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## Identification of $\alpha$ -glucosidase inhibitors from *Clinacanthus nutans* leaf extract using liquid chromatography-mass spectrometry-based metabolomics and protein-ligand interaction with molecular docking

(Article) [\(Open Access\)](#)Murugesu, S.<sup>a</sup>, Ibrahim, Z.<sup>a</sup>, Ahmed, Q.U.<sup>a</sup>, Uzir, B.F.<sup>a</sup>, Nik Yusoff, N.I.<sup>a</sup>, Perumal, V.<sup>b</sup>, Abas, F.<sup>c</sup>, Shaari, K.<sup>c</sup>, Khatib, A.<sup>a,c</sup> [✉](#) [👤](#)<sup>a</sup>Department of Pharmaceutical Chemistry, Kulliyah of Pharmacy, International Islamic University Malaysia, Kuantan, Pahang Darul Makmur 25200, Malaysia<sup>b</sup>Department of Pharmaceutical Technology, Faculty Pharmacy & Health Sciences, Universiti Kuala Lumpur, Royal College of Medicine Perak, Ipoh, Perak Darul Ridzuan 30450, Malaysia<sup>c</sup>Laboratory of Natural Products, Institute of Bioscience, Universiti Putra Malaysia, Serdang, Selangor Darul Ehsan 43400, Malaysia

### Abstract

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The present study used in vitro and in silico techniques, as well as the metabolomics approach to characterise  $\alpha$ -glucosidase inhibitors from different fractions of *Clinacanthus nutans*. *C. nutans* is a medicinal plant belonging to the Acanthaceae family, and is traditionally used to treat diabetes in Malaysia. n-Hexane, n-hexane: ethyl acetate (1:1, v/v), ethyl acetate, ethyl acetate: methanol (1:1, v/v), and methanol fractions were obtained via partitioning of the 80% methanolic crude extract. The in vitro  $\alpha$ -glucosidase inhibitory activity was analyzed using all the fractions collected, followed by profiling of the metabolites using liquid chromatography combined with mass spectrometry. The partial least square (PLS) statistical model was developed using the SIMCA P<sup>+</sup>14.0 software and the following four inhibitors were obtained: (1) 4,6,8-Megastigmatrien-3-one; (2) N-Isobutyl-2-nonen-6,8-diyamide; (3) 1',2'-bis(acetyloxy)-3',4'-didehydro-2'-hydro- $\beta$ ,  $\psi$ -carotene; and (4) 22-acetate-3-hydroxy-21-(6-methyl-2,4-octadienoate)-olean-12-en-28-oic acid. The in silico study performed via molecular docking with the crystal structure of yeast isomaltase (PDB code: 3A4A) involved a hydrogen bond and some hydrophobic interactions between the inhibitors and protein. The residues that interacted include ASN259, HID295, LYS156, ARG335, and GLY209 with a hydrogen bond, while TRP15, TYR158, VAL232, HIE280, ALA292, PRO312, LEU313, VAL313, PHE314, ARG315, TYR316, VAL319, and TRP343 with other forms of bonding. © 2019 Xi'an Jiaotong University

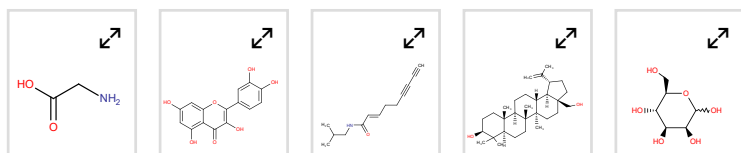
### SciVal Topic Prominence [i](#)

Topic: Acanthaceae | Antioxidants | Nutans leaves

Prominence percentile: 68.957 [i](#)

### Chemistry database information [i](#)

#### Substances



#### Author keywords

[Clinacanthus nutans](#) [Diabetes](#) [LC-MS-QTOF](#) [Metabolomics](#) [Molecular docking](#)  
 [\$\alpha\$ -Glucosidase inhibitors](#)

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## EMTREE drug terms:

1,2' bis(acetyloxy) 3' ,4' didehydro 2' hydro beta psi carotene  
 22 acetate 3 hydroxy 21 (6 methyl 2,4 octadienoate)olean 12 en 28 oic acid  
 4,6,8 megastigmatrien 3 one alpha glucosidase inhibitor Clinacanthus nutans extract  
 n isobutyl 2 nonen 6,8 diynamide plant extract quercetin unclassified drug

## EMTREE medical terms:

Acanthaceae Article Clinacanthus nutans controlled study crystal structure  
 enzyme inhibition hydrogen bond hydrophobicity IC50 least square analysis  
 liquid chromatography liquid chromatography-mass spectrometry mass spectrometry  
 metabolomics molecular docking

## Chemicals and CAS Registry Numbers:

quercetin, 117-39-5

## Manufacturers:

Drug manufacturer:

chemspider, United States

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International Islamic University Malaysia	PRIGS18-027-0027	
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## References (33)

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- 1 Bahmani, M., Zargaran, A., Rafeian-Kopaei, M., Saki, K.  
 Ethnobotanical study of medicinal plants used in the management of diabetes mellitus in the Urmia, Northwest Iran ([Open Access](#))

(2014) *Asian Pacific Journal of Tropical Medicine*, 7 (S1), pp. S348-S354. Cited 153 times.  
<http://www.elsevier.com/locate/journaldescription.authors/722894/description#description>  
 doi: 10.1016/S1995-7645(14)60257-1

[View at Publisher](#)

- 2 Tee, E.-S., Yap, R.W.K.  
 Type 2 diabetes mellitus in Malaysia: Current trends and risk factors

(2017) *European Journal of Clinical Nutrition*, 71 (7), pp. 844-849. Cited 12 times.  
<http://www.nature.com/ejcn/index.html>  
 doi: 10.1038/ejcn.2017.44

[View at Publisher](#)

- 3 Azmi, S.M.N., Jamal, P., Amid, A.  
Xanthine oxidase inhibitory activity from potential Malaysian medicinal plant as remedies for gout  
(2012) *International Food Research Journal*, 19 (1), pp. 159-165. Cited 29 times.  
[http://www.ifrj.upm.edu.my/19%20\(01\)%202011/\(21\)IFRJ-2010-271%20Parveen.pdf](http://www.ifrj.upm.edu.my/19%20(01)%202011/(21)IFRJ-2010-271%20Parveen.pdf)
- 
- 4 Alam, A., Ferdosh, S., Ghafoor, K., Hakim, A., Juraimi, A.S., Khatib, A., Sarker, Z.I.  
Clinacanthus nutans: A review of the medicinal uses, pharmacology and phytochemistry (Open Access)  
(2016) *Asian Pacific Journal of Tropical Medicine*, 9 (4), pp. 402-409. Cited 37 times.  
<http://www.elsevier.com/aps/finding/journaldescription.authors/722894/description#description>  
doi: 10.1016/j.apjtm.2016.03.011  
View at Publisher
- 
- 5 Arullappan, S., Rajamanickam, P., Thevar, N., Kodimani, C.C.  
In vitro screening of cytotoxic, antimicrobial and antioxidant activities of Clinacanthus nutans (Acanthaceae) leaf extracts (Open Access)  
(2014) *Tropical Journal of Pharmaceutical Research*, 13 (9), pp. 1455-1461. Cited 34 times.  
[http://www.tjpr.org/vol13\\_no9/2014\\_13\\_9\\_11.pdf](http://www.tjpr.org/vol13_no9/2014_13_9_11.pdf)  
doi: 10.4314/tjpr.v13i9.11  
View at Publisher
- 
- 6 Lee, S.Y., Mediani, A., Nur Ashikin, A.H., Azliana, A.B.S., Abas, F.  
Antioxidant and  $\alpha$ -glucosidase inhibitory activities of the leaf and stem of selected traditional medicinal plants  
(2014) *International Food Research Journal*, 21 (1), pp. 165-172. Cited 37 times.  
[http://www.ifrj.upm.edu.my/21%20\(01\)%202014/24%20IFRJ%2021%20\(01\)%202014%20Faridah%20359.pdf](http://www.ifrj.upm.edu.my/21%20(01)%202014/24%20IFRJ%2021%20(01)%202014%20Faridah%20359.pdf)
- 
- 7 Hung, W.Y., Tun, C.W., Thin, W.C.  
The use of calibration approaches for quantitative GC/MS analysis- secobarbital example  
(2006) *Forensic Sci. J.*, 5, pp. 13-19. Cited 3 times.
- 
- 8 Liu, W., Yin, D., Li, N., Hou, X., Wang, D., Li, D., Liu, J.  
Influence of environmental factors on the active substance production and antioxidant activity in *Potentilla fruticosa* L. and its quality assessment (Open Access)  
(2016) *Scientific Reports*, 6, art. no. 28591. Cited 23 times.  
[www.nature.com/srep/index.html](http://www.nature.com/srep/index.html)  
doi: 10.1038/srep28591  
View at Publisher
- 
- 9 Wang, R., Lu, Y., Wang, S.  
Comparative evaluation of 11 scoring functions for molecular docking  
(2003) *Journal of Medicinal Chemistry*, 46 (12), pp. 2287-2303. Cited 682 times.  
doi: 10.1021/jm0203783  
View at Publisher
- 
- 10 Javadi, N., Abas, F., Hamid, A.A., Simoh, S., Shaari, K., Ismail, I.S., Mediani, A., (...), Khatib, A.  
GC-MS-Based Metabolite Profiling of *Cosmos caudatus* Leaves Possessing Alpha-Glucosidase Inhibitory Activity  
(2014) *Journal of Food Science*, 79 (6), pp. C1130-C1136. Cited 28 times.  
<http://www3.interscience.wiley.com/journal/118509799/issueyear?year=2008>  
doi: 10.1111/1750-3841.12491  
View at Publisher

- 11 Yang, J., Kwon, Y.S., Kim, M.J.  
**Isolation and characterization of bioactive compounds from *Lepisorus thunbergianus* (Kaulf.)** ([Open Access](#))  
  
(2015) *Arabian Journal of Chemistry*, 8 (3), pp. 407-413. Cited 9 times.  
<http://colleges.ksu.edu.sa/Arabic%20Colleges/CollegeOfScience/ChemicalDept/AJC/default.aspx>  
(ScienceDirect <http://www.sciencedirect.com/science/journal/18785352>)  
doi: 10.1016/j.arabjc.2014.11.056  
  
View at Publisher
- 
- 12 Mediani, A., Abas, F., Khatib, A., Maulidiani, H., Shaari, K., Choi, Y.H., Lajis, N.H.  
**<sup>1</sup>H-NMR-based metabolomics approach to understanding the drying effects on the phytochemicals in *Cosmos caudatus***  
  
(2012) *Food Research International*, 49 (2), pp. 763-770. Cited 34 times.  
doi: 10.1016/j.foodres.2012.09.022  
  
View at Publisher
- 
- 13 Lawal, U., Leong, S.W., Shaari, K., Ismail, I.S., Khatib, A., Abas, F.  
 **$\alpha$ -Glucosidase Inhibitory and Antioxidant Activities of Different *Ipomoea aquatica* Cultivars and LC-MS/MS Profiling of the Active Cultivar**  
  
(2017) *Journal of Food Biochemistry*, 41 (2), art. no. e12303. Cited 6 times.  
<http://www.blackwellpublishing.com/journal.asp?ref=0145-8884&site=1>  
doi: 10.1111/jfbc.12303  
  
View at Publisher
- 
- 14 Aykul, S., Martinez-Hackert, E.  
**Determination of half-maximal inhibitory concentration using biosensor-based protein interaction analysis**  
  
(2016) *Analytical Biochemistry*, 508, pp. 97-103. Cited 14 times.  
<http://www.elsevier.com/inca/publications/store/6/2/2/7/8/1/index.htm>  
doi: 10.1016/j.ab.2016.06.025  
  
View at Publisher
- 
- 15 Pluskal, T., Castillo, S., Villar-Briones, A., Orešič, M.  
**MZmine 2: Modular framework for processing, visualizing, and analyzing mass spectrometry-based molecular profile data** ([Open Access](#))  
  
(2010) *BMC Bioinformatics*, 11, art. no. 395. Cited 961 times.  
<http://www.biomedcentral.com/1471-2105/11/395>  
doi: 10.1186/1471-2105-11-395  
  
View at Publisher
- 
- 16 Seong, S.H., Roy, A., Jung, H.A., Jung, H.J., Choi, J.S.  
**Protein tyrosine phosphatase 1B and  $\alpha$ -glucosidase inhibitory activities of *Pueraria lobata* root and its constituents**  
  
(2016) *Journal of Ethnopharmacology*, 194, pp. 706-716. Cited 22 times.  
[www.elsevier.com/locate/jethpharm](http://www.elsevier.com/locate/jethpharm)  
doi: 10.1016/j.jep.2016.10.007  
  
View at Publisher
- 
- 17 Banerjee, P., Erehman, J., Gohlke, B.-O., Wilhelm, T., Preissner, R., Dunkel, M.  
**Super Natural II-a database of natural products** ([Open Access](#))  
  
(2015) *Nucleic Acids Research*, 43 (D1), pp. D935-D939. Cited 58 times.  
<http://nar.oxfordjournals.org/>  
doi: 10.1093/nar/gku886  
  
View at Publisher

- 18 Lestari, W., Dewi, R.T., Kardono, L.B.S., Yanuar, A.  
Docking sulochrin and its derivative as  $\alpha$ -glucosidase inhibitors of *Saccharomyces cerevisiae* ([Open Access](#))

(2017) *Indonesian Journal of Chemistry*, 17 (1), pp. 144-150. Cited 3 times.  
<http://pdm-mipa.ugm.ac.id/ojs/index.php/ijc/article/download/1209/1259>  
doi: 10.22146/ijc.23568

[View at Publisher](#)

---

- 19 Dolinsky, T.J., Nielsen, J.E., McCammon, J.A., Baker, N.A.  
PDB2PQR: An automated pipeline for the setup of Poisson-Boltzmann electrostatics calculations ([Open Access](#))

(2004) *Nucleic Acids Research*, 32 (WEB SERVER ISS.), pp. W665-W667. Cited 1625 times.  
doi: 10.1093/nar/gkh381

[View at Publisher](#)

---

- 20 Wang, K., Bao, L., Ma, K., Zhang, J., Chen, B., Han, J., Ren, J., (...), Liu, H.  
A novel class of  $\alpha$ -glucosidase and HMG-CoA reductase inhibitors from *Ganoderma leucocontextum* and the anti-diabetic properties of ganomycin I in KK-A<sup>ym</sup>mice

(2017) *European Journal of Medicinal Chemistry*, 127, pp. 1035-1046. Cited 28 times.  
<http://www.journals.elsevier.com/european-journal-of-medicinal-chemistry/>  
doi: 10.1016/j.ejmech.2016.11.015

[View at Publisher](#)

---

- 21 Yawadio Nsimba, R., Kikuzaki, H., Konishi, Y.  
Antioxidant activity of various extracts and fractions of *Chenopodium quinoa* and *Amaranthus* spp. seeds

(2008) *Food Chemistry*, 106 (2), pp. 760-766. Cited 172 times.  
doi: 10.1016/j.foodchem.2007.06.004

[View at Publisher](#)

---

- 22 (2013), pp. 323-355.  
Database of Multi- and Megavariate Data Analysis, Basic Principles and Applications, Third revised edition,  
Chapter 18, Umetrics Academy  
<https://pdfs.semanticscholar.org/045f/6250ad3a3e1c5337f4859c4464617926cd5c.pdf>

- 23 Cai, J., Liu, B., Ling, P., Su, Q.  
Analysis of free and bound volatiles by gas chromatography and gas chromatography-mass spectrometry in uncased and cased tobaccos

(2002) *Journal of Chromatography A*, 947 (2), pp. 267-275. Cited 43 times.  
doi: 10.1016/S0021-9673(02)00015-8

[View at Publisher](#)

---

- 24 Slaghenaufi, D., Perello, M.-C., Marchand-Marion, S., Tempere, S., de Revel, G.  
Quantitative solid phase microextraction - Gas chromatography mass spectrometry analysis of five megastigmatrienone isomers in aged wine

(2014) *Analytica Chimica Acta*, 813, pp. 63-69. Cited 15 times.  
doi: 10.1016/j.aca.2014.01.019

[View at Publisher](#)

---

- 25 Yadav, S.A., Ramalingam, S., Jebamalaairaj, A., Subban, R., Sundaram, K.M.  
**Biochemical fingerprint and pharmacological applications of *Barleria noctiflora* L.f. leaves**  
  
(2016) *Journal of Complementary and Integrative Medicine*, 13 (4), pp. 365-376.  
[www.degruyter.com/view/j/jcim](http://www.degruyter.com/view/j/jcim)  
doi: 10.1515/jcim-2015-0106  
  
View at Publisher
- 
- 26 Boonen, J., Baert, B., Burvenich, C., Blondeel, P., De Saeger, S., De Spiegeleer, B.  
**LC-MS profiling of N-alkylamides in *Spilanthes acmella* extract and the transmucosal behaviour of its main bio-active spilanthol**  
  
(2010) *Journal of Pharmaceutical and Biomedical Analysis*, 53 (3), pp. 243-249. Cited 45 times.  
doi: 10.1016/j.jpba.2010.02.010  
  
View at Publisher
- 
- 27 Mbeunkui, F., Grace, M.H., Lategan, C., Smith, P.J., Raskin, I., Lila, M.A.  
**Isolation and identification of antiplasmodial N-alkylamides from *Spilanthes acmella* flowers using centrifugal partition chromatography and ESI-IT-TOF-MS**  
  
(2011) *Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Sciences*, 879 (21), pp. 1886-1892. Cited 24 times.  
doi: 10.1016/j.jchromb.2011.05.013  
  
View at Publisher
- 
- 28 Veryser, L., Taevernier, L., Wynendaele, E., Verheust, Y., Dumoulin, A., De Spiegeleer, B.  
**N-alkylamide profiling of *Achillea ptarmica* and *Achillea millefolium* extracts by liquid and gas chromatography–mass spectrometry (Open Access)**  
  
(2017) *Journal of Pharmaceutical Analysis*, 7 (1), pp. 34-47. Cited 4 times.  
<http://www.journals.elsevier.com/journal-of-pharmaceutical-analysis>  
doi: 10.1016/j.jpha.2016.09.005  
  
View at Publisher
- 
- 29 Yamamoto, K., Miyake, H., Kusunoki, M., Osaki, S.  
**Crystal structures of isomaltase from *Saccharomyces cerevisiae* and in complex with its competitive inhibitor maltose (Open Access)**  
  
(2010) *FEBS Journal*, 277 (20), pp. 4205-4214. Cited 96 times.  
[http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1742-4658](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1742-4658)  
doi: 10.1111/j.1742-4658.2010.07810.x  
  
View at Publisher
- 
- 30 Yan, J., Zhang, G., Pan, J., Wang, Y.  
 **$\alpha$ -Glucosidase inhibition by luteolin: Kinetics, interaction and molecular docking**  
  
(2014) *International Journal of Biological Macromolecules*, 64, pp. 213-223. Cited 77 times.  
doi: 10.1016/j.ijbiomac.2013.12.007  
  
View at Publisher
- 
- 31 An, H.-J., Nugroho, A., Song, B.-M., Park, H.-J.  
**Isoeugenin, a novel nitric oxide synthase inhibitor isolated from the rhizomes of *imperata cylindrica* (Open Access)**  
  
(2015) *Molecules*, 20 (12), pp. 21336-21345. Cited 10 times.  
<http://www.mdpi.com/1420-3049/20/12/19767/pdf>  
doi: 10.3390/molecules201219767  
  
View at Publisher

- 32 Ayu, S.A., Samsul, B.S., Santosh, F.  
Antidiabetic activity of ethanolic extract of Imperata cylindrical (alang) leaves in alloxan induced diabetic rats  
(2012) *Arch. Pharm. Pract.*, 3.  
46

- 33 Rønneberg, H., G. Andrewes, A., Borch, G., Berger, R., Liaaen-Jensen, S.  
CD correlation of C-2'substituted monocyclic carotenoids

(1985) *Phytochemistry*, 24 (2), pp. 309-319. Cited 22 times.  
doi: 10.1016/S0031-9422(00)83543-8

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