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Biomolecules Open Access
Volume 10, Issue 2, February 2020, Article number 287

Investigation of α-glucosidase inhibitory metabolites from Tetracera scandens leaves by GC–MS metabolite profiling and docking studies

(Article) (Open Access)

Nokhala, A.[a], Siddiqui, M.J.[a,b], Ahmed, Q.U.[a,b], Bustamam, M.S.A.[c], Zakaria, Z.A.[d,e]

[a]Department of Pharmaceutical Chemistry, Kulliyyah of Pharmacy, International Islamic University Malaysia, Indera Mahkota, Kuantan, Pahang 25200, Malaysia
[b]Pharmacognosy Research Group, Kulliyyah of Pharmacy, International Islamic University Malaysia, Indera Mahkota, Kuantan, Pahang 25200, Malaysia
[c]Laboratory of Natural Products, Institute of Bioscience, Universiti Putra Malaysia, Serdang, Selangor 43400, Malaysia

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Abstract

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Stone leaf (Tetracera scandens) is a Southeast Asian medicinal plant that has been traditionally used for the management of diabetes mellitus. The underlying mechanisms of the antidiabetic activity have not been fully explored yet. Hence, this study aimed to evaluate the α-glucosidase inhibitory potential of the hydromethanolic extracts of T. scandens leaves and to characterize the metabolites responsible for such activity through gas chromatography–mass spectrometry (GC–MS) metabolomics. Crude hydromethanolic extracts of different strengths were prepared and in vitro assayed for α- glucosidase inhibition. GC–MS analysis was further carried out and the mass spectral data were correlated to the corresponding α-glucosidase inhibitory IC50 values via an orthogonal partial least squares (OPLS) model. The 100%, 80%, 60% and 40% methanol extracts displayed potent α-glucosidase inhibitory potentials. Moreover, the established model identified 16 metabolites to be responsible for the α- glucosidase inhibitory activity of T. scandens. The putative α-glucosidase inhibitory metabolites showed moderate to high affinities (binding energies of −5.9 to −9.8 kcal/mol) upon docking into the active site of Saccharomyces cerevisiae isomaltase. To sum up, an OPLS model was developed as a rapid method to characterize the α-glucosidase inhibitory metabolites existing in the hydromethanolic extracts of T. scandens leaves based on GC–MS metabolite profiling. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.

SciVal Topic Prominence

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Prominence percentile: 90.131

Chemistry database information

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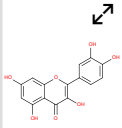

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(2015) Asian Pacific Journal of Tropical Biomedicine

Optimization of hyperglycemic induction in zebrafish and evaluation of its blood glucose level and metabolite fingerprint treated with psychotria malayana Jack Leaf extract

Benchoula, K. , Khatib, A. , Quzwain, F.M.C.
(2019) Molecules

Chemical constituents, larvicidal effects and radical scavenging activity of tetracera breyniana schltdl. (Dilleniaceae)

de Lima, C.C. , Lyra Lemos, R.P. , Conserva, L.M.
(2013) Journal of Applied Pharmaceutical Science

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		60percent methanol-water extract of Tetracera scandens, leaves, dry, Malaysia, Pahang, forest at Tasik Chini	60percent methanol-water extract of Tetracera scandens, leaves, dry, Malaysia, Pahang, forest at Tasik Chini,	40percent methanol-water extract of Tetracera scandens, leaves, dry, Malaysia, Pahang, forest at Tasik Chini,	20percent methanol-water extract of Tetracera scandens, leaves, dry, Malaysia, Pahang, forest at Tasik Chini,

Author keywords

GC · Metabolite profiling · Molecular docking · MS metabolomics · Orthogonal partial least squares · Tetracera scandens · α-glucosidase inhibition

Indexed keywords

EMTREE drug terms: 1 monopalmitin · 24 methylenecycloartenol acetate · 5 methoxy 8,8 dimethyl 10 (3 methyl 2 butenyl) 2h,8h pyrano [3,2 g]chromen 2 one · alpha glucosidase · alpha tocopherol · catechin · cycloartenol · drug metabolite · emodin · herbaceous agent · linoleic acid · oligo 1,6 glucosidase · palmitic acid · phytol · plant extract · quercetin · questin · sitosterol · stigmasterol · Tetracera scandens extract · unclassified drug

EMTREE medical terms: Article · binding affinity · controlled study · drug identification · drug potency · drug screening · drug synthesis · enzyme active site · enzyme inhibition · IC50 · in vitro study · mass fragmentography · medicinal plant · metabolic fingerprinting · molecular docking · nonhuman · plant leaf · Tetracera scandens

Chemicals and CAS Registry Numbers:

alpha glucosidase, 9001-42-7; alpha tocopherol, 1406-18-4, 1406-70-8, 52225-20-4, 58-95-7, 59-02-9; catechin, 13392-26-2, 154-23-4; cycloartenol, 469-38-5; emodin, 518-82-1, 57828-45-2; linoleic acid, 1509-85-9, 2197-37-7, 60-33-3, 822-17-3; oligo 1,6 glucosidase, 9032-15-9; palmitic acid, 57-10-3; phytol, 150-86-7; quercetin, 117-39-5; sitosterol, 19044-06-5, 83-46-5; stigmasterol, 83-48-7

Funding details

Funding sponsor	Funding number	Acronym
International Islamic University Malaysia		IIUM

Funding text

The authors wish to thank the Kulliyyah of Pharmacy and Research Management Centre, IIUM, Kuantan for support and providing the research facilities. The authors would like to thank Santosh N. Mokale ? department of pharmaceutical chemistry, Y.B. Chavan college of pharmacy, Aurangabad, Maharashtra, India ? for his valuable input during the review process of this manuscript.

ISSN: 2218273X
Source Type: Journal
Original language: English
DOI: 10.3390/biom10020287
PubMed ID: 32059529
Document Type: Article
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References (44)

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1 Bell, M., Blais, J.M.

"-Omics" workflow for paleolimnological and geological archives: A review

(2019) *Science of the Total Environment*, 672, pp. 438-455. Cited 5 times.
www.elsevier.com/locate/scitotenv
doi: 10.1016/j.scitotenv.2019.03.477

View at Publisher

2 Yuliana, N.D., Khatib, A., Choi, Y.H., Verpoorte, R.

Metabolomics for bioactivity assessment of natural products

(2011) *Phytotherapy Research*, 25 (2), pp. 157-169. Cited 92 times.
doi: 10.1002/ptr.3258

View at Publisher

3 Tebani, A., Afonso, C., Marret, S., Bekri, S.

Omics-based strategies in precision medicine: Toward a paradigm shift in inborn errors of metabolism investigations (Open Access)

(2016) *International Journal of Molecular Sciences*, 17 (9), art. no. 1555. Cited 52 times.
http://www.mdpi.com/1422-0067/17/9/1555/pdf
doi: 10.3390/ijms17091555

View at Publisher

4 Sharif, K.M., Rahman, M.M., Azmir, J., Khatib, A., Hadijah, S., Mohamed, A., Sahena, F., (...), Zaidul, I.S.M.

Orthogonal Partial Least Squares Model for Rapid Prediction of Antioxidant Activity of Pereskia bleo by Fourier Transform Infrared Spectroscopy

(2014) *Analytical Letters*, 47 (12), pp. 2061-2071. Cited 13 times.
www.tandf.co.uk/journals/titles/00032719.asp
doi: 10.1080/00032719.2014.898150

View at Publisher

5 Murugesu, S., Ibrahim, Z., Ahmed, Q.-U., Yusoff, N.-I.N., Uzir, B.-F., Perumal, V., Abas, F., (...), Khatib, A.

Characterization of ?-glucosidase inhibitors from clinacanthus nutans lindau leaves by gas chromatography-mass spectrometry-based metabolomics and molecular docking simulation (Open Access)

(2018) *Molecules*, 23 (9), art. no. 2402. Cited 10 times.
http://www.mdpi.com/1420-3049/23/9/2402/pdf
doi: 10.3390/molecules23092402

View at Publisher

6 D'Urso, G., Pizza, C., Piacente, S., Montoro, P.

Combination of LC–MS based metabolomics and antioxidant activity for evaluation of bioactive compounds in Fragaria vesca leaves from Italy

(2018) *Journal of Pharmaceutical and Biomedical Analysis*, 150, pp. 233-240. Cited 15 times.
www.elsevier.com/locate/jpba
doi: 10.1016/j.jpba.2017.12.005

View at Publisher

7 Mediani, A., Abas, F., Maulidiani, M., Khatib, A., Tan, C.P., Safinar Ismail, I., Shaari, K., (...), Ismail, A.

Characterization of metabolite profile in Phyllanthus niruri and correlation with bioactivity elucidated by nuclear magnetic resonance based metabolomics (Open Access)

(2017) *Molecules*, 22 (6), art. no. 902. Cited 7 times.
http://www.mdpi.com/1420-3049/22/6/902/pdf
doi: 10.3390/molecules22060902

View at Publisher

8 Atanasov, A.G., Waltenberger, B., Pferschy-Wenzig, E.-M., Linder, T., Wawrosch, C., Uhrin, P., Temml, V., (...), Stuppner, H.

Discovery and resupply of pharmacologically active plant-derived natural products: A review (Open Access)

(2015) *Biotechnology Advances*, 33 (8), pp. 1582-1614. Cited 658 times.
www.elsevier.com/inca/publications/store/5/2/5/4/5/5/index.htt
doi: 10.1016/j.biotechadv.2015.08.001

View at Publisher

9 Dunn, W.B., Ellis, D.I.

Metabolomics: Current analytical platforms and methodologies

(2005) *TrAC - Trends in Analytical Chemistry*, 24 (4), pp. 285-294. Cited 773 times.
www.elsevier.com/locate/trac
doi: 10.1016/j.trac.2004.11.021

View at Publisher

10 Dettmer, K., Aronov, P.A., Hammock, B.D.

Mass spectrometry-based metabolomics

(2007) *Mass Spectrometry Reviews*, 26 (1), pp. 51-78. Cited 1200 times.
doi: 10.1002/mas.20108

View at Publisher

11 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 37 times.
http://www3.interscience.wiley.com/journal/118509799/issueyear?year=2008
doi: 10.1111/1750-3841.12491

View at Publisher

12 Ray, S., Dutta, M., Chaudhury, K., De, B.

GC–MS based metabolite profiling and angiotensin i-converting enzyme inhibitory property of black tea extracts (Open Access)

(2017) *Brazilian Journal of Pharmacognosy*, 27 (5), pp. 580-586. Cited 2 times.
http://www.scielo.br/pdf/rbfar/v27n5/0102-695X-rbfar-27-05-0580.pdf
doi: 10.1016/j.bjp.2017.05.006

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13 Das, S., Dutta, M., Chaudhury, K., De, B.

Metabolomic and chemometric study of Achras sapota L. fruit extracts for identification of metabolites contributing to the inhibition of α-amylase and α-glucosidase

(2016) *European Food Research and Technology*, 242 (5), pp. 733-743. Cited 15 times.
http://link.springer.de/link/service/journals/00217/index.htm
doi: 10.1007/s00217-015-2581-0

View at Publisher

14 Maree, J., Kamatou, G., Gibbons, S., Viljoen, A., Van Vuuren, S.

The application of GC-MS combined with chemometrics for the identification of antimicrobial compounds from selected commercial essential oils

(2014) *Chemometrics and Intelligent Laboratory Systems*, 130, pp. 172-181. Cited 33 times.
doi: 10.1016/j.chemolab.2013.11.004

View at Publisher

15 Eriksson, L.
(2006) *Multi-and Megavariate Data Analysis*. Cited 1420 times.
second ed.; MKS Umetrics AB: Umeå, Sweden

16 Umar, A., Ahmed, Q.U., Muhammad, B.Y., Dogarai, B.B.S., Soad, S.Z.B.M.
Anti-hyperglycemic activity of the leaves of Tetracera scandens Linn. Merr. (Dilleniaceae) in alloxan induced diabetic rats

(2010) *Journal of Ethnopharmacology*, 131 (1), pp. 140-145. Cited 49 times.
doi: 10.1016/j.jep.2010.06.016

View at Publisher

17 Muliyah, E., Sulistijorini, S., Sulistyaningsih, Y.C., Rafi, M.
Tetracera scandens as a medicinal plant: Secretory structures, histochemistry, and antibacterial activity
(2018) *J. Trop. Life Sci.*, 8, pp. 68-74.

18 Thanh, T.B., Thanh, H.N., Minh, H.P.T., Le-Thi-Thu, H., Ly, H.D.T., Duc, L.V.
Protective effect of Tetracera scandens L. leaf extract against CCl_4-induced acute liver injury in rats (Open Access)

(2015) *Asian Pacific Journal of Tropical Biomedicine*, 5 (3), pp. 221-227. Cited 12 times.
http://www.journals.elsevier.com/asian-pacific-journal-of-tropical-biomedicine/
doi: 10.1016/S2221-1691(15)30009-5

View at Publisher

19 Nguyen, M.T.T., Awale, S., Tezuka, Y., Tran, Q.L., Watanabe, H., Kadota, S.
Xanthine oxidase inhibitory activity of Vietnamese medicinal plants (Open Access)

(2004) *Biological and Pharmaceutical Bulletin*, 27 (9), pp. 1414-1421. Cited 120 times.
http://www.jstage.jst.go.jp/article/bpb/27/9/1414/_pdf
doi: 10.1248/bpb.27.1414

View at Publisher

20 Nguyen, M.T.T., Nguyen, N.T.
A new lupane triterpene from Tetracera scandens L., xanthine oxidase inhibitor

(2013) *Natural Product Research*, 27 (1), pp. 61-67. Cited 20 times.
doi: 10.1080/14786419.2011.652960

View at Publisher

21 Lee, M.S., Kim, C.H., Hoang, D.M., Kim, B.Y., Sohn, C.B., Kim, M.R., Ahn, J.S.
Genistein-derivatives from Tetracera scandens stimulate glucose-uptake in L6 myotubes (Open Access)

(2009) *Biological and Pharmaceutical Bulletin*, 32 (3), pp. 504-508. Cited 45 times.
http://www.jstage.jst.go.jp/article/bpb/32/3/504/_pdf
doi: 10.1248/bpb.32.504

View at Publisher

22 Murugesu, S., Ahmed, Q.U., Uzir, B.F., Nik Yusoff, N.I., Perumal, V., Ibrahim, Z., Abas, F., (...), Khatib, A.
Rapid investigation of α-glucosidase inhibitory activity of Clinacanthus nutans leaf using infrared fingerprinting

(2019) *Vibrational Spectroscopy*, 100, pp. 22-29. Cited 2 times.
http://www.elsevier.com/locate/vibspec
doi: 10.1016/j.vibspec.2018.10.007

View at Publisher

23 Saleh, M.S.M., Siddiqui, M.J., Mat So'ad, S.Z., Roheem, F.O., Saidi-Besbes, S., Khatib, A.
Correlation of FT-IR fingerprint and α-glucosidase inhibitory activity of salak (salacca zalacca) fruit extracts utilizing orthogonal partial least square (Open Access)

(2018) *Molecules*, 23 (6), art. no. 1434. Cited 2 times.
http://www.mdpi.com/1420-3049/23/6/1434/pdf
doi: 10.3390/molecules23061434

View at Publisher

24 Robinson, A.R., Gheneim, R., Kozak, R.A., Ellis, D.D., Mansfield, S.D.
The potential of metabolite profiling as a selection tool for genotype discrimination in Populus (Open Access)

(2005) *Journal of Experimental Botany*, 56 (421), pp. 2807-2819. Cited 34 times.
doi: 10.1093/jxb/eri273

View at Publisher

25 Yamamoto, K., Miyake, H., Kusunoki, M., Osaki, S.
Crystal structures of isomaltase from Saccharomyces cerevisiae and in complex with its competitive inhibitor maltose

(2010) *FEBS Journal*, 277 (20), pp. 4205-4214. Cited 110 times.
http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1742-4658
doi: 10.1111/j.1742-4658.2010.07810.x

View at Publisher

26 Imran, S., Taha, M., Ismail, N.H., Kashif, S.M., Rahim, F., Jamil, W., Hariono, M., (...), Wahab, H.
Synthesis of novel flavone hydrazones: In-vitro evaluation of α-glucosidase inhibition, QSAR analysis and docking studies

(2015) *European Journal of Medicinal Chemistry*, 105, pp. 156-170. Cited 55 times.
http://www.journals.elsevier.com/european-journal-of-medicinal-chemistry/
doi: 10.1016/j.ejmech.2015.10.017

View at Publisher

27 Imran, S., Taha, M., Ismail, N.H., Kashif, S.M., Rahim, F., Jamil, W., Wahab, H., (...), Khan, K.M.
Synthesis, in vitro and Docking Studies of New Flavone Ethers as α-Glucosidase Inhibitors

(2016) *Chemical Biology and Drug Design*, 87 (3), pp. 361-373. Cited 32 times.
http://www.wiley.com/bw/journal.asp?ref=1747-0277
doi: 10.1111/cbdd.12666

View at Publisher

28 Easmin, S., Sarker, M.Z.I., Ghafoor, K., Ferdosh, S., Jaffri, J., Ali, M.E., Mirhosseini, H.
Al-Juhaimi, F.Y.; Perumal, V.; Khatib, A. Rapid investigation of α-glucosidase inhibitory activity of Phaleria macrocarpa extracts using FTIR-ATR based fingerprinting
(2016) *J. Food Drug Anal*, pp. 1-10.

29 Kim, S.-J., Jeong, S.-H., Hur, Y.-Y., Jung, S.-M.
Metabolite profiling of four different tissue locations in grape leaf of brown spot disease caused by Pseudocercospora vitis

(2015) *Plant OMICS*, 8 (6), pp. 523-528. Cited 2 times.
http://www.pomics.com/kim_8_6_2015_523_528.pdf

30 Alam, M.A., Zaidul, I.S.M., Ghafoor, K., Sahena, F., Hakim, M.A., Rafii, M.Y., Abir, H.M., (...), Khatib, A.
In vitro antioxidant and, α-glucosidase inhibitory activities and comprehensive metabolite profiling of methanol extract and its fractions from Clinacanthus nutans (Open Access)

(2017) *BMC Complementary and Alternative Medicine*, 17 (1), art. no. 181. Cited 8 times.
http://www.biomedcentral.com/bmccomplementalternmed/
doi: 10.1186/s12906-017-1684-5

View at Publisher

31 Collado-González, J., Grosso, C., Valentão, P., Andrade, P.B., Ferreres, F., Durand, T., Guy, A., (...), Gil-Izquierdo, Á.
Inhibition of α-glucosidase and α-amylase by Spanish extra virgin olive oils: The involvement of bioactive compounds other than oleuropein and hydroxytyrosol

(2017) *Food Chemistry*, 235, pp. 298-307. Cited 25 times.
www.elsevier.com/locate/foodchem
doi: 10.1016/j.foodchem.2017.04.171

View at Publisher

32 Indrianingsih, A.W., Tachibana, S.
α-Glucosidase inhibitor produced by an endophytic fungus, Xylariaceae sp. QGS 01 from Quercus gilva Blume
(2017) *Food Sci. Hum. Wellness*, 6, pp. 88-95. Cited 15 times.

33 Liu, B., Kongstad, K.T., Wiese, S., Jäger, A.K., Staerk, D.
Edible seaweed as future functional food: Identification of α-glucosidase inhibitors by combined use of high-resolution α-glucosidase inhibition profiling and HPLC-HRMS-SPE-NMR

(2016) *Food Chemistry*, 203, pp. 16-22. Cited 44 times.
www.elsevier.com/locate/foodchem
doi: 10.1016/j.foodchem.2016.02.001

View at Publisher

34 Miyazawa, M., Yagi, N., Taguchi, K.
Inhibitory Compounds of α-Glucosidase Activity from Arctium lappa L (Open Access)

(2005) *Journal of Oleo Science*, 54 (11), pp. 589-594. Cited 22 times.
doi: 10.5650/jos.54.589

View at Publisher

35 Su, C.-H., Lai, M.-N., Ng, L.-T.
Inhibitory effects of medicinal mushrooms on α-amylase and α-glucosidase – enzymes related to hyperglycemia

(2013) *Food and Function*, 4 (4), pp. 644-649. Cited 27 times.
doi: 10.1039/c3fo30376d

View at Publisher

36 Kumar, S., Kumar, V., Prakash, O.
Enzymes inhibition and antidiabetic effect of isolated constituents from Dillenia indica (Open Access)

(2013) *BioMed Research International*, 2013, art. no. 382063. Cited 29 times.
doi: 10.1155/2013/382063

View at Publisher

37 Ortiz-Andrade, R.R., García-Jiménez, S., Castillo-España, P., Ramírez-Ávila, G., Villalobos-Molina, R., Estrada-Soto, S.

α-Glucosidase inhibitory activity of the methanolic extract from Tournefortia hartwegiana: An anti-hyperglycemic agent

(2007) *Journal of Ethnopharmacology*, 109 (1), pp. 48-53. Cited 154 times.
doi: 10.1016/j.jep.2006.07.002

View at Publisher

38 Malik, E.M., Müller, C.E.

Anthraquinones As Pharmacological Tools and Drugs

(2016) *Medicinal Research Reviews*, 36 (4), pp. 705-748. Cited 75 times.
http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1098-1128
doi: 10.1002/med.21391

View at Publisher

39 Zengin, G., Locatelli, M., Ceylan, R., Aktumsek, A.

Anthraquinone profile, antioxidant and enzyme inhibitory effect of root extracts of eight Asphodeline taxa from Turkey: can Asphodeline roots be considered as a new source of natural compounds? (Open Access)

(2016) *Journal of Enzyme Inhibition and Medicinal Chemistry*, 31 (5), pp. 754-759. Cited 41 times.
doi: 10.3109/14756366.2015.1063623

View at Publisher

40 Jung, H.A., Ali, M.Y., Choi, J.S.

Promising inhibitory effects of anthraquinones, naphthopyrone, and naphthalene glycosides, from Cassia obtusifolia on α-glucosidase and human protein tyrosine phosphatases 1B (Open Access)

(2017) *Molecules*, 22 (1), art. no. 28. Cited 19 times.
http://www.mdpi.com/1420-3049/22/1/28/pdf
doi: 10.3390/molecules22010028

View at Publisher

41 Kang, W., Yu, H., Wang, J.

Bglucosidase inhibitory compounds from seeds of cassia obtusifolia

(2012) *Chemistry of Natural Compounds*, 48 (3), pp. 465-466. Cited 4 times.
http://www.kluweronline.com/issn/0009-3130
doi: 10.1007/s10600-012-0275-4

View at Publisher

42 Xu, Y.-L., Tang, L.-Y., Zhou, X.-D., Zhou, G.-H., Wang, Z.-J.

Five new anthraquinones from the seed of Cassia obtusifolia

(2015) *Archives of Pharmacal Research*, 38 (6), pp. 1054-1058. Cited 13 times.
http://www.springerlink.com/content/0253-6269
doi: 10.1007/s12272-014-0462-x

View at Publisher

43 Yang, D., Zhao, J., Liu, S., Song, F., Liu, Z.

The screening of potential α-glucosidase inhibitors from the Polygonum multiflorum extract using ultrafiltration combined with liquid chromatography-tandem mass spectrometry

(2014) *Analytical Methods*, 6 (10), pp. 3353-3359. Cited 18 times.
http://www.rsc.org/Publishing/Journals/AY/About.asp
doi: 10.1039/c4ay00064a

View at Publisher

44 Torres-Naranjo, M., Suárez, A., Gilardoni, G., Cartuche, L., Flores, P., Morocho, V.

Chemical constituents of Muehlenbeckia tamnifolia (Kunth) meisn (Polygonaceae) and Its in Vitro α-amilase and α-glucosidase inhibitory activities (Open Access)

(2016) *Molecules*, 21 (11), art. no. 1461. Cited 40 times.
http://www.mdpi.com/1420-3049/21/11/1461/pdf
doi: 10.3390/molecules21111461

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Siddiqui, M.J.; Department of Pharmaceutical Chemistry, Kulliyyah of Pharmacy, International Islamic University Malaysia, Indera Mahkota, Kuantan, Pahang, Malaysia; email:siddiquijamshed@hotmail.com

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