

Universitas Scientiarum (Univ. Sci.) (ISSN 0122-7483 printed version; ISSN 2027-1352 online version), was founded in 1987 by the Faculty of Science of the Pontificia Universidad Javeriana, Bogota, Colombia. It is an Open Access, multidisciplinary, peer-reviewed Journal, directed to researchers in the exact and natural sciences.

The objective of our journal is to contribute original theoretical and practical knowledge to promote the understanding necessary to resolve environmental and health problems within the Latin-American context.

The journal has a distinguished editorial board composed of 63 Ph.D. leading researchers in different fields from around the world (20 countries).

Universitas Scientiarum publishes original articles, short communications, reviews, mini-reviews (meta-analysis, review of methods and concepts), methods articles, and book reviews. The journal accepts manuscripts in English, Spanish and Portuguese, although English is encouraged.

Advantages of publishing with us:

Unrestricted open access

First on-line (article is published as soon as it is accepted)

Fast review processing (***the time from submission to first on-line publication is less than three months***)

High quality peer-review

No page charges

Free PDF

First color page free of charge

Free, limited, paper reprints

Paper citation update (analytics)

The journal is indexed and referenced in Scopus (Q4), SciELO, Addition of SciELO Database to Web of Knowledge (ISI; SciELO Citation Index) ASFA, Latindex, Redalyc, Chemical Abstracts (CA), Directory of Open Access Journals (DOAJ), Google Academic, LILACS, Periódica, ULRICHSWEB, Académica, e-revist@s and National Bibliographic Index (Publindex, A2), COPERNICUS, and Dialnet. *Universitas Scientiarum* is ranked third among Latin American multidisciplinary journals.

Every paper submitted is subjected to international peer-review by experts in each discipline. In order to provide the highest publication quality, once a manuscript has been accepted for publication, it will undergo free language copyediting, typesetting, and reference validation

The journal is printed three times a year (April, August and December); however, every paper is published, as first on line, once it has been accepted (open access).

All submissions are processed online through the management and publishing Open Journal System (OJS).

Open Journal System registration and manuscripts submission:

www.javeriana.edu.co/scientiarun/web

www.javeriana.edu.co/scientiarun/ojs

To submit their manuscript, authors should follow these steps:

NEW submittal>fill in the fields>SAVE>upload submittal files>SAVE>fill in author and manuscript data>SAVE>Upload supplementary files >SAVE and END submittal.

Further information please contact us at:

scientiarum@javeriana.edu.co

Universitas Scientiarum webpage:

www.javeriana.edu.co/scientiarun/web

www.javeriana.edu.co/scientiarun/ojs



Address: Oficina 627, Edificio 52 Carlos Ortiz, Carrera 7 No 43-82, Bogotá, Colombia, Suramérica. Tel: 57-1-3208320 ext 4159. Fax 57-1-3208320 ext 4070.



Universitas Scientiarum is licensed under Creative Commons 2.5 of Colombia: Attribution - Noncommercial - No Derivative Works. Whole or partial printed reproduction of this work is prohibited, including typeface design and cover, without the express or written authorization of the Pontificia Universidad Javeriana and authors.



La Revista *Universitas Scientiarum* se encuentra bajo la licencia Creative Commons 2.5 de Colombia: Reconocimiento - No comercial - Sin obras derivadas. Prohibida la reproducción impresa total o parcial de esta obra - incluido el diseño tipográfico y de portada - sin autorización expresa y por escrito de la Pontificia Universidad Javeriana y de sus autores.

Universitas Scientiarum encourages authors to submit high quality, original, interdisciplinary and multidisciplinary research papers in the exact and natural sciences, within a broad variety of disciplines and topics:

Mathematics and statistics
Bioinformatics and modeling
Information and computer sciences
Physics
 Material science

Chemistry
 Organic chemistry
 Natural products and Medicinal plants
 Inorganic chemistry
 Analytic chemistry
 Phytochemistry
 Chemical biology

Biochemistry
 Neuroscience
 Human biochemistry
 Clinical biochemistry

Biology
 Cell biology and cancer
 Morphology, physiology and behavior
 Stem cell research
 Zoology, Botany

Natural history
 Life histories

Genetics and Evolution
 Molecular biology
 Population genetics
 Molecular systematics
 Microorganisms' genetics

Taxonomy and Systematics
Biodiversity

 Ornithology
 Entomology
 Herpetology
 Ichthyology
 Mastozoology

Biogeography
Ecology

 Population ecology
 Conservation biology
 Community ecology

Ecosystem ecology
Landscape ecology
Global change ecology
Monitoring
Plant ecology
Ecological niche
Dispersal and connectivity ecology

Conservation biology
 Management

Marine Sciences
 Oceanography
 Marine ecology
 Coral reefs and management
 Coral reproduction and recruitment

Limnology
Agricultural entomology
Land sciences
Geology
 Geochemistry

Biomedical sciences
 Epidemiology

Microbiology
 Applied microbiology
 Intracellular bacteria
 Antimicrobial resistance
 Clinical microbiology
 Virology
 Environmental microbiology
 Soil and water microbiology

Immunology
Parasitology
Infectious diseases
 Protozoan diseases

Nutrition sciences
 Food quality
 Food chemistry
 Health and nutrition
 Clinical nutrition

Biotechnology
 Environmental biotechnology
 Soil and water treatment
 Microbial biotechnology

Veterinary
Multidisciplinary sciences (i.e. Astronomy)



Universitas Scientiarum (Univ. Sci.)

Vol. 18 N° 2 Mayo-Agosto de 2013

Disponible en:

www.javeriana.edu.co/scientiarun/web

www.javeriana.edu.co/scientiarun/ojs

COMITÉ EDITORIAL

Editor en Jefe	Alberto Acosta, Ph.D. Pontificia Universidad Javeriana	Asistente Editorial	Paola Correa Cuadros
Co-Editor	Humberto Gil Silva Rafeiro, Ph.D. Pontificia Universidad Javeriana	Diagramadora	Marly Rincón López
Comité Editorial	Carlos Sarmiento, Ph.D. Universidad Nacional de Colombia Colombia	Corrector de Estilo	Martha Vallejo
	Diógenes Campos, Ph.D. Universidad Jorge Tadeo Lozano Colombia	Revisión Inglés	Gypsy Español (T&T)
	Eric Treml, Ph.D. University of Melbourne Australia	Revisión Portugués	Humberto Gil Silva Rafeiro, Ph.D. Pontificia Universidad Javeriana
	Erick C. Franklin, Ph.D. Hawaii Institute of Marine Biology USA	Técnico en OJS	Juan Fernando Álvarez, MA.
	Jhon Mario González, Ph.D. Universidad de los Andes Colombia	Secretaria Editorial	Nigza Evetti Ramírez Lara
	Josefina Jover de la Prida, Ph.D. Universidad Central “Marta Abreu” de Las Villas Cuba	Colaboradores voluntarios	Camilo Ernesto López Aguirre (Biólogo)
	Rubem Carlos A. Guedes, Ph.D. Universidade Federal de Pernambuco Brasil	Impresión	Mónica Andrea Rodríguez Infante (Bióloga)
	Wanzhi Cai, Ph.D. China Agricultural University China	Foto de carátula	Fundación Cultural Javeriana de Artes Gráficas – JAVEGRAF –
			Juan Felipe Albarracín Lagarto Arcoiris o Cola de Látigo (<i>Cnemidophorus lemniscatus</i> Linnaeus, 1758) forrajando en Playa Blanca, Santa Marta, Colombia.



Pontificia Universidad
JAVERIANA
Bogotá

Rector	Joaquín Sánchez García, S.J.
Vicerrector Académico	José Vicente Durán Casas, S.J.
Secretario General	Dr. Jairo Cifuentes Madrid
Decana Académica Facultad de Ciencias	Ingrid Schuler, Ph.D.

ASESORES CIENTIFICOS

COLOMBIA

Camilo Jiménez, M.Ed.*Physics*Pontificia Universidad Javeriana
cjimenez@javeriana.edu.co**Concepción Puerta Bula, Ph.D.***Biomedical sciences*Pontificia Universidad Javeriana
cypuerta@javeriana.edu.co**Diógenes Campos, Ph.D.***Physics*Universidad Jorge Tadeo Lozano
dcamposr@utadeo.edu.co**Eddy Pariguan, Ph.D.***Mathematics*Pontificia Universidad Javeriana
epariguan@javeriana.edu.co**Fabio Roldán, Ph.D.***Environmental microbiology*Pontificia Universidad Javeriana
fabio.roldan@javeriana.edu.co**John Mario González, Ph.D.***Inmunology*Universidad de los Andes
johgonza@uniandes.edu.co**Juan Carlos Salcedo Reyes, Ph.D.***Physics*Pontificia Universidad Javeriana
salcedo.juan@javeriana.edu.co**Julio Delgado Boada, Ph.D.***Microbial biotechnology*Biotechnova
jdelgado26@hotmail.com**Ludis Morales Álvarez, Ph.D.***Human biochemistry*Pontificia Universidad Javeriana
ludis.morales@javeriana.edu.co**Luis A. Barrera, Ph.D.***Clinical biochemistry*Pontificia Universidad Javeriana
abarerra@javeriana.edu.co**Pedro Monterrey, Ph.D.***Mathematics, Epidemiology and Statistics*Universidad del Rosario
pedro.monterrey@urosario.edu.co

INTERNACIONAL

Héctor R. Galleguillos, Ph.D.*Geochemistry*Universidad de Antofagasta
hgalleguillos@uantof.clChile **Jordi Jordana, Ph.D.***Veterinary*Universidad Autónoma de Barcelona
jordi.Jordana@uab.catEspaña **José Manuel Siverio, Ph.D.***Microbial biotechnology, Biochemistry*Universidad de la Laguna
jsiverio@ull.esEspaña **Josefina Jover de la Prida, Ph.D.***Chemistry*Universidad Central "Marta Abreu" de Las Villas
jjover@uclv.edu.cuCuba **Joseph Mark Shostell, Ph.D.***Biology*Penn State University
joseph.Shostell@gmail.comUSA **Julia A. Sanchez, Ph.D.***Parasitology*Universidad Centro Occidental
Lisandro Alvarado
juliasanchezch@yahoo.comVenezuela **Manuel Carlos López, Ph.D.***Biomedical sciences*Instituto de Parasitología y Biomedicina, CSIC
mclopez@ipb.csic.esEspaña **Maria Carmen Thomas Carazo, Ph.D.***Biomedical sciences, Protozoan diseases*Instituto de Parasitología y Biomedicina, CSIC
mctomas@ipb.csic.esEspaña **Muhamad Hagerat, Ph.D.***Physics – Chemistry*The Academic Arab College of
Education, Haifa
muha4@macam.ac.ilIsrael **Antonio R. Quesada, Ph.D.***Mathematics*University of Akron
aquesada@uakron.eduUSA **Armando Cáceres Estrada***Químico Biólogo, Inmunólogo*Universidad de San Carlos
(USAC)

acaceres46@hotmail.com

Guatemala **Blanca Estela Barragán Huertas, Ph.D.***Biotechnology*Escuela Nacional de
Ciencias Biológicas

bbarraga59@yahoo.com

México **Carmen Thomas Carazo, Ph.D.***Biomedical sciences, Protozoan diseases*Instituto de Parasitología y
Biomedicina, CSIC

mctomas@ipb.csic.es

España **Constantino González, Ph.D.***Conservation biology,**Biodiversity, Ecology*Universidad Nacional Autónoma
de México (UNAM)

cgs@ibiologia.unam.mx

México **Enrique Martínez, Ph.D.***Ecological niche*Universidad Nacional Autónoma
de México (UNAM)

emm@ibiologia.unam.mx

México **Fanny Guzman Quimbayo, Ph.D.***Biomedical sciences*

Universidad Católica de

Valparaíso

fanny.guzman@ucv.cl

Chile **Gabriel Padilla, Ph.D.***Microorganisms genetics*

Universidad de Sao Paulo

gpadilla@icb.usp.br

Brasil 

AGRADECIMOS A LOS SIGUIENTES EVALUADORES DEL Vol. 18 No. 2

Aakash Deep, Ph.D.
Maharshi Dayanand University, Rohtak
India 

Agustin Schiariti, Ph.D.
INIDEP
Argentina 

Alberto Gómez Mejía
Pontificia Universidad Javeriana
Colombia 

Ana Eucares Von Laer, Ph.D.
Universidade Federal de Pelotas
Brasil 

Ana Majtey, Ph.D.
Universidad de Granada
España 

Ana María Campos Rosario, Ph.D.
Universidad Jorge Tadeo Lozano
Colombia 

Andrea Pace, M.Sc.
Università degli Studi di Palermo
Italia 

Bruno de Moura Escger, Ph.D.
Universidade Federal do Rio de Janeiro
Brasil 

Cesar Augusto Ipenza Peralta, M.Sc.
Sociedad Peruana de Derecho Ambiental
Perú 

Crispin Humberto García Cruz, Ph.D.
Universidade Estadual Paulista Júlio de Mesquita Filho
Brasil 

Daniel Carrillo, Ph.D.
University of Florida
USA 

Diana Torres López, Ph.D.
Pontificia Universidad Javeriana
Colombia 

Elvira María Alvarado, Ph.D.
Universidad Jorge Tadeo Lozano
Colombia 

George Emilio Sampaio Barreto, Ph.D.
Pontificia Universidad Javeriana
Colombia 

James L. Smith, Ph.D.
Agricultural Research Service
USA 

Janeth González Santos, Ph.D.
Pontificia Universidad Javeriana
Colombia 

José Antonio Lepe Jiménez, Ph.D.
Hospital Universitario Virgen del Rocío, Sevilla
España 

Juana López Martínez, Ph.D.
Centro de Investigaciones Biológicas del Noroeste S.C.
México 

Julio Omar Prieto García, Ph.D.
Universidad Central "Marta Abreu" de Las Villas
Cuba 

Kátia Regina Teixeira dos Santos, Ph.D.
Embrapa Agrobiología
Brasil 

Luis Garrigós Leite, Ph.D.
Instituto Biológico
Brasil 

Luis Lorenzo Sánchez Soto, Ph.D.
Universidad Complutense, Madrid
España 

Luz Bettina Villalobos B., Ph.D.
Universidad de Oriente, Núcleo de Sucre, Cumaná
Venezuela 

Manuel Siguëñas Saavedra, M.Sc.
Instituto Nacional de Innovación Agraria-INIA
Perú 

Marcela Franco Correa, Ph.D.
Pontificia Universidad Javeriana
Colombia 

Márcia de Aguiar Ferreira, Ph.D.
Universidade de Brasília
Brasil 

María Celina Rodicio Rodicio, Ph.D.
Universidad de Santiago de Compostela
España 

María Claudia Diazgranados Cadelo, M.Sc.
Conservación Internacional Colombia
Colombia 

María Eugenia Ramírez Osorio
Pontificia Universidad Javeriana
Colombia 

Mario Godinho Junior, Ph.D.
Universidade Federal de Goiás
Brasil 

Marisa Ribeiro de Itapema Cardoso, Ph.D.
Universidade Federal do Rio Grande do Sul
Brasil 

Markus Neureiter, Ph.D.
BOKU University of Natural Resources and Life Sciences
Austria 

Mónica Mesa Cadavid, Ph.D.
Universidad de Antioquia
Colombia 

Nelson Simões, Ph.D.
Universidade dos Açores
Portugal 

Olga Lucia Sopó Rincón, M.Sc.
Fundación Cardiorvascular de Colombia
Colombia 

Refat El-Sayed, Ph.D.
Umm Al-Qura University, Saudi Arabia Saudita 

Sebastien Dupont, Ph.D.
Université de Bourgogne, Dijon
Francia 

Tomasz Plech, Ph.D.
University of Lublin
Polonia 

Yolanda Flores Lara, Ph.D.
Universidad de Sonora (Unison)
México 

Vol. 18 N° 2

Contenido/Content/Índice

Mayo – Agosto de 2013

Original Paper: Microbiología Aplicada / Applied Microbiology / Microbiologia Aplicada

Evaluation of three methods of preservation of *Azotobacter chroococcum* and *Azotobacter vinelandii*

Daniel Rojas Tapias, Mabel Ortiz-Vera, Diego Rivera, Joseph Kloepper, Ruth Bonilla

129

Original Paper: Física / Physics / Física

Coherencia y entrelazamiento en dinámica no Markoviana de qubits

Cristian E Susa, John H Reina

141

Original Paper: Ciencias Multidisciplinares / Multidisciplinary Sciences / Ciências Multidisciplinares

Bioprospecting in Colombia

Leonardo Güiza, Diana Bernal

153

Original Paper: Agricultura y Entomología / Agriculture and Entomology / Agricultura e Entomologia

Susceptibility of *Delia platura* to seven entomopathogenic nematode isolates from the Central Andes region of Colombia

Carolina M. Jaramillo, Jose-Joaquin Celeita, Adriana Sáenz

165

Original Paper: Física / Physics / Física

Conductividad iónica en nuevos composites (PEO)₁₀(CF₃COONa)-X % Al₂O₃

Nori M. Jurado, I Delgado, R A Vargas

173

Short communication: Biología Molecular / Molecular Biology / Biología Molecular

Temperatura de almacenamiento y cantidad de ARN extraído de plasma materno

Paola Andrea Ayala-Ramírez, Liz Ariane Gonzalez-Ropero, Reggie García-Robles

181

Original paper: Bioinformática y Modelado / Bioinformatics & Modeling / Bioinformática e Modelagem

Structural features of the two-component system, LisR/LisK, suggests multiple responses for the adaptation and survival of *Listeria monocytogenes*

Nelson E. Arenas, Andrés Gutiérrez, Myriam Sánchez-Gómez, Luz Mary Salazar, Edgar Reyes Montaño

189

Review Paper: Microbiología Aplicada / Applied Microbiology / Microbiologia Aplicada

La Electroforesis en Gel de Campo Pulsado (PFGE) para la diferenciación molecular de *Listeria monocytogenes*

Ángela María Cardozo-Bernal, Luisa Fernanda Ramón, Raúl A. Poutou-Piñales, Ana K. Carrascal-Camacho, Diana Corina Zambrano

203

Instructions for authors

223