Scopus

Documents

Ahda, M.[a b] , Jaswir, I.[c d] , Khatib, A.[b] , Ahmed, Q.U.[b] , Mahfudh, N.[a] , Ardini, Y.D.[e] , Rohman, A.[f]

FTIR fingerprinting profiling, antioxidant activity, and α-glucosidase inhibitory activity of Orthosiphon stamineus leaf ethanolic extracts

(2023) *International Journal of Food Properties*, 26 (1), pp. 2025-2038.

DOI: 10.1080/10942912.2023.2241660

[a] Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[b] Department of Pharmaceutical Chemistry, Faculty of Pharmacy, International Islamic University Malaysia, Kuantan, Malaysia
[c] Department of Pharmaceutical Technology, Faculty of Pharmacy, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[d] INHART, International Islamic University Malaysia, Kuala Lumpur, Malaysia
[e] Paediatric Dentistry and Dental Public Health Department, Kulliyyah of Dentistry, International Islamic University Malaysia, Kuantan, Malaysia
[f] Center of Excellence, Institute of Halal Industry and Systems (PUI-PT IHIS), Gadjah Mada University, Yogyakarta, Indonesia

Abstract
Orthosiphon stamineus Benth (O. stamineus) leaves are herb plant parts that can act as an antioxidant and α-glucosidase inhibitor. Finding the best O. stamineus extract that serves as an antioxidant and α-glucosidase inhibitory agent is an essential requirement. Additionally, a clustering analysis based on FTIR spectra should be performed using principal component analysis (PCA) and partial least squares (PLS). Based on this study, the 40% ethanolic extract of O. stamineus leaves is a potent extract as an antioxidant and α-glucosidase inhibitory agent. Whereas 20% ethanolic extract of O. stamineus leaves is only applied as an α-glucosidase agent. Furthermore, discrimination analysis of O. stamineus leaf extracts showed that FTIR-based analysis can discriminate nicely each water, 60%, 80%, and 100% ethanolic extracts. This study reported that the obtained model has the determination coefficient of R2X: 0.991, R2Y: 0.964, and Q2Y: 0.946, which showed a good model and a good prediction. However, the classification method did not distinguish clearly between 20% and 40% ethanolic extracts. 20% ethanolic extract of O. stamineus leaves is always paired with 40% ethanolic extract of O. stamineus. Furthermore, several functional groups from O. stamineus leaf extracts contribute toward both biological activities including alkane groups, carbonyl groups, methylene groups, ester groups, and alkyl di-substitutions. Based on this study, quality control of potent extract as an antioxidant and as an α-Glucosidase Inhibitor should be conducted using a specific marker-based analysis. © 2023, Published with license by Taylor & Francis Group, LLC. © 2023 Mustofa Ahda, Irwandi Jaswir, Alfi Khatib, Qamar Uddin Ahmed, Nurkhasanah Mahfudh, Yunita Dewi Ardini and Abdul Rohman.

Author Keywords
antioxidant; infrared fingerprinting; quality control; α-glucosidase inhibitory agent

Index Keywords
Antioxidants, Fourier transform infrared spectroscopy, Least squares approximations, Plant extracts, Principal component analysis; Antioxidant activities, Ethanolic extracts, FTIR, Glucosidase, Glucosidase inhibitors, Infrared fingerprinting, Inhibitory activity, Leaf extracts, Orthosiphon stamineus, A-glucosidase inhibitory agent; Quality control

References

- Yu, F., Takahashi, T., Moriya, J., Kawaura, K., Yamakawa, J., Kusaka, K., Itoh, T., Kanda, T.
  Traditional Chinese Medicine and Kampo: A Review from the Distant Past for the Future
  (2006) *J. Int. Med. Res*, 34 (3), pp. 231-239.
- Motoo, Y., Seki, T., Tsutani, K.
  Traditional Japanese Medicine, Kampo: Its History and Current Status
  (2011) *Chin. J. Integr. Med*, 17 (2), pp. 85-87.
- Lele, R.D.
  (2021) *History of Medicine in India, National Centre of Indian Medical Heritage Central Council for Research in Ayurvedic Sciences (CCRAS)*,
  Ministry of AYUSH, Government of India, New dehli, India

- Hossain, M.A., Mizanur Rahman, S.M.
  Isolation and Characterisation of Flavonoids from the Leaves of Medicinal Plant Orthosiphon Stamineus
  (2015) *Arabian J. Chem*, 8 (2), pp. 218-221.

- Ashraf, K., Sultan, S., Adam, A.
  Orthosiphon Stamineus Benth. is an Outstanding Food Medicine: Review of Phytochemical and Pharmacological Activities
  (2018) *J. Pharm. Bioallied Sci*, 10 (3), pp. 109-118.
  Accessed Jul-Sep 2018

- Retinasamy, T., Shaikh, M.F., Kumari, Y., Zainal Abidin, S.A., Othman, I.
  Orthosiphon Stamineus Standardized Extract Reverses Streptozotocin-Induced Alzheimer's Disease-Like Condition in a Rat Model
  (2020) *Biomed*, 8 (5), p. 104.

- Hemmami, H., Seghir, B.B., Zeghoud, S., Ben Amor, I., Kouadri, I., Rebiai, A., Zaater, A., Sawicka, B.
  Desert Endemic Plants in Algeria: A Review on Traditional Uses, Phytochemistry, Polyphenolic Compounds, and Pharmacological Activities
  (2023) *Molecules*, 28 (4), p. 1834.

- Khalil, N., El-Jalel, L., Yousif, M., Gonaid, M.
  Altitude Impact on the Chemical Profile and Biological Activities of Satureja Thymbra L. Essential Oil
  (2020) *BMC Complement. Med. Ther*, 20, p. 186.

- Sukweenadhi, J., Yunita, O., Setiawan, F., Kartini, S., Danduru, M.T., Avanti, A.P., Avanti, C.
  Antioxidant Activity Screening of Seven Indonesian Herbal Extract
  (2020) *Biodiversitas*, 21 (5), pp. 2062-2067.

- Wang, C.Z., Ni, M., Sun, S., Li, X.L., He, H., Mehendale, S.R., Yuan, C.-S.
  Detection of Adulteration of Notoginseng Root Extract with Other Panax Species by Quantitative HPLC Coupled with PCA
  (2009) *J. Agric. Food Chem*, 57 (6), pp. 2363-2367.

- Bampali, E., Germer, S., Bauer, R., Kulić, Z.
  HPLC-UV/HRMS Methods for the Unambiguous Detection of Adulterations of Ginkgo Biloba Leaves with Sophora Japonica Fruits on an Extract Level
  (2021) *Pharm. Biol*, 59 (1), pp. 438-443.

- Pratiwi, R., Dipadharma, R.H.F., Prayugo, I.J., Layandro, O.A.
  Recent Analytical Method for Detection of Chemical Adulterants in Herbal Medicine
  (2021) *Molecul*, 26 (21), p. 6606.

- Juliani, Y., Budijanto, N.D., Wijaya, C.H., Khatib, A.
  α-Glucosidase Inhibitors and Antioxidant Compounds from Orthosiphon Stamineus Benth Using FTIR Based Metabolomic
  (2016) *J. Teknologi dan Industr. Panagan*, 27 (1).

- Nipun, T.S., Khatib, A., Ahmed, Q.U., Redzwan, I.E., Ibrahim, Z., Khan, A.Y.F., Primaharinastiti, R., El-Seedi, H.R.
  Alpha-Glucosidase Inhibitory Effect of Psychotria Malayana Jack Leaf: A Rapid Analysis Using Infrared Fingerprinting
  (2020) *Molecul*, 25 (18), p. 4161.

- Sulaiman, N., Idayu, M.I., Ramlan, A.Z., Fasha, M.N., Farahiyah, A.N.N., Mailina, J., Azah, M.A.N.
  Effect of Extraction Methods on Yields, Chemical Compounds of Gaharu (Aquilaria

malaccensis)
(2015) *J. Trop. Forest Sci*, 27 (3), pp. 413-419.

- Li, X., Zhu, F., Zeng, Z.
Effects of Different Extraction Methods on Antioxidant Properties of Blueberry Anthocyanins
(2020) *Open Chem.*, 19 (1), pp. 138-148.

- Ahda, M., Lestari, W., Rahayu, T.
Total Phenol Content and Antioxidant Activity of Various Concentration of Ethanol Extract of Psidium Guajava L
(2019) *Int. J. Pharm.Res*, 11 (3), pp. 1077-1082.

- Chandra, S., Khan, S., Avula, B., Lata, H., Yang, M.H., ElSohly, M.A., Khan, I.A.
Assessment of Total Phenolic and Flavonoid Content, Antioxidant Properties, and Yield of Aeroponically and Conventionally Grown Leafy Vegetables and Fruit Crops: A Comparative Study
(2014) *Evid. Based Complement. Altern. Med*, pp. 1-9.

- Byun, N.Y., Heo, M.R., Yim, S.H.
Correlation of Anti-Wrinkling and Free Radical Antioxidant Activities of Areca Nut with Phenolic and Flavonoid Contents
(2021) *Food Sci. Technol*, 41 (4), pp. 1041-1049.

- Chelladurai, G.R.M., Chinnachamy, C.
Alpha Amylase and Alpha Glucosidase Inhibitory Effects of Aqueous Stem Extract of Salacia Oblonga and Its GC-MS Analysis
(2018) *Braz. J. Pharm. Sci*, 54 (1), pp. 1-10.

- Setford, P.C., Jeffery, D.W., Grbin, P.R., Muhlack, R.A.
Factors Affecting Extraction and Evolution of Phenolic Compounds During Red Wine Maceration and the Role of Process Modelling
(2017) *Trends Food Sci. Technol*, 69, pp. 106-117.

- Mariya John, K.M., Vijayan, D., Raj Kumar, R., Premkumar, R.
Factors Influencing the Efficiency of Extraction of Polyphenols from Young Tea Leaves
(2006) *Asian J. Plant Sci*, 5 (1), pp. 123-126.

- Abdul Razak, M.F.B., Yong, P.K., Shah, M.D., Abdullah, L.C., Yee, S.S., Yaw, T.C.S.
The Effect of Varying Solvent Polarity on Extraction Yields of Orthosiphon Stamineus Leaves
(2012) *J. Appl. Sci*, 12 (11), pp. 1207-1210.

- Bingol, Z., Kızıltaş, H., Gören, A.C., Kose, L.P., Topal, M., Durmaz, L., Alwasel, S.H., Gulcin, İ.
Antidiabetic, Anticholinergic and Antioxidant Activities of Aerial Parts of Shaggy Bindweed (Convulvulus Betonicifolia Miller Subsp.)–Profiling of Phenolic Compounds by LC-HRMS
(2021) *Heliyon*, 7 (5).

- Phong, H.X., Viet, N.T., Quyen, N.T.N., Thinh, P.V., Trung, N.M., Ngan, T.T.K.
Phytochemical Screening, Total Phenolic, Flavonoid Contents, and Antioxidant Activities of Four Spices Commonly Used in Vietnamese Traditional Medicine
(2021) *Mater. Today Proc*, 56, pp. 1-5.

- Zhang, J., Wang, J., Brodbelt, J.S.
Characterization of Flavonoids by Aluminum Complexation and Collisionally Activated Dissociation
(2005) *J. Mass. Spectrom*, 40 (3), pp. 350-363.
Mar, PMID: 15674859

- Wang, X., Zhao, W., Zhang, X., Wang, Z., Han, C., Xu, J., Yang, G., Li, Z.
The Prediction of Active Ingredients and Polypharmacological Mechanisms of Orthosiphon Stamineus Benth. (Lamiaceae) of Dai Medicine Based on Network Pharmacology
(2021) *bioRxiv*, pp. 1-24.

- Bassalat, N., Kadan, S., Melamed, S., Yaron, T., Tietel, Z., Karam, D., Kmail, A., Zaid, H.
In vivo and in vitro Antidiabetic Efficacy of Aqueous and Methanolic Extracts of Orthosiphon Stamineus Benth
(2023) *Pharmaceut*, 15 (3), p. 945.

- Kamarudin, N.A., Markom, M., Latip, J.
Effects of Solvents and Extraction Methods on Herbal Plants Phyllanthus Niruri, Orthosiphon Stamineus and Labisia Pumila
(2016) *Indian J. Sci. Technol*, 9 (21).

- Damsud, T., Grace, M.H., Adisakwattana, S., Phuwapraisirisan, P.
Orthosiphol a from the Aerial Parts of Orthosiphon Aristatus is Putatively Responsible for Hypoglycemic Effect via α-Glucosidase Inhibition
(2014) *Nat. prod. communicat*, 9 (5).
1934578X1400900

- Saidan, N.H., Hamil, M.S.R., Memon, A.H., Abdelbari, M.M., Hamdan, M.R., Mohd, K.S., Abdul Majid, A.M.S., Ismail, Z.
Selected Metabolites Profiling of Orthosiphon Stamineus Benth Leaves Extracts Combined with Chemometrics Analysis and Correlation with Biological Activities
(2015) *BMC Complementary Altern. Med*, 15 (1).

- Islam, A.K.M.S., Ahmad, M.N., Mee Sim, M.Y., Ismail, Z., Noor, A.M.
Quantification of Bioactive Caffeic Acid in Orthosiphon Stamineus Benth Using a Disposable Taste Sensor
(2016) *Int. J. Electrochem. Sci*, 11 (1), pp. 322-332.

- Aziz, Z., Yuliana, N.D., Simanjuntak, P., Rafi, M., Syamsudin, S.
FTIR and HPLC-Based Metabolomics of Yacon Leaves Extracts (Smallanthus Sonchifolius [Poepp & Endl.] H. Robinson) from Two Locations in Indonesia
(2020) *Indones. J. Chem*, 20 (3), pp. 567-578.

- Tew, W.Y., Ying, C., Wujun, Z., Baocai, L., Yoon, T.L., Yam, M.F., Jingying, C.
Application of FT-IR Spectroscopy and Chemometric Technique for the Identification of Three Different Parts of Camellia Nitidissima and Discrimination of Its Authenticated Product
(2022) *Front. Pharmacol*, 13, p. 931203.

- Huang, B., Chen, T., Xiao, S., Zha, Q., Luo, P., Wang, Y., Cui, X., Zhou, H.
A New Approach for Authentication of Four Ginseng Herbs and Their Related Products Based on the Simultaneous Quantification of 19 Ginseng Saponins by UHPLC-TOF/MS Coupled with OPLS-DA
(2017) *R.S.C. Adv*, 7 (74), pp. 46839-46851.

- Easmin, S., Sarker, M.Z.I., Ghafoor, K., Ferdosh, S., Jaffri, J., Ali, M.E., Mirhosseini, H., Khatib, A.
Rapid Investigation of α-Glucosidase Inhibitory Activity of Phaleria Macrocarpa Extracts Using FTIR-ATR Based Fingerprinting
(2017) *J. Food Drug. Anal*, 25 (2), pp. 306-315.

- Tsanaktsidou, E., Karavasili, C., Zacharis, C.K., Fatouros, D.G., Markopoulou, C.K.
Partial Least Square Model (PLS) as a Tool to Predict the Diffusion of Steroids Across Artificial Membranes
(2020) *Molecul*, 25 (6), p. 1387.

- Fatmarahmi, D.C., Susidarti, R.A., Swasono, R.T., Rohman, A.
  A Development Method of FTIR Spectroscopy Coupled with Chemometrics for Detection of Synthetic Drug Adulterants of Herbal Products in Quaternary Mixture
  (2022) *J. Appl. Pharm. Sci*, 12 (3), pp. 191-201.

Correspondence Address
Ahda M.; Department of Pharmaceutical Chemistry, Indonesia; email: mustofa_ahda@yahoo.com

Publisher: Taylor and Francis Ltd.

ISSN: 10942912
CODEN: IJFPF
Language of Original Document: English
Abbreviated Source Title: Int. J. Food Prop.
2-s2.0-85166970912
Document Type: Article
Publication Stage: Final
Source: Scopus