

BAB 5

KESIMPULAN DAN SARAN

5.1 Kesimpulan

Berdasarkan hasil penelitian yang dilakukan mengenai pengujian potensi antiglikasi asam amino sistein dengan metode enzimatik menggunakan glukometer, maka dapat disimpulkan hal-hal sebagai berikut:

1. Metode enzimatik menggunakan glukometer terbukti dapat digunakan untuk mengukur kadar glukosa dan mengevaluasi aktivitas antiglikasi melalui penurunan kadar glukosa selama proses inkubasi.
2. Asam amino sistein tidak menunjukkan penurunan kadar glukosa yang signifikan selama masa inkubasi sehingga tidak terbukti memiliki efek antiglikasi dalam kondisi uji ini.

5.2 Saran

Berdasarkan dari hasil penelitian dan kesimpulan yang telah dilakukan, disarankan agar pada penelitian selanjutnya dilakukan optimasi kondisi inkubasi, khususnya pada suhu dan lama waktu, untuk menjaga kestabilan asam amino sistein agar tidak mengalami oksidasi dan degradasi. Perlu dilakukan variasi konsentrasi sistein dan penggunaan pelarut atau *buffer* berbeda untuk mengevaluasi potensi antiglikasi sistein secara lebih menyeluruh. Dapat dipertimbangkan penggunaan metode analisis tambahan seperti spektrofotometri atau kromatografi untuk memperkuat hasil identifikasi aktivitas antiglikasi.

DAFTAR PUSTAKA

- Abbas, G., Harrasi-Al, A.S., Hussain, H., Hussain, J., Rashid, R. and Choudhary, M.I. 2015, Antiglycation Therapy: Discovery of Promising Antiglycation Agents for the Management of Diabetic Complications, *Pharmaceutical Biology*, **54(2)**: 198-206.
- Abdullah, A., Nurjanah., Hidayat, T. dan Yusefi, V. 2013, Profil Asam Amino dan Asam Lemak Kerang Bulu (*Anadara antiquata*), *Masyarakat Pengolahan Hasil Perikanan Indonesia*, **16(2)**: 159-160.
- Ahmad, R., Sah, A.K. and Ahsan, H. 2016, Biochemistry and Pathophysiology of Glycation of DNA: Implications in Diabetes, *Archives of Clinical and Biomolecul Research*, **1(1)**: 32-33.
- Aliza, N. 2020, Efek Kombinasi *Platelet Rich Plasma*, *Fibroblast Growth Actor*, Ekstrak Etanol Buah Okra terhadap Penurunan Kadar Glukosa Darah Mencit, *Skripsi*, Sarjana Farmasi, Sekolah Tinggi Farmasi Indonesia, Perintis Padang.
- Arif, B., Arif, Z., Ahmad, J., Perveen, K., Bukhari, N.A., Ashraf, J.M., Moinuddin. and Alam, K. 2022, Attenuation of Hyperglycemia and Amadori Products by Aminoguanidine in Alloxan Diabetic Rabbits Occurs via Enhancement in Antioxidant Defenses and Control of Stress, *Plos One*, **17(1)**: 1-12.
- Berlian, V., Frethernety, A., Permatasari, S., Alexandra, F.D. dan Widayati, R. 2024, Potensi Antiglikasi Ekstrak Etanol Batang Bajakah Kalawait (*Uncaria gambir* (*W.Hunter*) Roxb.) dengan Reaksi Glikasi Secara in Vitro, *Jurnal Surya Medika*, **10(2)**: 172-178.
- Chilukuri, H., Kolekar, Y.M., Bhosle, G.S., Godbole, R.K., Kazi, R.S., Kulkarni, M.J. and Fernandes, M. 2013, N-(3-Aminoalkyl) Proline Derivatives with Potent Antiglycation Activity, *RSC Advances*, **5(94)**: 1-10.
- Chilukuri, H., Kulkarni, M.J. and Fernandes, M. 2018, Revisiting Amino Acids and Peptides as Antiglycation Agents, *MedChemComm*, **9**: 614 - 624.

- Cohen, R., Bitton, R.E., Herzallh, N.S., Cohen, Y. and Yehezkeli, O. 2021, Utilization of FAD-Glucose Dehydrogenase from *T. Emersonii* for Amperometric Biosensing and Biofuel Cell Device, *Analytic Chemistry*, **93(33)**: 11585-11591.
- Coral, B.D., Sulochana. and Angayarkanni. 2015, Free Amino Acids Glycine and Glutamic Acid Inhibit Angiogenesis Induced by AGE in Bovine Retinal Endothelial Cells, *Journal of Glycomics & Lipidomics*, **5(2)**: 1-7.
- Cunningham, A., Oudejans, L.L., Geugien, M., Martins, D.A., Wierenga, A.T.J., Erdem, A., Sternadt, D., Huls, G. and Schuringa, J.J. 2024, The Nonessential Amino Acid Cysteine is Required to Prevent Ferroptosis in Acute Myeloid Leukimia, *Blood Advances*, **8(1)**: 56-69.
- Edelstein, D. and Brownlee, M. 1992, Mechanistic Studies of Advanced Glycosylation end Product Inhibition by Aminoguanidine, *Diabetes*, **41**: 26-29.
- Feroz, A., Khaki, P.S.S., Khan, M.S. and Bano, B. 2020, Protein Aggregation as a Consequence of Non-Enzymatic Glycation: Therapeutic Intervention Using Aspartic Acid and Arginine, *International Journal of Biological Macromolecules*, **163(2020)**: 1844-1858.
- Holendova, B. and Hlavata, L.P. 2023, Cysteine Residu in Signal Transduction and its Relevance in Pancreatic Beta Cells, *Frontiers in Endocrinology*, **14**: 1-8.
- Hosen, A., Mamun, A., Robin, Md.A., Habiba, U. and Sultana, R. 2021. Maillard Reaction: Food Processing Aspects, *North american Academic Research (NAAR) Journal*, **4(9)**: 44-52.
- Koike, S., Saito, Y. and Ogasawara, Y. 2023. Novel Fluorometric Assay of Antiglycation Activity Based on Methylglyoxal - Induced Protein Carbonylation, *Antioksidan*, **12(12)**: 1-14.
- Kosmachevskaya, O.V., Nasybullina, E.I., Pugachenko, I.S., Novikova. and Topunov, A.F. 2022, Antiglycation and Antioxidant Effect of Nitroxyl Towards Hemoglobin, *Antioxidants*, **11(10)**: 1-20.
- Kumar, R., Saha, P., Kumar, Y., Sahana, S., Dubey, A. and Prakash, O. 2020, A Riview on Diabetes Melitus: Typel & Type2, *Word Journal of Pharmacy and Pharmaceutical Sciences*, **9(10)**: 838-850.

- Kustiningsih, Y., Megawati, N., Kartiko, J.J. dan Lutpiatina, L. 2017, Pengaruh Variasi Suhu Awal Reagen Terhadap Kadar Glukosa Darah Metode Enzimatik, *Medical Laboratory Technology Journal*, **3(1)**: 103 - 107.
- Lavilla, L.M., Lavilla, A.JR.C., Burnea, B.K.F. and Inutan, D.E. 2024, L-cysteine Sequestering Methyl Glyoxal Prevents Protein Glycation: A Combined in Vitro and in Silico Evaluation, *Current Issues in Pharmacy and Medical Sciences*, **37(2)**: 114 – 120.
- Lin, C.C. and Yin, M.C. 2008, Antiglycation and Anti-VEGF Effects of S-Ethyl Cysteine and S-Propyl Cysteine in Kidney of Diabetic Mice, *Molecular Nutrition & Food Research*, **52(11)**: 1358-1364.
- Mossine, V.V., Linetsky, M., Glinsky, G.V., Ortwerth, B.J. and Feather, M.S. 1999, Superoxide Free Radical Generation by Amadori Compounds: the Role of Acyclic Forms and Metal Ions, *Chemical Research in Toxicology*, **12(3)**: 230–236.
- Moggach, S.A., Allan, D.R., Clark, S.J., Gutmann, M.J., Parsons, S., Pulham, C.R. and Sawyer, L. 2006, High-Pressure Polymorphism in L-Cysteine: the Crystal Structures of L-Cysteine-III and L-Cysteine-IV, *Acta Crystallographica Section B Structural Science*, **62(2)**: 296-309.
- Murugaiyan, S.B., Ramasamy, R., Gopal, N. and Kuzhandaivelu, V. 2014, Biosensors in Clinical Chemistry: an Overview, *Advanced Biomedical Research*, **67(3)**: 1-9.
- Muthenna, P., Akileshwari, C. and Reddy, G.B. 2012. Ellagic Acid, a New Antiglycating Agent: its Inhibition of N^ε-(Carboxymethyl) Lysine, *Biochemical Journal*, **442(1)**: 221–230.
- Perkeni. 2021. *Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 Dewasa di Indonesia*. Jakarta: PERKENI.
- Perrone, A., Giovino, A., Benny, J. and Martinelli, F. 2020, Advanced Glycation and Products (AGEs): Biochemistry, Signaling, Analytical Methods, and Epigenetic Effects, *Oxidative Medicine and Cellular Longevity*, **2020**: 1-18.
- Povichit, N., Phrutivorapongkul, A., Suttajit, M., Chaiyasut, C. and Leelapornpisid. 2010, Phenolic Content and in Vitro Inhibitory Effects on Oxidation and Protein Glycation of Some Thai Medical Plants, *Dapartemen of Pharmaceutical Science Faculty of Pharmacy*, **23(4)**: 403 – 408.

- Putri, A.C., Suzery, M. dan Aminin, A.L.N. 2023, Analisis Aktivitas Antiglikasi pada Berbagai Konsentrasi Ekstrak Etanol dari Produk Fermentasi Daun Matoa, *Greensphere: Journal of Environmental Chemistry*, **3(1)**: 18-24.
- Rodwattanagul, S., Nimlamool, W. and Okonogi, S. 2023, Antioxidant, Antiglycation, and Anti-Inflammatory Activities of *Caesalpinia mimosoides*, *Drug Discoveries & Therapeutics*, **17(2)**: 114-120.
- Septianingtyas, E. dan Agustini, R. 2021, Pengaruh Jenis *Yeast* Terhadap Kadar Glukosa Darah Mencit (*Mus musculus*) yang Terindikasi Diabetes Melitus Tipe 2, *UNESA Journal of Chemistry*, **10(2)**: 129-134.
- Shendurse, A.M. and Khedkar, C.D. 2016, Glucose: Properties and Analysis, *The Encyclopedia of Food and Healty*, **3**: 239- 247.
- Situmorang, P.R., Zalukhu, B. dan Napitupulu, D.S. 2023, Perbandingan Peningkatan Kadar Gula Darah Sebelum dan Setelah Pemberian Gula Putih, Gula Aren, dan Madu pada Mahasiswa TLM di STIKes Santa Elisabeth Medan Tahun 2023, *Journal of Indonesia Medical Laboratory and Science*, **4(2)**: 136-147.
- Sousa, S.F., Ribeiro, A.J.M., Neves, R.P.P., Bras, N.F., Cerqueira, N.M. F.S.A., Fernandes, P.A. and Ramos, M.J. 2017, Application of Quantum Mechanics/Molecular Mechanics Methods in the Study of Enzymatic Reaction Mechanisms, *Wiley Interdisciplinary Reviews: Computational Molecular*, **7(2)**: 1-55.
- Suhartono, E., Setiawan, B., Mashur., Junuarti, M., Kamilah, I. dan Haudhiya. 2008, Modifikasi Protein Akibat Pembebanan Glukosa dengan Model Reaksi Glikosilasi Nonenzimatik in Vitro, *Mutiara Medika*, **8(1)**: 40-47.
- Wu, S., Snajdrova, R., Moore, C.J., Baldenius, K. and Bornscheuer, T.U. 2021, *Biocataly: Enzymatic Synthesis for Industrial Applications*, *Enzyme Catalysis*, **60**: 88-119.
- Wu, G. 2010, Functional Amino Acids in Growth, Reproduction, and Health, *Advanced in Nutrition*, **1(1)**: 31-37.
- Yeh, W., Hsia, S., Lee, W. and Wu, C. 2017, Polyphenols with Antiglycation Activity and Mechanisms of Action: A Review of Recent Findings, *Journal of Food and Drug Analysis*, **25(1)**: 84-92.