



New Technologies and Frontiers of Science

Agri and Biobusiness

First InPrInt Seminar

Partnership Building towards
Stronger Engagement in International Collaboration

Dr. Evanguedes Kalapothakis

UFMG, Belo Horizonte
19-23 November 2018

A little about the dynamics of PRINT UFMG

Mobility

OUTGOING – grants for activities outside of Brazil

- PhD (six to twelve months)
- Junior Professor (six months)
- Senior Professor (six months)

INCOMING - grants for activities at UFMG

- Postdoctoral (12 months, renewable)
- Early-career researcher (12 months, renewable)
- Senior Professor (15 days)

Agri and Biobusiness
meeting
22 november
2018

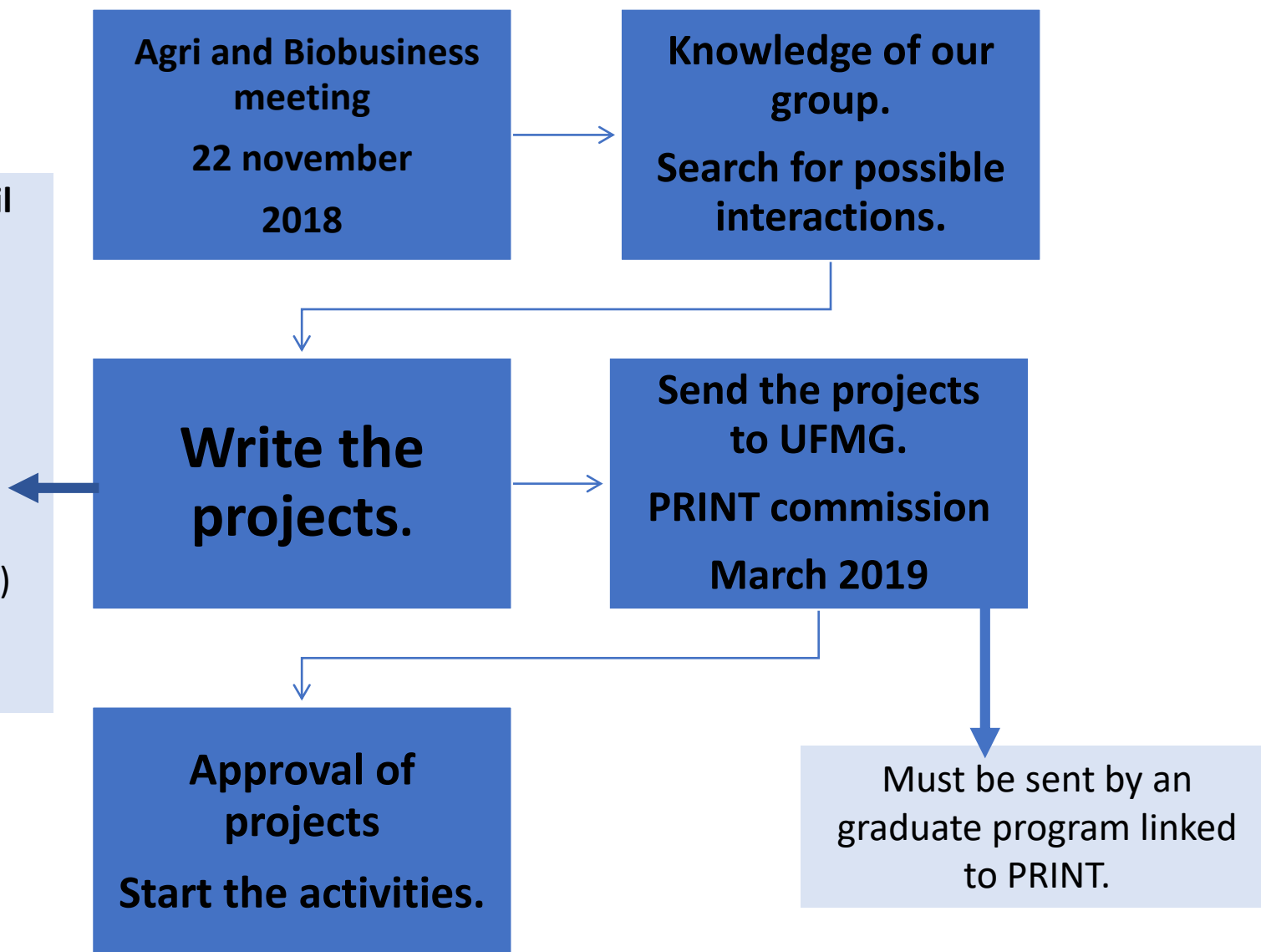
Knowledge of our
group.
Search for possible
interactions.

Write the
projects.

Send the projects
to UFMG.
PRINT commission
March 2019

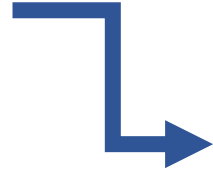
Approval of
projects
Start the activities.

Must be sent by an
graduate program linked
to PRINT.

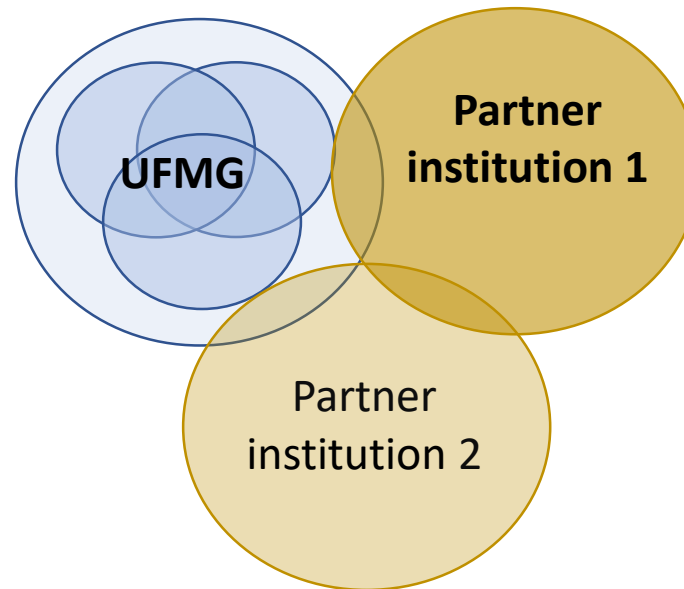


Basic characteristics of projects

Interaction among different graduate programs from UFMG



Interaction with one or more foreign Universities





Matrix of the Institutional Project of Internationalization

Thematic axes (★: number of projects in interaction)

Aging
Agro- and bio-business
Basic science and its applications
Big data and artificial intelligence
Biotechnology
Borders and migrations
Chronic, emergent and neglected diseases
Cities and territories
Climate change
Development, inclusion and exclusion
Education
Energy
Industry 4.0
Languages, gender and identity
Natural resources
Novel materials and nanotechnology
Public policies and political regimes
Traditions, cultures and arts
Violence, conflicts and regulation

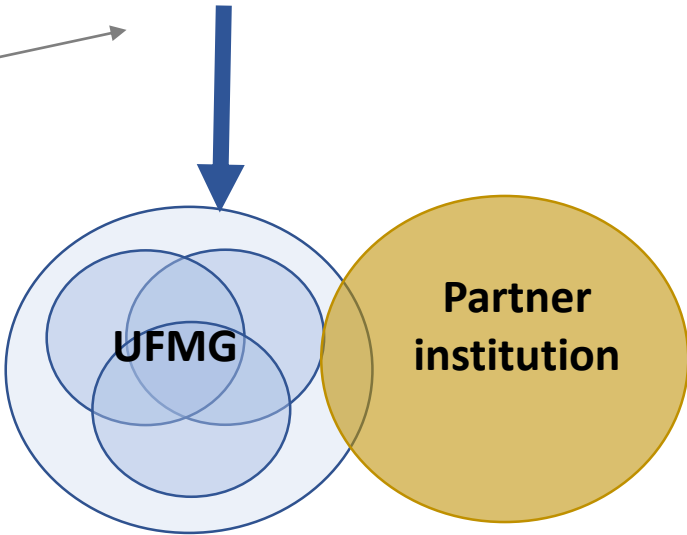
Theme New Technologies and Frontiers of Science



New Technologies and Frontiers of Science
★
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- Agri and bio-business
- Basic Science and its applications
- Biga data and artificial intelligence
- Biotechnology
- Cities and territories
- Education
- Industry 4.0
- Languages, genderand identity
- Natural resources
- Novel material and nonotechnology

We can send a single proposal



What do we (UFMG) expect with collaborative projects?

Improve the quality of our work.

Publications

Patents

Training of human resources

That may reflect:

**social, economic and environmental
improvements.**

UFMG Graduate programs taking part in our Agri and Biobusiness meeting.

Animal production.....Dr. Diego Vicente da Costa, diego2@ufmg.br, Dr. Eduardo Robson Duarte duartevet@hotmail.com
Cell BiologyDr. Rodolfo Cordeiro Giunchetti giunchetti@icb.ufmg.br
Chemistry.....Zenilda Cardeal zenilda.cardeal@gmail.com, Dr. Lúcia Pimenta lpimenta.qui@gmail.com
Food SciencesJacqueline A. Takahashi <jat@qui.ufmg.br>
GeneticsEvanguedes Kalapothakis Kalapothakis@gmail.com, Dr. Jurandir Magalhães,
jurandir@cnpms.embrapa.br, Dr. Claudia Guimarães claudia.guimaraes@embrapa.br
LawFabiana de Menezes Soares Fabiana de Menezes Soares fabimz@icloud.com
Production engineering.....Raoni Rajão raoniguerra@gmail.com
**Sanitation, Environment
and Water Resources**Antonio Teixeira de Matos atmatos@desa.ufmg.br , Dr. Míriam C.S. Amaral miriam@desa.ufmg.br
Crop ProductionDiego Vicente da Costa diego@ica.ufmg.br
Plant biologyDr. Luzia V. Modolo lvmodolo@gmail.com, Dr. Ângelo de Fátima angelo.geqob@yahoo.com.br

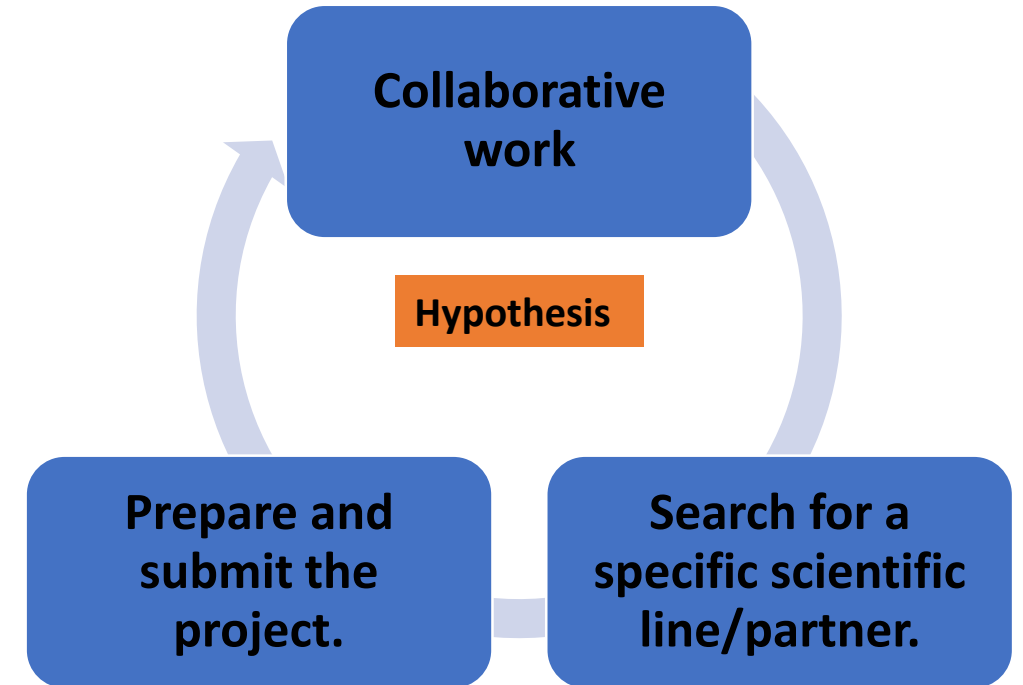
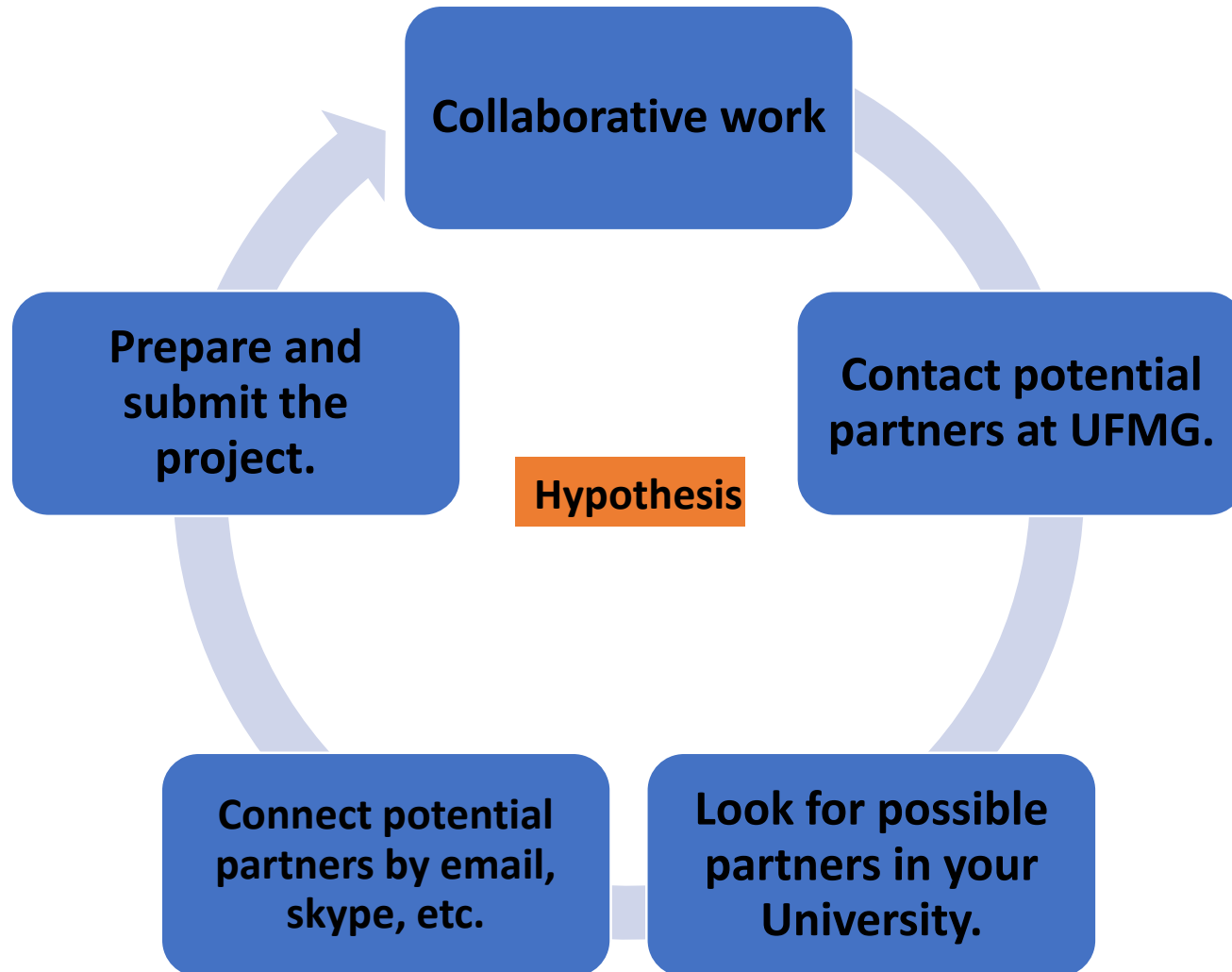
Adriana Franca drisfranca@gmail.com Sou a Profª Adriana França e assumi semana passada a coordenação do PPGCA. Meus dados/área de atuação foram listados pela prof Jacqueline. Estou a disposição para informações complementares e estarei presente hoje na apresentação

Partner institutions willing to collaborate with UFMG in this project (so far)

- Vrije Universiteit – Dr. Anna Bon - Netherlands
- University of Southampton – Dr. David Wilson - UK
- Lincoln University - Dr. Hugh Bigsby – New Zealand
- University of Alberta - Dr. Cristian Gonzalez-Paez - Canada

New collaborations will be most welcome!

The success of our meeting depends on understanding the dynamics of each partner university.



The dynamics of our meeting today.

**A presentation about the work of colleagues
interested in starting an international
collaboration.**



**A presentation of the external institutions
present at this meeting.**



Talk for interactions.

Research issues and questions



Dr. Evanguedes Kalapothakis
Kalapothakis@gmail.com

Research topic

- Biological control
- Use of natural antimicrobials in the treatment of infections.
- Forensic genetics

UFMG Graduate programs involved:

- Genetics
- Technologic innovation

Partners and funding agencies:

- EMBRAPA - Brazilian Agricultural Research Corporation

Biological control.

Doru luteipes (Scudder, 1876) as a predator of *Spodoptera frugiperda* (J.E. Smith, 1797).

Objective: To avoid the growth of fungi in *Doru luteipes* eggs for high-scale production.
Development of informative material (videos) to clarify farmers about the importance of *Doru luteipes* in biological control.



Female and nymph feeding on eggs of *Spodoptera frugiperda*.



Dr. Evanguedes Kalapothakis
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Dr. Ivan Cruz
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PATENT: Enzymatically modified sunflower oil, process of obtaining and using its derivatives as antimicrobial.



Tested in the prevention and treatment of interdigital dermatitis



Dr. Jurandir Magalhães
jurandir@cnpmc.embrapa.br



Dr. Claudia Guimarães
claudia.guimaraes@embrapa.br

Research topics

- Physiological, molecular and genetic mechanisms underlying crop tolerance to abiotic stresses on tropical regions, including those enhanced by global climate changes.
- Development of new tools for Marker-Assisted Selection aimed at developing crops with enhanced resilience to abiotic stresses

UFMG Graduate programs involved:

- Genetics
- Bioinformatics

Partners and funding agencies:

- CNPq
- CAPES
- FAPEMIG

In press: PNAS - 2018

Repeat variants for the SbMATE transporter protect sorghum roots from aluminum toxicity by transcriptional interplay in *cis* and *trans*

Janaina Melo¹, Laura Martins², Beatriz Barros¹, Maiana Pimenta², Ubiraci Lana¹, Christiane Eliza Duarte², Maria Pastina¹, Claudia Guimaraes¹, Robert Schaffert¹, Leon Kochian³, Elizabeth Fontes², Jurandir V. Magalhães¹

¹Embrapa Maize and Sorghum, ²Universidade Federal de Viçosa, ³University of Saskatchewan

Submitted to Proceedings of the National Academy of Sciences of the United States of America



REVIEW
published: 26 September 2018
doi: 10.3389/fpls.2018.01490



Emerging Pleiotropic Mechanisms Underlying Aluminum Resistance and Phosphorus Acquisition on Acidic Soils

Jurandir V. Magalhães^{1,2*}, Miguel A. Piñeros^{3*}, Laiane S. Maciel^{1,2} and Leon V. Kochian⁴

¹ Embrapa Maize and Sorghum, Sete Lagoas, Brazil, ² Departamento de Biologia Geral, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, ³ Robert W. Holley Center for Agriculture and Health, USDA-ARS, Cornell University, Ithaca, NY, United States, ⁴ Global Institute for Food Security, University of Saskatchewan, Saskatoon, SK, Canada



Dr. Jurandir Magalhães
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SCIENTIFIC REPORTS

OPEN

Exploiting sorghum genetic diversity for enhanced aluminum tolerance: Allele mining based on the *Alt_{SB}* locus

Barbara Hufnagel^{1,2,3}, Claudia T. Guimarães^{1,2}, Eric J. Craft³, Jon E. Shaff¹, Robert E. Schaffert¹, Leon V. Kochian⁴ & Jurandir V. Magalhães^{1,2}

Received: 2 February 2018
Accepted: 7 June 2018
Published online: 04 July 2018



Dr. Claudia Guimarães
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Patents

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



PCT

(43) International Publication Date
27 November 2008 (27.11.2008)

(10) International Publication Number
WO 2008/144257 A2



The Sorghum Aluminum Tolerance Gene SbMATE 2007



Pedido nacional de Invenção, Modelo de Utilidade, Certificado de Adição de Invenção e entrada na fase nacional do PCT

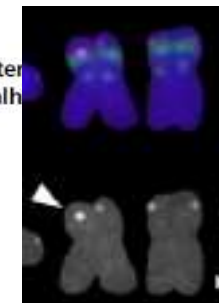
Número do Processo: BR 10 2017 019923 1

Detection and Introgression of ZmMATE1 in maize to improve Aluminum Tolerance – Submitted in 2017.



Aluminum tolerance in maize is associated with higher *MATE1* gene copy number

Lyza G. Maron^{a,1}, Claudia T. Guimarães^b, Matias Kirst^{c,d}, Patrice S. Albert^e, James A. Birchler^e, Peter Edward S. Buckler^{a,f}, Alison E. Coluccio^a, Tatiana V. Danilova^{e,2}, David Kudrna^g, Jurandir V. Magalhães^a, Miguel A. Piñeros^a, Michael C. Schatz^h, Rod A. Wing^g, and Leon V. Kochian^{a,1}



New building
for classrooms
(under construction)



NMR facilities

Hazardous
reactions

Central analytical facility

Main building – Research Laboratories

Teaching Laboratories

New research building
(under construction)



1. Nuclear Magnetic Resonance (NMR) – 400 MHz
2. Thermal and elemental analysis
3. HPLC – High Performance Liquid Chromatography
4. Atomic Absorption, IR, UV-VIS
5. X-ray diffraction and fluorescence.
6. Mass spectrometry
7. Microcalorimetry,
8. Mossbauer spectroscopy
9. Positron annihilation and half time spectroscopy.



Research themes at Chemistry Graduate program

2.2 Agro and Biobusiness

- Valorisation of products, side products, and rejects from forestry and agricultural
- Development of new products, agrochemicals, fertilizers and pesticides, natural insecticides; allelopathic agents
- Contaminant analysis
- Drug analysis
- Remediation methods for agriculture contamination



Prof. Zenilda L Cardeal
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Research issues and questions



Dr. Antônio Matos
atmatos@desa.ufmg.br



Dr. Míriam C.S. Amaral
miriam@desa.ufmg.br

Research topic

- Agricultural reuse of domestic and industrial wastewater
- Nutrients recovery from wastewater

UFMG Graduate programs involved:

- Sanitation, Environment and Water Resources

Partners and funding agencies:

- CNPq
- CAPES
- FAPEMIG
- DAAD



Research issues and questions

Research topic

- Agricultural reuse of domestic and industrial wastewater
- Nutrients recovery from wastewater



Research issues and questions



Dr. Rodolfo Cordeiro Giunchetti
giunchetti@icb.ufmg.br

Research topic

- Canine visceral leishmaniasis immunotherapy and vaccine
- Vaccines against dog and cattle ticks

UFMG Graduate programs involved:

- Cellular Biology
- Parasitology

Partners and funding agencies:

- CNPq
- CAPES
- FAPEMIG

Pedido nacional de Invenção, Modelo de Utilidade, Certificado de
Adição de Invenção e entrada na fase nacional do PCT

Major Patents:

- Vaccine against canine visceral leishmaniasis
- Therapeutic vaccine applied for immunotherapy of human and / or canine visceral leishmaniasis
- Immunobiological study to control the vector of leishmaniasis and its process of obtaining
- Peptide, vaccine for sand fly control and applications
- Vaccinal composition containing mosquito proteins and process of obtention



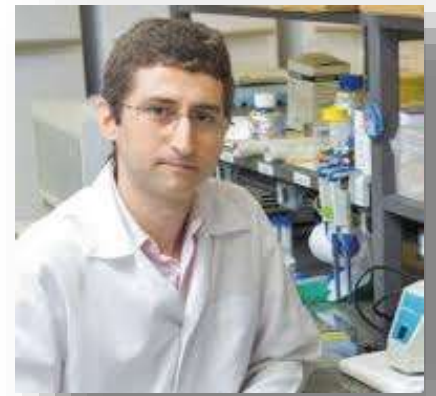
Vaccines based on *Leishmania* and sand fly antigens for leishmaniasis control



Vaccines based on mosquito antigens for arboviruses controlling



Vaccines against dogs and cattle ticks



Dr. Rodolfo Cordeiro Giunchetti
giunchetti@icb.ufmg.br

de Mendonça et al. Parasites & Vectors (2016) 9:473
DOI 10.1186/s13071-016-1752-4

Parasites & Vectors

RESEARCH

Open Access

Multicomponent LBSap vaccine displays immunological and parasitological profiles similar to those of Leish-Tec® and Leishmune® vaccines against visceral leishmaniasis

Lucimila Zanandré de Mendonça¹, Lucilene Aparecida Rosende^{1,2}, Mariana Ferreira Lima³, Rodrigo Dias da Oliveira Aquino Soares⁴, Bruno Mendes Roat⁵, Renata Alves de Oliveira e Castro⁶, Mauricio Azevedo Batista⁷, Denise Silveira Lemos⁸, Juliana de Assis Silva Gomes⁹, Ricardo Terezo Fujikawa⁹, Simone Aparecida Rosende⁹, Cláudio Assis Martins-Filho⁹, Rodrigo Cunha-Oliveira⁹, Walderez Dinêtas Dutra⁹, Alexandre Barbosa Reis⁹ and Rodolfo Cordeiro Giunchetti¹⁰

Parasites & Vectors (2016) 9:473



Content not available at ScienceDirect

Veterinary Parasitology

Journal homepage: www.elsevier.com/locate/ypar

Research paper

Therapeutic vaccine of killed *Leishmania amazonensis* plus saponin reduced parasite burden in dogs naturally infected with *Leishmania infantum*

Kelvinson Fernandes Viana^{1,2,3,4}, Giulia Lacerda⁵, Natália Soares Teixeira⁶, Alex Sander Rodrigues Cangussu⁶, Raimundo Wagner Sousa Aguiar⁶, Rodolfo Cordeiro Giunchetti⁷

¹ Universidade Federal de Minas Gerais (UFMG), Faculdade de Medicina Veterinária, Belo Horizonte, Minas Gerais, Brazil

² Laboratório de Parasitologia e Vacinas, Departamento de Ciências e Tecnologia, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Minas Gerais, Brazil

³ Laboratório de Imunologia, Departamento de Biologia, Instituto de Biologia, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Minas Gerais, Brazil

Research issues and questions

Dr. Luzia V. Modolo
lvmodolo@gmail.com



Research topic

- Development of Urease Inhibitors-Based Urea Formulations for Sustainable Agricultural Purposes
- Enzyme Engineering for the Production of Valuable Natural Products

UFMG Graduate programs involved:

- Plant Biology
- Chemistry
- Pharmaceutical Sciences

Partners and funding agencies:

- CNPq
- CAPES
- FAPEMIG

Cite this: *RSC Adv.*, 2015, 5, 44507

Design, syntheses and evaluation of benzoylthioureas as urease inhibitors of agricultural interest†

Tiago O. Brito,^{‡a} Aline X. Souza,^{‡b} Yane C. C. Mota,^b Vinicius S. S. Morais,^b Leandro T. de Souza,^{bc} Ângelo de Fátima,^d Fernando Macedo Jr^{*a} and Luzia V. Modolo^{*b}

Urea is one of the most used nitrogen fertilizers worldwide. However, occurrence of urea hydrolysis to ammonia and carbon dioxide on soil surface, catalyzed by soil ureases, considerably reduces nitrogen availability to crops. In this study, we describe the design, synthesis and screening of sixty five benzoylthioureas (BTUs) for their ability to inhibit purified jack bean and soil ureases. BTUs were readily obtained in one pot, two steps synthesis with no need of cumbersome procedures for product purification. *In vitro* assays revealed BTUs **11**, **12**, **14**, **19–22** and **37** as the most active jack bean urease inhibitors. Such BTUs were found to be able to bind to both catalytic and allosteric sites of urease, acting therefore as mixed-type inhibitors. Out of 28 compounds that effectively inhibited soil ureases activity, BTUs **3**, **6**, **10**, **12**, **16**, **19** and **22** were determined to be more potent than the reference inhibitor *N*-(butyl) thiophosphoric triamide (NBPT; 40%). The other 22 BTUs were as potent as NBPT on soil ureases. The temperature-tolerance of BTUs, along with their ability to inhibit soil ureases, makes of this class of compounds potential additive for urea-based fertilizers.

Received 29th April 2015

Accepted 11th May 2015

DOI: 10.1039/c5ra07886e

www.rsc.org/advances

Dr. Luzia V. Modolo
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Network for the
development of
novel urease
inhibitors

Research issues and questions

Chemistry

Dr. Ângelo de Fátima
angelo.geqob@yahoo.com.br



Research topic

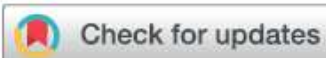
- **The design, synthesis and evaluation of organic molecules with potential to inhibit ureases**, hydrolase enzymes known as central factors for some diseases in humans and nitrogen losses in agricultural fields supplemented with urea.

UFMG Graduate Programs Involved:

- Plant Biology
- Pharmaceutical Sciences

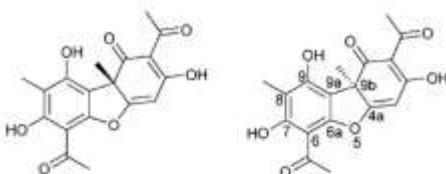
Partners and Funding Agencies:

- CAPES, CNPq, and FAPEMIG
- BASF (Brazil)

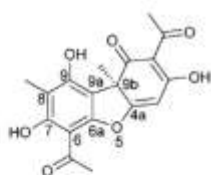


Cite this: *New J. Chem.*, 2018, 42, 5356

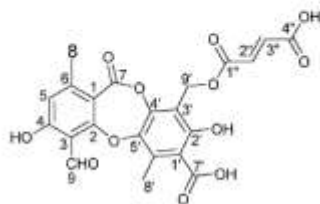
In vitro inhibition of *Helicobacter pylori* and interaction studies of lichen natural products with jack bean urease†



(*R*)-(+)-Usnic acid (1)



(*S*)-(-)-Usnic acid (2)



Fumarprotocetraric acid (3)

Secondary metabolites produced by lichens.

Tiago C. A. Lage, ^a Thamilla Maria S. Maciel, ^b Yane C. C. Mota, ^c Francesca Sisto, ^d José R. Sabino, ^e Josué C. C. Santos, ^b Isis M. Figueiredo, ^b Carla Masia, ^d Ângelo de Fátima, ^f Sergio A. Fernandes ^{*a} and Luzia V. Modolo ^c

The interaction of (*S*)-(-)-usnic acid (2) and fumarprotocetraric acid (3), isolated from *Cladonia rappii* (lichen), and commercial (*R*)-(+)-usnic acid (1) with urease was investigated *in vitro* by molecular spectroscopy at pH 7.4 and kinetics experiments using jack bean type III urease. All lichen compounds tested interact with urease by a statistical quenching mechanism forming non-fluorescent complexes that change the native protein structure. Formation of complexes was spontaneous and stabilized mainly by electrostatic forces, in which the interaction magnitude was determined to be $3 < 2 < 1$. Compound 2, whose tridimensional structure is disclosed here, acts as a mixed inhibitor while compounds 1 and 3 function as competitive ones. The (*R*)-(+)-UA (1) is the most efficient lichen metabolite with respect to impairment of the growth of five *H. pylori* strains. The minimum inhibitory concentrations (MIC) for the lichen metabolites tested were lower (from 2- to 7.8-fold) than those of omeprazole (reference drug) against all *H. pylori* strains tested. Overall, the lichen metabolites 1–3 are promising lead compounds for the design of more efficient urease inhibitors for the treatment of *H. pylori* infections.



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‡This work was made possible partly by the **Network for the Development of Novel Urease Inhibitors (www.redniu.org).**

Received 5th January 2018,
Accepted 13th February 2018

DOI: 10.1039/c8nj00072g

Research issues and questions

Chemistry

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Research topic

- Special interest is devoted to investigate secondary metabolites with potential application in food, agriculture and medicine. We routinely use NMR-based metabolomic studies.

UFMG Graduate Programs Involved:

- Vegetal Biology

Partners and Funding Agencies:

- CAPES, CNPq, and FAPEMIG



Incorporation of an invasive plant into a native insect herbivore food web

Menno Schilthuizen^{1,2,3}, [Lúcia P. Santos Pimenta](#)^{2,4}, Youri Lammers¹, Peter J. Steenbergen², Marco Flohil⁵, Nils G.P. Beveridge^{1,2}, Pieter T. van Duijn^{1,6}, Marjolein M. Meulblok^{1,6}, Nils Sosef^{1,6}, Robin van de Ven^{1,6}, Ralf Werring^{1,6}, Kevin K. Beentjes⁷, Kim Meijer³, Rutger A. Vos^{1,8}, Klaas Vrieling², Barbara Gravendeel^{1,2,6}, Young Choi^{2,9}, Robert Verpoorte², Chris Smit³ and Leo W. Beukeboom³

¹ Endless Forms group, Naturalis Biodiversity Center, Leiden, the Netherlands

² Institute for Biology Leiden, Leiden University, Leiden, the Netherlands

³ Groningen Institute for Evolutionary Life Sciences, University of Groningen, Groningen, the Netherlands

⁴ Departamento de Química, Instituto de Ciências Exatas, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

⁵ ServiceXS, Leiden, the Netherlands

⁶ University of Applied Sciences Leiden, 1

Machado *et al. Parasites & Vectors* (2015) 8:113
DOI 10.1186/s13071-015-0708-6



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**Parasites
& Vectors**

Inflammopharmacology

<https://doi.org/10.1007/s10787-017-0426-0>

ORIGINAL ARTICLE

RESEARCH

Open Access

Anti-inflammatory and antinociceptive properties of the hydroalcoholic fractions from the leaves of *Mart. in mice*

Nematicidal activity of *Annona crassiflora* leaf extract on *Caenorhabditis elegans*

Alan Rodrigues Teixeira Machado^{1*}, Sebastião Rodrigo Ferreira², Felipe da Silva Medeiros¹, Ricardo Toshio Fujiwara², José Dias de Souza Filho¹ and [Lúcia Pinheiro Santos Pimenta](#)¹

Cristina da Costa Oliveira¹ · Natália Alves de Matos¹ · Clarice de Carvalho Veloso¹ · Gisele Avelar Lage² · [Lúcia Pinheiro Santos Pimenta](#)² · Igor Dimitri Gama Duarte¹ · Thiago Roberto Lima Romero¹ · André Klein¹ · Andrea de Castro Perez¹

Research issues and questions



Dr. Diego Vicente da Costa
diego2@ufmg.br

Research topic

- Edible insects farming
- Monogastric animal nutrition
- Use of Insects as food and feed

UFMG Graduate programs involved:

- Animal production
- Crop production

Partners:

- TAMU (USA), BGU (Israel), AUAP (Germany)

Funding agencies:

- BNB, CNPq, FAPEMIG

Research issues and questions



Dr. Eduardo Robson Duarte
duartevet@hotmail.com

Research topic

- Ruminal microbiota and potential biotechnology of fungi and lactic bacteria from ruminants animal

UFMG Graduate programs involved:

- Animal production
- Crop production

Partners:

- Agricultural Science Institute (CUBA)

Funding agencies:

- CNPq, FAPEMIG

Research issues and questions

Fabiana de Menezes Soares
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Research topic - Law School

Agrifood Legislation: Complex System

Specific lawmaking

(Phitosanitary , Animal Health, Food Security)

Law Post Graduate Programs (since 1932) :

75 Professors

365 students

Partners and funding agencies:

- CNPq
 - CAPES
 - FAPEMIG
 - Unil - Switzerland
 - Ulaval - Canada
- Unibo - Italy
Bielefeld – Germany



Research issues and questions

Research topic – Law School & IEAT (Transdisciplinary Advanced Studies)

Agrifood Legislation: Rights, Culture & Language

Tensions:

Codex Alimentarius x Traditional Products

Multilevel Legislation & Regulations

Cultural Approaches: Food as language - Gastrodiplomacy



12 UFMG Graduate programs taking part in our Agri and Biobusiness meeting.

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Animal Science

Animal production

Bioinformatics

Cell Biology

Chemistry

Environment and Water Resources

Food Sciences

Genetics

Law

Production engineering

Sanitation, Environment and Water Resources

Plant Science

Research issues and questions



Dr. Junio Cota
junioes@gmail.com

Research topic

- Biofuels / High-value Bioproducts
- High-value Product from Insect Meal

UFMG Graduate programs involved:

- Plant Science
- Animal Science

Partners and funding agencies:

- CTBE/CNPEM
- BNB - Bank in Northeastern Brazil
- CNPq
- PRPq/UFMG

RESEARCH

Open Access



Development of a low-cost cellulase production process using *Trichoderma reesei* for Brazilian biorefineries

Simo Ellilä^{1,2*}, Lucas Fonseca¹, Cristiane Uchima¹, Junio Cota^{1,3}, Gustavo Henrique Goldman⁴, Markku Saloheimo⁴, Vera Sacon¹ and Matti Silka-aho²

Bioprocess and Microbial Technology 39 (2017) 21–32

Contents lists available at ScienceDirect

Enzyme and Microbial Technology

journal homepage: www.elsevier.com/locate/tem



Development of a chimeric hemicellulase to enhance the xylose production and thermotolerance

José A. Diogo^{1,2,3}, Zaira B. Hoffmam^{1,2,3}, Leticia M. Zanphorlin^{1,2}, Junio Cota³, Carla B. Machado³, Lúcia D. Wolf³, Fabio Squina⁴, André R.L. Damásio³, Mario T. Murakami³, Roberto Ruller^{4,5}

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Bioconversion of Hemicellulose Into Ethanol and Value-Added Products: Commercialization, Trends, and Future Opportunities

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Assembling a xylanase–lichenase chimera through all-atom molecular dynamics simulations

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Comparative analysis of three hyperthermophilic GH1 and GH3 family members with industrial potential

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The *Penicillium echinulatum* Secretome on Sugar Cane Bagasse

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Mechanistic Strategies for Catalysis Adopted by Evolutionary Distinct Family 43 Arabinanases*

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Patents

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2. Natureza: ☒ Invenção ☐ Modelo de Utilidade ☐ Certificado de Adição

3. Título da Invenção ou Modelo de Utilidade (54):

COQUETEL ENZIMÁTICO DE TRICHODERMA HARZIANUM SUPLEMENTADO COM ENZIMAS ACESSÓRIAS, PROCESSO DE OBTENÇÃO E SEU USO

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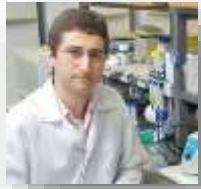
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