

## REFERENCES

- Aiyer, P.V., 2005, Amylases and Their Applications, *African Journal Of Biotechnology*, Vol.4 (13), 1525-1529.
- Adisakwattana, S., Chantarasinlapin, P., Thammarat, H., Yibchok-Anun, S., 2009, A Series of Cinnamic Acid Derivatives and Their Inhibitory Activity on Intestinal  $\alpha$ -glucosidase, *Journal of Enzyme Inhibition and Medicinal Chemistry*, 24(5), 1194–1200.
- Almasdy D., Rahma F., 2018, Survei Risiko Penyakit Diabetes Melitus Terhadap Masyarakat Kota Padang, *Jurnal sains farmasi & klinis.*, 5(2), 134-142.
- Al-Trad, B., Alkhateeb, H., Alsmadi, W., Al-Zoubi, M., 2018, Eugenol Ameliorates Insulin Resistance, Oxidative Stress and Inflammation in High Fat Diet/Streptozotocin Induced Diabetic Rat, *Life Sci.*, 183-188
- Anand, D., A., V., Arulmoli, R., Parasuraman, S., 2016, Overviews of Biological Importance of Quercetin: A Bioactive Flavonoid, *Pharmacognosy reviews.*, 10(20), 84-89.
- Ariandi, 2016, Pengenalan Enzim Amilase ( $\alpha$ -Amylase) Dan Reaksi Enzimatiknya Menghidrolisis Amilosa Pati Menjadi Glukosa, *Jurnal Dinamika*, 7(1), 74-82.
- Arun, C., Duvoor, C., Reddy Dendi, V. S., Kraleti, S., Chada, A., Ravilla, R., Marco, A., Shekhawat, N. S., Montales, M. T., Kuriakose, K., Sasapu, A., Beebe, A., Patil, N., Musham, C. K., Lohani, G. P., & Mirza, W., 2017, Clinical Review of Antidiabetic Drugs: Implications for Type 2 Diabetes Mellitus Management, *Frontiers in endocrinology*, 8, 6.
- Bailey, C.J., 2004, Avandamet : Combined Metformin-rosiglitazone Treatment Againsts Insulin Resistance in Type 2 Diabetes. *Int J Clin Pract.* 58:867-76.
- Begum, A.N., Terao, J., 2002, Protective effect of quercetin against cigarette tar extract-induced impairment of erythrocyte deformability, *J Nutr Biochem.*, 265–72.
- Bendre, S.R., Rajput, J.D., Bagul, S.D., Karandikar, P.S., 2016, Outlooks on Medicinal Properties of Eugenol and its Synthetic Derivatives, *Natural Product of Chemistry and Research.*, Vol 4, 2329-6836.
- Bisswanger, H., 2014, Enzyme assays, *Perspectives in Science*, 1(1-6), 41–55.

- Carrasco H, Raimondi M, Svetaz L, Di Liberto M, Rodriguez MV, 2012  
Antifungal activity of eugenol analogues, *Influence of different substituents and studies on mechanism of action. Molecules*, 17: 1002-1024.
- Charan, R.M.R., Srinivasan, V., Selvaraj, S., Mahapatra, S.K., 2015, Eugenol: A versatile phytomedicine, *International Journal of Pharmacy and Pharmaceutical Sciences.*, 7, 35-40.
- Eck, P., 2013, Recombinant DNA Technologies in Food. *Biochemistry of Foods.*, 503–556.
- Fransisca, Kristiana, 2012, *Awas Pankreas Rusak Penyebab Diabetes*, Cerdas Sehat, Jakarta
- Geller, B.D., Dreyfus., B. W., Gouvea, J., V., Turepen C., Redish, E. F., 2014, “*Like Dissolve Like*”: Unpacking Student Reasoning About Thermodynamic Heuristics, *May 2016*, 157-160
- Gomariz, M., Blaya, S., Acebal, P., Carretero, L., 2014, Real Time UV-Visible Spectroscopy Analysis of Purple Membrane-Polyacrylamide Film Formation Taking into Account Fano Line Shapes and Scattering, *Plos One.*, 9(10).
- Griffiths, D.W., 1986, The Inhibition of Digestive Enzymes by Polyphenolic Compounds. *Nutritional and Toxicological Significance of Enzyme Inhibitors in Foods*, 509-516.
- Häckl, L.P.N., Cuttle, G., Sanches Dovichi, S., Lima-Landman, M. T., & Nicolau., 2002, Inhibition of angiotensin-converting enzyme by quercetin alters the vascular response to bradykinin and angiotensin I, *Pharmacology*, 65(4), 182-186.
- Hames, B.D., Hooper, N.M., 2000, *Biochemistry: The instant Notes*. 2<sup>nd</sup> edition, Hongkon, Springer-verlag.
- Hamden K, Keskes K, Belhaj S., 2011, Inhibitory potential of omega-3 fatty and fenugreek essential oil on key enzymes of carbohydrate-digestion and hypertension in diabetes rats, *Lipids Health Dis*, 10:226.
- Hestiana D.W., 2017, Faktor Faktor yang Berhubungan Dengan Kepatuhan Pengelolaan Diet Pada Pasien Rawat Jalan Diabetes Melitus Tipe 2 di Semarang, *Journal of Health Education*, 2(2), 2527-4252.

- Jadhav, R.m and Puchchakayala, G., 2012, Hypoglycemic and Antidiabetic Activity of Flavonoids: Boswellic Acid, Ellagic Acid, Quercetin, Rutin on Streptozotocinnicotinamide Induced Type 2 Diabetic Rats, *Int.J.Pharm.Pharm.Sci.*, 4(2), 2-7.
- Khalil, A. A., Rahman, U. ur, Khan, M. R., Sahar, A., Mehmood, T., & Khan, M., 2017, Essential oil eugenol: sources, extraction techniques and nutraceutical perspectives, *RSC Advances*, 7(52), 32669-32681.
- Kidane Y, Bokrezion T, Mebrahtu J, Mikias M, Yacob B.G., Nahom F, Oliver O.A., 2018, In Vitro Inhibition of  $\alpha$ -Amylase and  $\alpha$ -Glucosidase by Extracts from *Psidium unctulata* and *Meriandra bengalensis*, *Evidence-Based Complementary and Alternative Medicine*, (1): 1-9.
- Kishore. D., Kundu, S., Kayastha, A.M., 2012, Thermal, Chemical and pH Induced Denaturation of a Multimeric b-Galactosidase Reveals Multiple Polyherbal Formulation, *Journal of Applied Pharmaceutical Science*, 4(9), 61-65.
- Kuroda M, Mimaki Y, Ohtomo T, Yamada J, Nishiyama T, Mae T, Kishida H, Kawada T, 2012, Hypoglycemic effects of clove (*Syzygium aromaticum* flower buds) on genetically diabetic KK-Ay mice and identification of the active ingredients, *J Nat Med*, 66:394-399.
- Lakhanpal, P., Rai, D.K., 2007, Quercetin: A Versatile Flavonoid, *Int J Med Update*, (2), 22-37.
- Lana D.T., T., Chairil, A., Endang, A., 2019, Synthesis of Curcumin Analogs Under Ultrasound Irradiation for Inhibiting  $\alpha$ -amylase, *Materials Science Forum.*, 948 MSF (Scheme 1), 115-119.
- Listyo.A.B., Kusriani, D. & Fachriyah, E., 2018, Isolasi Asam Ferulat dari Daun Mindi (*Melia azedarach L.*) dan Uji Aktivitas Antioksidan, *Jurnal Kimia dan Pendidikan Kimia*, 3(1), 30-37.
- Lorian V., 1988, Difference Between In Vitro and In Vivo Studies, *Antimicrobial Agents and Chemotherapy*, 32(10), 1600-1601.
- Mnafgui.K., Kaanichy.F., Derbali.A., Hamden.K., Derbali.F., Slama.S., 2013,

Inhibition of key enzymes related to diabetes and hypertension by Eugenol in vitro and in alloxan-induced diabetic rats, *Archives of Physiology and Biology*, vol 13, 1-9.

Mohammadi, N., S., Özgüneş, H., & Başaran, N, 2017, Öjenolün Farmakolojik Ve Toksikolojik Özellikleri, *Turkish Journal of Pharmaceutical Sciences.*, 14(2), 201–206.

Nankar, R., Prabhakar, P. K., & Doble, M., 2017, Hybrid drug combination: Combination of ferulic acid and metformin as anti-diabetic therapy. *Phytomedicine*, 37, 10–13.

Oroojan, A.A, 2020, Eugenol Improves Insulin Secretion and Content of Pancreatic Islets from Male Mouse, *International Journal of Endocrinology*, 2020, 5-9.

Ozdal, T., Capanoglu, E., and Altay, F., 2013, A Review on Protein-phenolic Interactions and Associated Changes, *Food Res. Int.*, 51, 954–970.

Paiva, L. B., Goldbeck, R., dos Santos, W. D., & Squina, F. M., 2013, Ferulic acid and derivatives: Molecules with potential application in the pharmaceutical field, *Brazilian Journal of Pharmaceutical Sciences*, 49(3), 395–411.

Pernin, A., Bosc, V., Maillard, M.N., & Dubois-Brissonnet, F., 2019, Ferulic acid, and eugenol have different abilities to maintain their inhibitory activity against *Listeria monocytogenes* in emulsified systems, *Frontiers in Microbiology*, 10, 1-10.

Phabkar, P.K., Prasad, R., Ali, S., and Doble, M., 2013, Synergistics Interaction of Ferulic Acid with Commercial Hypoglycemic Drugs in Streptozotocin Induced Diabetics Rats, *Phytomedicine*, 20(6), 488-494.

Pujiyanto, S., Wijanarka., Raharja, B., Anggreini, V., 2019, Aktivitas Inhibitor  $\alpha$ -Amilase Ekstrak Etanol Tanaman Brotowali (*Tinaspora crispa* L.), *Bioma: Berkah Ilmiah Biologi.*, 21 (2), 91-99.

Sreedhar D, Virendra S.L., Manthan J., Ajay P., Prashanth M., Udupa N., 2010, Physicians Prescribing Pattern of Oral Antidiabetic Drugs, *International Journal of Research and Review*, Vol 2 (6), 32-42.

Solomon H, 2019, Medicinal Foods as Potential Therapies for Type-2 Diabetes and Associated Diseases, *Academic Press*, Massachusetts.

- Tadera, K., Minami, Y., Takamatsu, K., and Matsuoka, T., 2006, Inhibition of  $\alpha$ -Glucosidase and  $\alpha$ -Amylase by Flavonoids, *Journal of Nutritional Science and Vitaminology*, 52(2), 149-153.
- Tallarida, R.J., 2011, Quantitative Methods for Assessing Drug Synergism, *Genes & Cancer*, 2(11), 1003-1008.
- Tandra, H., 2013, *Life Healthy with Diabetes*, Rapha Publishing, Yogyakarta.
- Tazkiah, N.P., Rosahdi, T.D., Suproadin, A., 2019, Isolasi dan Karakterisasi Enzim Amilase dari Biji Nangka (*Artocarpus heterophyllus*), *Al-kimiya*. 4(1), 17-22.
- Triono, S., 2005, Mempelajari Kompleks Amilosa-Iodium dan Amilosa Asetat dari Umbi Talas menggunakan Spektrometer, *Tesis*, Jurusan Kimia FMIPA UGM, Yogyakarta.
- Utami, S. W., Sudarma, I.M., Hamdin, C.D., 2019, Efek Pemberian Eugenol Isolat Bunga Cengkeh (*Syzygium aromaticum*) terhadap Histologi Pankreas Tikus Diabetes, *Jurnal Ilmu Kefarmasian Indonesia*, 17(2), 160.
- Weiss, J., Loeffler, M., & Terjung, N., 2015, The antimicrobial paradox: why preservatives lose activity in foods, *Current Opinion in Food Science*, 4, 69–75.
- Zubin P., Goldenberg, R., & Katz, P., 2018, Definition, Classification and Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome. *Canadian Journal of Diabetes*, 42, S10–S15.
- Zduńska, K., Dana, A., Kolodziejczak, A., & Rotsztejn, H., 2018, Antioxidant properties of ferulic acid and its possible application, *Skin Pharmacology and Physiology*, 31(6), 332–336.
- Zheng, Y., Tian, J., Yang, W., Chen, S., Liu, D., Fang, H., Zhang, H., & Ye, X., 2020, Inhibition mechanism of ferulic acid against  $\alpha$ -amylase and  $\alpha$ -glucosidase. *Food Chemistry*, 317, 126346.



**Determining the Synergy of Eugenol-Ferulic Acid as Antidiabetic Agents as Determined by  $\alpha$ -Amylase Assay**

ISHMAEL AMANDRIKA, 1. Prof. Dr. Chairil Anwar and Mr. Respati Tri Swasono, S.Si, M.Phil., Ph.D.  
Universitas Gadjah Mada, 2021 | Diunduh dari <http://etd.repository.ugm.ac.id/>