

## **BAB V**

### **KESIMPULAN DAN SARAN**

#### **1.1 Kesimpulan**

1. Hasil studi literatur senyawa metabolit sekunder dari *Clinacanthus nutans* L adalah flavonoid (flavon, anthocyanin, vitexin, C-flavon glikosil), fenol (vanilin, asam galat, asam caffeic), steroid (stigmasterol, B-sitosterol), triterpenoid (lupeol, buletin) dan mengandung sulfur yaitu klinamid D, klinamid E.
2. Hasil studi literatur terhadap aktivitas farmakologi berpotensi sebagai antioksidan sedang ( $176.05 \pm 0.02\%$  dan  $IC_{50} 118,31 \mu\text{g/ml}$  DPPH radikal) dan sebagai antiproliferatif terhadap kultur sel kanker sehingga dapat digunakan sebagai alternatif pengobatan.
3. Hasil studi literatur menunjukkan korelasi antara aktivitas antioksidan, antikanker dan senyawa kimia dengan mekanisme kerja menangkap senyawa reaktif dan mendonorkan atom yang berpasangan dengan radikal bebas sehingga dapat mencegah efek dari paparan radikal bebas seperti kerusakan pada sel dan aktivitasnya sebagai antikanker dapat menghambat aktivitas, dan merusak mitokondria sel kanker dan meningkatkan pengaruh penghambatan terhadap sel kanker.

#### **1.2 Saran**

1. Penelitian selanjutnya perlu dilakukan studi literatur dari *Clinacanthus nutans* yang membahas mengenai kandungan kimia dan efek farmakologi lain yang terkandung dalam tanaman *Clinacanthus nutans*

2. Adanya sediaan herbal dari tanaman *Clinacanthus nutans* yang dirancang sebagai pengobatan alternatif dari antikanker dan sebagai antioksidan.

## DAFTAR PUSTAKA

- Aditya, D. 2009. Penelitian Deskriptif. Surakarta: Politeknik Kesehatan Surakarta.
- Akhlaghi M, Bandy B. 2009. Review article: mechanisms of flavonoid protection against myocardial ischemia reperfusion injury. *Journal Molecular and Cellular Cardiology* **46**: 309–317
- Ames, B. N., Shigenaga, M. K. 1992, *DNA Damage by endogenous oxidants and mitogenesis as causes of aging and cancer*. In: Scandalios (ed.), Molecular Biology of free Radical Scavenging Systems. Cold Spring Harbor Laboratory Press: 1-22.
- Alam A, Zaidul, Ghafoor K, Sahena F, Hakim, Raffi, MH. Bostanudin, M.F. 2017. Vitro Antioxidant and,  $\alpha$ -glucosidase Inhibitory Activities and Comprehensive Metabolite Profiling of Methanol Extract and its Fractions from *Clinacanthus nutans*. *BMC Complementary and Alternative Medicine*. Malaysia. **17(181)**: 1-10.
- Anonim”, 2012. “ Identifikasi Senyawa Bahan Alam Serta Uji Antioksidan Ekstrak Lempuyang Gajah (Zingiber zerumber), diakses tanggal 17 febuari 2014. <http://chittaputri.blogspot.com/2012/01/identifikasi-senyawa-bahan-alam-serta.html>
- Anwar, R.. 2005. Meta Analisis. Sub bagian fertilitas dan endokrinologi reproduksi bagian obstetri dan ginekologi fakultas kedokteran UNPAD Bandung [Skripsi]
- Arullapan, S., Rajamanickam P Thevar N., & Kodimani Carol C. 2014. In Vitro Screening of Cytotoxic, Antimicrobial and Antioxidant Activities of *Clinacanthus nutans* (Acanthaceae) leaf extracts. Malaysia. **13(9)**: 1455-1461
- Backer, C. A. and R.C. Backhuizen Van der Brink, 1965. *Flora of Java*. Volume III, 2nd ed., N.V.P. Noordhoff, Groningen, pp. 544, 548, 583.
- Brotosisworo, S., 1979, Obat Hayati Golongan Glikosida, Yogyakarta, Fakultas Farmasi Universitas Gajah Mada
- Chelyn, J.L., Omar, M.H., Yousof, N.S.A.M., Ranggasamy, R., Wasiman, M.I., Ismail, Z. 2014, Analysis of FlavoneC-Glycosides in the Leaves of *Clinacanthus nutans* (Burm. f.) Lindau by HPTLC and HPLC-UV/DAD, *The Scientific World Journal*, 2014(1-6).

- Cook, N. C., and Samman, S., 1996, Review Flavonoids-Chemistry, Metabolism, Cardioprotective Effect, And Dietary Sources, *J. Nutr. Biochem.*, **(7)**: 66-76.
- Cuppett, S., M. Schrepf, dan Hall III, C., 1954, ‘Natural Antioxidant – Are They Reality’, dalam Foreidoon Shadidi: *Natural Antioxidants, Chemistry, Health Effect and Applications*, AOCS Press, Champaign, Illinois, pp. 12-24.
- Cheung-Ong K., Giaever G and Nislow C., 2013. DNA-Damaging agents in cancer chemotherapy, *Chem Biol.*
- Choi C S, Yin C s, Bakar a A, et al (2006). *Nasal carriage of Staphylococcus aureus among health adults*. J Microbiol Immunol Infect. **39**: 458-64.
- DiPiro JT, Talbert RL, Yee GC, Matzke GR, Wells BG, Posey LM. (2009). *Pharmacotherapy: A Pathophysiologic Approach* 7th Ed. United States (US): McGraw-Hill Companies.
- Dewoto, H.R., 2007, Pengembangan Obat Tradisional Indonesia menjadi Fitofarmaka, *Majalah Kedokteran Indonesia*, **57(7)**: 205-211.
- Febriansah R, dan Dewayanti A. 2020. Chemopreventive Activity of *Clinacanthus nutans* L. Ethyl Acetate Fraction on Breast Cancer Cells Line. *Advances in Health Sciences Research*. Yogyakarta. **33**: 520-527
- Fessenden, R.J. dan J. S. Fessenden. 1986. “Organic Chemistry”, 3<sup>rd</sup>.ed. Wadsworth Inc., Belmont, California.
- Foh Le C, Kailaivasan Hareesh T, Chow Chuen-S, Abdullah Z, Ling Kiong-S, & Fang Mun-Chee. 2016. hytosterols isolated from *Clinacanthus nutans* induce immunosuppressive activity in murine cells. International Immunopharmacology. Kepong, Selangor, Malaysia
- Fong Y, Piva T, Dekiwadia C, Urban S, Huynh T. 2016. Comparison of cytotoxicity between extracts of *Clinacanthus nutans* (Burm. f.) Lindau leaves from different locations and the induction of apoptosis by the crude methanol leaf extract in D24 human melanoma cells. BMC Complementary and Alternative Medicine. Malaysia. **16(368)**: 1-12

- Fong Y, Wimalasari D, Piva T, Dekiwadia C, Urban S, Huynh T. 2019. Evaluation of cytotoxic and apoptotic activities of *Clinacanthus nutans* (Burm. f.) Lindau leaves against D24 human melanoma cells. journal homepage: [www.elsevier.com/locate/hermed](http://www.elsevier.com/locate/hermed). Journal of Herbal Medicine. Malaysia. 1-8.
- Farnsworth, N. R., 1966, Biological and Phytochemical Screening of Plants, *J.Pharm. Sci.*, **55** (3): 225-276.
- Ghasemzadeh A, Nasiri A, Jaafar, Bagdadi A, and Ahmad I. 2014. Changes in Phytochemical Synthesis Chalcone Synthase Activity and Pharmaceutical Qualities of Sabag Snake Grass (*Clinacanthus nutans* L) in Relation to Plant Age. Department of Crop Science, Faculty of Agriculture, University Putra Malaysia. **19**: 17632-17648.
- Hamid Abd H, Yahaya Hayati I, Yusoff M Mashitah, and Zareen Seema. 2016. Bioassay-guided Isolation and Antioxidant Activity of Sulfur containing Compounds from *Clinacanthus nutans*. Gambang Kuantan, Pahang, Malaysia. 1-5.
- Harborne, J.B., 1987, *Metode Fitokimia Penuntun Cara Modern Menganalisis Tumbuhan* Terbitan 2, diterjemahkan dari Bahasa Inggris oleh Padwinata, K., ITB, Bandung
- Haron H, Tohan Md, Abas R, Hamdan R, Azman N, Khairuddien, Arsal H. 2019. In Vitro Cytotoxic Activity of *Clinacanthus nutans* Leaf Extracts Against HeLa Cells. Malaysia. **20**(2): 601-609.
- Hutapea, J. R., 1995. *Inventaris Tanaman Obat Indonesia*, Dep Kes RI, Jakarta, 154.
- Hesse, M. 1981, *Alkaloid Chemistry*, John Wiley and Sons, Inc, New York
- Heyne, K., 1987. *Tumbuhan Berguna Indonesia*, Jilid III, Cetakan ke-I, Yayasan Sarana Warna Jaya, Jakarta, 175-179.
- Hoelz, L. b. b., Horta, B.A.C., Araujo, J.O., Albuquereque, G., Alencastro, R.B., Silva, J.F. 2010. Quantitative Structure Activity Relationships of Antioxidant Phenolic Compounds. *Journal of Chemical and Pharmaceutical Research* 2(5): 291-306.
- Ikan, R. 1969, *Natural products (A laboratory Guide)*, The Hebrew University of Jerusalem, Jerusalem
- Indrawati, Maya. 2009. Bahaya kanker bagi wanita dan pria. Jakarta: Buku Pendidikan untuk Kehidupan.

- Ismail Z, Toha Md, Muhamad M, Kamal M, Zain M, Arsal H. 2020. Antioxidant Effects, Antiproliferative Effects, and Molecular Docking of *Clinacanthus nutans* Leaf Extracts. Malaysia. **25:** 1-18.
- Khoo W, Kow A, Lee T, Tan Ping C, Shaari K, Tham L, Abas F. 2018. A Comprehensive Review on Phytochemistry and Pharmacological Activities of *Clinacanthus nutans* (Burm.f.) Lindau. Malaysia. **18(39):** 1-39.
- Kinsella, K., Taeuber., 1993, *An Aging World II*, International Population Report, Bureau of the Census, Washington DC, pp: 92-95.
- Kong, H. S., Sani A. 2018. Antimicrobial properties of the aceton leaves and stems extracts of *Clinacanthus nutans* from three different simples/ areas against pathogenic microorganism. International food research journal. Malaysia. **25(4):** 1698-1702.
- Kristio 2007. Tanaman obat Indonesia. [http://toiusd.Multiply.com/journal?&page\\_start=160](http://toiusd.Multiply.com/journal?&page_start=160). [23 Mar 2010]
- Madhavi, D.L., R.S. Singhal., Kulkarni, P.R., 1985, 'Technological Aspects of Food Antioxidants', Madhavi, S.S. Deshpande dan D.K. Salunkhe: *Food Antioxidant, Technological, Toxicological and Health Perspectives*. Marcel Dekker Inc., Hongkong, pp. 161-265.
- Matsjeh, S., 2002, *Kimia Hasil Alam Senyawa Metabolit Sekunder Tumbuhan Flavonoid, Terpenoid dan Alkaloid*, Jurusan Kimia FMIPA UGM: Yogyakarta.
- Missailidis, S., 2008. Anticancer Therapeutics. Edisi ke-1. West Sussex, UK: A Jhon Wiley & Sons, Ltd.
- Moodie, F. M. 2004. Oxidative stress and cigarette smoke alter chromatin remodeling but differentially regulate NF-KB activation and proinflammatory cytokine release in alveolar epithelial cells. The FASEB Journal 2004; **18(189):** 7-9
- Murray, R. K., Granner, D. K., & Rodwell, V. W. Biokimia Harper (27 ed). Jakarta: Buku Kedokteran EGC; 2009
- Mutazah, Rizawati H, Hamid A, Ramli M, Aluwi Mohd F, Yusoff. M. 2019. *In vitro* cytotoxicity of *Clinacanthus nutans* fractions on breast cancer cells and molecular docking study of sulphur containing compounds against caspase-3. journal homepage: [www.elsevier.com/locate/foodchemtox](http://www.elsevier.com/locate/foodchemtox). Food and Chemical Toxicology. Malaysia.
- Neal, M. J., 2005, *Medical Pharmacology at a Glance*. Erlangga, Jakarta. **5:** 46-47

- Padmawinata, K., 1995, *Kandungan Organik Tumbuhan Tinggi*, (Terjemahan dari Robinson, T. 1991. The Organic Constituents of Higher Plant, 6th ed), Penerbit ITB, Bandung.
- Pei Ying Ng, Chyen M, Hee Ng, Koh Y, Tiong L, Piu P, Tan H, Lim y, Yen Ng. 2017. *Clinacanthus Nutans* Hexane Extracts Induce Apoptosis Through a Caspase-Dependent Pathway in Human Cancer Cell Lines. *Asian Pacific Journal of Cancer Prevention*. Malaysia. **18 (4)**: 917-926
- Rahman A, Nurliyana. M.Y, Afiqah N, Osman A, Hamid M, Lila Mohd A. 2019. Antitumor and antioxidant effects of *Clinacanthus nutans* Lindau in 4 T1 tumorbearing mice. *BMC Complementary and Alternative Medicine*. Malaysia **19(340)**: 1-9
- Ramesh, Chandra, 2002. Antibacterial activity of *Curcuma longa rhizoma* extract on pathogenci bacteria. diakses mei 2014. <http://www.iisc.ernet.in/currsci/sep252002/737>.
- Robinson, T., 1995, Kandungan Organik Tumbuhan Tingkat Tinggi, Penerbit ITB, Bandung, pp 128-285.
- Salim, Z., & Munadi, E. 2017. *Info Komoditi Tanaman Obat*. Jakarta: Badan Pengkajian dan Pengembangan Perdagangan Kementerian Perdagangan Republik Indonesia.
- Simbala, H. E. I., 2009. Analisis Senyawa Alkaloid beberapa Jenis Tumbuhan Obat sebagai Bahan Aktif Fitokimia. *Pacific Journal*. **1(4)**: 489-94.
- Siswandono dan Bambang Soekardjo. 2008. *Kimia Medisinal Edisi 2*, Surabaya: Erlangga.
- Sofyan D. 2008 Inhibisi fraksi aktif daun dandang gendis (*Clinachanthus nutans*) pada pertumbuhan Saccharomyces cerevisiae sebagai uji potensi antikanker [skripsi]. Bogor: Fakultas Matematika dan Ilmu Pengetahuan Alam, Institut Pertanian Bogor.
- Souza D, Gindiri L, FORTES a, Kubica F, Endrele J, Roehrs R, Sliva M, Manfredini V, Denardin G. 2020. Phytochemical Analysis, Antioxidant Activity, Antimicrobial Activity, and Cytotoxicity of Chaptalia nutans Leaves. Brazil. pp. 1-15.
- Sulaiman Che, S.I., Basril M, Chan Wei K, Ashari Efliza S, Fard Masoumi R.H, & Ismail I. 2015. In Vitro Antioxidant, Cytotoxic, and Phytochemical Studies of *Clinacanthus nutans* L Leaf Extracts. Selangor Malaysia. **9(34)**: 861-874

- Sulaiman Che, S.I., Basril M, Chan Wei K, Ashari Efliza S, Fard Masoumi R.H, & Ismail I. 2015. In Vitro Antioxidant, Cytotoxic, and Phytochemical Studies of *Clinacanthus nutans* L Leaf Extracts. Selangor Malaysia. **11(54):** 1-11
- Suryanto dan Setiawan. 2013. Stuktur data *datawarehouse* Tanaman Obat Indonesia dan Hasil Penelitian Obat Tradisional dan Hasil Penelitian Obat Tradisional. (Seminar National Sistem Informasi Indonesia).
- Shim, S Y, Aziana I & Khoo, B Y, 2012, Perspective and insight on *Clinacanthus nutans* Lindau in traditional medicine, International journal of integrative biology. Malaysia. **14(1):** 7-9
- Topcu T, Ertas A, Kolakb U, Öztürk MULubelen A. 2007. Antioxidant activity tests on novel triterpenoids from *Salvia macrochlamys*. ARKIVOC **7:** 195-208.
- Thongchai S et al. 2008. Anti-herpes simplex virus type 1 activity of crude ethyl acetate extract derived from leaves of *Clinacanthus nutans* Lindau. J Sci Technol **27:** 318-326.
- Tsiapara AV, Jaakkola M, Chinou I, Graikou K, Tolonen T, Virtanen V, Moutsatsou P. 2009. Bioactivity of Greek honey extracts on breast cancer (MCF-7), prostate cancer (PC-3) and endometrial cancer (Ishikawa) cells: profile analysis of extracts. Food Chemistry. **116(3):** 702 709
- Wanikiat P, Panthong A, Sujayanan P, Y, Yoosool C, Rossi AG, Reutrakul V. 2008. The antiinflamatory effects and the inhibition of neutrophil responsiveness by *Barleria lupulina* and *Clinacanthus nutans* extracts. J Ethnopharmacol. **116:** 234-244.
- White, P.J. and Y. Xing. 1954, *Antioxidants from Cereals and Legumes dalam Foreidoon Shahidi: Natural Antioxidants, Chemistry, Health Effect and Applications*, AOCS Press, Champaign, Illinois, pp. 25-63.
- Widiyanti, 2006 dalam Oktaviana, 2010, Kajian Kadar Kurkuminoid, Total Fenol dan Aktivitas Antioksidan Ekstrak Temulawak (*Curcuma xanthorrhiza* Roxb.) pada Berbagai Teknik Pengeringan dan Proporsi Pelarutan, [skripsi], Fakultas Pertanian Universitas Sebelas Maret Surakarta, Surakarta.

- Yakop Fahmi, Ghafar A bd AS, Yong Keong Y, Yazan Saiful L, Hanafiah Mohamad R, Lim Vuanghoa, & Eshak Zolkapli. 2018. Silver nanoparticles *Clinacanthus Nutans* leaves extract induced apoptosis towards oral squamous cell carcinoma cell lines. Malaysia. **46:** S2, S131–S139.
- YU Qun, Li Chuan, Duan Z, Liu Bing, Duan W, and Shang F. 2017. Ultrasonic Microwave-Assisted Extraction of Polyphenols, Flavonoids, Triterpenoids, and Vitamin C from *Clinacanthus nutans*. China. **1:** 89–94
- Yusof, Z, Ramasamy, Mahmood Z, & Yaacob S. 2018. Vermicompost Supplementation Improves the Stability of Bioactive Anthonyacin and Phenolic Compounds in *Clinacanthus nutans* Lindau. Kuala Lumpur Malaysia.
- Yoosook C, Panpisutchai Y, Chaichana S, Santisuk T, Reutrakul V. 1999. Evaluation of anti-HSV-2 activities of *Barleria lupulina* and *Clinacanthus nutans*. *J Ethnopharmacol* 67:179-187.
- Yong Keong, Y., Tan Jie J, Teh Sin S, Huimah S, Ea Lian C, Chiong Siong H, & Ahmad Z. 2013. *Clinacanthus nutans* Extracts Are Antioxidant with Antiproliferative Effect on Cultured Human Cancer Cell Lines. Malaysia. **13:** 1-8.
- Zakaria ZA, Mohamed AM, Jamil NS, Rofiee MS, Somchit MN, Zuraini A, Arifah AK, Sulaiman MR. (2011). In vitro cytotoxic and antioxidant properties of the aqueous, chloroform and methanol extracts of *Dicranopteris linearis* leaves. African Journal of Biotechnology. **10(2):** 273- 282.
- Zheng, W& Wang, S Y., 2003, Oxygen Radical Absorbing Capacity of Phenolics in Blueberries Cranberries, Chokeberries, and Lingonberries, *J Agric. Food Chem*, **51(2):** 502-5

