

ISSN 2027-1352 (online version)  
ISSN 0122-7483 (printed version)

Universitas.

# Scientiarum

Vol. 18 No. 3 Septiembre-Diciembre de 2013



Brocoli - 3D Tree Fractal - Paul Nylander - www.bugman123.com



Pontificia Universidad  
**JAVERIANA**  
Bogotá

Revista de Ciencias / Journal of Sciences / Journal das Ciencias



*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, Bogotá, 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 a Latin-American context.

The journal has a distinguished editorial board composed of 70 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, reviews of methods and concepts), methods articles, and book reviews. The journal accepts manuscripts in English, Spanish and Portuguese; however, 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

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/scientiarum/ojs](http://www.javeriana.edu.co/scientiarum/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](mailto:scientiarum@javeriana.edu.co)

*Universitas Scientiarum* webpage:

[www.javeriana.edu.co/scientiarum/web](http://www.javeriana.edu.co/scientiarum/web)

Articles are available instantly and permanently on line for all readers, at no charge. No embargos apply.



Green Open Access Journal: The author can use the publisher's or published PDF version on their personal or their institution's web page or in a noncommercial repository. The journal has no processing fees for authors (no publication charge for page, color figures, processing, hosting, or PDF use).

**Address:** Oficina 627, Edificio 52 Carlos Ortíz, 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  
    Microorganism 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° 3

Septiembre-Diciembre de 2013

Disponible en:

[www.javeriana.edu.co/scientiarum/web](http://www.javeriana.edu.co/scientiarum/web)

[www.javeriana.edu.co/scientiarum/ojs](http://www.javeriana.edu.co/scientiarum/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, M.A.
	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	Mónica Andrea Rodríguez Infante (Bióloga)
	Rubem Carlos A. Guedes, Ph.D. Universidade Federal de Pernambuco Brasil	Impresión	Fundación Cultural Javeriana de Artes Gráficas – JAVEGRAF –
	Wanzhi Cai, Ph.D. China Agricultural University China	Foto de carátula	Brócoli – capa completa 3D Tree Fractal – Paul Nylander <a href="http://www.bugman123.com">www.bugman123.com</a>



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.

## COMITÉ CIENTÍFICO - EDITORES ASOCIADOS POR TEMÁTICA

### Alexander Meskhi, Ph.D., D.Sc.

*Mathematics*

A. Razmadze Mathematical Institute  
- Academy of Sciences  
alex72meskhi@yahoo.com

Georgia 

### Ana Isabel Vásquez Vélez, Ph.D.

*Plant taxonomy and Systematic*

Universidad del Valle  
anaisabelvasvel@gmail.com

Colombia 

### Bernardo Vargas, Ph.D.

*Marine ecology and Monitoring*  
NOAA, University of Hawaii  
bernardo.vargasangel@noaa.gov

USA 

### Carlos L. Armando Cespedes Acuña

*Chemistry of Natural Products,*

*Chemical Ecology,*

*Natural Insecticides-Herbicides*

Universidad Del Bío-Bío, Chile  
cespedes.leonardo@gmail.com

Chile 

### Elvira María Alvarado Ch, Ph.D.

*Ecology, Coral reproduction and Recruitment*  
Universidad Jorge Tadeo Lozano  
elvaradocochaon@gmail.com

Colombia 

### Eric Trembl, Ph.D.

*Connectivity, Spatial analysis, Graph theory,  
Modeling, and Dispersal*

University of Melbourne  
etrembl@unimelb.edu.au

Australia 

### Gabino Garrido Garrido, Ph.D.

*Pharmaceutical Sciences, cardiovascular, inflammation, pain  
and natural products* Universidad Católica del Norte  
gabinocl@yahoo.com

Chile 

### George Barreto, Ph.D.

*Neuroscience*

Pontificia Universidad Javeriana  
gsampaio@javeriana.edu.co

Colombia 

### Igor Dimitri Forero, Ph.D.

*Entomology, Biodiversity, Systematics, Evolution,  
Biogeography*

Pontificia Universidad Javeriana  
forero-i@javeriana.edu.co

Colombia 

### Inés de la Caridad Aloma, Ph.D.

*Analytic chemistry*

Universidad Central Marta  
Abreu de Las Villas  
inesav@uclv.edu.cu

Cuba 

### Ismael Samudio, Ph.D.

*Terry Fox Laboratory*

British Columbia Cancer Agency  
Ismael.samudio@gmail.com

Canada 

### James M. Mair, Ph.D.

*Marine biology*

Heriot-Watt University  
j.m.mair@hw.ac.uk

Escocia 

### Jeffrey Robens, Ph.D.

*Pharmacology, Cell Biology*  
Edanz Group  
jrobens@edanzgroup.com

Estados Unidos 

### Jorge H. Jácome Reyes, Ph.D.

*Botany and Plant ecology*

Pontificia Universidad Javeriana  
jacomej@javeriana.edu.co

Colombia 

### Jose G. Mijares Palacio , Ph.D.

*Mathematics*

Denver University  
Jose.MijaresPalacios@du.edu  
USA 

### José Pastor Giménez Q., Ph.D.

*Mathematics*

Universidad de los Andes  
jigimenez@ula.ve  
Venezuela 

### Juan C. Moreno Piraján, Ph.D.

*Chemistry*

Universidad de los Andes  
jumoreno@uniandes.edu.co  
Colombia 

### Juan Carlos Salcedo Reyes, Ph.D.

*Physics*

Pontificia Universidad Javeriana  
salcedo.juan@javeriana.edu.co

Colombia 

### León Darío Pérez Pérez, Ph.D.

*Chemistry*

Pontificia Universidad Javeriana  
leon.perez@javeriana.edu.co

Colombia 

### Luca Rastrelli, Ph.D.

*Natural products and  
Medicinal plants*

University of Salerno  
rastrelli@unisa.it  
Italia 

### Luis Gonzalo Sequeda C., M.Sc.

*Analytic chemistry, Phytochemistry,  
Quality systems and Food*

Pontificia Universidad Javeriana  
lsequeda@javeriana.edu.co

Colombia 

### Manuel Ruiz, Ph.D.

*Population genetics*

Pontificia Universidad Javeriana  
mruiiz@javeriana.edu.co

Colombia 

### Marcela Franco Correa, Ph.D.

*Soil mycology and Microbiology*

Pontificia Universidad Javeriana  
franco@javeriana.edu.co

Colombia 

### Maria Inés Giménez, Ph.D.

*Molecular biology and*

*Proteolysis of Haloarchaea*

Universidad Nacional de Mar del Plata  
migimen@mdp.edu.ar

Argentina 

### Marylin E. Hidalgo Díaz, Ph.D.

*Microbiology of intracellular bacteria,  
Antimicrobial resistance*

Pontificia Universidad Javeriana  
hidalgo.m@javeriana.edu.co

Colombia 

### Nelson Rangel Buitrago, Ph.D.

*Geology and Land sciences*

Universidad de Cádiz (UCA)  
nelson.rangel@invemar.org.co

España 

### Nohora Galvis, Ph.D.

*Coral reef management*

Fundación ICRI  
icri.colombia@gmail.com

Colombia 

### Norberto Chavarría Hernández, Ph.D.

*Biotecnología*

Instituto de Ciencias Agropecuarias  
norberto@uaeh.edu.mx

México 

### Pablo Sáenz Agudelo, Ph.D.

*Population genetics and Dispersal ecology*

University of Science and Technology  
Red Sea Research Center, King Abdullah  
pablo.saenzagudelo@kaust.edu.sa

Arabia Saudita 

### Rafael Baquero Parra, Ph.D.

*Physics*

CINVESTAV -IPN  
rbaquero@fis.cinvestav.mx

México 

### Raúl Poutou, Ph.D.

*Environmental biotechnology,*

*Biological treatment of water and soil*

Pontificia Universidad Javeriana  
rpoutou@javeriana.edu.co

Colombia 

### Refugio Rodríguez V., Ph.D.

*Environmental biotechnology, Biological treatment of water  
and soil*

CINVESTAV-IPN  
rrodrig@cinvestav.mx

México 

### Sergio Córdoba, M.Sc.

*Ornithology, Ecology and Evolution*

Princeton University  
scordoba@princeton.edu

USA 

### Sergio E. de Carvalho Machado, Ph.D

*Psychiatry/Neuroscience*

Universidade Federal do Rio de Janeiro  
secm80@yahoo.com.br

Brasil 

### Sunghoon Jung, Ph.D.

*Biodiversity, Entomology, Molecular systematics, Heteroptera*

Research Institute for Agricultural and Life  
Sciences, Seoul National University  
john23@snu.ac.kr

Corea del Sur 

### Víctor González Betancourt, Ph.D.

*Biodiversity, Natural history, Entomology*

Southern Oklahoma State University  
Division of Entomology, Natural History Museum  
victorgonzab@gmail.com

USA 

### Victor Salceda Sacanelles, Ph.D.

*Population genetics, Drosophila, Chromosomal  
polymorphisms, Radiation*

Instituto Nacional de Investigaciones Nucleares  
victor.salceda@inin.gob.mx

México 

### Vladimir V. Kouznetsov, Ph.D.

*Chemical biology, Organic chemistry*

Universidad Industrial de Santander UIS  
vkuznechnik@gmail.com

Colombia 

### Wanzhi Cai, Ph.D.

*Entomology, Agricultural entomology, Heteroptera*

China Agricultural University  
caiwz@cau.edu.cn

China 

## 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  
abarreira@javeriana.edu.co**Pedro Monterrey, Ph.D.***Mathematics, Epidemiology and Statistics*

Universidad del Rosario

pedro.monterrey@urosario.edu.co

### INTERNACIONAL

**Antonio R. Quesada, Ph.D.***Mathematics*

University of Akron

aquesada@uakron.edu

USA **Jordi Jordana, Ph.D.***Veterinary*

Universidad Autónoma de Barcelona

jordi.jordana@uab.cat

España **Armando Cáceres Estrada***Chemical Biologist*

Universidad de San Carlos (USAC)

acaceres46@hotmail.com

Guatemala **José Manuel Siverio, Ph.D.***Microbial biotechnology, Biochemistry*

Universidad de la Laguna

jsiverio@ull.es

España **Blanca Estela Barragán Huertas, Ph.D.***Biotechnology*

Escuela Nacional de Ciencias Biológicas

bbarraga59@yahoo.com

México **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 São Paulo

gpadilla@icb.usp.br

Brasil **Héctor R. Galleguillos, Ph.D.***Geochemistry*

Universidad de Antofagasta

hgalleguillos@uantof.cl

Chile **Julia A. Sanchez, Ph.D.***Parasitology*

Universidad Centro Occidental

Lisandro Alvarado

juliasanchezch@yahoo.com

Venezuela **Manuel Carlos López, Ph.D.***Biomedical sciences*

Instituto de Parasitología y Biomedicina, CSIC

mclopez@ipb.csic.es

España **María Carmen Thomas Carazo, Ph.D.***Biomedical sciences, Protozoan diseases*

Instituto de Parasitología y Biomedicina, CSIC

mctomas@ipb.csic.es

España **Muhamad Hagerat, Ph.D.***Physics, Chemistry*

The Academic Arab College of

Education, Haifa

muha4@macam.ac.il

Israel 

## AGRADECemos A LOS SIGUIENTES EVALUADORES DEL Vol. 18 No. 3

---

Adalton Raga, Ph.D. <i>Instituto Biológico</i> Brasil 	Durvalina María Mathias, Ph.D. <i>Universidade Estadual Paulista</i> Brasil 	Jorge Eliécer Robles Camargo, Ph.D. <i>Pontifícia Universidad Javeriana</i> Colombia 	Orlando Coto, Ph.D. <i>Instituto de Investigaciones en Fruticultura Tropical</i> Cuba 
Adelina del Pilar Meléndez M., M.Sc. <i>Universidad Nacional</i> Colombia 	Edelberto Silva Gómez, M.Sc. <i>Universidad Nacional de Colombia</i> Colombia 	José Luis Hernández Mendoza, Ph.D. <i>Instituto Politécnico Nacional</i> México 	Pedro C. Hidalgo, Dr. rer.nat. <i>Universidad de la República</i> Uruguay 
Adriana S. Manzano de A., Ph.D. <i>CONICET</i> Argentina 	Edgar Martínez Granja, Ph.D. <i>Universidad de Ciencias Aplicadas y Ambientales</i> Colombia 	José Manuel Pingarrón C., Ph.D. <i>Complutense University of Madrid</i> España 	Priscila da Silva Delabona, Ph.D. <i>Brazilian Bioethanol Science and Technology Laboratory</i> Brasil 
Adriana Sáenz Aponte, M.Sc. <i>Pontifícia Universidad Javeriana</i> Colombia 	Edilberto Pozo Velásquez, Ph.D. <i>Universidad Central "Marta Abreu" de las Villas</i> Cuba 	Julio Lozano Gutiérrez, Ph.D. <i>Universidad Autónoma de Zacatecas</i> México 	Rafael Braga da Silva, Ph.D. <i>Embrapa Milho e Sorgo</i> Brasil 
Aldomairo Negrisoli Junior, Ph.D. <i>Embrapa</i> Brasil 	Ellie Anne López Barrera, Ph.D. <i>Fundación Conservación Ambiente</i> Colombia 	Lizbeth González-Herrera, Ph.D. <i>Universidad Autónoma de Yucatán</i> México 	Ramón Compañó Beltrán, Ph.D. <i>Universidad de Barcelona</i> España 
Alex C. Manhães, Ph.D. <i>Universidade do Estado do Rio de Janeiro</i> Brasil 	Emily Danies Ordoñez, MD. <i>NYUMC</i> USA 	Luis Alberto Franco Ospina, Ph.D. <i>Universidad de Cartagena</i> Colombia 	Ramón Mauricio Coral V, Ph.D. <i>Instituto Politécnico Nacional</i> México 
Ana Cristina Vigliar Bondioli, Ph.D. <i>Universidade de São Paulo</i> Brasil 	Estéfane Cardinot Reis, Ph.D. <i>Universidade do Estado do Rio de Janeiro (UERJ)</i> Brasil 	Luis Manuel de León R., Ph.D. <i>Universidad de Guanajuato</i> México 	Ricardo Vera Bravo, Ph.D. <i>Pontifícia Universidad Javeriana</i> Colombia 
Andrea Jimena Santamaría, MD. <i>University of Miami</i> USA 	Eva Edilia Avila Muro, Ph.D. <i>Universidad de Guanajuato</i> México 	Luis Gonzalo Sequeda C., M.Sc. <i>Pontifícia Universidad Javeriana</i> Colombia 	Rodrigo Zieri, Ph.D. <i>Universidade Estadual Paulista - UNESP/IBILCE</i> Brasil 
Antonio Puyet Catalina, Ph.D <i>Universidad Complutense de Madrid</i> España 	Fredy Omar Gamboa Jaimes, Ph.D. <i>Pontifícia Universidad Javeriana</i> Colombia 	Manuel I. Rodríguez Fernández, M.Sc. <i>Universidad de los Andes</i> Colombia 	Samson Guenne, Ph.D. <i>University of Ouagadougou (Burkina Faso)</i> Burkina 
Boris Leonardo Blotto Acuña <i>Museo Argentino de Ciencias Naturales</i> Argentina 	Gabino Garrido Garrido, Ph.D. <i>Universidad Católica del Norte</i> Chile 	Marcela Franco Correa, Ph.D. <i>Pontifícia Universidad Javeriana</i> Colombia 	Sergio Eduardo de Carvalho M., Ph.D. <i>University of Rio de Janeiro</i> Brasil 
Carla Andréa Delatorre, Ph.D. <i>Universidade Federal do Rio Grande do Sul</i> Brasil 	George Emilio Barreto, Ph.D. <i>Pontifícia Universidad Javeriana</i> Colombia 	Marco A. Cristancho Ardila, Ph.D. <i>CENICAFFE</i> Colombia 	Teresa Hernández Sotomayor, Ph.D. <i>Centro de Investigación Científica de Yucatán</i> México 
Cedric Stephan Graebin, Ph.D. <i>Federal Rural University of Rio de Janeiro</i> Brasil 	Igor Guerreiro Hamoy, Ph.D. <i>Universidade Federal Rural da Amazônia (UFR.A)</i> Brasil 	Marylin Hidalgo, Ph.D. <i>Pontifícia Universidad Javeriana</i> Colombia 	Veralice M. Sales de Bruin, Ph.D. <i>Universidade Federal do Ceará</i> Brasil 
César I. Pérez Maldonado, Ph.D. <i>Universidad de Los Andes</i> Venezuela 	Ingrid Patricia Dávalos R., Ph.D. <i>Universidad de Guadalajara</i> México 	Mauricio Pinto Nunes, M.Sc. <i>Secretaria de Estado da Saíde do Paraná</i> Brasil 	Victor M. Salceda Sacanelles, Ph.D. <i>Instituto Nacional de Investigaciones Nucleares</i> México 
Chi-Chiang Yang, Ph.D. <i>Chung Shan Medical University</i> Taiwán 	Iván Cruz, Ph.D. <i>Empresa Brasileira de Pesquisa Agropecuária EMBRAPA</i> Brasil 	Milton J. Crosby Granados, Ph.D. <i>Universidad Nacional de Colombia</i> Colombia 	Yolanda Flores Lara <i>Universidad de Sonora (Unison)</i> México 
Claudio Carneiro Filgueiras, Ph.D. <i>Universidade do Estado do Rio de Janeiro</i> Brasil 	Jackeline Pereira Andrade, M.Sc. <i>Federal University of Bahia Reconcaro</i> Brasil 	Murilo Marchioro, Ph.D. <i>Universidade Federal de Sergipe</i> Brasil 	Yolanda Pico García, Ph.D. <i>Universidad de Valencia</i> España 
Cleberson Ribeiro, Ph.D. <i>Universidade Federal de Viçosa</i> Brasil 	Jairo Castaño Zapata, Ph.D. <i>Universidad de Caldas</i> Colombia 	Nathali López Cardona, M.Sc. <i>Instituto Colombiano Agropecuario ICA</i> Colombia 	
Domenico Pavone, Ph.D. <i>Universidad de Carabobo</i> Venezuela 			

Plantas medicinales / Medicinal plants/ Plantas medicinais

**Review Article. Natural products and Chagas' disease: the action of triterpenes acids isolated from *Miconia* species**

Daniele da Silva Ferreira, Viviane Rodrigues Esperandim, Maria Gabriela Marçal, Naraya Bruna Dos Reis Neres, Nayanne Larissa Cunha, Márcio Luís Andrade e Silva, Wilson Roberto Cunha

243

**Mini Review. Anti-infectious activity in plants of the genus *Tabebuia***

Francisco Javier Jiménez-González, Luz Angela Veloza, Juan Carlos Sepúlveda-Arias

257

Neurociencia / Neuroscience / Neurociência

**Original Article. Relação entre qualidade do sono e funções cognitivas em pacientes com doença de Parkinson**

Altair Brito dos Santos, Shirley L. Campos, Sidarta Ribeiro, Ludis Morales, Janneth González, Joabes dos Santos Trindade, George E. Barreto

269

Biotecnología /Biotechnology / Biotecnologia

**Review Article. Tolerancia al aluminio en especies vegetales: mecanismos y genes**

Andrea Carreño, Alejandro Chaparro-Giraldo

283

Ciencias Multidisciplinares / Multidisciplinary sciences / Ciênciа multidisciplinares

**Original Article. Scientific financial funding in Colombia from 2000 to 2012**

Jorge Mario Rodríguez-Fernández

311

Biología molecular / Molecular biology / Biología molecular

**Short communication. AMDAR y PCR-extra-rápida para la identificación de la tortuga cabezona *Caretta caretta* (Testudines: Cheloniidae) utilizando el gen mitocondrial citocromo c oxidasa I (COI)**

Daniel Lancheros-Piliego, Javier Hernández Fernández

321

Microbiología aplicada / Applied microbiology / Microbiología aplicada

**Original Article. Factores climáticos y su influencia en la expresión de enfermedades fúngicas en cultivares de *Heliconia***

Juan Manuel López-Vásquez, Marta Leonor Marulanda Ángel, Ana María López Gutiérrez

331

Instructions for authors

345