Molecular Insights into the Antidiabetic Potential of Excavatin-A as an α-Glucosidase Inhibitor: An Integrated Molecular Docking and Molecular Dynamics Study

Muhammad Ikhlas Abdjan,[1,2] Nanik Siti Aminah,[3,4,*] Alfinda Novi Kristanti,[3,4] Abdullahi Musa,[5] Imam Siswanto,[3] Axl Laurens Lukas Windah,[3,6] Tin Myo Thant,[7,8] Yoshiaki Takaya,[9] Salar Hafez-Ghoran[10] and Yan Wang[7]

[1]*Department of Chemistry, Faculty of Science and Technology, Airlangga University, Surabaya, East Java, 60115, Indonesia*

[2]*Department of Chemistry, Faculty of Mathematics and Natural Science, State University of Surabaya, Surabaya, East Java, 60231, Indonesia*

[3]*Department of Chemistry, Faculty of Science and Technology, Airlangga University, Surabaya, East Java, 60115, Indonesia*

[4]*Biotechnology of Tropical Medicinal Plants Research Group, Airlangga University, Surabaya, East Java, 60115 Indonesia*

[5]*Floret Center for Advanced Genomics and Bioinformatics Research, Chemistry, Ikeja, Lagos, 100271, Nigeria*

[6]*Faculty of Science and Technology, Airlangga University, Surabaya, East Java, 60115, Indonesia*

[7]*Key Laboratory for Chemistry and Molecular Engineering of Medicinal Resources (Ministry of Education of China), Guangxi Key Laboratory of Chemistry and Molecular Engineering of Medicinal Resources, University Engineering Research Center for Chemistry of Characteristic Medicinal Resources (Guangxi), School of Chemistry and Pharmaceutical Sciences, Guangxi Normal University, Guilin, Guangxi, 541004, China*

[8]*Department of Chemistry, Panglong University Ministry of Education, Shan, Panglong, 06114, Myanmar*

[9]*Faculty of Pharmacy, Meijo University, 150 Yagotoyama, Tempaku, Nagoya, 468-8503, Japan*

[10]*Laboratory for Functional Foods and Human Health, Center for Excellence in Post-Harvest Technologies, North Carolina Agricultural and Technical State University, North Carolina Research Campus, 500 Laureate Way, Kannapolis, North Carolina, 28081, United States*

[*]*Email:* nanik-s-a@fst.unair.ac.id (N. S. Aminah)

Received: 23 April 2026; Revised: 07 June 2026; Accepted: 15 September 2026

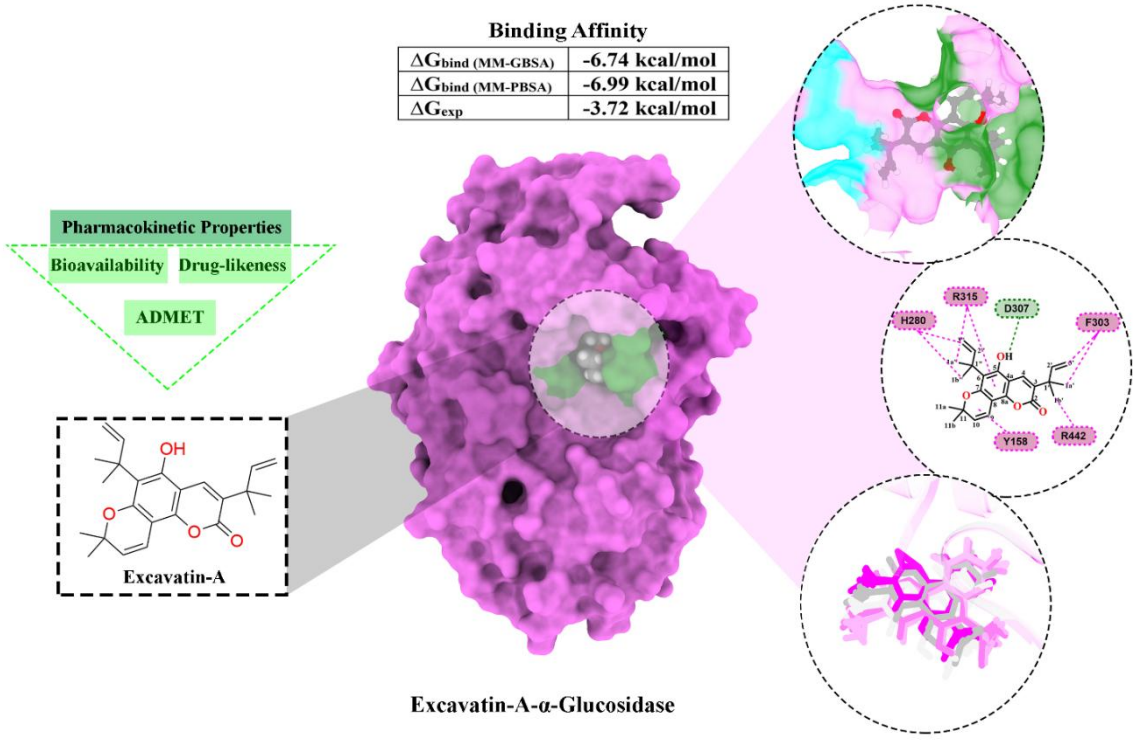
Type: Research article.

Abstract

α-Glucosidase enzymes were targeted to hydrolyse oligosaccharides into monomers, thereby increasing blood glucose levels in people with type 2 diabetes mellitus (DM). Natural products offer diverse, accessible compounds for drug discovery. Excavatin-A (ExA) is a new compound of coumarin derivatives that has quite a structural similarity to nordentatin (Nor) and has been known as a promising α-Glucosidase inhibitor. Through a structure-based approach, the interaction of these

compounds with α-Glucosidase at the molecular level was studied. For evaluation purposes, the compounds Nordentatin and acarbose (Aca) were used as controls. The results showed that the dynamic behaviour of each system reached equilibrium over the simulation time, as indicated by stability and rigidity analyses. Meanwhile, the theoretical (ΔG_{bind}) and experimental (ΔG_{exp}) binding affinities show a good correlation, with Aca-α-Glu > ExA-α-Glu > Nor-α-Glu. Moreover, the residue on the gate pocket (especially Y158) leads to stabilising ExA binding with a decomposition energy ("ΔG"〗_"bind" ^"residue"): -3.28 kcal/mol. ExA shows its potential as a promising drug candidate by meeting the Lipinski rules (only one violation), good bioavailability (0.55), good oral absorption (+Human Intestinal Absorption(HIA)), and non-toxicity (non-AMES and non-hepatotoxicity). This work provided useful molecular insights into Excavatin-A as a potential α-glucosidase inhibitor.

Table of Contents



Innovative Description: The first to report the potential of the new coumarin derivative Excavatin-A as a potential α-Glucosidase inhibitor through computational studies.