ISSN: 2250-1177	**CAB Abstracts**	**E-Mail:** editor.jddt@gmail.com
NLM ID: 101656626	**ICMJE**	**Phone:** +91-9783920207
CrossRef DOI Prefix:10.22270	**Index Copernicus**	**Frequency:** 12 Issue/Year
CODEN (CAS-USA): JDDTAO	**Global Health**	**Double-Blind Peer-reviewed**
CAS (American Chemical Society)	**Publons**	

Journal of Drug Delivery and Therapeutics (JDDT) is a *double-blind peer-reviewed International* Journal dedicated to the publication of research papers, reviews, mini-reviews, Short communications and case studies. This publication is intended for a broad, interdisciplinary audience of academic and industrial researchers actively engaged in basic and applied laboratory practices related to Pharmaceutical Science and Therapeutics.

About the Society:

Journal of Drug Delivery and Therapeutics is an official publication of the Society of Pharmaceutical and Medical Professionals (SPMP). The objects of the society are to nurture and encourage the study and practice of the Pharmaceutical and medical sciences, and to promote social contacts among pharmacists in the country.

Call for Papers:

Volume 16, Issue 07, 2026 (**Last Date of submission:** 30-*June-2026*, **Issue Releasing Date:** *15-July-2026*)

Authors can submit manuscripts through the online submission system or email us at editor.jddt@gmail.com

Basic Information

1. **Journal Title:** Journal of Drug Delivery and Therapeutics
2. **Discipline, Focus & Scope:** Pharmaceutical Sciences & Medical Sciences
3. **Publisher:** Society of Pharmaceutical and Medical Professionals (SPMP)
4. **Country:** India
5. **Language:** English
6. **Publishing Frequency:** Monthly
7. **Editor Name:** Ram C Dhakar

   Editorial Office: SRG Hospital & Medical College, Jhalawar, Rajasthan, India

   Phone: +91-9783920207

   Email: editor.jddt@gmail.com

   Website: http://jddtonline.info/index.php/jddt

8. **Current Status: Online only**
9. **e-ISSN:** 2250-1177 **P-ISSN:** NA

10. **Membership**: ICMJE, Portico, CrossRef
11. **Year of Start**: 2011

Journal Code:

ISSN: 2250-1177

CODEN(USA-NLM): JDDTAO

NLM ID: 101656626

WorldCat ID: 879704190

CrossRef-DOI prefix: 10.22270

Email- editor.jddt@gmail.com**, Phone-** +91-9783920207

WHO COVID-19 Global literature on coronavirus disease

International Journal of Medical Sciences and Pharma Research (IJMSPR)

Asian Journal of Dental and Health Sciences (AJDHS)

Our Media Partner:

Kindcongress

Informa Connect Limited: Drug Delivery Strategies & Drug Device Combination Products digital conference

Fusion Conferences Ltd, Unit 5D Lynx Business Park, Fordham Road, Snailwell, Cambridgeshire, CB8 7NY. This Conference has postponed due to COVID-19.

CURRENT ISSUE

Vol. 16 No. 5 (2026): Volume 16, Issue 5, May 2026

PUBLISHED: 2026-05-15

Research

FORMULATION AND EVALUATION OF POLYHERBAL HAND SANITIZER

D Venkateshwari, K. B. Ilango , V Alageshwari , N Dhanush Kumar , Irfan M Mohammed , G. Nithish , Praveen Sekar

18-26

A PHYSICOCHEMICAL AND CHROMATOGRAPHIC FINGERPRINT STUDY ON TILVAK GHRITA: A POLYHERBAL FORMULATION

Rushikesh Shivtare , Harish Kumar Singhal

27-31

FORMULATION AND EVALUATION OF INDOMETHACIN-LOADED BIGEL FOR ENHANCED TOPICAL DRUG DELIVERY

Umaymah Ahmareen , Yasmine Abdul Aziz, Wasifa Tabassum, Bramhotri Rout, S K Shaik Humayun

32-39

XANTHINE OXIDASE INHIBITION AND ANTI-LUNG CANCER EFFECTS OF THE LONICERA JAPONICA THUNB–PARIS POLYPHYLLA VAR. CHINENSIS HERBAL PAIR

Quang-Ung Le , Thi-Lan Dinh

40-48

DEVELOPMENT OF A HIGH-RETENTION OCULAR GEL FOR PROLONGED INTRAOCULAR PRESSURE CONTROL USING TIMOLOL MALEATE

Himanshi Verma, Shashank Waghe, Navdeep Jaiswal

49-54

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7729

DOWNLOAD PDF HTML

ANALYSING THE RELEASE PARAMETERS AND CHARACTERISATION OF MUCOADHESIVE NON-SELECTIVE BETA BLOCKER SUSTAINED-RELEASE BUCCAL FILMS

Abstract Display: 98 / PDF PDF Downloads: 137 / PDF PDF Downloads: 24

Shubhangi Yashwant Aher

55-64

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7735

DOWNLOAD PDF HTML

EXCIPIENTS USED IN PEDIATRIC ORAL DOSAGE FORMS: CHALLENGES AND PERSPECTIVES FOR SAFE HOSPITAL PRACTICE

Abstract Display: 174 / PDF PDF Downloads: 120 / PDF PDF Downloads: 23

Saliou Khouma , Moussa Diop, Mor Fall , Djiby Faye , Souleymane Aidara , Mamadou Soumboundou

65-72

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7730

DOWNLOAD PDF HTML

EVALUATION OF ORGANIC ACIDS, CYTOTOXICITY, ORAL ACUTE TOXICITY AND DIURETIC EFFECT OF PHASEOLUS VULGARIS CROPS ETHYL ACETATE EXTRACT FOR CARDIOVASCULAR HEALTH IMPROVEMENT

Abstract Display: 130 / PDF PDF Downloads: 114 / PDF PDF Downloads: 18

Windingoudi Rimwagna Christian OUEDRAOGO, Mathieu NITIEMA , Boukaré KABORE , Souleymane COMPAORE , Moumouni KOALA , Floricuta RANGA , Ramona SUHAROSCHI , Fifamin Judith AHOUNOU AÏKPE , Felix Bondo KINI , Lazare BELEMNABA , Sylvin OUEDRAOGO

73-81

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7765

DOWNLOAD PDF HTML

IN VITRO AND IN SILICO ASSESSMENT OF THE ANTI-INFLAMMATORY POTENTIAL OF ETHANOLIC LEAF EXTRACT OF PITHECELLOBIUM DULCE

Abstract Display: 159 / PDF PDF Downloads: 125 / PDF PDF Downloads: 24

Srinivasu Matta, Chekuri Ajay Varma, Chapala Sudheer , Chapisetti Sesha Dhanalakshmi, Dhabal Kumar Satapathy, V Bhaskararaju

82-94

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7740

DOWNLOAD PDF HTML

FORMULATION AND EVALUATION OF DARK CHOCOLATE-BASED HEALTHY BAR USING AMLA POWDER

Sanjivani Mahale , Prajkta A. Kate

95-101

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7762

DOWNLOAD PDF HTML

PROSPECTS FOR THE EVOLUTION OF THE PHARMACEUTICAL CODE OF DEONTOLOGY IN CÔTE D'IVOIRE

Paule Mireille ALLOUKOU-BOKA , Anne Cinthia AMONKOU-N'GUESSAN , mnaudeperine@gmail.com, Aziz Flores KAMELAN , Franck Habib GAUZE , Antoine Serge AMARI

102-106

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7780

DOWNLOAD PDF HTML

FORMULATION AND EVALUATION OF NANOGEL BY USING PERGULARIA DAEMIA FOR ANTI-INFLAMMATORY PROPERTY

Tahura J. Shaikh , Vishal S. Madankar , Sampat D. Navale

107-114

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7745

DOWNLOAD PDF HTML

FORMULATION AND EVALUATION OF RUTIN TRIHYDRATE TOPICAL HYDROGEL

Amreen Mansuri , Dishant Gupta , Rajat Pawar , P. K. Dubey , Sunita Patidar

115-127

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7781

DOWNLOAD PDF HTML

CARDIORENAL EFFECTS OF SGLT2 INHIBITORS: A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

Mor Fall , Maïmouna Touré , Souleymane Aidara , Barry Boubacar , Ndèye Absatou Diaw , Moussa Diop , Djiby Faye , Mactar Amadou

128-138

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7782

DOWNLOAD PDF HTML

Review

MEDICINAL PLANTS IN THE MANAGEMENT OF UROLITHIASIS: PHYTOCHEMICAL CONSTITUENTS AND PHARMACOLOGICAL EVIDENCE

 Abstract Display: 211 / PDF PDF Downloads: 127 / PDF PDF Downloads: 32

Pooja Bagdi

139-144

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7715

DOWNLOAD PDF HTML

ROLE OF OMEGA-3 POLYUNSATURATED FATTY ACIDS IN HUMAN HEALTH: CHEMISTRY, MECHANISMS, AND CLINICAL EVIDENCE

 Abstract Display: 130 / PDF PDF Downloads: 496 / PDF PDF Downloads: 50

Dipak Patil

145-152

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7718

DOWNLOAD PDF HTML

LIPID-BASED NANOCARRIERS FOR TARGETED DRUG AND NUTRACEUTICAL DELIVERY: DEVELOPMENT, CHARACTERIZATION, APPLICATIONS, AND INDUSTRIAL CHALLENGES

 Abstract Display: 137 / PDF PDF Downloads: 127 / PDF PDF Downloads: 34

Anjali Mishra , Apoorva Kumari , Pranjal Kumar , Arya Kumari , Manas Ranjan Nayak , Rupam Vishwannaath

153-162

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7720

DOWNLOAD PDF HTML

APPROACHES FOR PREDICTING STORAGE-INDUCED REACTIVE IMPURITIES IN PHARMACEUTICAL DRUGS

 Abstract Display: 105 / PDF PDF Downloads: 132 / PDF PDF Downloads: 29

Harshali Shende , Nishita Nagpure , Janhvi Kuware , Shubham Gupta , Veerendra Dhoke , Tirupati Rasala

163-172

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7758

DOWNLOAD PDF HTML

BICONTINUOUS CUBIC PHASE LIPID NANOPARTICLES CUBOSOMES: FORMULATION, CHARACTERIZATION, AND THERAPEUTIC APPLICATIONS

Abstract Display: 168 / PDF Downloads: 122 / PDF Downloads: 24

Ranjith M, Shruti A. Khandke , R. Niha , Sahil Ansari , S. Tamilnila

173-181

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7733

DOWNLOAD PDF HTML

ADVANCED DRUG DELIVERY APPROACHES FOR ANTIDIABETIC AGENTS: STRATEGIES TO ENHANCE BIOAVAILABILITY, EFFICACY, AND PATIENT COMPLIANCE

Abstract Display: 119 / PDF Downloads: 136 / PDF Downloads: 20

H G Srusti, Darshini K, K V Poorvika, Bramhotri Rout

182-191

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7739

DOWNLOAD PDF HTML

INTEGRATIVE DETERMINANTS OF CHRONIC KIDNEY DISEASE: PSYCHODYNAMIC STRESS, NUTRITIONAL DYSREGULATION, AND ENVIRONMENTAL TOXICITY AS EMERGING PHARMACOLOGICAL TARGETS

Abstract Display: 191 / PDF Downloads: 130 / PDF Downloads: 21

Ranjna Devi, Nikhil Singh, Bhawana Rawat, Koena Saini

192-207

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7760

DOWNLOAD PDF HTML

ADVANCEMENT IN GREEN NANO-FORMULATION FOR MANAGEMENT OF GYNAECOLOGICAL DISORDERS: EMERGING TRENDS AND THERAPEUTIC INSIGHTS

Abstract Display: 176 / PDF Downloads: 128 / PDF Downloads: 36

Pyari Payal Beura , Sulagna Dash Mohapatra , Adyasha Dash , Rashmirekha Satpathy , Sanjay Kumar Raul

208-215

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7738

DOWNLOAD PDF HTML

GLOBAL TRENDS AND BURDEN OF DIABETES MELLITUS (DM): A COMPREHENSIVE REVIEW OF EPIDEMIOLOGY, RISK FACTORS, HEALTH DISPARITIES, AND FUTURE PROJECTIONS

Abstract Display: 218 / PDF Downloads: 140 / PDF Downloads: 40

Rashmi Khanijau , Mona Rajiv Kukkar , Ena Trehan , Priya Singh

216-231

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7761

DOWNLOAD PDF HTML

INTEGRATIVE POTENTIAL OF MAJOON SURANJAN IN THE MANAGEMENT OF VARICOSE VEINS: A REVIEW OF UNANI HUMORAL THEORY AND CONTEMPORARY MOLECULAR MECHANISMS

Mahboob us Salam, Vijay Bhan Singh , Faiyaz Ahmad , Bushra Sabir , Badruddeen, Minhajul Haque Ansari, Kaynat Fatima

232-239

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7743

DOWNLOAD PDF HTML

Case Studies

CAFFEINE CONSUMPTION PATTERNS AND AWARENESS AMONG PHARMACY UNDERGRADUATE STUDENTS: A CASE STUDY FROM IMT PHARMACY COLLEGE, ODISHA

Bishnupriya Jyotish , Prasad Kumar Mohapatra , Sujit Harichandan, Abhimanyu Muduli

12-17

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7748

DOWNLOAD PDF HTML

Case Series

ANTIOXIDANT, ANTI-INFLAMMATORY AND REPRODUCTIVE EFFECTS OF THE ANTI-DIABETIC POLYHERBAL FORMULATION, "INSULINEVÉGÉTALE": EVIDENCE FROM A CASE SERIES FROM CAMEROON

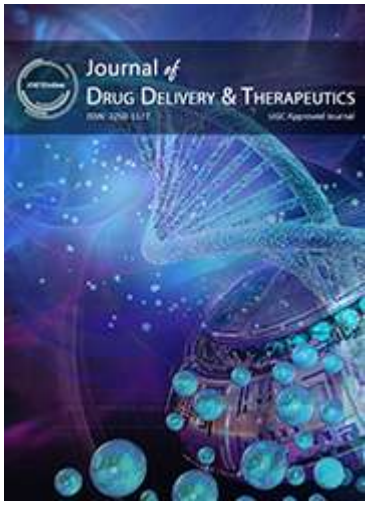
Mariama Mbouh , Junior Tegha Kum Muankang , Antoine Kada Sanda, Brainda Anais Mbou Foudji , Jude Funwie Nforben , Raphael Ndam Teboh , Bertilla Kisevi , Gisele Longnjinou Zoum , Edouard Nantia Akono

1-11

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i5.7707

DOWNLOAD PDF HTML

VIEW ALL ISSUES >



Online ISSN: 2250-1177

MAKE A SUBMISSION

CATEGORIES

LATEST PUBLICATIONS

Parse error: Unclosed '(' on line 53325 in **/home/jddtonline/domains/jddtonline.info/public_html/cache/fc-geoIP-all.php** on line **53328**

Editorial Team

Reviewer Team

Members of the reviewer board are selected from all JDDT Journal reviewers for regularly providing timely, high-quality reports on submitted manuscripts.

Dr. Adithya Polasa, Computational Biology Scientist, Boehringer Ingelheim Pharmaceuticals, Inc., 900 Ridgebury Road | Ridgefield CT 06877 adi.polasa@gmail.com LinkedIn Google Scholar ResearchGate

Dr. Mostafa Amirinejad, Department of Chemistry, School of Sciences, Ferdowsi University of Mashhad, Mashhad, Iran. Research interests: Drug Delivery Nanomedicine. Google Scholar ResearchGate Email: Amirinejadmo@gmail.com

Dr. Dipti Nanda, Bihar University of Health Sciences & Aryabhatta Knowledge University **Research interests:** Metabolic syndrome, Type 2 Diabetes, Polycystic Ovary Syndrome & Phytochemicals. ORCID ID ResearchGate Email: diptinanda30@gmail.com

Shivshankar Madhukar Nagrik, M.Pharm (Pharmaceutics), Rajarshi Shahu College of Pharmacy, Buldhana, Maharashtra E-Mail ID: shivshankarnagrik11@gmail.com LinkedIn: https://rb.gy/dtc8tm

Mr. Shashwat Pandey, Assistant Professor, Institute of Pharmaceutical Sciences (LUIPS), University of Lucknow, India. Email: Shashwatpandey0510@gmail.com, contact no. 8787085931

Anantha Krishna Makineni, Project Manager-Project & Alliance Management, Adaptive Phage Therapeutics, 708 Quince Orchard Rd, Gaithersburg, MD 20878, United States. Research Interests: Antimicrobials, Biotechnology, Biopharmaceuticals, ananthakmakineni@gmail.com +1 409-678-0318

Anil Kumar Dindigala, Scientist III, Thermofisher Scientific Inc, Greenville, NC, 27858, USA. Email-id: anildindigala@gmail.com Google Scholar

Dr. ISHIMWE Alain Prudence, Lecturer at INES-RUHENGERI, MUSANZE, Faculty of Applied Fundamental Sciences, Department of Biomedical laboratory sciences, Rwanda. pishimwe@ines.ac.rw

Dr S.T. Sathya Meonah, Freelance Medical Writer, Bangalore, India. Website www.healthwritehub.com Email: drsathya@healthwritehub.com LinkedIn

Pallav Dave, Regulatory Compliance Analyst, Louisville, KY, 40223, USA

Dr. Chetankumar, Assistance professor BLDEA'S SSM College of Pharmacy and Research Centre, Vijayapur-586103, State -Karnataka, India. chetanpatil8123@gmail.com

Dr. Rekha Gour, Department of Pharmacology, Associate Professor, SVCP, Indore, M. P. India. Email: gourrekha4@gmail.com

Dr. Harjeet Singh, Sr. Research Officer, CARI (CCRAS), Patiala, harjeet_cops@yahoo.com Phone: 9501505323

Dr. Shrinidhi Annadka, Staff Research Scientist, Department of Medicinal Chemistry and Molecular Pharmacology, Purdue University 575 Stadium Mall Dr. West Lafayette, IN 47907 shrinidhi.annadkaa@gmail.com Google Scholar

Siva Ram Munnangi, Research Scholar in Pharmaceutics and Drug Delivery, School of Pharmacy, The University of Mississippi, Oxford, Mississippi-38655. Phone: 6622000742 Email: smunnang@go.olemiss.edu

Dr. Mohamed Hassan Osman Ebar, Nova Diagnostics and Research, Somalia Mhassan.ibar@gmail.com

Dr Virendra Gomasse, Department of Pharmaceutics, Jayawantrao Sawant College of Pharmacy and Research, Pune, 411028, India viren.gomase1@gmail.com https://orcid.org/0000-0003-2454-1779 Google Scholar Web of Science Researcher ID: C-7402-2015 Scopus Author ID: 16041780000

Prashanth Parupathi, Research Scholar (Ph.D. in Pharmacology & toxicology), Long Island University, Brooklyn, NY, USA. Email: prashanth.parupathi@my.liu.edu

Dr. Srinivas Ganta, Quality Control Chemist, ScieGen Pharmaceutical Inc, NewYork, USA. Mobile No: 617-639-6636 E-mail: srinivasg87@yahoo.com ResearchGate Google Scholar

Dr. Bhavin Gajera, Sr. Formulation Scientist, Impel NeuroPharma, 201 Elliott Avenue West, Suite 260 Seattle, WA 98119, USA Google Scholar ResearchGate LinkedIn bhavin.pharmacy@outlook.com

Dr. Deepanjan Datta, Assistant Professor, Department of Pharmacy, Lloyd Institute of Management & Technology (Pharm.), Plot No.11, Knowledge Park 2, Greater Noida, U.P. 201306. Email id: deepanjan.datta@lloydpharmacy.edu.in deepanjandtt@gmail.com Contact: 9102514454. Google Scholar Researchgate.Net

Dr. Ahmed Said Mohamed, Centre d'Etude et de Recherche de Djibouti, Institut de Recherche Médicinale. Tél. (+253)773474 32 Email: demahom0907@live.com

Mr. Shivanand Kolageri, Assistant Professor, Ikon Pharmacy College Bengalore, Karnataka, India. Email.id: shivanandkolageri1996@gmail.com, Mobile No: +91- 8904312073

Dr. Audumbar Digambar Mali, Asst. Professor, Department:- Pharmaceutics, Sahyadri College of Pharmacy, Methwade, Sangola, Solapur, Maharashtra, Mo. No. 07977758012, 09975928350. Email: audumbarmali9@gmail.com. Google Scholar

Dr. Sanyogita Shahi, Ph.D., M.Sc. B.Sc., Professor in Kalinga University, Naya Raipur, India

Mob:+91-9203600005 Email: drsanyogitashahi@gmail.com sanyogita.shahi@kalingauniversity.ac.in

Sunayana Mallappa Mali, Sahyadri College of Pharmacy, Methwade, Tal- Sangola, Dist- Solapur, Maharashtra, India E- mail: - sunayanamali01@gmail.com Mobile No.: - 09739368590

Abu Hazafa, University of Agriculture Faisalabad, Pakistan, Email: abuhuzaifavirk@gmail.com Mobile: +923056517149

Dr. Mostapha BRAHMI, University of Dr Moulay Tahar Saida, Faculty of Sciences, Biology Department, Laboratory of Biotoxicology, Pharmacognosy and Biological recovery of plants (LBPVBP), Algéria. Email: brahmi.mustapha@gmail.com

Fuad M Laman, Department of Pharmacy, University of Asia Pacific, Dhanmondi, Dhaka-1209, Bangladesh & Pharmaceutical Sciences, Long Island University, Brooklyn, New York 11201, USA. Email: fuad.m.laman@gmail.com

Dr. Debashish Ghose, Assistant Professor (Dept. of Pharmaceutics) Roland Institute of Pharmaceutical Sciences,Khodasingh Berhampur -760010, Odisha. Email: dave.ghose87@gmail.com. Mobile: +919658961202

Dr. Mittal Maheshwari, Associate professor and HOD (Pharmaceutics) at A-One Pharmacy College, Ahmedabad, India. Mob: +918152009493, 798442741, E-mail: mittalmaheshwary@gmail.com

Prof. P.R. Dahake, Assistant Professor, Department of Pharmaceutical Biotechnology, Sudhakarrao Naik Institute of Pharmacy, Pusad, India Email: pavandahake3@gmail.com Mobile: 9860296987, 9075180363

Ajit Kumar Varma, Assistant Professor, Oriental University, Indore, M.P., India. Contact: +919827692726, 9770007800 E-mail: ajitpharma786@gmail.com

Priyal Jain, Associate Professor, SIRTS-Pharmacy, Bhopal, MP India – 462041. Email: pnpharma@gmail.com +9199931-81881

Sukhwant Singh, Associate Professor, SIRTS-Pharmacy, Bhopal, M.P., India. Email: singh.sukhwant@gmail.com Mobile: 919713238396

Kausar Shafaat, Faculty of Pharmacy, Sinha College, Aurangabad, Bihar- 824102 Email: kausarsiwan786@gmail.com Mob: 8789566302

Abhishek Sharma, Assistant Professor, SIRTS-Pharmacy, Bhopal, M.P., India E-Mail: abhi007_bpl@yahoo.co.in Mobile: 09406543832

Dr. G Venkata Nagaraju, B.Pharm, Pharm D.(PB), Assistant Professor, Koringa College of Pharmacy, Kakinada, E.G. Dist, A.P., India. E-Mail: nagaraju.pharmd18@gmail.com

Ranjan Singh, Assistant professor, G. D. Memorial College of pharmacy, Jodhpur, Rajasthan Mobile No: +91-8005522673 E-mail: rxsingh8@gmail.com

Pooja Chawla, Department of Pharmaceutical Chemistry, School of Pharmacy, Babu Banarsi Das University Lucknow, India. pvchawla@gmail.com

Dr.(Mrs) Padmini H. Sharma, Associate Professor, Padamshree Dr. D.Y.Patil collage of Pharmacy Akurdi Pune, India. Email: pharmabrain20@yahoo.co.in 09881715675

Dejen Nureye, (MSc in pharmacology), Department of Pharmacy, College of Medicine and Health Sciences, Mizan-Tepi University (Mizan Campus), P.O. Box 260, Mizan-Aman, Ethiopia

Saladdin Mohammed, Department of Pharmacology and Clinical Pharmacy, College of Health Sciences, School of Pharmacy, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia

Solomon Assefa, (B.Pharm, Msc), Department of Pharmacology and Clinical Pharmacy, College of Health Sciences, School of Pharmacy, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia

Zelalem Tilahun, (B.Pharm, MSc), College of Health Sciences, School of Pharmacy, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia

Dr. Annie John, Transmission Electron Microscopy Laboratory, Biomedical Technology Wing, Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram, India- 695012

Chandran Sunitha, Transmission Electron Microscopy Laboratory, Biomedical Technology Wing, Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram, India- 695012. Area of specialization: Bone tissue engineering, Osteoporosis, Hydroxyapatite bone substitute and Stem Cell Therapy.

Shafique Ahmad, Department of Pharmacology, Faculty of Pharmacy, Hamdard University, New Delhi, India

Piyush Agarwal, Department of Pharmaceutics, Geetanjali Institute of Pharmacy, Udaipur, India

Mithun Bhowmick, NRI Institute of Pharmaceutical Sciences, Bhopal, Madhya Pradesh, India

Zeeshan Ahmad, Department of Pharmaceutics, Faculty of Pharmacy, Integral University, Dasauli, Kursi Road, Lucknow, India-226026

Sana Farooqui, Department of Pharmacology, Faculty of Pharmacy, Integral University, Dasauli, Kursi Road, Lucknow, India-226026

Bharat Khurana, 1Nanomedicine Research Centre, Department of Pharmaceutics, I.S.F. College of Pharmacy, Moga (Punjab) India 2Department of Pharmacy, Maharaja Ranjit Singh Punjab Technical University, Bathinda, (Punjab) India

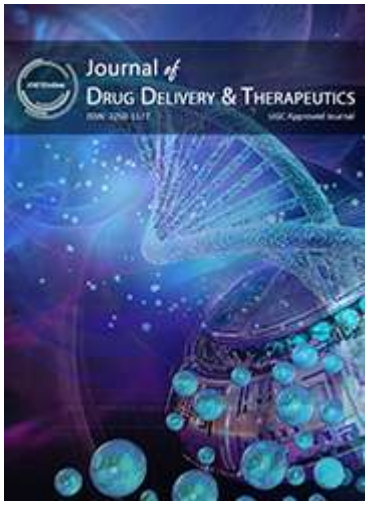
Farhin Zaidi, D/o Tahaffuzi wa Samaji Tib (Preventive & Social Medicine), School of Unani Medical Education & Research, Jamia Hamdard, New Delhi-110062

Rubi Anjum, D/o Tahaffuzi wa Samaji Tib (Preventive & Social Medicine), School of Unani Medical Education & Research, Jamia Hamdard, New Delhi-110062, India.

Baby Beny, Department of Pharmaceutics, Karnataka College of Pharmacy, Bangalore-560064, Karnataka, India

V V Prasanth, Department of Pharmaceutics, Gautham College of Pharmacy, Bangalore-560032, Karnataka, India.

Rashmi Dahima, School of Pharmacy, Devi Ahilya Vishwa Vidyalaya, Indore (India)



Online ISSN: 2250-1177

MAKE A SUBMISSION

CATEGORIES

LATEST PUBLICATIONS

Vol. 16 No. 4 (2026): Volume 16, Issue 4, April 2026

PUBLISHED: 2026-04-15

Research

EVALUATION OF THE NOOTROPIC ACTIVITY OF THE ETHANOLIC LEAF EXTRACT OF NEOLAMARCKIA CADAMBA IN EXPERIMENTAL ANIMAL MODELS

Srinivasu Matta, Sayyad Arshiya, Sai Krishana Nallajerla, Dhabal Kumar Satapathy

1-7

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7655

DOWNLOAD PDF HTML

DESIGN AND CHARACTERIZATION OF NICOTINE POLACRILEX-LOADED CUBOSOMAL NANOGEL FOR ENHANCED TOPICAL DRUG DELIVERY

Shashank Namannavar , Chandrashekar C. Patil , Arjun L Uppar, Sneha Jakaraddi

8-15

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7657

DOWNLOAD PDF HTML

DEVELOPMENT AND CHARACTERIZATION OF CAFFEINE-LOADED NIOSOME HYDROGEL FOR TOPICAL DELIVERY

Sneha Jakaraddi, Chandrashekar C. Patil, Arjun L Uppar, Shashank Namannavar

16-23

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7658

DOWNLOAD PDF HTML

DEVELOPMENT AND VALIDATION OF A RP-HPLC-PDA METHOD FOR SIMULTANEOUS DETERMINATION OF PHENOBARBITAL AND PHENYTOIN IN PURE FORM AND ITS

PHARMACEUTICAL DOSAGE FORM

Suchitra Duddagi, Akulas Shushma, CH Sudha Bhargavi, Munija Pancheddula , Sandyarani Deekonda

24-31

POLYPHENOLIC EXTRACT FROM ENTADA AFRICANA GUILL. PERS IS A POTENTIAL ANTIOXIDANT AND ANTI-TUMOR NECROSIS FACTOR ALPHA (TNFA) INGREDIENT

Ridel Mbiandou Njami , Ferdinand Kouoh Elombo, Sylvain Nsangou Pechangou, Bradley Bolling, Frederic Nico Njayou , Paul Fewou Moundipa

32-38

FORMULATION AND EVALUATION OF CAFFEINE-LOADED CUBOSOMES HYDROGEL FOR TOPICAL DELIVERY

Arjun L Uppar, Chandrashekar C. Patil, Shashank Namannavar, Pankaj Ajit Deshmane

39-47

ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED IN THE TREATMENT OF GASTROENTERITIS AND URINARY TRACT INFECTIONS IN CHILDREN AGED 0–5 IN THE CITY OF GUELENDENG AND ITS SURROUNDINGS

Djetenbe RONDOUBA , Ngam-asra NADJIOROM , Martinien ATAKEWANG DJETOLOUM , Azor DJEKILAMBER , Yeba MBAIDE

48-54

PHYSICOCHEMICAL CHARACTERIZATION AND THIN LAYER CHROMATOGRAPHIC FINGERPRINTING OF DRAKSHADI GHRITA: A FOUNDATIONAL STUDY FOR STANDARDIZATION

Sagarika S Lal , Harish Kumar Singhal , Manisha Goyal , Rajeev Soni

55-57

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7675

DOWNLOAD PDF HTML

INTESTINAL DRUG ABSORPTION KINETICS DETERMINED IN USSING CHAMBERS IS AFFECTED BY THE NATURE OF THE PHYSIOLOGICAL MEDIA

Abstract Display: 118 / PDF PDF Downloads: 98 / PDF PDF Downloads: 22

Godefroy Bruno MAMADOU , Linh Chi BUI , Ferdinand KOUOH ELOMBO , Nicolas LIMAS-NZOUZI , Nathalie Ialy-Radio, Bruno ETO , Gilles PONCHEL

58-67

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7687

DOWNLOAD PDF HTML

FORMULATION AND SWELLING EVALUATION OF STARCH–GLYCEROL-BASED BIOPOLYMER FILMS FOR POTENTIAL WOUND DRESSING APPLICATIONS

Abstract Display: 162 / PDF PDF Downloads: 140 / PDF PDF Downloads: 27

Moussa Diop, Mor Fall, Saliou Khouma , Djiby Faye , Magatte Cissé , Marie Jeanne Arlette Ciss, Sidy Mouhamed Dieng , Youssou Ndao , Louis Augustin D Diouf

68-73

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7650

DOWNLOAD PDF HTML

FORMULATION AND ANTIBACTERIAL EVALUATION OF A GLYCERIN SOAP INCORPORATED WITH CYMBOPOGON CITRATUS ESSENTIAL OIL

Abstract Display: 170 / PDF PDF Downloads: 113 / PDF PDF Downloads: 31

Moussa Diop , Amadou Diop , Saliou Khouma, Mor Fall , Djiby Faye , Magatte Cissé , Marie Jeanne Arlette Ciss , Sidy Mouhamed Dieng

74-78

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7656

DOWNLOAD PDF HTML

ROLE OF TILADI MODAK IN ENHANCING PAEDIATRIC NUTRITION: AN ANALYTICAL STUDY

Abstract Display: 134 / PDF PDF Downloads: 98 / PDF PDF Downloads: 17

Sangeeta Kumari , Harish Kumar Singhal , Manisha Goyal , Ashok Kumar Yadav

79-82

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7676

DOWNLOAD PDF HTML

COMPREHENSIVE PRECLINICAL EVALUATION OF THE VLP VACCINE “GAM-VLP-ROTA” FOLLOWING SINGLE-DOSE ADMINISTRATION: HEMATOLOGY, BIOCHEMISTRY, AND HISTOPATHOLOGY IN

SPRAGUE–DAWLEY RATS (PART II)

Oleg V. Ledenev , Ludmila V. Kostina , Olesya V. Eliseeva , Oleg E. Latyshev , Maria M. Silaenkova, Igor A. Dyachenko , Gulsara A. Slashcheva , Elvira R. Shaykhutdinova , Ekaterina N. Kazakova , Elena S. Sadovnikova , Olga I. Patsap , Arkady N. Murashev , Tatiana V. Grebennikova

83-91

DEVELOPMENT AND IN VITRO EVALUATION OF GASTRORETENTIVE FLOATING MATRIX TABLETS OF HYDRALAZINE

Munija Pancheddula, U. Srilatha, Nemuri Mounika, Srujana Raparti

92-99

POTENTIATION OF ANTIMALARIAL ACTIVITY IN ARTEMISIA ANNUA CULTIVATED IN THE PRESENCE OF FODDER PEANUTS AND BENEFICIAL MICROORGANISMS

Ferdinand Kouoh Elombo , JJ Alladoum Kadounia , M Mbiandjeu Tchoumke , J O Kuamou Nzoutap , D Nwaga

100-103

ANALYZING FOXO3A GENE AS A MARKER IN ADULTS WITH HYPERTENSION

Yohana Yohana , Meiyanti Meiyanti , Deasyka Yastani , Zakiaturahhmi Zakiaturahhmi , Suweino Tjhia

104-108

2D QSAR OF NOVEL HYBRID MOTIFS OF 4-NITROIMIDAZOLE-PIPERAZINYL TAGGED 1,2,3-TRIAZOLES FOR ANTI-CANCER ACTIVITY AGAINST BREAST CANCER CELL LINE MCF-7

Pranay Raikwar , Arun Kumar Rai , Shabnam Yadav , Nitin Singh Rajput , Shivraj Pandey , Megha Mishra , Pradeep Kumar Singour

109-119

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7662

DOWNLOAD PDF HTML

DEVELOPMENT AND EVALUATION OF REPAGLINIDE SOLID DISPERSION TABLETS USING NATURAL SUPERDISINTEGRANTS

Abstract Display: 117 / PDF Downloads: 94 / PDF Downloads: 14

Saritha Damineni , Mohammed Altaf, Anupama Koneru

120-125

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7618

DOWNLOAD PDF HTML

FORMULATION AND COMPARATIVE EVALUATION OF SUSTAINED RELEASE MATRIX TABLET WITH A MARKETED DICLOFENAC GEL

Abstract Display: 132 / PDF Downloads: 105 / PDF Downloads: 37

Madhur Yadav; Swati Mittal; Siddharth Vardhan Singh , Babita Kumar

126-136

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7671

DOWNLOAD PDF HTML

GENOTYPIC DIVERSITY AND MULTIDRUG RESISTANCE PROFILES OF AMPC-PRODUCING ESCHERICHIA COLI AND KLEBSIELLA PNEUMONIAE IN ABAKALIKI, NIGERIA

Abstract Display: 137 / PDF Downloads: 85 / PDF Downloads: 23

Henrietta Uzoeto , Ismaila Danjuma Mohammed , Ugonna Cassandra Aniokete , Ikemesit Udeme Peter

137-145

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7711

DOWNLOAD PDF HTML

Review

EFFICACY AND THERAPEUTIC RATIONALE OF MANAHVEDA DIABOHEALTH TABLETS IN DIABETES CARE: AN OVERVIEW

Abstract Display: 132 / PDF Downloads: 90 / PDF Downloads: 33

Naseem Akhtar Khan, Ghulamuddin Sofi, Md Najibur Rahman, Barkati Md Tarique, Talat Nahid

146-153

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7634

DOWNLOAD PDF HTML

THE CLINICAL RELEVANCE OF ARTAVA: FROM UPADHATU TO MODERN PROTEOMIC DIAGNOSTIC BIOFLUID: A NARRATIVE REVIEW

Dr. Ekta , B. Pushpalatha , Prof. K. Bharathi

154-158

CRISPR-CAS SYSTEMS: MECHANISMS, VARIANTS, AND BIOMEDICAL APPLICATIONS: A COMPREHENSIVE REVIEW

Augustine Chinedu Ihim, Kelechi Caroline Obi, Patrick Chinedu Obi, Ini Edeh, Donatus F.N. Ozuruoke , Tochukwu Anthony Ikwelle

159-164

A THOROUGH ANALYSIS OF NATURAL POLYMERS AS FUNCTIONAL EXCIPIENTS IN CONTEMPORARY PHARMACEUTICAL FORMULATIONS

Antesh Kumar Jha , Mahesh Prasad , Shashi Shankar , Anant Prakash Pandey , Abhishek Singh , Shiv Kumar Srivastava

165-176

PHYTOCONSTITUENTS IN HERBAL TOOTHPASTES: MECHANISMS FOR PLAQUE CONTROL AND GINGIVAL HEALTH

Rajveer Bhaskar , Monika Ola , Sonali Matkar

177-184

NANOTECHNOLOGY-DRIVEN DRUG DELIVERY SYSTEM: RECENT ADVANCES, APPLICATIONS AND FUTURE PERSPECTIVES

Manisha Chandola , Karuna Dhaundhiyal , Abhijeet Ojha , Arun Kumar Singh , Vikas Bhatt

185-194

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7694

DOWNLOAD PDF HTML

Note-Commentary

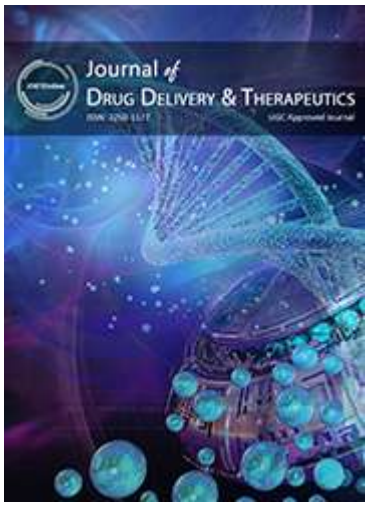
MIZAJ METRIC: A DEEP LEARNING FRAMEWORK FOR UNANI TEMPERAMENT ANALYSIS: A HYPOTHESIS

Hafiz Iqtidar Ahmad , Mudassir Hasan Khan , S M Ahmer , Farooq Ahmad Dar

195-201

VIEW ABSTRACT PDF https://doi.org/10.22270/jddt.v16i4.7673

DOWNLOAD PDF HTML



Online ISSN: 2250-1177

MAKE A SUBMISSION

CATEGORIES

LATEST PUBLICATIONS

Parse error: Unclosed '(' on line 53325 in **/home/jddtonline/domains/jddtonline.info/public_html/cache/fc-geoIP-all.php** on line **53328**

Journal of Drug Delivery & Therapeutics

Analyzing FOXO3A gene as a marker in adults with hypertension

Yohana Yohana

Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

https://orcid.org/0009-0006-3019-8064

Meiyanti Meiyanti

Department of Pharmacology and Pharmacy, Faculty of Medicine, Universitas Trisakti, Indonesia

https://orcid.org/0000-0002-1770-5504

Deasyka Yastani

Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

https://orcid.org/0009-0001-0378-5101

Zakiaturahhmi Zakiaturahhmi

Department of Physiology, Faculty of Medicine, Universitas Syiah Kuala, Indonesia

Suweino Tjhia

Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

ABSTRACT

Hypertension remains a global health problem. It caused high morbidity and death. It occurs in people in low- and middle-income countries which aged 30 to 80 years old. Symptoms are often asymptomatic; it became unaware until reached an advanced stage. Vascular aging is suspected to be one of the causes of high blood pressure. Modification layers of blood vessels such as thick, stiff, and inelastic, are caused by oxidative stress. This development is influenced by the FOXO3A gene. FOXO3A plays a role in slowing aging which is a transcription factor that plays a role in signal modulation, cell death, oxidation-reduction reactions, cell metabolism and DNA damage. Previous research on FOXO3A gene expression in people over 70 years of age found significantly lower levels compared to those aged 50-60 years. Because of the limited knowledge regarding FOXO3A gene expression in hypertension, this study aims to analyzed FOXO3A gene expression in the elderly. Sixty subjects were divided into hypertension and normotension based on JNC 8 criteria. Quantitative Real Time PCR was used to calculate FOXO3A expression. The Livak formula was used to measure elative expression. FOXO3A relative expression was 7.95 fold lower in hypertension than normotension. FOXO3A expression was reduced in hypertension. Further research at the protein level is needed to confirm these findings.

Keywords: hypertension, expression, mRNA, FOXO3A

Keywords: hypertension , expression, mRNA

DOI https://doi.org/10.22270/jddt.v16i4.7697

AUTHOR BIOGRAPHIES

Yohana Yohana , Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

Meiyanti Meiyanti , Department of Pharmacology and Pharmacy, Faculty of Medicine, Universitas Trisakti, Indonesia

Department of Pharmacology and Pharmacy, Faculty of Medicine, Universitas Trisakti, Indonesia

Deasyka Yastani , Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

Zakiaturahhmi Zakiaturahhmi , Department of Physiology, Faculty of Medicine, Universitas Syiah Kuala, Indonesia

Department of Physiology, Faculty of Medicine, Universitas Syiah Kuala, Indonesia

Suweino Tjhia, Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

REFERENCES

1. Harrison DG, Coffman TM, Wilcox CS. Pathophysiology of Hypertension: The Mosaic Theory and Beyond. Circ Res. 2021;128(7):847–63. Available from: https://pubmed.ncbi.nlm.nih.gov/33793328/

2. Meiyanti M, Yohana , Margo E, Chudri J, Pusparini ,, Faradilla MA. Factors Associated with Plasma Malondialdehyde Levels in People over 40 Years. Journal of Drug Delivery and Therapeutics. 2023 Jul 15;13(7):52–6. Available from: https://jddtonline.info/index.php/jddt/article/view/6142

3. Margo E, Meiyanti , Chondro F, Kartadinata E, Yohana ,. Relationship Blood Pressure and Exercise with Vitamin D Levels in Employees. Journal of Drug Delivery & Therapeutics [Internet]. 2022;12(5-S):27. Available from: https://openurl.ebsco.com/contentitem/doi:10.22270%2Fjddt.v12i5-s.5709?sid=ebsco:plink:crawler&id=ebsco:doi:10.22270%2Fjddt.v12i5-s.5709

4. Foote K, Rienks M, Schmidt L, Theofilatos K, Yasmin, Ozols M, et al. Oxidative DNA damage promotes vascular ageing associated with changes in extracellular matrix-regulating proteins. Cardiovasc Res [Internet]. 2025;121(4):614–28. Available from: https://pubmed.ncbi.nlm.nih.gov/38717632/

5. Yan R, Zhang X, Xu W, Li J, Sun Y, Cui S, et al. ROS-Induced Endothelial Dysfunction in the Pathogenesis of Atherosclerosis. Aging Dis. 2024;16(1):250. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11745424/

6. Hardiany NS, Nurfiyana W, Iswanti FC. Polymorphism of the Forkhead box-O3 (FOXO3) Longevity Gene rs2802292 and senescence-associated secretory phenotype (SASP) in Indonesian Elderly Population. Nutr Healthy Aging. 2024;9(1):47–54. Available from: /doi/pdf/10.3233/NHA-231516?download=true

7. Nurfiyana W, Iswanti FC, Hardiany NS. T Allele of FOXO3 rs2802292 Increases CCL2 Concentration and Slightly Decreases TGF-β Concentration in Indonesian Elderly. Molecular and Cellular Biomedical Sciences. 2024 Nov 1;8(3):167.

8. Yohana Y, Faradilla MA, Tungka EX, Kurniasari K. Gene expression of sirtuin-1 in adult with hypertension. JPBIO (Jurnal Pendidikan Biologi). 2025 Apr 30;10(1):50–8.

9. Chen R, Morris BJ, Donlon TA, Nakagawa K, Allsopp RC, Willcox BJ, et al. FOXO3 Longevity Genotype Mitigates Risk Posed by Hypertension on Incident Coronary Artery Disease in Middle-Aged Men: Kuakini Honolulu Heart Program. J Gerontol A Biol Sci Med Sci. 2024;79(12):glae254. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11642614/

10. Nakagawa K, Chen R, Greenberg SM, Ross GW, Willcox BJ, Donlon TA, et al. Forkhead box O3 longevity genotype may attenuate the impact of hypertension on risk of intracerebral haemorrhage. J Hypertens [Internet]. 2022;40(11):2230. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9553272/

11. Yohana Y, Faradilla MA, Meiyanti M, Hartanti MD, Margo E, Anastasya KS. mRNA Relative Expression Catalase in Hypertension. Bioscientist : Jurnal Ilmiah Biologi. 2024 Sep 28;12(2):1821.

12. Hardiany NS, Karman AP, Safa A, Calista P, Anindyanari BG, Rahardjo DE, et al. The Effect of Fasting on Oxidative Stress in the Vital Organs of New Zealand White Rabbit [Internet]. Vol. 11, Reports of Biochemistry & Molecular Biology. 2022. Available from: www.RBMB.net

13. Hardiany NS, Paramita R, Sucitra. The mRNA expression of Forkhead box O3a (FOXO3a) as a longevity-associated gene in leucocytes of elderly women [Internet]. Vol. 2. Jurnal Pakistan Medical Association; 2021. p. 74–7. Available from: https://pubmed.ncbi.nlm.nih.gov/33785946/

14. Mizani S, Keshavarz A, Vazifeh Shiran N, Bashash D, Allahbakhshian Farsani M. Expression Changes of SIRT1 and FOXO3a Significantly Correlate with Oxidative Stress Resistance Genes in AML Patients. Indian Journal of Hematology & Blood Transfusion. 2022;39(3):392. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10247606/

15. Qin H, Zhang H, Zhang X, Zhang S, Zhu S, Wang H. Resveratrol attenuates radiation enteritis through the SIRT1/FOXO3a and PI3K/AKT signaling pathways. Biochem Biophys Res Commun [Internet]. 2021;554:199–205. Available from: https://pubmed.ncbi.nlm.nih.gov/33812084/

16. Lin D, Luo H, Dong B, He Z, Ma L, Wang Z, et al. FOXO3a Induces Myocardial Fibrosis by Upregulating Mitophagy. Front Biosci (Landmark Ed) [Internet]. 2024;29(2). Available from: https://pubmed.ncbi.nlm.nih.gov/38420796/

17. Yu W, Gao B, Li N, Wang J, Qiu C, Zhang G, et al. Sirt3 deficiency exacerbates diabetic cardiac dysfunction: Role of Foxo3A-Parkin-mediated mitophagy. Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease. 2017;1863(8):1973–83. Available from: https://doi.org/10.2337/db12-1625

18. Sun T, Han Y, Li JL, Jiao XY, Zuo L, Wang J, et al. FOXO3a-dependent PARKIN negatively regulates cardiac hypertrophy by restoring mitophagy. Cell & Bioscience 2022 12:1 [Internet]. 2022;12(1):204-. Available from: https://link.springer.com/article/10.1186/s13578-022-00935-y

19. Torigoe TH, Willcox DC, Shimabukuro M, Higa M, Gerschenson M, Andrukhiv A, et al. Novel protective effect of the FOXO3 longevity genotype on mechanisms of cellular aging in Okinawans. npj Aging 2024 10:1. 2024;10(1):18-. Available from: https://www.nature.com/articles/s41514-024-00142-8

PUBLISHED

2026-04-15

HOW TO CITE

Yohana Y, Meiyanti M, Yastani D, Zakiaturahhmi Z, Tjhia S. Analyzing FOXO3A gene as a marker in adults with hypertension. J. Drug Delivery Ther. [Internet]. 2026 Apr. 15 [cited 2026 Jun. 11];16(4):104-8. Available from: https://jddtonline.info/index.php/jddt/article/view/7697

More Citation Formats

ISSUE

Vol. 16 No. 4 (2026): Volume 16, Issue 4, April 2026

SECTION

Research

Authors who publish with this journal agree to the following terms:

a. Authors retain copyright and grant the journal right of first publication with the work simultaneously licensed under a Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0). that allows others to share the work with an acknowledgment of the work's authorship and initial publication in this journal.
b. Authors are able to enter into separate, additional contractual arrangements for the non-exclusive distribution of the journal's published version of the work (e.g., post it to an institutional repository or publish it in a book), with an acknowledgment of its initial publication in this journal.
c. Authors are permitted and encouraged to post their work online (e.g., in institutional repositories or on their website) prior to and during the submission process, as it can lead to productive exchanges, as well as earlier and greater citation of published work (See The Effect of Open Access).

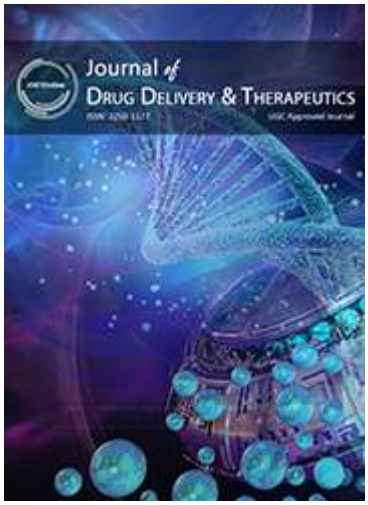
HOW TO CITE

Yohana Y, Meiyanti M, Yastani D, Zakiaturahhmi Z, Tjhia S. Analyzing FOXO3A gene as a marker in adults with hypertension. J. Drug Delivery Ther. [Internet]. 2026 Apr. 15 [cited 2026 Jun. 11];16(4):104-8. Available from: https://jddtonline.info/index.php/jddt/article/view/7697

MORE CITATION FORMATS

Most read articles by the same author(s)

- Meiyanti Meiyanti, Lyfanni Fiesa Mulia, Mulia, Pusparini, The Relationship between Antipsychotic Drug Use and Liver Enzyme Levels in People with Mental Disorders , Journal of Drug Delivery and Therapeutics: Vol. 12 No. 1 (2022): Volume 12, Issue 1, Jan-Feb 2022
- Meiyanti Meiyanti, , Yohana, Eveline Margo, Juni Chudri, , Pusparini, Meutia Atika Faradilla, Factors Associated with Plasma Malondialdehyde Levels in People over 40 Years , Journal of Drug Delivery and Therapeutics: Vol. 13 No. 7 (2023): Volume 13, Issue 7, July 2023
- Meiyanti Meiyanti, Eveline Margo, Monica Dwi Hartanti, Juni Chudri, Lie Tanu Merijanti, Arleen Devita, Correlation of Three Anthropometric Parameters with the Percentage of Body Fat and Visceral Fat in the Productive Age Group , Journal of Drug Delivery and Therapeutics: Vol. 12 No. 2 (2022): Volume 12, Issue 2 March-April 2022
- Lie Tanu Merijanti, Pusparini Pusparini, Meiyanti Meiyanti, Alvina Alvina, Monica Dwi Hartanti, Muljadi Tjahjadi, Career Development and Psychopathological Symptoms on Female Workers , Journal of Drug Delivery and Therapeutics: Vol. 13 No. 4 (2023): Volume 13, Issue 4, April 2023



Online ISSN: 2250-1177

MAKE A SUBMISSION

CATEGORIES

LATEST PUBLICATIONS

Parse error: Unclosed '(' on line 53325 in **/home/jddtonline/domains/jddtonline.info/public_html/cache/fc-geoIP-all.php** on line **53328**

Available online on 15.04.2026 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Full Text Article

Research Article

Analyzing FOXO3A gene as a marker in adults with hypertension

Yohana Yohana [1*], Meiyanti Meiyanti [2], Deasyka Yastani [3], Zakiaturahhmi [4], Suweino [5]

[1,3,5] Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia

[2] Department of Pharmacology and Pharmacy, Faculty of Medicine, Universitas Trisakti, Indonesia

[4] Department of Physiology, Faculty of Medicine, Universitas Syiah Kuala, Indonesia

Article Info:

Article History:

Received 23 Jan 2026
Reviewed 07 March 2026
Accepted 29 March 2026
Published 15 April 2026

Cite this article as:

Yohana Y, Meiyanti M, Yastani D, Zakiaturahhmi, Suweino, Analyzing FOXO3A gene as a marker in adults with hypertension, Journal of Drug Delivery and Therapeutics. 2026; 16(4):104-108 *DOI: http://dx.doi.org/10.22270/jddt.v16i4.7697*

For Correspondence:

Yohana Yohana, Department of Biochemistry, Faculty of Medicine, Universitas Trisakti, Indonesia Email: dryohana@trisakti.ac.id

Abstract

Hypertension remains a global health problem. It caused high morbidity and death. It occurs in people in low- and middle-income countries which aged 30 to 80 years old. Symptoms are often asymptomatic; it became unaware until reached an advanced stage. Vascular aging is suspected to be one of the causes of high blood pressure. Modification layers of blood vessels such as thick, stiff, and inelastic, are caused by oxidative stress. This development is influenced by the FOXO3A gene. FOXO3A plays a role in slowing aging which is a transcription factor that plays a role in signal modulation, cell death, oxidation-reduction reactions, cell metabolism and DNA damage. Previous research on FOXO3A gene expression in people over 70 years of age found significantly lower levels compared to those aged 50-60 years. Because of the limited knowledge regarding FOXO3A gene expression in hypertension, this study aims to analyzed FOXO3A gene expression in the elderly. Sixty subjects were divided into hypertension and normotension based on JNC 8 criteria. Quantitative Real Time PCR was used to calculate FOXO3A expression. The Livak formula was used to measure elative expression. FOXO3A relative expression was 7.95 fold lower in hypertension than normotension. FOXO3A expression was reduced in hypertension. Further research at the protein level is needed to confirm these findings.

Keywords: hypertension, expression, mRNA, FOXO3A

INTRODUCTION

Hypertension remains one of the major global health challenges in the category of non-communicable diseases, the incidence of hypertension continues to increase with age. Usually, they are not aware of the symptoms and signs of high blood pressure. It could cause death and disability in all age groups, especially the elderly.[1] Based on 2024 data, Indonesia ranks 4th in the world with the number of hypertension diseases. More than 70% of individuals aged over 60 years experienced this condition and is a major risk factor for various cardiovascular diseases such as coronary heart disease, heart failure, and stroke. Data from the World Health Organization (WHO) reports that hypertension affects around 1.28 billion adults worldwide, with the majority living in low- and middle-income countries. Based on data from the 2023 Indonesian Health Survey (SKI), the prevalence of hypertension in the population aged 18 years and over in Indonesia reached 30.8% - 34.11%.[2] This prevalence has increased significantly year by year and became a serious health threat with complications of heart disease and stroke. The burden of disease caused by hypertension is not only limited to individual morbidity and mortality, but also has a significant impact on health systems and national economies through long-term care costs and lost productivity.[3]

One of the factors that cause hypertension was vascular aging. It plays a major role in the pathogenesis of hypertension in the elderly population. The aging process of the cardiovascular system is characterized by progressive structural and functional changes in blood vessels, including endothelial dysfunction, increased arterial stiffness, intima-media thickening, and chronic low-grade inflammation. Shear stress and blood viscosity factors also made endothelial damage inevitable. These changes collectively contribute to the increase in peripheral resistance and systolic blood pressure, which are characteristic of hypertension in the elderly. A study demonstrated that vascular aging is associated with increased oxidative DNA damage and decreased expression of DNA repair enzymes such as 8-Oxoguanine DNA Glycosylase (OGG1). These findings indicate that the accumulation of poorly repaired molecular damage is a fundamental mechanism driving vascular aging and its pathological consequences, including age-related hypertension. At the cellular level, the aging process involves the progressive accumulation of molecular damage, including oxidative DNA damage and

mitochondrial dysfunction.[4] It reported that excessive mitochondrial reactive oxygen species (ROS) in aging endothelial cells not only exacerbate cellular oxidative damage but also trigger chronic inflammation in the arterial wall through the activation of pro-inflammatory pathways such as NF-κB, ultimately accelerating atherogenesis and vascular dysfunction.[5] Other regulator that has a significant impact on cellular response, inflammation, and vascular health is FOXO3A. It is a transcriptional factor involved in oxidative stress resistance, mitochondrial function, DNA repair, and cell survival. Superoxide dismutase and catalase are antioxidant enzymes also affected by it.[6] In the cardiovascular system, FOXO3A has been shown to protect endothelial cells and vascular smooth muscle cells from various physiological and pathological stresses. Genetic association studies have identified FOXO3A variants, particularly rs2802292, as one of the most consistent genetic factors associated with human lifespan across populations, suggesting a protective role against age-related diseases including hypertension, cardiovascular disease, diabetes, and cancer.[7] A distinct study showed relative mRNA expression of FOXO3A was higher in people between 60-70 years old than people over 70 years old. Older people have lower FOXO3A expression. Aligned with this study, Sirtuin-1 relative expression decreased in participants with hypertension over 50 years while catalase relative expression was not significantly lower in hypertension adults.[8] Genetic and translational studies in human populations provide strong evidence for the role of FOXO3A in moderating cardiovascular risk. concluded that the FOXO3 genotype associated with longevity (rs2802292 variant) exerts a protective effect against coronary artery disease in men with hypertension. Interestingly, interaction analysis showed that the protective effect of the FOXO3A genotype was only seen in hypertensive subjects, not in normotensive subjects. Proteomic analysis in the same cohort revealed specific proteins associated with amelioration of chronic biological stress in FOXO3A longevity genotype carriers, involving innate immune response pathways, inflammatory responses, and signal transduction moderation.[9] These findings suggest that FOXO3A may moderate the adverse effects of hypertension on the cardiovascular system through mechanisms that enhance cellular resilience to hemodynamic and metabolic stress. [10]Yet, various studies about the expression FOXO3A gene contributing to patho-mechanism hypertension still remain unclear. Therefore, the purpose of this study is to analyse expression FOXO3A in adults with hypertension over 50 years old.

MATERIAL AND METHODS

This research was conducted with Ethical clearance 001/KER/FK/12/2025 from an ethical committee Faculty of Medicine Universitas Trisakti. Sixty people over 50 years old were separated into hypertension and normotension groups parallel with JNC VIII. The number of samples has been calculated and adjusted according to the inclusion and exclusion criteria. The inclusion criteria for participants were those aged over 50 years and committed to participating in the research, while the exclusion criteria were participants who had liver disease, cancer, and autoimmune diseases.

RNA isolation

Vein blood was collected about 2 ml. It is isolated into RNA with the Quick RNA Miniprep kit. The entire extraction process follows the kit's procedures. Initially, the blood is added with cell lysis buffer and Proteinase K. After incubation, the sample is added with isopropanolol and centrifuged. Finally, the sample is washed with an RNA wash buffer. The extraction results are added with RNA-Free Water and stored at -80 degrees Celsius. Before being used for cDNA production, the concentration is measured at a wavelength of 260/280 nm using a nanophotometer.[11]

cDNA synthesis and quantitative Real Time Polymerase Chain Reaction

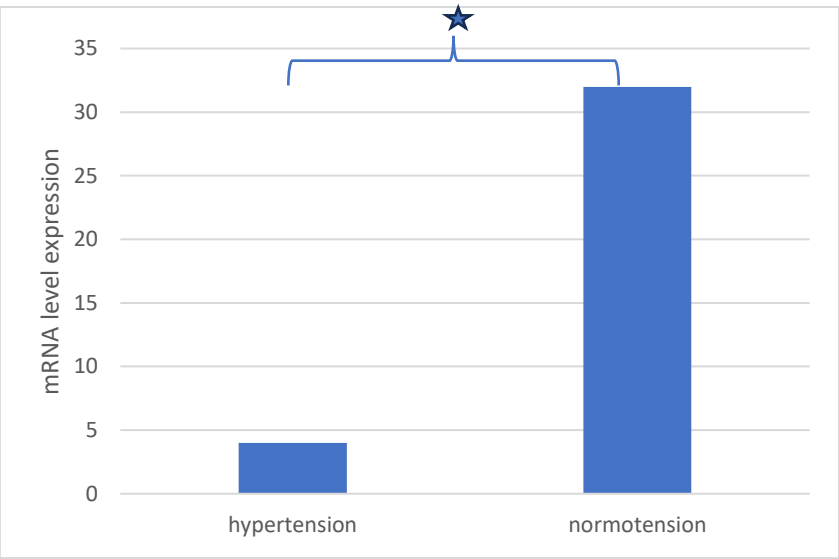
cDNA was developed by SENSOQUEST PCR machine. 200ng total RNA was added into SensiFAST cDNA Synthesis kit along with reverse transcriptase enzyme and nucleus free water (NFW). cDNA construction began with a denaturation process at 95 degrees Celsius and annealing at 60 degrees Celsius. The total reaction was 40 cycles. Product was kept in -20 degrees Celscius. FOXO3A mRNA expression was investigated with 2 step qRT PCR (QiAquant 96 5 plex). cDNA for qRT PCR was made by adding 9 ul NFW and 1 ul cDNA. SensiFAST SYBR Green NO-ROX was added into cDNA with forward and reverse FOXO3A primer including NFW up to 20 ul. Reaction was made duplo and the PCR cycle was up to 50. FOXO3A primer sequences were TTGGAAGAACTCCATCCGACA (forward) and CCACGGCTCTTGGTGTACTT (reverse).[12] House keeping gene was GADPH and primer sequences were GTC TCC TCT GAC TTC AAC AGC G (forward) and ACC ACC CTG TTG CTG TAG CCA A (reverse). Result was displayed in Ct (cycle threshold) value. It was used to appraise FOXO3A expression at both groups. Livak method was ruled out to count level expressions.[8]

Statistical analysis

Data analysis was performed with SPSS Ver 29. Normality test using Shapiro Wilk. Comparison Data was analyzed with Mann-Whitney Test.[13]

RESULTS

A total of 60 participants were included in the final analysis, comprising 30 subjects in the hypertension group and 30 subjects in the normotension.



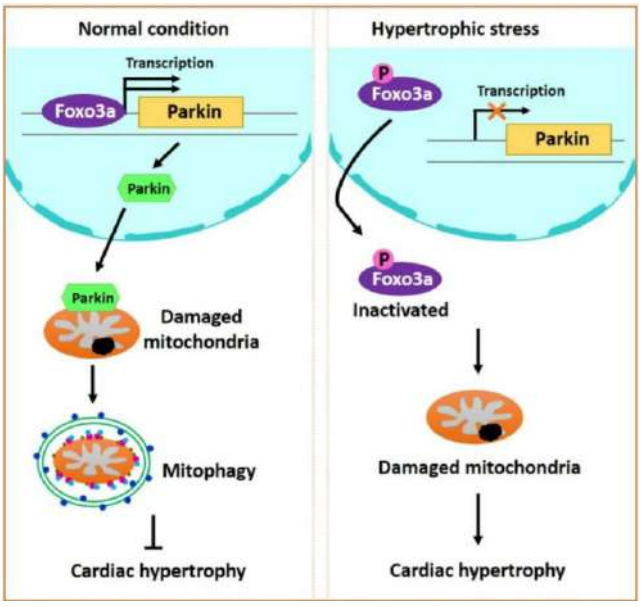
Graphic 1. mRNA FOXO3A level expression through GADPH ((p < 0.001).

Using the Mann–Whitney U test, the distribution of expression values differed significantly between the hypertension and normotensive groups. As depicted in the graph 1, mRNA FOXO3A expression was 7.98 folds lower in hypertension than normotension. It significantly decreased in hypertension people over 50 years old.

DISSCUSSION

This study found that mRNA expression FOXO3A was lower in hypertension people compared to normotension people. This finding is in line with previous studies where FOXO3A expression was found to decrease significantly in the elderly group over 70 years compared to the 50-60 years age group. Increasing age decreases the expression of the FOXO3A gene, which plays a role in cell survival and defence against ROS through regulating the expression of antioxidants such as catalase and MnSOD as well as redox balance in mitochondria.[13] Our previous study also showed a decrease in catalase expression in the hypertensive group compared to normotensive. Although not significantly decreased, catalase as an antioxidant enzyme has the ability to convert ROS compounds into neutral.[11] Different results were found in patients with acute myeloid lymphocytic cancer, where FOXO3A expression was found to increase compared to controls. Other genes whose expression also increased in acute myeloid lymphocytic were Sirt-1, MnSOD and Catalase. There is evidence of a strong positive correlation between Sirtuin-1 and FOXO3A. It stated that overexpression in cancer cells will consume higher energy than normal cells, thus having high resistance to oxidative stress, cell survival, and inhibiting cell apoptosis.[14] Another study on FOXO3A expression in radiation enteritis showed the ability of apoptosis and the antioxidant activity of SOD2 and Catalase. This study used resveratrol, which is hypothesized to be able to strengthen the work of the FOXO3A transcription factor through the PI3K/AKT pathway and deacetylate FOXO3A through Sirt1 activation.[15]

Recent research has shown FOXO3A as a transcription factor for mitophagy. Mitophagy is a form of homeostasis of autophagy that balances free radical scavenging, thus preventing mitochondrial damage. Increased FOXO3A expression was found in cardiac fibroblast cells treated with Angiotensin II, but decreased phosphorylated FOXO3A expression. Knocked-down FOXO3A and treated with Angiotensin II significantly inhibited proliferation and migration. Increased expression of PINK1 and Parkin factors, but decreased expression of p62 in cardiac fibroblast cells.[16] Another pathway that demonstrates the link between mitophagy and FOXO3A is the condition of cardiac dysfunction in patients with diabetes mellitus, where decreased mitophagy activity was found. Decreased Sirt3-FOXO3A-Parkin pathway reduces the effect of mitophagy, which plays a role in cardiomyopathy in diabetes mellitus.[17]



Graphic 2. Mitophagy signalling in cardiac hypertrophy

Another study found that FOXO3A activation under normal conditions causes Parkin to be expressed, allowing mitophagy to occur in dysfunctional

mitochondria, preventing cardiac muscle hypertrophy. Graphic 2 shows that cardiac muscle hypertrophy is caused by FOXO3A being phosphorylated, preventing Parkin from being expressed, preventing the elimination of damaged mitochondria. Mitophagy plays a crucial role in cardiac muscle aging and the development of heart failure, including changes in cardiac muscle cells, development, and remodelling. FOXO3A could inhibit the development of cardiomyopathy in cardiac muscle cells treated with Angiotensin II. Sarcomere formation, increased cell surface area, and increased cardiac hormone markers are indicate the absence of Angiotensin II.[18]

The forkhead box O type 3 family plays a role in longevity. This has been demonstrated through various studies of variations associated with longevity. One study conducted on Okinawans found the rs2802292 variant to be significantly associated with longevity exceeding 95 years. The variant is associated with the G allele compared to the T allele, where the variation is associated with telomere effects. Various chronic diseases are also associated with pro-inflammatory and anti-inflammatory cytokine activity that can lead to senescence. FOXO3A variations are said to protect the risk of coronary heart disease, especially those with the G allele. In women over 55 years old who have the G allele have lower IL-6 levels than those with the T allele. Results by gender that women and men have similar telomere length trends in the G allele and the T allele. For ages 19-54 years and those over 55 years old, variations in the G allele were also found to be significantly associated with FOXO3 expression.[19] On the other hand, FOXO3A expression was found to be significantly lower in those over 70 years of age compared to those aged 60-70 years. Different age groups, races, and genders may have different outcomes through different mechanisms.[13]

CONCLUSION

This study found FOXO3A downregulate in people with hypertension over 50 years old. As a transcription factor, FOXO3A plays a role in various processes that contribute to heart disease, including mitophagy, a specific autophagy pathway for damaged mitochondria. Proposing FOXO3A as an aging dan vascular disease marker could open up promising diagnostic opportunities and the development of therapeutic targets. Further protein level examination is needed to support the diagnosis.

Acknowledgement: This research received grant from DRPMF Faculty of Medicine Universitas Trisakti, Jakarta, Indonesia.

Conflict of interest: The researcher didn't have any conflict of interest.

REFERENCES

1. Harrison DG, Coffman TM, Wilcox CS. Pathophysiology of Hypertension: The Mosaic Theory and Beyond. Circ Res. 2021;128(7):847–63. Available from: https://pubmed.ncbi.nlm.nih.gov/33793328/
2. Meiyanti M, Yohana , Margo E, Chudri J, Pusparini ,, Faradilla MA. Factors Associated with Plasma Malondialdehyde Levels in People over 40 Years. Journal of Drug Delivery and Therapeutics. 2023 Jul 15;13(7):52–6. Available from: https://jddtonline.info/index.php/jddt/article/view/6142
3. Margo E, Meiyanti , Chondro F, Kartadinata E, Yohana ,. Relationship Blood Pressure and Exercise with Vitamin D Levels in Employees. Journal of Drug Delivery & Therapeutics [Internet]. 2022;12(5-S):27. Available from: https://openurl.ebsco.com/contentitem/doi:10.22270%2Fjddt.v12i5-s.5709?sid=ebsco:plink:crawler&id=ebsco:doi:10.22270%2Fjddt.v12i5-s.5709
4. Foote K, Rienks M, Schmidt L, Theofilatos K, Yasmin, Ozols M, et al. Oxidative DNA damage promotes vascular ageing associated with changes in extracellular matrix-regulating proteins. Cardiovasc Res [Internet]. 2025;121(4):614–28. Available from: https://pubmed.ncbi.nlm.nih.gov/38717632/
5. Yan R, Zhang X, Xu W, Li J, Sun Y, Cui S, et al. ROS-Induced Endothelial Dysfunction in the Pathogenesis of Atherosclerosis. Aging Dis. 2024;16(1):250. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11745424/
6. Hardiany NS, Nurfiyana W, Iswanti FC. Polymorphism of the Forkhead box-O3 (FOXO3) Longevity Gene rs2802292 and senescence-associated secretory phenotype (SASP) in Indonesian Elderly Population. Nutr Healthy Aging. 2024;9(1):47–54. Available from: /doi/pdf/10.3233/NHA-231516?download=true
7. Nurfiyana W, Iswanti FC, Hardiany NS. T Allele of FOXO3 rs2802292 Increases CCL2 Concentration and Slightly Decreases TGF-β Concentration in Indonesian Elderly. Molecular and Cellular Biomedical Sciences. 2024 Nov 1;8(3):167.
8. Yohana Y, Faradilla MA, Tungka EX, Kurniasari K. Gene expression of sirtuin-1 in adult with hypertension. JPBIO (Jurnal Pendidikan Biologi). 2025 Apr 30;10(1):50–8.
9. Chen R, Morris BJ, Donlon TA, Nakagawa K, Allsopp RC, Willcox BJ, et al. FOXO3 Longevity Genotype Mitigates Risk Posed by Hypertension on Incident Coronary Artery Disease in Middle-Aged Men: Kuakini Honolulu Heart Program. J Gerontol A Biol Sci Med Sci. 2024;79(12):glae254. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11642614/
10. Nakagawa K, Chen R, Greenberg SM, Ross GW, Willcox BJ, Donlon TA, et al. Forkhead box O3 longevity genotype may attenuate the impact of hypertension on risk of intracerebral haemorrhage. J Hypertens [Internet]. 2022;40(11):2230. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9553272/
11. Yohana Y, Faradilla MA, Meiyanti M, Hartanti MD, Margo E, Anastasya KS. mRNA Relative Expression Catalase in Hypertension. Bioscientist : Jurnal Ilmiah Biologi. 2024 Sep 28;12(2):1821.
12. Hardiany NS, Karman AP, Safa A, Calista P, Anindyanari BG, Rahardjo DE, et al. The Effect of Fasting on Oxidative Stress in the Vital Organs of New Zealand White Rabbit [Internet]. Vol. 11, Reports of Biochemistry & Molecular Biology. 2022. Available from: www.RBMB.net
13. Hardiany NS, Paramita R, Sucitra. The mRNA expression of Forkhead box O3a (FOXO3a) as a longevity-associated gene in leucocytes of elderly women [Internet]. Vol. 2. Jurnal Pakistan Medical Association; 2021. p. 74–7. Available from: https://pubmed.ncbi.nlm.nih.gov/33785946/
14. Mizani S, Keshavarz A, Vazifeh Shiran N, Bashash D, Allahbakhshian Farsani M. Expression Changes of SIRT1 and FOXO3a Significantly Correlate with Oxidative Stress Resistance Genes in AML Patients. Indian Journal of Hematology & Blood Transfusion. 2022;39(3):392. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10247606/
15. Qin H, Zhang H, Zhang X, Zhang S, Zhu S, Wang H. Resveratrol attenuates radiation enteritis through the SIRT1/FOXO3a and PI3K/AKT signaling pathways. Biochem Biophys Res Commun [Internet]. 2021;554:199–205. Available from: https://pubmed.ncbi.nlm.nih.gov/33812084/
16. Lin D, Luo H, Dong B, He Z, Ma L, Wang Z, et al. FOXO3a Induces Myocardial Fibrosis by Upregulating Mitophagy. Front Biosci

(Landmark Ed) [Internet]. 2024;29(2). Available from: https://pubmed.ncbi.nlm.nih.gov/38420796/

17. Yu W, Gao B, Li N, Wang J, Qiu C, Zhang G, et al. Sirt3 deficiency exacerbates diabetic cardiac dysfunction: Role of Foxo3A-Parkin-mediated mitophagy. Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease. 2017;1863(8):1973–83. Available from: https://doi.org/10.2337/db12-1625
18. Sun T, Han Y, Li JL, Jiao XY, Zuo L, Wang J, et al. FOXO3a-dependent PARKIN negatively regulates cardiac hypertrophy by restoring mitophagy. Cell & Bioscience 2022 12:1 [Internet]. 2022;12(1):204-. Available from: https://link.springer.com/article/10.1186/s13578-022-00935-y
19. Torigoe TH, Willcox DC, Shimabukuro M, Higa M, Gerschenson M, Andrukhiv A, et al. Novel protective effect of the FOXO3 longevity genotype on mechanisms of cellular aging in Okinawans. npj Aging 2024 10:1. 2024;10(1):18-. Available from: https://www.nature.com/articles/s41514-024-00142-8