

## A highly nutritious native seed as an innovative food resource in Central America

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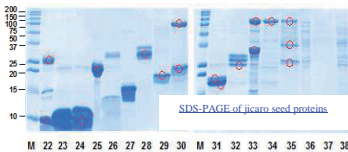
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Jicaro (*Crescentia alata*), or calabash tree, is a tree belonging to the Bignoniaceae family and common in agropastoral systems in the dry regions of Central America<sup>1</sup>. Its fruits have a calabash shape and have been used since the pre-Colombian, not only as a staple food but also for its multiple uses as traditional medicine, cooking utensils and containers. The jicaro fruit is spherical and contains lots of little seeds embedded in a sweet pulp, surrounded by a lignified pericarp. The edible seeds which represent 5% of the total weight of the fruit, are dark brown, flat and heart-shaped (9 mm length, 7mm width and 2mm thickness). Jicaro seed is composed of two white cotyledons surrounded by a dark-brown, very thin and strongly adherent seed coat. Jicaro seed is still widely consumed in Mesoamerica<sup>2</sup>, especially in El Salvador and Nicaragua, as a brown popular beverage "horchata". Little research on jicaro exists, and few studies have attempted to characterize the nutritional value of jicaro seed<sup>3</sup>.

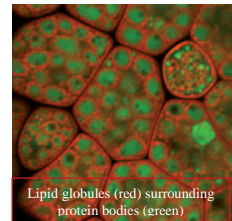
The aim of our study was to gain a better knowledge of the nutritional value of this small indigenous seed, its macro and micronutrient content, and of the presence or not of anti-nutritional factors.



Jicaro seed was found to be a good source of proteins (43.6 % d.b.) and lipids (38.0 % d.b.) which were the major constituents. Its nutritional composition is comparable to most protein-rich seeds and oilseeds such as soybeans, with the difference that jicaro seed contains no starch, more proteins and no anti-nutritional factors such as trypsin inhibitors (0.1 TIU/mg) and alpha-galactosides (stachyose, raffinose : 0.14 and <0.1 % d.b. respectively).

SDS-PAGE gel indicated a major proportion of low MW proteins (~10 kDa), albumins types, which, coupled with low levels of anti-nutritional factors, should facilitate the digestibility of proteins. Essential amino acids represented 16.0 % d.b. of the protein fraction, similarly to soybean. Fatty acid profiles revealed a high proportion of unsaturated fatty acids (77.6%), mainly oleic acid. Jicaro seed presented also the particularity to contain higher contents of minerals (phosphorus, magnesium, iron, zinc) and lower contents of phytates compared to soybean.

The observation of jicaro seeds by confocal laser scanning microscopy showed a very regular structure in the cell with spherical protein bodies surrounded by many small fat globules.



This native seed might be of a great interest in these unexploited regions of Central America, not only for its high nutritional potential but also as a plant source to extract a nutritive beverage such as milk for lactose intolerant people. Its valorisation should limit soybean imports and use local resources.

**Keywords** Oilseed; Nutritional value; Anti-nutritional factors; confocal laser scanning microscopy; SDS-PAGE

### References

- [1] Cordero J., Boshier D.H. 2003. *Crescentia alata*. In *Árboles de Centroamérica*, Catie. Eds. Oxford Forestry Institute, Oxford, UK. pp 497–502.
- [2] Staller J.E., 2010. Ethnohistoric sources on foodways, feasts, and festivals in Mesoamerica. In *Pre-columbian Foodways*. Staller, J., Eds. Springer. pp 23–69.
- [3] Lewy, S.V.M. 1960. Morro seed oil. *The Journal of the American Oil Chemist Society*. 37, 402–403.

# Book of Abstracts



2-4 November 2016, Barcelona / Spain



Established, emerging and exploratory  
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# Book of Abstracts

The Food Factor I Barcelona Conference, 2-4 November 2016, Barcelona (Spain)





## INTRODUCTION

This book contains a selection of the abstracts that were accepted for presentation at The Food Factor I Barcelona Conference, Established, emerging and exploratory food science and technology, which was held at the University of Barcelona, Spain, from 2 to 4 November 2016.

The first edition of this Food Factor Conference gathered around 250 participants, coming from more than 45 countries. And around 280 works were presented at the conference. This was a more than satisfactory level of attendance for this first research forum, especially in the context of a global budget constraint.

The organization called for research papers dealing with the following topics:

### Food chemistry and biochemistry

Topics: structure and function of major and minor components (either nutrient or non-nutrient) of foods, the biochemical changes produced during handling, storage, post-harvest/mortem processing, distribution or due to domestic conditions, and their impact on nutritional, physiological, sensorial, or toxicological properties and safety; Reports on new or improved techniques or methods for addressing these topics or on the chemistry of food contacting materials. Specific areas of interest were:

- Food bioactives
- Chemistry of food additives and preservatives
- Chemical analysis for the determination of authenticity and origin of foods
- Biochemical changes in cereal grains and legumes due to postharvest conditions and treatments (storage, germination, fermentation...)
- Biochemical changes in postharvest fruits and vegetables with impact in quality
- Biochemical changes produced in the conversion of muscle into meat and fish
- Biochemistry of the biosynthesis of milk components
- Biochemical changes of the transformation of milk into dairy products
- Browning reactions in foods
- Lipid peroxidation
- Computational chemistry in food research
- Chemistry of food packaging and food-handling materials

### Food microbiology

Topics: microorganisms that are related to human nutrition and health: those used to make foods or whose use and/or consumption can improve food production or host health; the detection, identification and quantification of those that pose a threat to food safety or quality (also applied to microbial toxins and metabolites and foodborne viruses); the study of their biology (biochemistry, ecology, genetics, physiology...); their role in various food processing methods and in food spoilage; their susceptibility to different physical or chemical agents, processing or packaging methods; or their interaction with different food chain environments and foodstuff, reports on the development and application of mathematical and computational tools in food research. Specific areas of interest were:

- Rapid detection of foodborne pathogens
- High throughput screening
- Norovirus and other viral agents in foods
- Antimicrobial/biocide resistance
- Microbial risk analysis: assessment, management and communication
- Microbiology of fermented foods and beverages
- Food defense

- Food contamination
- Mycotoxins
- Intestinal microbiota and host health
- Hygienic design of food manufacturing lines
- Epidemiology of foodborne pathogens
- Spoilage of soft drinks (with increasing levels of nutrients)
- Biofilms
- Cross-contamination
- Beneficial microbes
- Food parasites
- Microbial nutrition: probiotics
- Bacterial and fungal species: *Yersinia*, *Bacillus*, *Staphylococcus*, *Listeria*, *Salmonella*, *Escherichia coli*, *Vibrio*, *Campylobacter*, *Brucella*, *Mycobacterium*, *Clostridium*, *Streptococcus*, and others; Aflatoxins and other microbial-derived toxins; Norovirus, Rotavirus, Hepatitis virus and other viral agents

### Food physics

Topics: understanding and measurement of the physical properties of foods and their constituents: structural, rheological, textural, optical, electrical, thermodynamic, flowing, acoustic, mechanical..., how they change during processing, the relationship between the properties of their constituents (water, proteins, fats, oils, gasses, and minor constituents like vitamins and minerals) and their macroscopic properties (texture, taste, smell, colour, nutritional and health impact), or the developments of purely physical ways of treating foods, either thermal or non-thermal. Specific areas of interest are:

- Thermal modification of foods: heat-moisture treatment, annealing, microwave heating, osmotic pressure treatment ...
- Non-thermal modification of foods: ultrahigh-pressure treatments, instantaneous controlled pressure drop, high-pressure homogenizers, dynamic pulsed pressure, pulsed electric fields, freezing, thawing...
- Multiscale computer simulation and mathematical modeling of food structures
- Novel microscopy, image analysis, and characterization techniques
- Soft matter physics applied to food materials
- Colloidal structures, their interactions and relationship with food stability and overall macroscopic properties
- Modern technologies for sensory analysis
- Relationship between physical properties of food and consumer preferences

### Food analysis

Topics: analysis of foods and their constituents (amino acids, peptides, proteins, phenolic compounds, carbohydrates, DNA fragments, vitamins, functional ingredients or nutraceuticals, toxins, pesticide and drug residues, industrial, processing and packaging contaminants, additives, allergens, antibiotics, nanoparticles,...) by the use of analytical and imaging techniques and methods, in the context of the assessment of food structure, quality, safety, traceability, origin, authenticity, health benefits of certain constituents...; works featuring the analysis of large amounts of data generated by different techniques or time series of many variables (chemometrics). Specific areas of interest were:

- Instrumental techniques: biological, separation, spectroscopic, rheological, thermal, radiochemical, electrochemical, miniaturized microfluidic systems, modern foodomics and/or systems biological approaches...
- Imaging techniques: optical, confocal, electron, atomic force microscopies...
- Analysis of sensory properties of foods

- Sample preparation
- Qualitative analysis in a chemometric context
- Data pre-processing
- Calibration standards
- Hyperspectral images
- Image analysis and processing in food science and in industry
- Ingredient distribution in products
- Microstructures of foods: characterization and distribution
- e-noses and e-tongues
- Consumer behaviour

#### **Food processing and packaging**

Topics: established and novel processing and packaging technologies applied for delivering foods that last longer before spoiling (preservation), and that are available, safe, nutritious, and convenient, while minimizing environmental impact. Specific areas of interest were:

- Active and intelligent packaging
- Migration and potential health effects of packaging-associated chemicals of concern (Bisphenol-A, semicarbazide...)
- Modified atmosphere packaging
- Established and modern processing and preservation technologies: drying, cooling, freezing, heating, salting, fermentation, pasteurization, additives addition, irradiation, hurdle technology, use of high-pressure and pulsed electric field processing, dense phase carbon dioxide, ozone, ultrasonics, cold plasma, IR technologies, natural antimicrobials, oxygen depleted storage, microwave heating, low shear extrusion...
- Green technologies: supercritical fluid extraction, membrane technology, bioconversions...
- Biorefinery in the production of food components (proteins, carbohydrates, fats...)
- Dietary, health, and environmental concerns related to food processing
- Waste reduction in food processing and valorization of by-products

#### **Food engineering and hygienic design**

Topics: (hygienic) design and (safe) operation of food plants, including engineering tools for assessing and managing risks. Specific areas of interest were:

- Heat, mass transfer and fluid flow in food processing
- Artificial intelligence in food research and industry
- Mathematical modelling and software development for food research and industry
- Finding, correcting and preventing hazards in food industry: Hazard Analysis and Critical Control Point (HACCP), Microbial Risk Assessment (MRA)...

#### **Environmental impact of food production and consumption**

Topics: environmental impact of the food supply chain (carbon and water footprint, biodiversity, land use...), for each of the food groups. Specific areas of interest were:

- Food waste impact on climate, water, land and biodiversity
- Ways of reducing environmental impact
- Environmental impact of meat production

#### **Foods of plant origin**

Topics: plant, animal, crop or soil science relevant to the production of foods of plant origin: cereals, legumes, fruit and vegetables, sugar crops. Specific areas of interest were:

- Understanding phytobiomes for improved crop productivity
- Farming animal science: cattle, sheep, goats, horses, pigs, poultry
- Soil science

- Sustainable farming systems
- Genetic and non-genetic crop improvement
- Plant and crop protection
- Crop models
- Improvement of water use
- Resistance to pests and disease
- Modification of crops for reducing waste
- Filling the gap between plant and crop physiology
- Stress in crops produced by changing environmental conditions

#### **Foods of animal origin**

Topics: animal, vegetal, soil or marine/aquatic science relevant in the production of foods of animal origin: meat, fish, milk and their derived products, eggs, insects...

The regular conference program was complemented with two Plenary Lectures:

“Highlighting natural value: physical and chemical approaches in food processing” by Isabel C.F.R. Ferreira, from the Mountain Research Centre (CIMO), ESA, Polytechnic Institute of Bragança, Portugal

“Nonthermal processing technologies for food: Current applications and future perspectives” by Pedro Elez-Martínez, from the University of Lleida, Spain

We hope attendants and readers in general will find the content of this book of abstracts interesting, inspiring and useful and we look forward to seeing you in another fruitful edition of the conference in 2018.

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