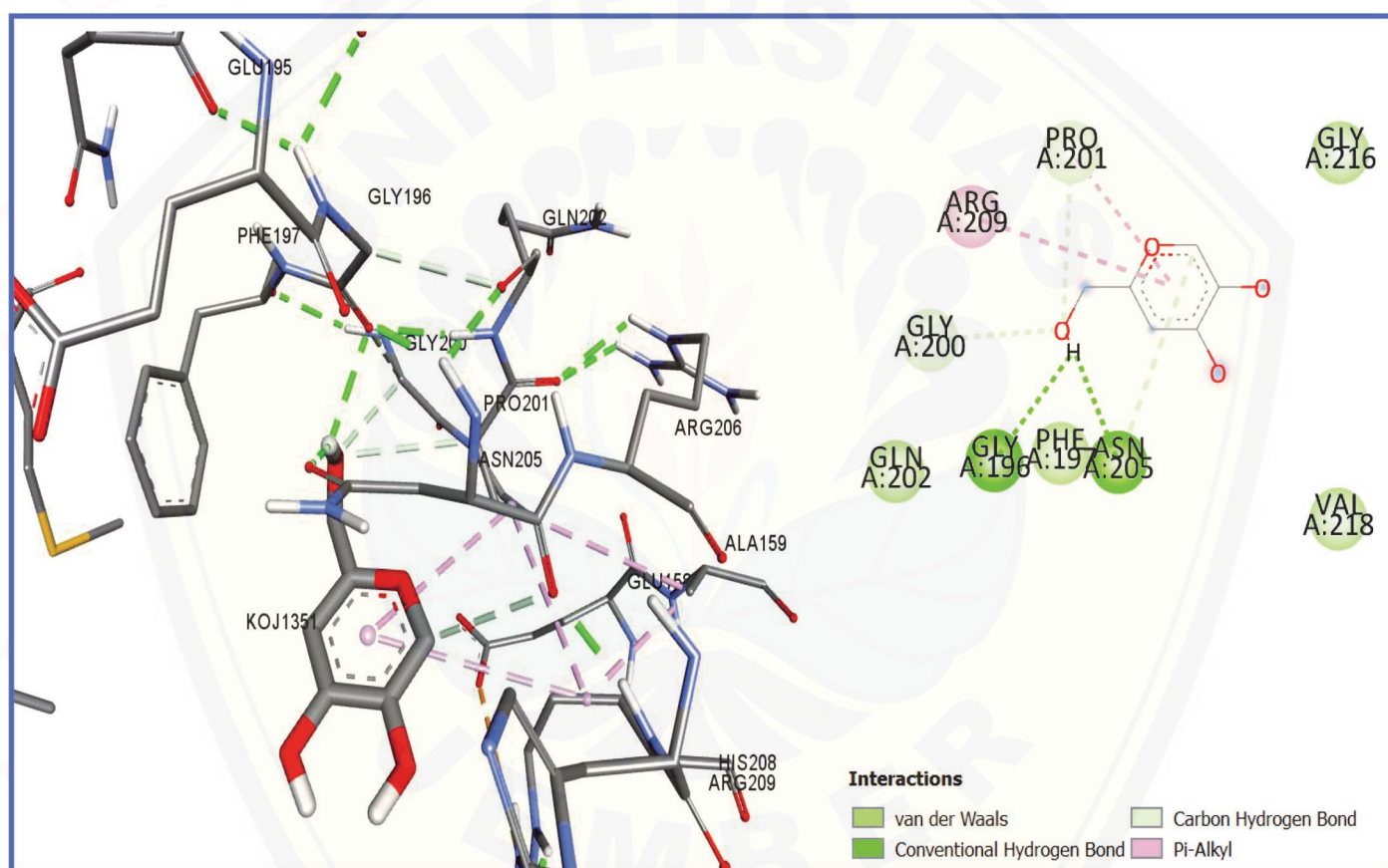


RASĀYAN

Journal of Chemistry

(An International Quarterly Research Journal of Chemical Sciences)



<http://doi.org/10.31788/RJC.2021.1446418>



Editorial Board

Editor-in-Chief:

Sanjay K. SHARMA, FRSC

Professor, Department of Chemistry &
Dean(Research), JECRC University, Jaipur, India

Contact: +91 9001699997

Email: editor@rasayanjournal.com,

Research Interest: Green Chemistry, Organic Chemistry and Water treatment

Editorial Office:

Pratima SHARMA

Publisher and Managing Editor,

RASĀYAN Journal of Chemistry,

23 'Anukampa', Janakpuri, Opp. Heerapura Power Stn.,Ajmer Road, Jaipur-302024 (India)

Contact: 9414202678

Email: rasayanjournal@gmail.com

Bassim H. Hammadi

Department of Chemical Engineering, College of Engineering, Qatar University, P.O. Box 2713, Doha, Qatar

Contact: +97440434142

Email: b.hammadi@qu.edu.qa

Research Interest: Reaction Engineering, Adsorption Technology

Eno E. EBENSO

Professor, North-West University Gauteng, South Africa

Contact: +27825387286

Email: Eno.Ebenso@nwu.ac.za

Research Interest:

Florent ALLAIS

Director, R&D Unit of Industrial Agro-Biotechnologies URD ABI- AgroParis Tech, Pomacle, France

Contact: +33 633 698 126

Email: Florent.allais@agroparistech.fr

Research Interest: Green Chemistry, Bio-based Polymers

Giusy LOFRANO

Department of Environment, University of Salerno, Salerno, Italy

Contact: 0039 347 90 60 670

Email: glofrano@unisa.it

Research Interest: nanotechnologies, wastewater treatment, advanced oxidation processes

Goutam BRAHMACHARI

Professor, Chemistry Department, Visva-Bharati University, Santiniketan-731235, India.

Contact: +91 943485744

Email: goutam.brahmachari@visva-bhartai.ac.in

Research Interest: Organic Synthesis; Green Chemistry; Natural products, Medicinal Chemistry

Hakan ARSLAN

Department of Chemistry, Faculty of Arts and Science, Mersin University, Mersin, TR-33343, Turkey

Contact: +90.532.7073122

Email: hakan.arslan@mersin.edu.tr

Research Interest: Coordination chemistry, Heterocyclic Chemistry, Kinetic Studies, X-ray diffraction studies, Spectroscopy

Ishmael MASESANE

Professor, Department of Chemistry, University of Botswana, Botswana

Contact: 26772874348

Email: MASESANE@UB.AC.BW

Research Interest: Organic synthesis, Natural product Chemistry, Medicinal Chemistry

Ime Bassey OBOT

Center of Research Excellence in Corrosion Research Institute, King Fahd University of Petroleum and Minerals (KFUPM), P.O. Box 489, Dhahran, 31262, Saudi Arabia

Contact: +966 13 860-8283

Email: obot@kfupm.edu.sa

Research Interest: Corrosion and Scale Inhibition, Chemo-informatics, Computational Chemistry.

Marei Mailoud EL-AJAILY

University of Benghazi, Faculty of Science, Department of Chemistry, Benghazi, Libya

Contact: 00218918315683

Email: melajaily@gmail.com

Research Interest: Mixed ligand complexes, Drugs, Applications, Corrosion inhibition, Molecular docking, DFT studies

Man SINGH

Professor and Dean, school of Chemical sciences, Gujrat central University, Gandhinagar, Gujrat, India

Contact: +91 9408635094

Email: mansingh50@hotmail.com

Research Interest: Surface Chemistry, Physical Chemistry

Mika SILLANPÄÄ

Department of Chemical Engineering, School of Mining, Metallurgy and Chemical Engineering, University of Johannesburg, Doornfontein 2028, South Africa

Contact: +358400205215

Email: mikaesillanpaa@gmail.com

Research Interest: Water treatment

Nnabuk Okon EDDY

Professor, Department of Chemistry, Ahmadu Bello University, Zaria, Kaduna State, Nigeria

Contact: +2348038198753

Email: nabukeddy@yahoo.com

Research Interest: Physical Chemistry, Computational Chemistry, Nanochemistry, Industrial Chemistry, Environmental Chemistry

Pankaj KUMAR

Professor and Head, Department of Chemistry, University of Energy and Petroleum studies, Dehradun, India

Contact: +917351958165

Email: pkumar@ddn.upes.ac.in

Research Interest: Biofuels and Bioenergy, Chemical sensors, Nano-materials, Minimization of industrial wastes

Priyan PERERA

Director - Center for Sustainability

Department of Forestry and Environmental Science

University of Sri Jayewardenepura, Sri Lanka

Contact: +94 718656457

Email: priyan@sjp.ac.lk

Research Interest: Environmental Sustainability, Ecology

R.V. SINGH

Ex Professor, Department of Chemistry, University of Rajasthan, Jaipur, India

Contact: +91 941406975

Email: rvsjpr@hotmail.com
Research Interest: Inorganic Chemistry

Ramesh. L. GARDAS

Department of Chemistry Indian Institute of Technology Madras Chennai-600 036, India
Contact: +91 9884996125
Email: gardas@iitm.ac.in
Research Interest: Physical Chemistry, Chemical Thermodynamics, Alternative Solvents

Soro YAYA

Laboratoire des Procédés Industriels de Synthèse, de l'Environnement et des Energies Nouvelles (LAPISEN), Institut National Polytechnique (INP-HB), Yamoussoukro, BP 991 Yamoussoukro (Côte d'Ivoire)
Contact: (+225) 07 71 67 66
Email: soro_y@yahoo.fr
Research Interest: Organic synthesis, Natural Products, waste management

Susheel MITTAL

Senior Professor, School of Chemistry & Biochemistry, Thapar Institute of Engineering & Technology (Deemed to be University), Bhadson Road, Patiala-147004, India
Contact: +91-9815653261
Email: smittal2001@yahoo.com
Research Interest: Voltammetric Sensors, Potentiometric Sensors, Biosensors, Ambient Air Quality and Human Health

V.K. GARG

Professor and Dean Centre for Environmental Science and Technology School of Environment and Earth Sciences Central University of Punjab, Bathinda- 151001, India
Contact: +919812058109
Email: vinodkgarg@yahoo.com
Research Interest: Pollution Monitoring and abatement, Solid Waste Management, Radioecology

Willian Aperador CHAPARRO

School of Engineering, Universidad Militar Nueva Granada, Bogotá-111121, Colombia
Contact: + 57 3142220552
Email: william.aperador@unimilitar.edu.co
Research Interest: Materials, batteries, corrosion, coatings, tribology

Volume 14 Number 4, October- December(2021)

SYNTHESIS AND STUDIES ON AROMATIC COPOLYESTER WITH ANTICANCER ACTIVITY DERIVED FROM 4,4'-DIHYDROXYBIPHENYL AND 3,5-DIHYDROXYTOLUENET. Sivaramakrishnan and G. Elango

OXIDATION KINETICS AND MECHANISTIC STUDIES OF THIOACIDS BY IMIDAZOLIUM DICHROMATERuchi Kalla, Devendra Kumar, Anurag Choudhary and Vinita Sharma

GENUS *Pothos*: A REVIEW OF CHEMICAL CONSTITUENTS AND BIOLOGICAL ACTIVITIESD. Dutta, M. J. Bordoloi, and N. K. Bhattacharyya

COAL MINING WASTE IS A VALUABLE SECONDARY RAW MATERIALU. Nazarbek, P.Abdurazova, S. Nazarbekova, M. Kambatyrov and Y. Raiymbekov

GELATIN AS A CORROSION BIOINHIBITOR AT SALINE MEDIA FROM FISH BONE OF MACKEREL (*Scomberomorus sp*)Fataa Kusumattaqiin, Bagus Agam Pradana, Abdul Halim

QBD BASED ANALYTICAL METHOD DEVELOPMENT AND VALIDATION FOR THE SEPARATION AND QUANTIFICATION OF AGOMELATINE AND ITS IMPURITIES IN SOLID ORAL DOSAGE FORMS USING HPLCSomana Siva Prasad, Bikshal Babu Kasimala and Venkateswara Rao Anna

TWO STEP SYNTHESIS OF INDAZOLE DERIVATIVES AND THEIR ANTI-CANCER EVALUATIONG. Laxman, Jagadeesh Kumar Ega and Kavitha Siddoju

DISPERSION BEHAVIOR OF CATIONIC SURFACTANT TREATED REDUCED GRAPHENE OXIDE IN DIFFERENT SOLVENTSK.N. Amba Sankar, P. Nandakumar, C. Sathishkumar, R. Deepa and Kallol Mohanta

ELECTROCHEMICAL BEHAVIOR OF MANGANESE DIOXIDE WHEN A PART OF THE COMPOSITE ELECTRODE AND ELECTROCHEMICAL LEACHING OF MANGANESE ORE IN A SULFURIC ACID MEDIUMA.B. Makhanbetov, B.E. Myrzabekov, T.E. Gaipov, A.Tazhibayev and U.A. Abduvaliyeva

CONTROLLED RELEASE STUDIES OF HYDROXYCHLOROQUINE SULPHATE (HCQ) DRUG-USING BIODEGRADABLE POLYMERIC SODIUM ALGINATE AND LIGNOSULPHONIC ACID BLENDSS. Giridhar Reddy

SYNTHESIS AND TESTING CATALYSTS BASED ON FLY ASH FROM THERMAL POWER PLANTS AND NATURAL ZEOLITE FOR GAS EMISSIONS PURIFICATION AND CATALYTIC PROCESSING OF HEAVY OILT.V. Shakiyeva, L. R. Sassykova, A.A. Khamlenko, A.R. Sassykova, A.A. Batyrbayeva, Zh. M. Zhaxibayeva, M. A. Kozhaisakova, A. Muratova, B.T. Dossumova, T. S. Abildin and M. Zhumagali

POLY (VINYL ALCOHOL)/ CARBOXYMETHYL CELLULOSE-SODIUM SALT/ CARROT FIBER-CONTAINING COMPOSITE THIN FILMS: THERMOMECHANICAL AND BIODEGRADATION STUDYSeema Rani, Kapil Gulati, Neera Raghav and Sanjiv Arora

SIMULTANEOUS QUANTIFICATION OF TIAGABINE AND ITS RELATED SUBSTANCE BY A STABILITY INDICATING RP-HPLC METHOD. N. V. Kishore, G.V. Ramana, R. Venkata Nadh and Giri Prasad Gorumutchu

SYNTHESIS, CHARACTERIZATION, ANTIMICROBIAL AND ANTI-INFLAMMATORY STUDIES OF SOME NOVEL SCHIFF BASE METAL COMPLEXES DERIVED FROM THE DRUG, DICLOFENACK. Kondareddy Gopinath Shilpa, Kengunte Halappa Shivaprasad and Medehal Rudrannagari Archana

MINERALOGICAL AND MORPHOLOGICAL CHARACTERIZATION OF ORGANICALLY AMENDED SOIL. Suya Padhra Haridha, F. Jeyamangalam, R. Mary Jenila and S. C. Vella Durai

SOLVATOCHROMIC STUDIES ON 4-(1,4-DIPHENYL-1H-IMIDAZOLE-2-YLTHIO)-2H-CHROMEN-2-ONE. Sujatha and Netravati Khanapurmath

INFLUENCE OF VARIOUS PARAMETERS ON THE DEFLUORINATION OF WET-PROCESS PHOSPHORIC ACID. Shaimerdenova, K. Zhantasov, A. Kadirbayeva, G. Shaimerdenova, G. Jussupbekova, Zh. Iztayev and B. Tastanbekova

In-vitro ANTI-INFLAMMATORY AND ANTI-ARTHRITIC ACTIVITY OF ETHANOLIC EXTRACT OF Hibiscus rosa sinensis LEAVES. Talapudi Sruthi, Chinta Koteswara Rao, R.A. Zerubabel Michael, S. Monica Nissy and D. V. Surya Prakash

ECO-FRIENDLY SYNTHESIS, SPECTRAL AND BIOPOTENTIAL INVESTIGATION OF Zn(II) AND Ni(II) COMPLEXES WITH BIO-ACTIVE SCHIFF BASE. Veeravel, K. Rajasekar, S. Balasubramaniyan and R. Selvarani

MODIFIED MAGNETIC CHITOSAN FOR METHYLENE BLUE ADSORPTION. Haya Fathana, Rahmi, Susilawati, Muhammad Adlim and Surya Lubis

MOLECULAR INTERACTION OF CURCUMIN, DEMETHOXYCURCUMIN, BISDEMETHOXYCURCUMIN, AND TURMERONE OF Curcuma longa WITH TYROSINASE AND TYROSINASE-RELATED PROTEIN-1D. Firmansyah, S. A. Sumiwi, N. M. Saptarini and J. Levita

EXTRACTION OF NON-FERROUS METALS AND RHENIUM FROM LEAD DUSTS OF COPPER PRODUCTION. S. Baigenzhenov, A. Akkenzheyeva, M. Turkmenbayeva, M. Kizdarbekova and M. D. Turan

GROWTH OF MULTI-WALLED CARBON NANOTUBES ALONG WITH GRAVITY BY SPRAY PYROLYSIS OF NATURAL PRECURSOR. Kanagaraj, P. Mahalingam, R. Siddharthan and P. Sivakumar

PHYTOCHEMICAL ANALYSIS OF SELECTED INDIAN MEDICINAL PLANTS BY HR-LCMS SPECTRA METHOD. Nateshan Anil and Venkateswara Rao Talluri

GEOCHEMISTRY ANALYSIS OF GROUNDWATER QUALITY: A CASE STUDY OF THE JEUNIB BASIN. Muhammad Irham, Muhammad Irpan, Dewi Sartika, Gartika Setiya Nugraha and Dian Budi Dharma

EFFECT OF DIVINYLBENZENE AND DICUMYL PEROXIDE ON THE PROPERTIES OF STANDARD INDONESIAN RUBBER'S (SIR-3L) BLENDS
Adiansyah, I. Elisabeth Purba, Z. Paulanda, Yusnaidar, I.P. Mahendra and S. Sijabat

EFFECT OF ANNEALING TEMPERATURE AND TIME ON THE PHOTOVOLTAIC PERFORMANCE OF NaSbS₂ SEMICONDUCTOR-SENSITIZED SOLAR CELLS PREPARED BY SILAR METHOD
Siti Utari Rahayu, Ming-Way Lee, Muhammad Noer Nasruddin, Kerista Sebayang and Herty Afrina Sianturi

APPLICATION OF TAMARIND SEEDS BASED CHELATING RESIN IN EFFLUENT TREATMENT
Neha Parihar, Kamini Sharma, Sawai Singh Rathore and Vikal Gupta

ANTIOXIDANT AND ANTIDIABETIC POTENTIALS OF Cucurbita pepo LEAVES EXTRACT FROM THE GULF REGIONS.
Chigurupati, Y.K. AlGobaisy, B. Alkhalifah, A. Alhowail, S. Bhatia, S. Das and S. Vijayabalan

QSAR APPROACH AND SYNTHESIS OF CHALCONE DERIVATIVES AS ANTIMALARIAL COMPOUND AGAINST Plasmodium Falciparum 3D7 Strain
S. S. W. Waskitha, F. E. Mulyana, N. F. Riza, Y. M. Stansyah, I. Tahir and T. D. Wahyuningsih

ABSORPTION CHARACTERISTICS OF NAPA SOIL AS CONGO RED DYE ADSORBENT IN SOLUTION WITH CONTINUOUS SYSTEM
Mawardi Mawardi, Bahrizal Bahrizal, Illyas Md Isa, Syarifah Aini, Rizky Z Putra and Fadhlurrahman Mawardi

THE EFFECT OF NiO LOADS ON CATALYTIC ACTIVITY OF NiO/ZSM-5 FOR TRANSESTERIFICATION OF RUBBER SEED OIL
D. Pandiangan, W. Simanjuntak, D. I. Alista and I. Ilim

WOUND HEALING BIOACTIVITY OF Curcuma Longa Linn
Wardatul Husna Irham and Rini Hardiyanti

SPECTRAL INVESTIGATIONS OF TRIVALENT EUROPIUM (Eu³⁺) IONS DOPED ZnBiNaPSr OXYFLUORIDE GLASSES FOR VISIBLE PHOTONIC DEVICE APPLICATIONS
D. Siva Raju, Megala Rajesh, S. Hima Bindu, J. Suresh Krishna, V. Vinay Krishna, B. Deva Prasad Raju and Ch. Linga Raju

ORGANO-Cu (II) CATALYST: AN EFFICIENT SYNTHESIS OF SUBSTITUTED N-HETEROCYCLES VIA DOUBLE CONDENSATION/ TANDEM OXIDATION/CYCLIZATION/ELIMINATION-CYCLIZATION REACTIONS FROM EASILY ACCESSIBLE PRECURSORS
Bittu Saha, Bijeta Mitra, Suvodip Mukherjee, Raju Subba, Dhiraj Brahmin, Biswajit Sinha and Pranab Ghosh

ELEMENTAL CHARACTERIZATION OF HUMAN BLOOD USING LASER-INDUCED BREAKDOWN SPECTROSCOPY UTILIZING 355 NM Nd: YAG OPERATED AT REDUCED PRESSURE OF He GASES
Khumaeni, W.S. Budi, A.Y. Wardaya, R. Hedwig and K. H. Kurniawan

ISOLATION, CHARACTERIZATION AND ANTIDIABETIC ACTIVITY OF PHENOLIC COMPOUNDS ISOLATED FROM Macaranga magna TURRILL
Minarti, A.H. Cahyana and A. Darmawan

1-(3-ACETYL PHENYL)-4-(4-ARYLIDENE)-2-PHENYL-1HIMIDAZOL-5(4H)-ONES: SYNTHESIS, SPECTROSCOPIC CHARACTERIZATION, ANTIMICROBIAL AND MOLECULAR DOCKING STUDIES. Aparna, D. Sandhya, N. J. P. Subhashini and L. N. Sharada

IMPROVING MECHANICAL AND PHYSICAL PROPERTIES ON THERMOPLASTIC SAGO STARCH BLENDS WITH THE ADDITION OF POLYPROPYLENE. A. Tanjung, N. Jamarun, S. Arief, H. Aziz, A.H. Ritonga and B. Isfa

COMPARITIVE ANALYSIS OF NOX AND SMOKE EMISSIONS OF BINARY DIESEL/ JME BLENDS DOPED WITH Al₂O₃ NANOPARTICLES STABILISED BY DEE AS SOLVENT AND TRITON-X100 and BRIJ58 SURFACTANTS. N.S.C. Chaitanya, Y.V.V. Satyanarayana Murthy, M.R.S. Satyanarayana, Surajith Ghosh and Syed Javed

A REVIEW ON OLIVE OIL AND *Nigella sativa* L. BLACK CUMIN SEED OIL: COMPOSITION AND BIOLOGICAL ACTIVITY. Nesrain Farhan, Nadia Salih and Jumat Salimon

KINETIC STUDIES OF THE UNSATURATED ACIDS, OXIDISED BY PYRIDINIUM DICHROMATE: A MECHANISTIC APPROACH. Varsha Bishnoi, Om Prakash and Pradeep K. Sharma

PHENOMENOLOGICAL MODEL OF UREA WATER SOLUTION DOSAGE STRATEGY FOR UREA-SELECTIVE CATALYTIC REDUCTION SYSTEM. Sadashiva Prabhu S., Nagaraj S. Nayak and Kapilan Natesan

KINETIC STUDIES ON THE SYNTHESIS OF ALKYL DIETHANOLAMIDE FROM *Terminalia catappa* L. SEED OIL. R. Gunawan, D. Suhendra, S.A. Iliyin and L. Kurniawati

EVALUATION OF THE CORROSION INHIBITIVE BEHAVIOUR OF PAWPAW FLUID ON A315 MILD STEEL AND A304 STAINLESS STEEL IN H₂SO₄ MEDIUM. Ayoola A. Ayodeji, Fayomi O. Sunday, Akande I. Godwin and Mgbahurike F. Chinemerem

PHYTOCHEMICAL AND PHARMACOLOGICAL EVALUATION OF A MEDICINAL PLANT OF INDONESIAN TENGGER ETHNIC GROUP. S. Nugraha, I.D. Anggita, A.A.I. Ratnadewi, T.A. Siswoyo, A.N.W. Pratama, R. Hendra and P.A. Keller

DETERMINATION OF THE EFFICIENCY OF HAFNIUM CARBIDE AND TANTALUM CARBIDE COATINGS DEPOSITED ON EXCHANGE MEMBRANE FUEL CELL. Ruiz-Madera, J. Bautista-Ruiz and W. Aperador

SYNTHESIS OF POLYACETYLENES CONTAINING CINNAMATE AND DERIVED CINNAMATE. A. Rahim

SYNTHESIS AND APPLICATION FOR THE REDUCTION OF 4-NITROPHENOL USING PALLADIUM NANOPARTICLES DECORATED GRAPHENE OXIDE. K. Saritha Rani, M. Sankararao and S. Mutta Reddy

LOW-COST CELLULOSIC BIOETHANOL PRODUCTION OF OIL PALM EMPTY FRUIT BUNCHES USING HYDROTHERMAL-ALKALINE PRETREATMENTS SYNERGETICALLY. M. Nurdin, S.P. Simanungkalit, A.S. Muis, D. Wibowo, Z. Arham, L.O.A. Salim, I. Irwan, M. Maulidiyah and H. Abimanyu

DAIRY WASTE WATER: A POWERHOUSE OF MICROBIAL FACTORIES FOR BIODEGRADATION
Neha Sharma, Vipin Saini, Harshita Bhagwani, Neetu Yadav and Darshan Chahar

SAMHONG MUSTARD CULTIVATION BY UTILIZING TILAPIA WASTE IN NUTRIENT FILM TECHNIQUE (NFT) AQUAPONICS SYSTEM BASED ON BIOFLOCS, AND ITS IMPACT ON WATER QUALITY
Deswati Deswati, Olly Norita Tetra, Latisha Putri Isara, Dewi Imelda Roesma and Hilfi Pardi

TEMPLATE DIRECTED SYNTHESIS AND CHARACTERIZATION OF MACROCYCLIC COMPLEXES: In-silico DOCKING AND ANTIMICROBIAL STUDIES
J. Kumar, P. Kumar, S. Kumar, R. Langyan and R. Kumar



PHYTOCHEMICAL AND PHARMACOLOGICAL EVALUATION OF A MEDICINAL PLANT OF INDONESIAN TENGGER ETHNIC GROUP

A.S. Nugraha^{1,2,✉}, I.D. Anggita², A.A.I. Ratnadewi², T.A. Siswoyo²,
A.N.W. Pratama¹, R. Hendra³ and P.A. Keller⁴

¹Drug Utilisation and Discovery Research Group, Faculty of Pharmacy, University of Jember, Jember, 68121, Indonesia.

²Graduate School of Biotechnology, PUI-BioTIn, University of Jember, Jember, 68121 Indonesia

³Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Riau, Riau, Indonesia

⁴School of Chemistry & Molecular Bioscience and Molecular Horizons, University of Wollongong, and Illawarra Health & Medical Research Institute, Wollongong, NSW 2522, Australia

✉Corresponding Author: arisatia@unej.ac.id

ABSTRACT

The people of Tengger, the last Hindu Society on the Javanese Island-Indonesia, use leaves from *Cordyline fruticosa* to treat different ailments related to blood circulation problems and high blood sugar levels. However, there are limited studies on the medicinal potency of the plant. In this study, the crude methanol extract was chemically profiled using a vanillin staining agent, then fractionated, and subjected to exhaustive preparative HPLC separation, which isolated the major components. Antioxidant and α -amylase inhibition bioassays were performed to evaluate the plant potency as an antidiabetic medicament. Chemical profiling indicated phenolic compounds present with the major constituent identified as rutinoid based on NMR and MS spectral data analysis. The crude methanol extract indicated DPPH scavenging activity with an IC_{50} value of 116.65 ± 2.60 $\mu\text{g/mL}$. The extract exhibited a moderate α -amylase inhibition with an IC_{50} value of 352.42 ± 2.76 $\mu\text{g/mL}$. Overall, this study reports the phytochemical and pharmacological evaluations of *Cordyline fruticosa* for the first time.

Keywords: Tengger, Sawang, *Cordyline fruticosa*, HPLC, Rapid Isolation, Antioxidant, Antidiabetic

RASAYAN J. Chem., Vol. 14, No.4, 2021

INTRODUCTION

The people of Tengger are located in the Bromo Mountain range region and are one of the few communities still practicing Hinduism in the Islam majority population of Indonesia. This society is rich in cultural values, including its traditional medicine, passed down throughout the generations. Locally named as "sawang," *Cordyline fruticosa* (L.) A.Chev has been domesticated by the Indigenous people of Tengger as a traditional medicine to treat diarrhea, dysentery and to reduce blood sugar levels. The shrub is also used as house ornaments enabling facile access for medicinal use.

There are limited reports on the *C. fruticosa* species, including isolation studies from the Cameroonian *C. fruticosa* leaves, which produced steroidal constituents, namely fruticoside H, fruticoside I and fruticoside J.¹ The aerial component of this Agavaceae plant produced a sulfated steroidal derivative (fruticogenin A) and steroidal saponins, fruticoside K, fruticoside L and fruticoside M.² Bioactivity evaluation on fruticoside K and M revealed cytotoxicity against melanoma A375, breast adenocarcinoma MDA-MB-231, and colon carcinoma HCT116 cell lines with IC_{50} values ranging from 21.52 - 86.21 μM . These are weakly active when compared to the cisplatin standard, which show IC_{50} values ranging from 0.54 - 6.45 μM .² In addition, fruticoside H and I possessed modest cytotoxic activity against human colon carcinoma HCT 116, human breast adenocarcinoma MDA-MB 231, and human malignant melanoma cell lines A375 with IC_{50} values ranging from 37.83 - 69.68 μM .¹

In this current study, the phytochemistry investigation of *C. fruticosa* isolated flavonoids and the antidiabetic and antioxidant activities evaluation were reported for the first time.

EXPERIMENTAL

Materials and Instrumentation

The leaves of *C. fruticosa* were collected from Tosari Village (Pasuruan District, East Java, Indonesia) by Ms Galuh Sukmawati, who identified and supplied the material. Sample vouchers were stored in the Drug Utilisation and Discovery Research Group, University of Jember, Indonesia, under accession CF2019. All chemicals used in the secondary metabolite isolation, antioxidant and antidiabetic bioassays were purchased from Merk.

Secondary metabolite profiling was performed using analytical High-Pressure Liquid Chromatography (HPLC) using a Shimadzu Prominence-I LC-2030C-3D PDA system controlled by LabSolutions LC Workstation Ver.5.73 with a symmetry C₁₈ column (5 μm, 100 Å, 4.6 x 150 mm). Secondary metabolite isolation was conducted using a Shimadzu Binary Preparative HPLC consisting of a preparative pump LC-20AP, a system controller CBM-20A, a preparative auto-sampler SIL-10AP and a UV-Vis detector SPD-M20A using similar software. A preparative column (Luna C₁₈ column, 5 μm, 100 Å, 19 x 150 mm) with a protective C₁₈ guard (5 μm, 100 Å, 19 x 10 mm) was employed. 1D and 2D-Nuclear Magnetic Resonance (NMR) spectra (¹H and ¹³C NMR, Correlated Spectroscopy (gCOSY), Heteronuclear Single Quantum Coherence (gHSQC), Heteronuclear Multiple Bond Correlation (gHMBC), Total Correlation Spectroscopy (zTOCSY)) were obtained a Bruker Avance 500 MHz at 500 and 125 MHz. Electrospray Ionisation Mass Spectrometry (ESIMS) spectra were generated from a Shimadzu LC-2010 mass spectrometer in positive and negative modes.

Extraction, Isolation and Molecular Characterization

The dried powdered sample (75.00 g) was soaked in methanol (1.5 L) followed by stirring for 24 h. The resulting filtrate was concentrated to produce a brown solid (7.40 g). The less polar components were removed by liquid-liquid partition using hexane followed by dichloromethane (5 x 25 mL). The remaining dichloromethane layer was re-extracted with ethyl acetate (5 x 50 mL) to produce a flavonoid-rich fraction (0.93 g). The extract was mixed with methanol: water (1:1, 50 mL) using sonication (30 min). The solution was loaded into a short C₁₈ column (1.5 x 2 cm) with pressure assistance to produce a 50 mL fraction. The supernatant was filtered (0.45 μm) and loaded onto preparative HPLC column (19 x 150 m, 5 μm) in 10 injection blocks with a gradient flow from 0-40% acetonitrile in water within 2 minutes, to a gradient flow from 40-100% acetonitrile in water within 18 minutes, isocratic development at 100% acetonitrile for 5 minutes before returning the system to 0% acetonitrile in water at 30 minutes. The flavonoid constituent, quercetin, was collected at *t_R* 18.5 minutes.

Quercetin-*O*-3-rutinoside (1)

Yellow solid (31.1 mg, 1.54 mg/g dried plant sample); ¹H-NMR (methanol-*d*₆, 500 MHz), 7.67 (s, 1H, H2'), 7.62 (d, ³*J* = 8.5 Hz, 1H, H6'), 6.88 (d, ³*J* = 8.5 Hz, 1H, H5'), 6.40 (d, ⁴*J* = 2.0 Hz, 1H, H8), 6.21 (d, ⁴*J* = 2.0 Hz, 1H, H6), 5.10 (d, ³*J* = 7.5 Hz, 1H, H1''), 4.52 (s, ³*J* ≤ 1 Hz, 1H, H1'''), 3.80 (dd, ³*J* = 10.9, ³*J* = 8.5 Hz, 1H, H6B''), 3.64 (m, 1H, H2'''), 3.54 (m, 1H, H3'''), 3.48 (m, 1H, H2''), 3.45 (m, 1H, H5'''), 3.42 (m, 1H, H3''), 3.39 (dd, ²*J* = 10.9, ³*J* = 8.5 Hz, 1H, H6A''), 3.33 (m, 1H, H5''), 3.27 (m, 1H, H4''), 3.27 (m, 1H, H4'''), 1.12 (d, ³*J* = 6.5 Hz, 3H, H6'''); ¹³C-NMR (CD₃OD, 125 MHz), 179.4 (C4), 166.0 (C7), 162.9 (C5), 159.3 (C2), 158.5 (C9), 149.8 (C4'), 145.8 (C3'), 135.6 (C3), 123.6 (C6'), 123.1 (C1'), 117.7 (C2'), 116.0 (C5'), 105.6 (C10), 104.7 (C1''), 102.6 (C1'''), 99.9 (C-6), 94.7 (C8), 78.1 (C5''), 77.2 (C3''), 75.7 (C2''), 73.9 (C4'''), 72.2 (C3'''), 72.1 (C2'''), 71.4 (C4''), 69.7 (C5'''), 68.5 (C6''), 17.9 (C6'''); ESMS: 611 (M+H)⁺ and 609 (M+H)⁻.

2,2-diphenyl-1-picrylhydrazyl (DPPH) Scavenging

This was performed based on a protocol reported by Soler-Rivas *et al.* (2000).³ A concentration series of methanol extracts were prepared (0, 1, 2, 4, 6, 8, 10, and 15 μg GAE/mL (GAE: Gallic Acid Equivalent)). To the methanol extract (2000 μL), DPPH reagent (90 μM, 1000 μL) was added, followed by incubation

for 30 minutes in the absence of light. Absorbance was recorded at λ 515 nm with the percent inhibition evaluated based on Equation 1, in which A^0 is the control slope, and A^1 is the sample slope.

$$\% \text{ Inhibition} = \frac{(A^0 - A^1)}{A^0} \times 100\% \quad (1)$$

α -Amylase Inhibition

The inhibition was profiled based on a standard protocol reported by Hasyim *et al.*⁴ The crude extract was prepared in a series of concentrations (0, 50, 100, 200 and 400 $\mu\text{g/mL}$). Crude extracts (100 μL) were added into tubes and labeled as S^+ and S^- . Dimethyl sulfoxide (DMSO) (30% in phosphate buffer 0.02 M, pH 6.9, 100 μL) were labeled as C^+ and C^- . Enzyme α -amylase (0.2 U/mL in phosphate buffer, pH 6.9, 150 μL) was added into S^+ , S^- , C^+ and C^- followed by incubation for 15 minutes at 37 $^\circ\text{C}$. Soluble starch (1% w/v, 250 μL) was loaded into each tube followed by further incubation for 15 minutes before the reaction was quenched by boiling for 1 minute. A portion of the mixture (160 μL) was added into tubes and was labeled with a similar code before 3,5-dinitrosalicylic acid (DNS) (80 μL) was added and the mixture boiled for 5 minutes. The solutions were diluted with distilled water (720 μL) followed by absorbance measurement at 540 nm. Acarbose was used as a positive control (standard drug). Percent inhibition was calculated based on Equation 2 below (C^+ : is the control with the enzyme, C^- : is the control without enzyme, S^+ : sample with enzyme, S^- : is a sample without enzyme). IC_{50} values were calculated as the concentration.

$$\% \text{ inhibition} = \frac{((C^+ - C^-) - (S^+ - S^-))}{(C^+ - C^-)} \times 100\% \quad (2)$$

α -Glucosidase Inhibition

This experiment was based on the bioassay method reported by Zhang *et al.* with modification.⁵ In a well was placed DMSO (10 μL), phosphate buffer (pH 7, 65 μL) and 4-nitrophenyl- β -D-glucopyranoside (*p*-NPG) (25 μL) and labeled as B^0 ; In a separate well was placed DMSO (10 μL), phosphate buffer (pH 7, 40 μL), 4-nitrophenyl- β -D-glucopyranoside (*p*-NPG) (20 mM, 25 μL) and α -glucosidase (0.2 U/mL, 25 μL) and labeled as B^1 . To a well, sample extract (series concentration 1000-31.25 $\mu\text{g/mL}$ in DMSO, 10 μL), *p*-NPG (20 mM, 25 μL) and phosphate buffer (pH 7, 65 μL) were loaded and labelled as S^0 ; another well was loaded with sample extract (series concentration 1000-31.25 $\mu\text{g/mL}$ in DMSO, 10 μL), phosphate buffer (pH 7, 40 μL), *p*-NPG (20 mM, 25 μL) and α -glucosidase (0.2 U/mL, 25 μL) were loaded and labelled as S^1 . The 96-well microplate was incubated at 37 $^\circ\text{C}$ for 30 minutes. The reaction was quenched with the addition of Na_2CO_3 solution (0.1 M, 100 μL) followed by absorbance measurement at λ 405 nm. IC_{50} values were calculated as the concentration.

$$\% \text{ Inhibition} = \frac{(B^1 - B^0) - (S^1 - S^0)}{(B^1 - B^0)} \times 100 \quad (3)$$

RESULTS AND DISCUSSION

The leaves were initially cleaned and air-dried prior to grinding to produce a dried powder to promote efficient extraction. As previous reports focused on the less polar components¹, in this study, the less polar constituents (fatty acids and steroids) were removed using hexane and dichloromethane by liquid-liquid partition. The remaining fraction was further partitioned with ethyl acetate to provide the semi-polar components, including phenolics and flavonoid secondary metabolites. The fraction was filtered through a short RP C_{18} cartridge followed by filtration with 0.45 μm HPLC filter prior to analytical HPLC separation using an optimized method of 40% to 100% solvent A within 18 minutes followed by isocratic development for 5 minutes (solvent A 0.1% trifluoroacetic acid (TFA) in H_2O and solvent B 0.1% trifluoroacetic acid in acetonitrile). Further separation was conducted using a semi-preparative HPLC, which successfully isolated the major component at t_R 18.5 minutes. Analysis of the ^1H and ^{13}C NMR spectra (Fig.-1) enabled identification of quercetin-*O*-3-rutinoside (Fig.-2) along with comparative data with that reported.⁶

Antioxidant and antidiabetic bioactivity studies on the crude extract (Table-1) show the methanol extract of *C. fruticosa* possessed higher superoxide scavenging activity than the standard natural antioxidant, vitamin C. Superoxide is the leading cause of oxidative stress in which the anion can generate highly reactive hydroxyl radicals. This process leads to lipid peroxidation of polyunsaturated fatty acid, which is

related to cell stability.⁷ Cell stress prevention through exogenic antioxidant supplements is necessary to recover from metabolic or degenerative diseases.^{8,9}

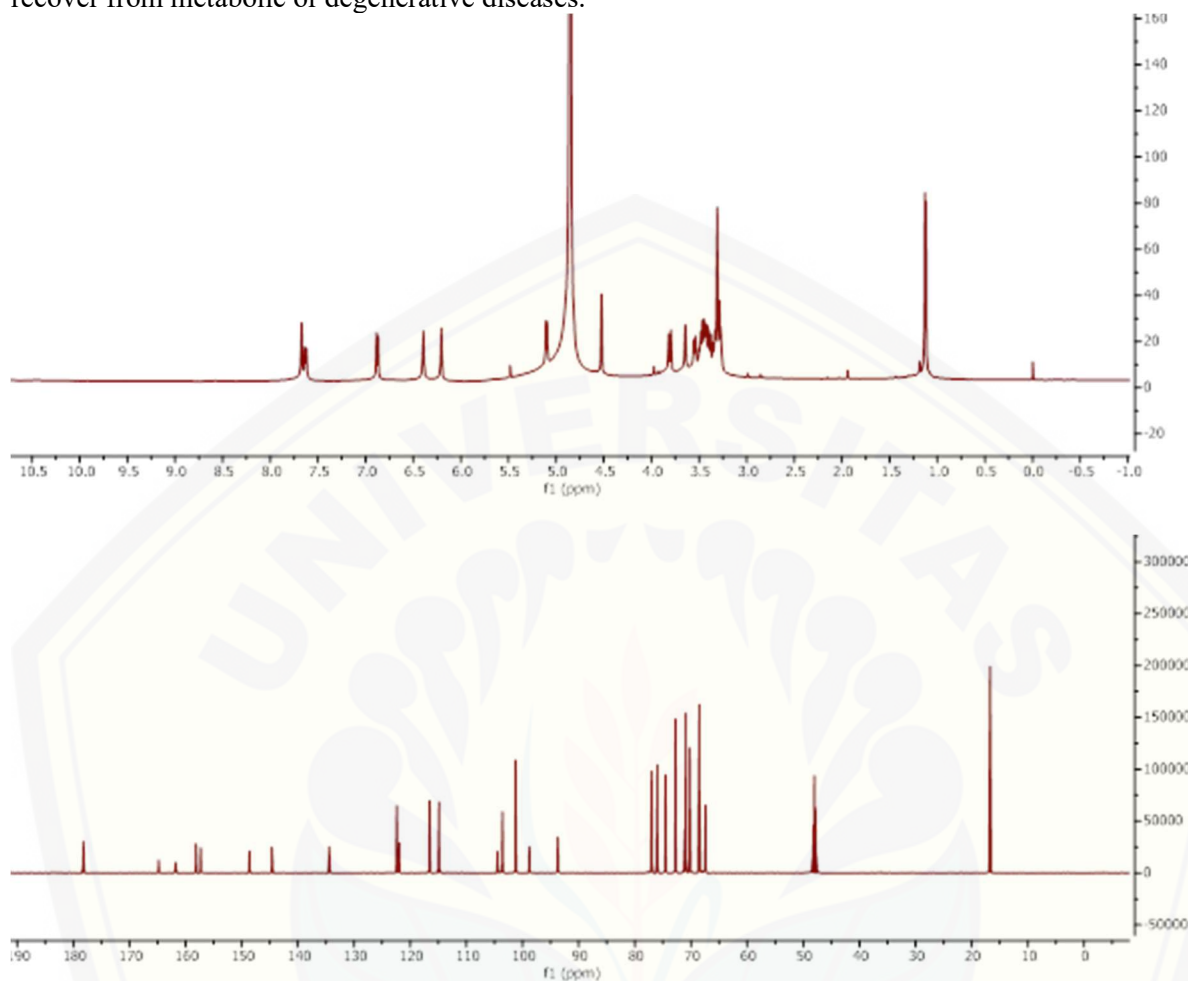


Fig.-1: ¹H-NMR Spectrum (top) and ¹³C-NMR Spectrum (bottom) of quercetin-*O*-3-rutinoside isolated from *C. fruticosa*

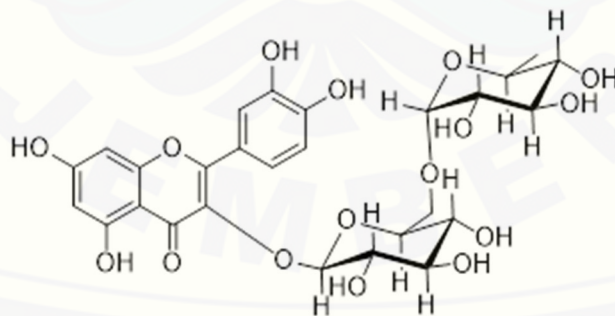


Fig.-2: Quercetin-*O*-3-rutinoside from the leaves of *C. fruticosa*.

Table-1: Antioxidant and Antidiabetic Activities of Crude Extract

Entry	IC ₅₀ , µg/mL		
	Antioxidant DPPH	α-Amylase inhibition	α-glucosidase inhibition
Methanol extract	116.65 ± 2.60	352.42 ± 2.76	368.91 ± 19.10
Acarbose	-	17.36 ± 0.33	0.98 ± 0.02
Ascorbic acid	110.75 ± 2.04	-	-

Although there is no report regarding the antioxidant and antidiabetic activity of constituents of *C. fruticose*, previous studies reported the detection or isolation of rutin from other species across different families.^{5,10,11} Therefore, this glycosidic flavonoid has been evaluated for several bioactivities, including as an antioxidant and antidiabetic agent. *In silico* screening protocols from natural compound, libraries have produced potential lead antidiabetic compounds, including rutin shown by *in vitro* and *in vivo* activities.¹² Rutin was able to reduce glucose concentration 7.2 fold at 4.0 mg/kg.B.wt dosage in male C57BL/6 mice.¹²

CONCLUSION

The crude methanol extract demonstrated a significant DPPH scavenging activity and a moderate α -amylase inhibition, in which spectral data analysis followed by literature comparison showed that the phenolic compound quercetin-*O*-3-rutinoside, isolated for the first time from *C. fruticosa*.

ACKNOWLEDGEMENT

ASN thanks Ms. Galuh Sukmawati for supplying the plant sample.

REFERENCES

1. R.T. Fouedjou, B. Teponno, L. Quassinti, M. Bramucci, D. Petrelli, L.A. Vitali, D. Fiorini, L.A. Tapondjou, L. Barboni, *Phytochemistry Letters*, **7**, 62(2014), <https://doi.org/10.1016/j.phytol.2013.10.001>
2. B.K. Ponou, R.B. Teponno, A.L. Tapondjou, M.A. Lacaille-dubois, L. Quassinti, M. Bramucci, L. Barboni, *Fitoterapia*, **134**, 454(2019), <https://doi.org/10.1016/j.fitote.2019.03.019>
3. C. Soler-Rivas, J.C. Espi'n, H.J. Wichers, *Phytochemical Analysis*, **11**, 330(2000), [https://doi.org/10.1002/1099-1565\(200009/10\)11:5%3C330::AID-PCA534%3E3.0.CO;2-G](https://doi.org/10.1002/1099-1565(200009/10)11:5%3C330::AID-PCA534%3E3.0.CO;2-G)
4. A. Hashim, M.S. Khan, M.S. Khan, M.H. Baig, S. Ahmad, *BioMed Research International*, **2013**, 1 (2013), <https://doi.org/10.1155/2013/729393>
5. L. Zhang, Z. Tu, T. Yuan, H. Wang, X. Xie, Z. Fu, *Food Chemistry*, **208**, 61(2016), <https://doi.org/10.1016/j.foodchem.2016.03.079>
6. S. Al-Majmaie, L. Nahar, G.P. Sharples, K. Wadi, S.D. Sarker, *Record of Natural Products*, **13**, 64(2019), <http://doi.org/10.25135/rnp.74.18.03.250>
7. A.A.I. Ratnadewi, L.D. Wahyudi, J. Rochman, Susilowati, A.S. Nugraha, T.A. Siswoyo, *Arabian Journal of Chemistry*, **13**, 1831(2020), <https://doi.org/10.1016/j.arabjc.2018.01.017>
8. R. Ramadhan, P. Phuwapraisirisan, I.W. Kusuma and R. Amirta, *Rasayan Journal of Chemistry*, **13(3)**, 1727(2020), <http://dx.doi.org/10.31788/RJC.2020.1335559>
9. A.S. Nugraha, A.E.N. Permatasari, C.P. Kadarwenny, D.K. Pratoko, B. Triatmoko, V.A. Rosyidi, I. Norcahyanti, I.P. Dewi, D. Dianasari, I.P. Sary, P. Wangchuk, *Journal of Herbs, Spices & Medicinal Plants*, **26**, 303(2020), <https://doi.org/10.1080/10496475.2020.1734136>
10. M. Mutakin, T. Juwita, S. Megantara, I. M. Puspitasari and J. Levita, *Rasayan Journal of Chemistry*, **13**, 1379(2020), <http://dx.doi.org/10.31788/RJC.2020.1335723>
11. S. Megantara, M. Mutakin, E. Halimah, E. Febrina, and J. Levita, *Rasayan Journal of Chemistry*, **13**, 1321(2020), <http://dx.doi.org/10.31788/RJC.2020.1335766>
12. J. Riyaphan, C.H. Jhong, S.R. Lin, C.H. Chang, M.J. Tsai, D.N. Lee, P.J. Sung, M.K. Leong, C.F. Weng, *Molecules*, **23**, 2260(2018), <https://doi.org/10.3390/molecules23092260>

[RJC-6499/2021]