun gaharu hasil pengeringan vakum, *Agrintech: Jurnal Teknologi Pangan dan Hasil Pertanian*, **3(2)**: 74–74.

- Poddębniak, P. and Kalinowska-Lis, U. 2024, A survey of preservatives used in cosmetic products, *Applied Sciences (Switzerland)*, **14(4)**: 1-15.
- Puspita Sari, R. and Teokarsa Laoli, M. 2019, Karakterisasi simplisia dan skrining fitokimia serta analisis secara KLT (Kromatografi Lapis Tipis) daun dan kulit buah jeruk lemon (*Citrus limon* (L.) Burm.f.), *Jurnal Ilmiah Farmasi* , **2(2)**: 59–68.
- Pyrzynska, K. 2022, Hesperidin: a review on extraction methods, stability and biological activities, *Nutrients*, **14(12)**: 1–11.
- Rafique, S., Hassan, S.M., Mughal, S.S., Hassan, S.K., Shabbir, N., Pervez, S., Mushtaq, M., and Farman, M. 2020, Biological attributes of lemon: a review, *Journal of Addiction Medicine and Therapeutic Science*, **6(1)**: 3–34.
- Ribeiro, A.D., Cardoso, M.N.A., Freire, J.C.P., Junior, E.C.F., Costa, M.M.A., Silva, P.G., Gomes, D.Q.C., Brito, E.M.M., Pereira, J.V. 2023, Antimicrobial activity of limonene: Integrative review, *Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromaticas*, **22(5)**: 581–593.
- Del Rosso, J.Q. and Kircik, L. 2024, The primary role of sebum in the pathophysiology of acne vulgaris and its therapeutic relevance in acne management, *Journal of Dermatological Treatment*, **35(1)**: 1–8.
- Roth GmbH, *Safety data sheet phyenoxyethanol*, 2021: Roth GmbH.
- Safitri, F.I., Nawangsari, D. and Febriana, D. 2021, Overview: application of carbopol 940 in gel, *Advances in Health Sciences Research*, **34**: 80–83.
- Salam, A.F. and Mostafa, F.A.A. 2014, Evaluation of antimicrobial activity and phytochemical analysis of citrus lemon, mandarin and orange peel, *J.Agric.Chem.and Biotechn*, **5(2)**: 45–53.
- Sharma, M.U., Arjariya, S., Chouksey, D.R., Sharma, D.N. 2022), A review: formulation and evaluation of pharmaceutical gel, *Journal of Pharmaceutical Negative Results*, **13(1)**: 1344–1362.
- Shaymaa, M., Mohammed, O. and Babeanu, N. 2022, Limonene - a biomolecule with potential applications in regenerative medicine, *Scientific Bulletin. Series F. Biotechnologies*, **26(2)**: 140–142.
- Shukr, M.H. and Metwally, G.F. 2013, Evaluation of topical gel bases formulated with various essential oils for antibacterial activity

- against methicillin-resistant *Staphylococcus aureus*, *Tropical Journal of Pharmaceutical Research*, **12(6)**: 877–879.
- Stuart, B., Maund, E., Wilcox, C., Seidharan, K., Sivaramakrishnan, G., Regas, C., Newell, D., Soulsby, I., Tang, K.F., Finlay, A.Y., Bucher, H.C., Little, P., Layton, A.M., and Santer, M. 2021, Topical preparations for the treatment of mild-to-moderate *acne vulgaris*: systematic review and network meta- analysis, *British Journal of Dermatology*, **185(3)**: 513.
- Susilo, B., Rohim, A. and Filayati, M.A.J. 2022, Vacuum drying as a natural preservation method of post-harvest lemon might accelerate drying duration and produce the high-quality of dried lemon slices, *Food Science and Technology*, **42**: 1–2.
- Sutaria, A.H., Masood, S. and Schlessiger, J. 2023, *Acne Vulgaris Continuing Education Activity*.
- Swarbrick, J. 2013, *Encyclopedia of Pharmaceutical Technology*, 4th ed, CRC Press, Boca Raton.
- Talon, M., Caruso, M. and Gmitter, F.G. 2020, *The Genus Citrus*, Woodhead Publishing, Duxford.
- Tamba, A.B.P. and Jusuf, N.K. 2020, The association between skin types and *acne vulgaris*, *Sumatera Medical Journal*, **3(1)**: 34–40.
- Tasman, R.S., Arisanty, A. and Stevani, H. 2023, Pengaruh penggunaan peningkat penetrasi propilen glikol terhadap laju difusi polifenol dalam gel ekstrak kulit buah naga merah (*Hylocereus polyrhizus*), *Jurnal Ilmiah Medicamento*, **9(2)**: 96–105.
- Thamkaew, G., Sjöholm, I. and Galindo, F.G. 2021, A review of drying methods for improving the quality of dried herbs, *Critical Reviews in Food Science and Nutrition*, **61(11)**: 1763–1786.
- Thapa, S., Poudel, K., Limbu, S.K., Dahal, G., and Pokhrel, S. 2022, Phytochemical screening, GC analysis and antibacterial activity of *citrus limon* peel extract and essential oil, *Journal of Nepal Chemical Society*, **43(1)**: 69–74.
- Urbain, A. and Simões-Pires, C.A. 2020, Thin-layer chromatography for the detection and analysis of bioactive natural products, *Encyclopedia of Analytical Chemistry*.

- Vasam, M., Korutla, S. and Bohara, R.A. 2023, Acne vulgaris: A review of the pathophysiology, treatment, and recent nanotechnology based advances, *Biochemistry and Biophysics Reports*, 36: 1–8.
- Wirawan, S. 2023, *Metodologi Penelitian untuk Tenaga Kesehatan*, Thema Publishing, Yogyakarta.
- Xiao, Q., Chen, G., Zhang, Y.H., Chen, F.Q., Weng, H. F., Xiao, A.F. 2021, Agarose stearate-carbomer940 as stabilizer and rheology modifier for surfactant-free cosmetic formulations, *Marine Drugs*, **19(6)**: 1–2.