BOOK OF ABSTRACTS





IV CONFERENCIA INTERNACIONAL DEL GRUPO IA VALSE FOOD CYTED Y VII SIMPOSIO CHIA LINK

November 14 to 18, 2022
La Plata - Jujuy, Argentina

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Norma Sammán
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PROMOTING FOOD RESEARCH AND INNOVATION WITH VALUABLE IBERO-AMERICAN ANCESTRAL SEEDS

IMPULSANDO LA INVESTIGACIÓN E INNOVACIÓN EN ALIMENTOS CON VALIOSAS SEMILLAS ANCESTRALES IBEROAMERICANAS

Based on presentations of the IV International Conference of IA ValSe-Food Network and VII Symposiun Chia-Link

EDITORIAL COMMITTEE

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PREFACE

We want to walk the full path, with a firm step on each stage, following Machado's verses:
"walker there is no path, you make the path as you go"

This book brings together the complete presentations of the IV International Ia ValSe-Food Conference and VII Symposium of Chia-Link Network, held in the cities of La Plata and Jujuy, Argentina, on November 14 to 18, 2022.
The topics are approached from diverse perspectives such as agronomic and nutritional properties, the content of bio-functional compounds, technological characteristics, and the development of new products from ancestral Latin American crops, responding to the motto ***Promoting research and innovation in food with valuable Ibero-American seeds.***
The presentations are the result of the collaboration and exchange of experiences between the members of the IA ValSe group and the Chia Link Network, consisting of 50 groups including institutions of the scientific-technological system, researchers, companies, and the industrial/consumer associations from 12 countries.
As we all know, the conservation of biodiversity is essential for food security and nutrition. Nowadays, the world largely relies on a reduced set of staple crops. Consumption of these native foods, along with scientific knowledge, will help to develop local economies and prevent any type of malnutrition and various non-communicable diseases.
Currently, the complex system of relationships demands interdisciplinary research processes, which draws in a combination of knowledge from different fields, without taking into account hierarchies or exclusions.
This book concludes another stage in the commitment to encourage the generation of knowledge to incorporate underexploited native crops, with a high content of nutrients, into the population's diet.
As well as the strengthened exchange of information between the participants of lA-ValSe Group and the Chia-Link Network.

The Editors

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INDEX

AGRONOMIC ASPECTS

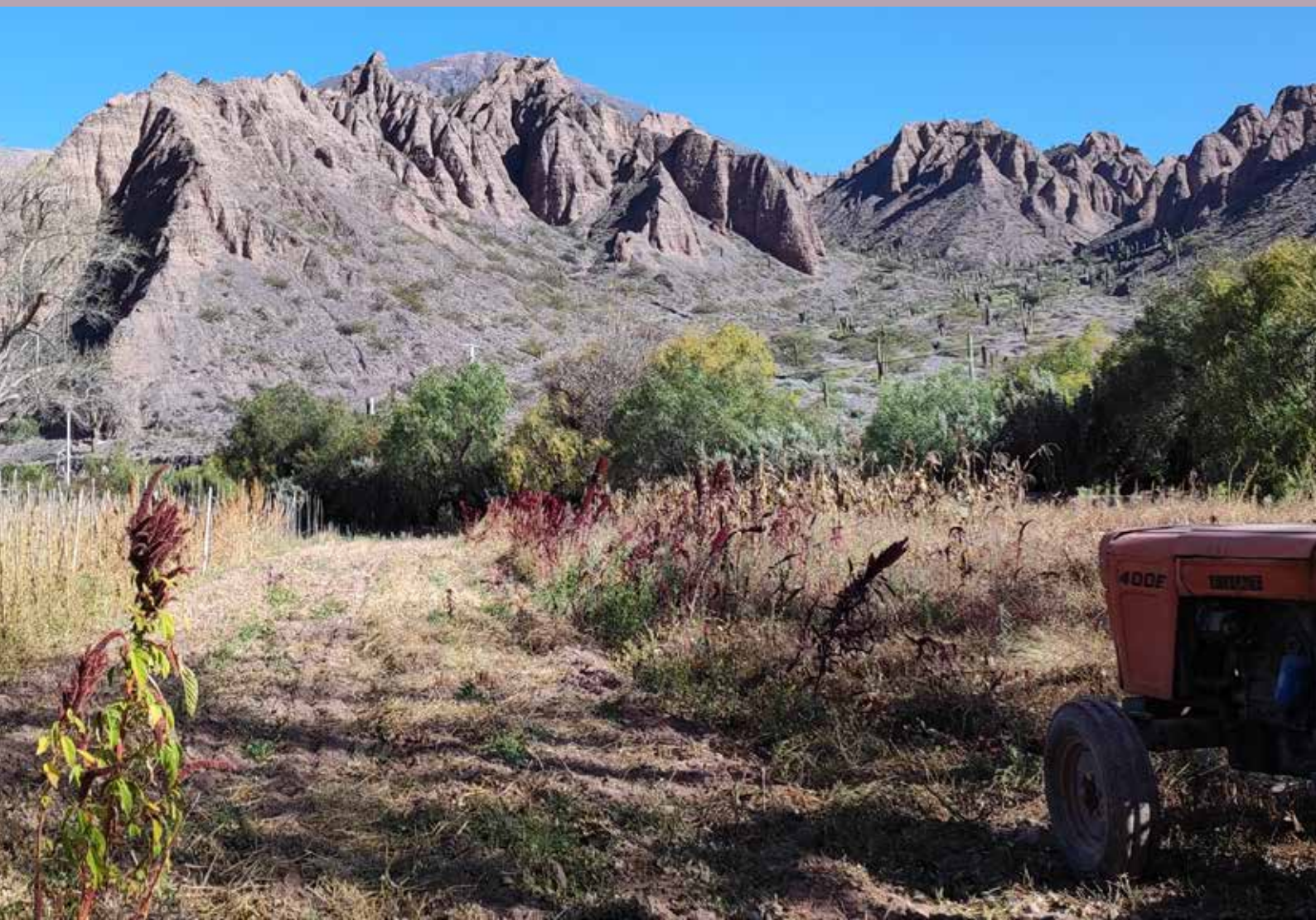
TECHNO-FUNCTIONAL ASPECTS

NUTRITIONAL AND NUTRACEUTICAL ASPECTS

PRODUCT DEVELOPMENT

ABSTRACTS

AGRONOMIC ASPECTS



AGROBIOTECHNOLOGY–SOME SELECTED CASES IN LATIN AMERICA: HIGH POTENTIAL LATIN AMERICAN CROPS

O. Paredes-López[a]*

[a]Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional (Cinvestav) Irapuato- Guanajuato, México

***Corresponding author:** octavio.paredes@cinvestav.mx

In the region there are genetic materials of high potential, especially originating in the area, or adapted to it, which have shown excellent food, nutritional, nutraceutical and functional characteristics. Unfortunately, its presence in the local diet has been relatively poor; and has caused irreversible losses; that is, substantial genetic erosions.
It is plausible to recognize that in the recent decades, producers and the general public have gradually reacted to the importance of rescuing these outstanding contributions of our original cultures to the food and medicine of our societies.
At a time when viral and microbial infections are on the rise, it is increasingly recognized that the best element of a natural vaccine is a healthy diet.
For all of the above, it is intended to briefly describe our regional potentialities with the purpose of betting on a more intelligent future based on our genetic and environmental resources.

Acknowledgments. This work was supported by grant Ia ValSe-Food-CYTED (119RT0567)

CHARACTERIZATION AND AGRONOMIC EVALUATION OF CHIA GERMOPLASM IN LA PLATA, BUENOS AIRES, ARGENTINA

M. E. Rodríguez[a], R. Lobo[b], M. Acreche[c], V. Castaldo[d], M. Pérez[d], A. Schneider Teixeira[a], L. Deladino[a] and V. Ixtaina[ae]*

[a]Centro de Investigación y Desarrollo en Criotecnología de los Alimentos (CIDCA), CONICET, UNLP, 47 y 116, La Plata, Argentina
[b] Estación Experimental Agroindustrial Obispo Colombres (EEAOC), William Cross 3150, Las Talitas, Tucumán, Argentina
[c] EEA Salta, Instituto Nacional de Tecnología Agropecuaria, CONICET, Ruta Nacional 68, km 172, 4403 Salta, Argentina
[d] Estación Experimental MDA Gorina, 501 y 149, Gorina, La Plata, Argentina
[e] Facultad de Ciencias Agrarias y Forestales (UNLP), 60 y 119, La Plata, Argentina

***Corresponding author:** vanesaix@hotmail.com

Chia (Salvia hispanica L), an ancestral crop currently revalued for its nutritional properties, is one of the main sources of omega-3 fatty acids. It is a short-day plant and sensitive to frost. The objective was to evaluate the possibility of growing chia in La Plata (Buenos Aires, Argentina) (34°54'29" S, 58°2'25" W), analysing inter and intrapopulation variability in 4 accessions of this species (CMP, EWP1, EWP2, EMP). Chia grains were sown on February 11st, in a randomized complete block design (3 replicates). Ten uniform and representative plants per plot were labelled and monitored throughout the crop cycle. Phenological stages and morphological characters (width and length of the fourth leave, number of pairs of unfolded leaves and side shoots, width of the main stem, inflorescence length, and height) were recorded from seedling emergence to harvest. The emergence and the first pair of unfolded leaves were recorded 3 d and 10 d after sown, respectively. The beginning of verticillaster emergence was detected after 50 d and the beginning of flowering after 66 d of sowing. The highest growth rate was achieved in CMP and EMP. After 77 d of sowing, CMP presented the highest values for the width of the main stem (10.4mm) and height (90.89 cm), which were statistically different from EMP. The lowest variability between populations was found for the number of pairs of unfolded leaves and side shoots. The observed variability is promising for plant breeding to obtain cultivars capable of completing their cycle in this latitude.

Acknowledgments. This work was supported by grant La ValSe-Food-CYTED (119RT0567), PICT 2018-2352 and UNLP X-901.

THE IMPACT OF ENVIRONMENTAL CONDITIONS, THE GENETIC FACTOR AND THEIR INTERACTION ON SEED QUALITY OF QUINOA

M. Reguera[a]*, S. Granado-Rodríguez[a], I. Maestro[a], L. Poza-Viejo[a], J. Matías[b], S. Vilariño[c], M. Orús[a], V. Cruz[b] and L. Bolaños[a]

[a] *Departamento de Biología, Universidad Autónoma de Madrid, c/Darwin 2, Campus de Cantoblanco, 28049, Madrid, España*

[b] *Instituto de Investigación Agraria "La Orden-Valdesequera" de Extremadura (CICYTEX). Badajoz, España*

[c] *Vitrosur Lab SLU. Algodonera del Sur, Carretera Trebujena C-441 (km 5.5), Lebrija, Sevilla, España*

***Corresponding author**: maria.reguera@uam.es

Quinoa is a highly balanced food with remarkable nutritional properties. Despite the importance of developing more nutritious food when attempting to ameliorate malnutrition (ensuring food security worldwide), limited efforts have been done exploring the exact mechanisms that control seed nutritional properties in crops trying to understand how the environmental conditions, the genetic factor, or their interaction could control these quality-related traits. Here, we present our latest works performed in the greenhouse and in the field aiming at studying how the adaptation of quinoa to changes in the environmental conditions influences the nutritional properties of its seeds. More specifically, we will present our main studies done evaluating i) the performance of different quinoa cultivars under two water regimes (optimal irrigation and water deficit) including the physiological and phenological characterization as well as the nutritional characterization of the seeds, ii) the cellular/molecular mechanisms associated with changes in the nutritional parameters in the seeds to assess genetic and environmental differences associated and iii) the role of quinoa rhizosphere microbiota regulating abiotic stress responses and nutritional quality of this crop. Overall, it will be discussed the fact that the improvement of quinoa seed quality and stress tolerance is still unexplored and challenging while key for food security and agriculture.

Acknowledgments. This work was supported by grant Ia ValSe-Food-CYTED (119RT0567) and by the Ministerio de Ciencia e Innovación (MICINN, Spain) (PID2019-105748RA-I00), the Comunidad de Madrid (CM)-Universidad Autónoma de Madrid (UAM) (SI1/PJI/2019-00124), the FPI UAM Fellowship Programme 2019 (to S. G. R.), the CM research assistant fellowship (to I. M. G.) and the Ramón y Cajal Programme 2019 (to M. R.).

NUTRITIONAL STATUS OF MICROPROPAGATED PLANTLETS OF TWO VARIETIES OF *Stevia rebaudiana* Bert UNDER DIFFERENT CULTURE CONDITIONS

S. Vilarino[a]*, M. C. Florido[b], J. L. Garcia[c] and M. Cantos[ca]

[a] *Vitrosur Lab SLU. Algodonera del Sur, Sevilla, España*
[b] *Departmant of Cristalografía, Mineralogía y Química Agrícola, Universidad de Sevilla, España*
[c] *Instituto de Recursos Naturales y Agrobiología de Sevilla (IRNAS), Sevilla, España*

***Corresponding author:** svilarino@algosur.com

Extracts obtained from plants of Stevia rebaudiana Bert have high sweetening capacity and without risks for health. The sexual reproduction of this species is characterized by the low germination efficiency of its seeds and the high heterogeneity of the resulting populations. Thus, asexual propagation, particularly micropropagation, is the preferred tool for obtaining a large number of healthy and genetically homogeneous plants in a short time. To study the effects of the substrate composition and culture system on the nutrient contents of resulting plantlets, two stevia varieties (Criolla and Morita), three culture media (Murashige and Skoog and two modifications of this medium) and two culture systems (Temporal Immersion System-TIS- and solid medium) were used. After 30 days of culture the stem length and leaf nutritional status were tested. The nutrient contents of the in vitro well-developed plants are clearly related with the substrate compositions. Except for manganese no differences were observed between both varieties in terms of macro or micronutrients levels. In most cases the nutrient levels were higher in the microplants grown in solid medium. The macro and micronutrient levels of the resulting plantlets reported and discussed here, for the first time, may be useful for future studies in order to establish normal nutrional status of references for researches working in stevia micropropagation.

Acknowledgments. This work was supported by grant Ia ValSe-Food-CYTED (119RT0567)

LIMITATIONS OF AMARANTH CULTIVATION IN THE KOLLA ABORIGINAL COMMUNITY OF FINCA TUMBAYA, TUMBAYA (JUJUY, ARGENTINA)

S. V. Abarza[a]* and G.E. Aracena[a]

[a]*Facultad de Ciencias Agrarias, UNJu. Alberdi 47, San Salvador de Jujuy, Jujuy, Argentina*

***Corresponding author:** silviaabarza@fca.unju.edu.ar

In the Kolla Finca Tumbaya Aboriginal Community (Tumbaya, Jujuy), the main activity of its inhabitants is family farming, cultivating Andean grains (corn, quinoa, beans and amaranth), horticultural species, flowers, fruit trees and fodder. Although amaranth (Amaranthus mantegasianus) germplasm has been recovered in the last decade with institutional/government support, the dissemination and acceptance achieved was far from that of quinoa in the region. In order to evaluate the factors that limit the development of amaranth cultivation, a study was carried out in the Raya Raya, Campo Agua Chica, lower sector of Tumbaya Grande and El Porvenir. Workshops were held at School No. 337 and semi-structured interviews were conducted with members of the Kolla Aboriginal Community of Finca Tumbaya, through visits to the territory. The results indicated that the main limitation is the scarcity and irregularity of rainfall, soils with low fertility, insufficient availability of seeds of ecotypes adapted to the area and local labor, unclear and motivating information to include amaranth in the diet, lack of financing to add value to the grain and economic assistance to farmers in the face of adverse environmental factors (frost, floods, etc.). It is suggested to continue with: -training to respond to the concerns of producers by providing agroecological management alternatives; -workshops to raise awareness of the nutritional value of amaranth and promote its inclusion in the diet; -technical meetings on options for incorporating value added to the grain and possible marketing channels.

Acknowledgments. To SeCTER. UNJu

CHARACTERISTICS OF THE CULLI MAIZE CROP AND PERCEPTION OF THE PRESENCE OF ANTHOCYANIN BY FAMILY FARMERS IN THE QUEBRADA DE HUMAHUACA, JUJUY, ARGENTINA

S. V. Abarza[a]*, D. A. Choque[a] and M. Mendez[a]

[a]*Facultad de Ciencias Agrarias, UNJu. Alberdi 47, San Salvador de Jujuy, Jujuy, Argentina*

***Corresponding author:** silviaabarza@fca.unju.edu.ar

Among the pigmented maize cultivated in the Quebrada de Humahuaca (Jujuy), culli maize (Zea mays L.) stands out for its dark purple coloration in the pericarp and also in the aleurone of the grain, a consequence of the presence of anthocyanins and other phenolic compounds. This and other corns were used as food and colorants since pre-Hispanic times.

The objective of the present work was: -To evaluate the presence of this maize in the plots cultivated by family farmers; -To systematize agroecological management tasks in Tumbaya grande/Tumbaya (23°51'28"S65°28'04"W), Colonia San José/Tilcara (23°23'18"S65°20'41"W) and Humahuaca (23°12'20"S65°21'02"O); and, -To inquire if they know the importance of anthocyanin for human health. It was revealed through semi-structured interviews that, in the study sites, culli corn is part of the polyculture carried out by the producers in their plots. Agricultural work is done manually (planting, hilling, weeding, irrigation and harvesting), using biofertilizers based on animal guano and ashes as an insecticide. The grain is used in family diets, mainly as flour, to prepare baked goods and beverages. It is also part of the cultural heritage of Andean ancestral rituals. The cobs and surplus flour are sold in local markets and fairs. Regarding anthocyanin, they are unaware of its characteristics and applications in medicine or other uses in the food industry. It is considered necessary to continue raising awareness of the value of this germplasm for the pigment it possesses, for the various uses that it currently provides and that can be extended to future generations.

Acknowledgments. To SeCTER, UNJu.

VALORIZATION OF ANDEAN BEANS IN INDIGENOUS COMMUNITIES OF THE QUEBRADA DE HUMAHUACA

M. Quiroga Mendiola[a]*, D. Alcoba[a], J. Quiroga Roger[a], R. Calizaya[a], D. Salve[a], B. Quiroga Mendiola[a]

[a]*INTA IPAF NOA. Ruta N°9. Km 1763. Maimará, Jujuy, Argentina*

***Corresponding author:** quiroga.mendiola@inta.gob.ar*

In Quebrada de Humahuaca, Jujuy as in most of the rural areas of northwestern Argentina, agricultural production constitutes the food base of families and sustains and recreates local identity. Production for self-consumption is a pillar of the agri-food strategy and configures, among other aspects, the people's memory. Originally from the central region of the Andes, the Andean bean (ñuña, n umia, poroto, pushpu or reventón bean) Phaseolus vulgaris L. can currently be found distributed from Cajamarca in Peru to Catamarca in Argentina. However, the production and use of the Andean bean have been practically left aside in our country. The paper presents the experience of INTA - IPAF Region NOA, in the rescue, integral valorization and promotion of the cultivation of Andean beans from the Quebrada de Humahuaca, in Northwest Argentina, recovering lines that are still found in the plots of the producing families local. For this, a network of actors dedicated to the production, research, and regional gastronomy was built in order to expand the productive heritage, through the collection, evaluation and multiplication of seeds, the recovery of ancestral knowledge, and the development of gastronomic products with territorial identity.

Acknowledgments. The experience is developed within the framework of the project "Conservation and Sustainable Use of Local Phytogenetic Resources for Food and Agriculture to contribute to the Food Security of Small Farmers in Argentina" financed by FAO.

PRODUCTIVE STRATEGY OF CAÑIHUA CULTIVATION IN THE FACE OF CLIMATE CHANGE FOR HUMAN AND ANIMAL NUTRITION IN THE ARID AND SEMI-ARID ZONES OF JUJUY

G.E. Aracena[a]*, S. V. Abarza[a] and J. Schimpf[a]

[a]*Facultad de Ciencias Agrarias, Universidad Nacional de Jujuy. Alberdi 47, S. S. de Jujuy, Jujuy, Argentina*

***Corresponding author:** guillermoaracena@fca.unju.edu.ar

Cañihua (Chenopodium pallidicaule Aellen) is a related crop of quinoa, which originated in the Andes of South America. Its cultivation is concentrated mainly in the high plateau regions of Peru and Bolivia. It adapts to extreme agroclimatic conditions, being able to thrive in conditions of low rainfall (150 mm/year), and in soils of poor fertility and high salinity. We must emphasize that this crop is highly resilient to climate change and characteristic of family farming in arid and semi-arid regions. In the town of Maimará, province of Jujuy, the first trials of 4 varieties of cañihua were carried out, with a distance of 70 cm between rows, with gravitational irrigation once every 10 days, according to the plant's requirements. The soil corresponds to textural class FA, slightly saline (CE: 3 dS/m) and rainfall during the campaign was only 100 mm per year, concentrated in the last vegetative stage. From the statistical analysis using the InfoStat program, average yields of 950 kg/ha were obtained from the four varieties planted on November 8. With a phenological period of 160 to 180 days from germination to physiological maturity. In conclusion, it was possible to determine that it is a promising crop for food in pursuit of food security at origin, and to be able to expand the agricultural area of the transverse slopes, generating a pasture of high nutritional quality for the transhumance of livestock that is raised in the area. Quebrada and Puna of the Province of Jujuy.

Acknowledgments. to Aboriginal community of the Quebrada de Humahuaca.

AMARANTH AND CHIA: TWO STRATEGIC ANCESTRAL GRAINS FOR MEXICO'S SUSTAINABILITY

J. F. Valenzuela Zamudio[a] and M. R. Segura Campos[a]*

[a]*Facultad de Ingeniería Química, Universidad Autónoma de Yucatán, Periférico Norte Km. 33.5, Tablaje Catastral 13615, Colonia Chuburná de Hidalgo Inn, Mérida, Yucatán, Mexico*

***Corresponding author:** maira.segura@correo.uady.mx

The agriculture sector is the world's largest employer, providing incomes for 40 percent of the world's population today. It is the largest source of income and employment for poor rural households and provides up to 80 percent of the food consumed globally. Nevertheless, up to 811 million people suffer from hunger, and the number of people facing acute food insecurity has more than doubled from 135 million to 276 million since 2019. For this reason, global organizations like the UN have been promoting several lines of action to reduce world hunger and food insecurity with a sustainability approach, meaning simultaneously tackling other issues such as environmental protection, health, social protection, and job opportunities. In this task, researchers have investigated several food sources that ensure sustainable production systems that help maintain ecosystems and have strengthened capacity for adaptation to climate change and extreme weather, in addition to providing incomes for small-scale food producers, in particular women and indigenous peoples. There is evidence that two Mexican native grains have the potential to meet these criteria: the pseudocereal amaranth and the oleaginous chia. Both ancient grains possess an outstanding nutritional value with a high protein content (14.5 – 24%) and numerous health benefits, such as antidiabetic, antihypertensive, antiobesity, and antioxidative activities. Nonetheless, the production of these grains is not successfully promoted in Mexico and political frameworks are not well established. The objective of this study is to summarize the current federal policies to stimulate amaranth and chia cultivation in Mexico.

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ECOPHYSIOLOGICAL BASES OF CHIA (*Salvia hispanica* L.) GRAIN YIELD

M. M. Acreche[a]*

[a] EEA Salta, Instituto Nacional de Tecnología Agropecuaria, CONICET, Ruta Nacional 68, km 172, Salta, Argentina

***Corresponding author:** acreche.martin@inta.gob.ar

Chia production has been encouraged due to its high essential fatty acid content. However, few studies have assessed the ecophysiological bases associated with yield improvements of this orphan crop. This abstract summarizes the main findings of field experiments conducted at Cerrillos-Salta. The experiments consisted of two chia populations and environmental manipulative treatments (sowing date and radiation availability). A phenological BBCH scale was developed to standardized experiments. With the delay in sowing date, the duration of all pre-flowering sub-phases decreased. Pre-flowering sub-phases showed a quantitative short-day response to thermo-photoperiod. The duration of the pre-inductive sub-phase was associated with the number of accumulated unfolded leaves, whereas the durations of the post-inductive sub-phases were not determined by the number of accumulated unfolded leaves. Higher verticillaster dry matter at flowering and grain yield were achieved when the durations of the pre-flowering sub-phases were increased. This improvement was associated with the chia's critical period for grain yield that spanned from 550 degree-days before flowering to 250 degree-days after flowering. In this period, grain number fully accounted for reductions in grain yield (a 40-20% decrease), with no responses in grain weight to shading. With the delay in sowing date, oil concentration decreased and protein concentration increased. There were significant and positive associations of oil concentration with day and night temperatures and accumulated intercepted radiation. As day and night temperatures increased, linoleic acid concentration decreased, whereas linolenic acid concentration increased. Chia has a high responsiveness to environmental factors that should be considered for breeding and management practices.

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ABSTRACTS

TECHNO-FUNCTIONAL ASPECTS

MOLECULAR ENCAPSULATION OF HYDROLYZED CHIA SEED OIL BY ULTRASONICALLY TREATED AMYLOSE INCLUSION COMPLEXES

E. Di Marco[a], V. Y. Ixtaina[ab] and M. C. Tomás[a]*

[a]*Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA), CCT La Plata (CONICET), Facultad de Ciencias Exactas (FCE-UNLP), CICPBA, 47 y 116, La Plata, Argentina*
[b]*Facultad de Ciencias Agrarias y Forestales (FCAyF-UNLP), 60 y 119, La Plata, Argentina*

***Corresponding author:** mabtom@hotmail.com

Chia (Salvia hispanica L.) seed oil is a naturally rich source of α-linolenic (~65%) and linoleic (~20%) essential fatty acids, which are known for their beneficial effects on health. However, they are highly susceptible to oxidative deterioration. Amylose, the linear component of starch, has the ability to form inclusion complexes with hydrophobic molecules (ligand), which may act as delivery systems of sensitive bioactive compounds, including essential omega-3 and omega-6 fatty acids. In the present work, it was compared the hydrolytic effectiveness of Candida rugosa and porcine pancreatic lipases to obtain chia seed oil-free fatty acids, which were complexed with high amylose starch through the alkaline method with and without the incorporation of ultrasonic treatment. The highest level of free fatty acids released (>80%) was reached with Candida rugosa lipase. The inclusion complexes formed with this hydrolysate displayed a typical V-type X-ray diffraction pattern (peaks at ~7.5, 13, and 20° (2 ϑ)), which confirmed an effective complexation. Besides, ultrasonically treated complexes displayed a small peak at ~21°, from crystallized saturated fatty acids. By attenuated total reflectance Fourier transform infrared spectroscopy, it was verified the presence of typical bands of fatty acids in the complexes, whose intensity increased after the application of ultrasonic treatment. The dissociation temperature determined by differential scanning calorimetry was >90 °C. According to this, Candida rugosa lipase showed better hydrolytic effectiveness on chia seed oil, and the fatty acids released were able to form amylose inclusion complexes with high thermal stability, whose properties varied after ultrasonic treatment.

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CHIA OIL-IN-WATER NANO-EMULSIONS PRODUCED BY MICROFLUIDIZATION

N. Censi[a], L. M. Julio[a] and M. C. Tomás[a]*

[a] *CIDCA (Centro de Investigación y Desarrollo en Criotecnología de Alimentos), (CONICET-CICPBA-FE, UNLP) 47 y 116, La Plata, Buenos Aires, Argentina*

***Corresponding author:** mabtom@hotmail.com

Oil-in-water (O/W) nanoemulsions (d<200 nm) are systems with considerable potential for protecting and delivering sensible ingredients such as chia seed oil rich in ω-3 fatty acids (~64% ALA). These systems can be formed by applying either low- or high-energy methods. High pressure homogenization, microfluidization and sonication are included within the latter. The main aim of this research work was to obtain and characterize chia oil-in-water nanoemulsions by microfluidization. Therefore, O/W nanoemulsions with 10% (w/w) of chia oil and 2% (w/w) of sodium caseinate were prepared at three levels of microfluidization pressure: 600, 1000 and, 1200 bar. Droplet size of the nanoemulsions, expressed as the Sauter mean diameter, were found between 108 to 125 nm. Additionally, the pH of the nanoemulsions was ~6,7 while the superficial droplet charge resulted between -37 to -41 mV. The global stability of the different systems was evaluated through the evolution of their Backscattering for 50 days. In this sense, nanoemulsions obtained at 1000 and 1200 bar recorded high global stability, while those at 600 bar showed some destabilization signs. In terms of the oxidative stability, all systems studied recorded low values of primary and secondary oxidation products as a function of storage determined by PV and TBARs assays, respectively. The omega-3 fatty acid content of nanosystems was also evaluated, without significant changes during the storage period. Thus, chia O/W nanoemulsions obtained by microfluidization proved to be suitable delivery systems of bioactive compounds of chia seed, with potential application in the development of functional food.

Acknowledgments. This work was supported by grants la ValSe-Food-CYTED (119RT0567) Spain, Universidad Nacional de La Plata (X907), Agencia Nacional de Promoción Científica y Tecnológica (PICT 2019-01775; 2020-01274), and CONICET PIP 2007 (Argentina).

CHARACTERIZATION OF THREE-LAYER MICROCAPSULES OF CHIA SEED OIL OBTAINED FOR ELECTROSTATIC DEPOSITION TECHNOLOGY

C. N. Copado[a], L. M. Julio[a], B. W. K. Diehl[c], V. Y. Ixtaina[ab] and M. C. Tomás[a]*

[a] *Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA), CCT La Plata (CONICET), Facultad de Ciencias Exactas (FCE-UNLP), CICPBA, 47 y 116, La Plata, Argentina*
[b] *F acultad de Ciencias Agrarias y Forestales (FCAyF-UNLP), 60 y 119, La Plata, Argentina*
[c] *Spectral Service GmbH, Emil Hoffman Str. 33, Cologne, Germany*

***Corresponding author:** mabtom@hotmail.com

Current trends in health care through food have increased interest in oils rich in omega-3 fatty acids due to their multiple health benefits. Chia seed oil represents the vegetable source with high α-linolenic content. A multilayer microencapsulation process was carried out to protect and deliver chia oil, which presents high susceptibility to lipid oxidation. A high-pressure homogenization process was performed with deoiled sunflower lecithin (pH 5) to obtain the primary emulsion. The secondary and tertiary layers were deposited, applying the layer-by-layer technique with the addition of chitosan and chia mucilage, respectively. After spray-drying these emulsions, the corresponding microcapsules were obtained and the influence of the type of microcapsules (mono or multilayered) was studied and stored at 25±2°C, 33% RH, in darkness for 90 days. The ζ-potential evidenced the electrostatic deposition of the layers through the inversion of the electric charge. Microcapsules presented a high microencapsulation efficiency (84–98%) and low moisture content and water activity levels. Most microparticles exhibited whitish and light color, spherical shapes, with continuous and slightly rough walls. The powder dispensability was compatible with instant foods. All the microcapsules presented low oxidation levels after storage (<10 meq hydroperoxides/kg oil), especially the three-layer systems. Three-layer microcapsules presented the highest omega-3 PUFA content after storage, whereas the monolayer systems exhibited the lowest values. These results suggest that the three-layer microcapsules studied are suitable to provide high stability against the oxidative deterioration of functional lipid components in chia oil and constitute a promising application in the food industry.

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QUALITY ASSESSMENT ON SEMI-DEFATTED CHIA (*Salvia hispanica* L.) FLOUR DURING STORAGE

E. N. Guiotto[a], S. M. Nolasco[b] and M. C. Tomás[a]*

[a] *Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA) – CCT La Plata - CONICET- Facultad de Ciencias Exactas (FCE- UNLP), 47 y 116, La Plata, Argentina*
[b] *Departamento de Ingeniería Química (TECSE) - Facultad de Ingeniería (UNCPBA) - Av. Del Valle 5737, Olavarría, Buenos Aires, Argentina*

***Corresponding author:** mabtom@hotmail.com

The chia seed (Salvia hispanica L.) is globally popular and valued for its nutritional and health attributes. After the oil extraction by cold pressing, press-cake rich in fiber, protein, and natural antioxidants emerges as a by-product. The aim of this research work was to study the effect of temperature (4±1 and 20±2°C) and different packaging materials (polyethylene (PE), polypropylene (PP), metalized biaxially oriented polypropylene films (BOPP), and triple kraft (K)) on the storage stability of semi-defatted chia flour for 240 days. The fatty acids profile of semi-defatted chia flour was stable under different storage conditions. The total phenolic content (TPC), and antioxidant activity by DPPH decreased significantly ($p<0.05$) with storage time. The α-tocopherols increased during storage for both temperatures, being significantly higher ($p<0.05$) in samples stored at 20 °C (16.18 mg/g), with respect to those stored at 4±1ºC (13.62 mg/g). On the other hand, γ- and δ- tocopherols observed after 240 days of storage at 4±1ºC and 20±2ºC were 428.7 and 380.9 mg/g, respectively; these values are indicating that the losses of γ- (22.5%) and δ- (31%) tocopherols are more rapid at higher storage temperature. Storage temperature significantly impacted the tocopherols stability. Chia flour showed a low microbial activity, possibly due to tocopherols and phenolic compounds. The results evidenced that temperature and storage time significantly affect the shelf life of chia flour, while no changes in the quality of chia flour were observed for the different packaging materials.

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TRENDS FOR PRESERVING FUNCTIONAL COMPOUNDS OF CHIA (*Salvia hispanica* L.) BY DELIVERY SYSTEMS

M. C. Tomás[a]*

[a]*Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA), CCT La Plata (CONICET), Facultad de Ciencias Exactas (FCE-UNLP), CICPBA, 47 y 116, La Plata, Argentina*

***Corresponding author:** mabtom@hotmail.com

Chia seed represents the vegetable source with the highest α-linolenic acid (ALA) content and also contributes nutritional and health benefits to consumers through its essential fatty acids, proteins, and dietary fiber contents. Chia oil contains ~ 65% ALA and an important level of PUFAs (~80%) being very susceptible to deterioration by lipid oxidation. In order to preserve these important compounds, a wide range of delivery systems were designed and investigated to protect and incorporate these functional lipids into food matrices. Some of them involve emulsification or emulsification followed by the application of a drying process of these sensitive compounds. Emulsions with functional ingredients (omega-3 fatty acids, proteins, soluble dietary fiber) from chia seeds are described and extensively characterized. In this regard, the influence of the type of emulsion and emulsifying agents, the aqueous phase composition (chia proteins, mucilage), pH, and refrigerated storage on the global physicochemical and oxidative stability of these systems were investigated. Besides, the drying of emulsions and the application of chia by-products as wall materials to obtain their respective powdered microencapsulated chia oils were studied in terms of their characteristics in microencapsulation efficiency, and dispersibility, microstructure, oxidative stability, among others. Therefore, this information is interesting and useful to the design of the appropriate delivery systems of bioactive chia compounds for potential application to the development of functional foods.

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PHYSICOCHEMICAL AND FUNCTIONAL CHARACTERIZATION OF UNCONVENTIONAL FLOURS AND CHIA EXPELLER WITH POTENTIAL APPLICATION IN THE FORMULATION OF GLUTEN-FREE FOODS

E. B. Coronel[ab]*, V. Y. Ixtaina[cd] and M. I. Capitani[ab]

[a] *TECSE, Departamento Ingeniería Química y Tecnología de los Alimentos, Facultad de Ingeniería, UNCPBA, Olavarría, Buenos Aires, Argentina*
[b] *CCT Tandil (CONICET), Tandil, Buenos Aires, Argentina*
[c] *Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA) CCT La Plata (CONICET), Facultad de Ciencias Exactas, UNLP, La Plata, Buenos Aires, Argentina*
[d] *Facultad de Ciencias Agrarias y Forestales (UNLP), La Plata, Buenos Aires, Argentina*

***Corresponding author:** esteficoronel@gmail.com

The production of gluten-free foods faces numerous technological challenges associated with the absence of gluten functionality and the supply of nutrients. In this sense, it is necessary to diversify the food industry in terms of both advances in ingredients and formulations and the production of functional foods. Chia, buckwheat, and legumes such as peas have great advantages for their incorporation into gluten-free foods due to their contribution of fiber, protein, polyunsaturated fatty acids, antioxidants, minerals, and vitamins. The objective of this work was to analyze the physicochemical and functional properties of native rice, buckwheat, yellow pea, green pea, and chia expeller flours. The chia expeller presented a content of lipids (12.27%), crude fiber (22.83%), and ashes (6.97%) significantly higher ($p<0.05$) than the other flours. Likewise, its protein content (29.30%) was significantly higher ($p<0.05$) than the rest, except green pea flour, which exhibited the highest protein percentage (30.39%). Regarding the functional properties, the water retention and absorption capacity and swelling (7.83, 6.66%, 10.71%, respectively) were significantly higher ($p<0.05$) in the chia expeller. Rice flour stood out for its ability to absorb organic molecules (8.07%). The emulsifying activity was higher in both pea flours (48.89 and 48.94%, green and yellow, respectively). Based on the results, the studied flours have a high potential to be incorporated into gluten-free foods, giving them nutritional and functional benefits.

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PHYSICOCHEMICAL AND TEXTURAL PROPERTIES OF PROTEIN COOKIES MADE WITH HYDROLYZED QUINOA FLOUR

I. A. Gremasqui[a], M. A. Giménez[a], C. N. Segundo[a], M. O. Lobo[a] and N. C. Sammán[a]*

[a] *CIITED Centro de Investigación Interdisciplinario en Tecnología y Desarrollo Social del NOA - CONICET. Facultad de Ingeniería, UNJu. Ítalo Palanca 10, Jujuy, Argentina*

***Corresponding author:** normasamman@gmail.com

Cookies are an alternative to add valuable nutrients since they are products of high consumption and great acceptability. Protein hydrolysates have been incorporated into different food products for people with special regimes due to the high absorption and biological activity of peptides. This study aimed to evaluate the effect of enrichment at various levels (10, 20 and 30%) of a quinoa flour hydrolysate (QFH) on the chemical composition, physical and textural properties of cookies made from wheat flour (WF) and broad bean flour (BF). The substitution of QFH significantly increased the protein, ash, dietary fiber and mineral content of the cookies compared to the control (C0) (made only with WF and BF). The diameter (D) increased (from 20%) while the thickness (T) decreased significantly, causing an increase in the propagation ratio (PR) of the cookies. Weight loss (WL) is less than the control and increases with enrichment, while specific volume (SV) decreases with enrichment. On the other hand, enrichment increased the hardness of the cookies. Regarding the color parameters of the cookies, the luminosity L decreased with the enrichment, the parameters a* (from 20%) and b* increased significantly in a positive way. Although the addition of QFH in the cookie formulation mainly affected the texture, however, this effect could be optimized with the addition of other additives. An enrichment degree of 20% makes it possible to obtain cookies with a high content of protein, fiber and minerals with acceptable characteristics.*

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UTILIZATION OF HYDROTHERMALLY TREATED FLOURS IN GLUTEN-FREE DOUGHS

M. A. Gimenez[a], C. N. Segundo[a], N. Dominguez[a], M. O. Lobo[a] and N. C. Samman[a]*

[a] *CIITED Centro de Investigación Interdisciplinario en Tecnología y Desarrollo Social del NOA - CONICET. Facultad de Ingeniería, UNJu. Ítalo Palanca 10, Jujuy, Argentina*

***Corresponding author:** normasamman@gmail.com

Hydrothermal treatments are suitable for modifying the physicochemical properties of flours because they favor the total or partial gelatinization of starch, allowing products with different rheological and water absorption capacities to be obtained. The objective of the study was to apply the processes of extrusion-cooking (CE), alkaline extrusion (OHE) and traditional nixtamalization (N) in four races of native maize from the province of Jujuy, Argentina (perlita, cuzco, chulpi and culli) to obtain flours with adequate aptitudes for use in gluten-free doughs. The different processes and the characteristics of each race had a significant effect ($p<0.05$) on the hydration properties of the flours, both factors showing a greater effect on flour from the chulpi race, indicated by the increase in its hydration properties. Therefore, in the textural properties, the elasticity and the viscosity index of the masses were dependent on the breed and the processes, influencing these properties by the subjective water capacity. CE gives greater elasticity to the masses, presenting the highest values the masses of the perlita race (5.58 mm). OHE provided a lower viscosity index (0.03N.s), indicating greater resistance to kneading. The N did not give remarkable properties to the formulation, showing the breakage of the masses to the touch. It is important to note that the EOH process provided doughs with adequate properties due to intermediate values of elasticity (4.47-4.5 mm) and resistance to kneading (0.34-0.078N.s). This study allowed to optimize the development of extensible masses and to select the chulpi and culli races.

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EFFECT OF ACID-EXTRUSION COOKING ON SOME PROPERTIES OF QUINOA STARCH

J. Rueda[a], M. Lobo[a], N. C. Sammán[a]* and C. M. Haros[b]*

[a] *Centro Interdisciplinario de Tecnología y Desarrollo Social. (CIITED-UNJu-CONICET). Italo Palanca 10. Jujuy, Argentina*
[b] *Instituto de Agroquímica y Tecnología de Alimentos (IATA), Consejo Superior de Investigaciones Científicas (CSIC), Av. Agustín Escardino 7, Parque Científico, Paterna, Valencia, España*

***Corresponding authors:** normasamman@gmail.com, cmharos@iata.csic.es

According to FAO, the economic potential of quinoa relies on the extraction and processing of by-products. Starch in quinoa represents a major component. Although it has limited application (due to its low solubility, and high reactivity to hydrolysis or reactive hydroxyl groups), certain technological processes can modify or even improve techno-functional or healthy properties. In this work, the effect of acid extrusion cooking on molecular, chemical and morphological properties of quinoa starch was evaluated. A quinoa sub-product from protein extraction (73% starch) was acidlyd extruded (100°C and 0, 10 and 40% of citric acid) and milled. Native (NS) and extruded (ES) samples were taken as control. Resistant starch (RS) and free glucose (FG) content were measured enzymatically. Molecular, structural and morphological characterization was assessed by infrared (IR) spectroscopy, laser diffractometric analysis and optical microphotography. Results showed that, acid esterification at 40 % caused a two-fold increase (1.10 g/100 starch dry basis) in the RS content, reduced the FG (mg/100g db) from 801.36 (NS) to 368.56(ES) and changed the IR spectrum due to the formation of new ester groups at a wavelength of 1712 cm-1 (carbonyl groups). Although, no significant differences were observed in the particle diameter of samples, microphotographs showed semi-crystalline structures (extruded and citrate starch) formed from native starch (starch aggregates). These data, suggest acid extrusion increased the RS content, formed citrate starch esters and changed the molecular and structural conformation of native quinoa starch. The evaluation of additional properties would elucidate the effect of these changes on the bio and techno-functional properties.

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OBTAINING A FUNCTIONAL FOOD FROM ANDEAN GRAINS THROUGH LACTIC ACID FERMENTATION

C. Salinas[a], M. D. Jiménez[a], M. Lobo[a] and N. Sammán[a]*

[a]*CIITED Centro de Investigación Interdisciplinario en Tecnología y Desarrollo Social del NOA - CONICET. Facultad de Ingeniería, UNJu, Ítalo Palanca 10, Jujuy, Argentina*

***Corresponding author:** normasamman@gmail.com

Quinoa and amaranth have excellent nutritional composition. Lactic fermentation is capable of transforming the functional, structural, organoleptic and nutritional properties of raw materials. The objective was to develop a product analogous to yogurt, suitable for special diets. The product was formulated with quinoa flour, amaranth, water, sugar and strawberries, and was fermented with an exopolysaccharide-producing strain of Lactobacillus Plantarum. Chemical parameters and BAL growth were monitored. The sensory analysis determined the best formulation and fermentation time. In the final product, proximal composition, microbial count, pH, antioxidant activity (DPPH), color, viscosity and the content of exopolysaccharides (EPS) were determined. The formula of the selected product was: 15 g quinoa/amaranth (50:50), 12 g sugar, 25 g strawberry pulp and 85 g water, fermented for 8 h. Its composition was: 19.60 g CH and 1.74 g protein/100 g of puree; viable cell count 7.60x108 CFU/g; pH 3.86 and IC50=10.3 mg/mL. Color parameters: L, a* and b* 43.85, 15.24 and 11.72, respectively. It presented a reddish-brown colour. During fermentation, the viscosity increased, reaching 5029 mPa*s at 10 rpm, due to the production of EPS (6.78 g EPS/L fermented mash); EPS production was not enough to significantly modify viscosity and texture due to the amylolytic capacity of BAL. It was described as having a rich, fruity, acid flavour, with a mild and pleasant smell, and a viscous texture. The food obtained is analogous to yogurt with acceptable sensory characteristics and suitable for vegetarians, coeliacs and lactose intolerants.*

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CHIA OIL MICROENCAPSULATION BY SPRAY DRYING USING MODIFIED SOY PROTEIN AS WALL MATERIAL

P.A. Gimenez[a], A.E. Bergesse[a], N. Camacho[a], P.D. Ribotta[a], M.L. Martinez[a] and A. González[a]*

[a]*Universidad Nacional de Córdoba, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Córdoba, Argentina*

***Corresponding author:** agustingonzalez@unc.edu.ar

Chia seed is source of polyunsaturated fatty acids. A diet rich in polyunsaturated fatty acids decreases the risk of many chronic non-communicable diseases. The incorporation of omega-3-rich oils in processed foods seems to be an efficient way to increase its consumption, however, when these are exposed to process conditions, oxidation reactions occur. Microencapsulation technology is an alternative to enhance lipids stability. The use of vegetable proteins as wall materials is being widely developed. The objective of the present work was to study the effect of the microencapsulation using chemically modified soy protein as wall material on chia oil oxidative stability. The crosslinking effect on soy protein with different concentrations of gallic and tannic acids was evaluated. Chia oil was incorporated into the dispersions using a high-speed homogenizer and the emulsions were dried by Spray-Drying. The microcapsules moisture content and water activity were around 2.96-5.86% and 0.17, respectively. The encapsulation efficiency was among 54-78%. The oxidative stability determined by the Rancimat analysis showed a positive correlation between the amount of cross-linking agent used and the induction time, reaching a maximum of 27.9 h. Six systems were selected for the storage test. After 90 days, the peroxide value was lower for those samples with the higher proportion of crosslinker agent used. The results demonstrated that use of these polyphenols as crosslinkers of the wall material exerts a positive effect in the protection of the chia oil derived from obtaining an optimized wall material and from the intrinsic antioxidant properties of these crosslinkers.

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PREPARATION OF CORN STARCH NANOPARTICLES BY WET-STIRRED MEDIA MILLING FOR CHIA OIL VEHICULIZATION

M. G. Bordón[abc]*, F. Chiarin[b], R. Bruschini[b], N. Camacho[e], H. Severini[b], M. L. Martínez[bcd], S. Palma[e] and P. D. Ribotta[abc]

[a] *Instituto de Ciencia y Tecnología de Alimentos Córdoba (ICYTAC, CONICET-UNC).Córdoba, Argentina*
[b] *Departamento de Química Industrial y Aplicada (FCEFyN-UNC).Córdoba, Argentina*
[c] *Instituto de Ciencia y Tecnología de Alimentos (ICTA, FCEFyN-UNC). Córdoba, Argentina*
[d] *Instituto Multidisciplinario de Biología Vegetal (IMBIV, CONICET-UNC). Córdoba, Argentina*
[e] *Unidad de Investigación y Desarrollo en Tecnología Farmacéutica (UNITEFA, CONICET-UNC). Córdoba, Argentina*

***Corresponding author:** maria.gabriela.bordon@mi.unc.edu.ar

Nowadays, chia oil is known as the richest vegetable source of omega-3 fatty acids. An organic-free method was applied to produce corn starch nanoparticles, which were designed to stabilize Pickering emulsions containing chia oil. The liquid stream resulting from a laboratory-scale mill assisted by zirconia beads was filtered, centrifuged and homogenized to prepare the continuous phase of the emulsions. Experiments were performed as follows: 24 h (milling time), 0.1-0.2 mm (beads' diameter), 1600 rpm (impeller speed), 25% (volume occupied by the grinding media), 1-7% w/v (starch concentration). Exploratory experiments were carried out to analyze the influence of centrifugation and homogenization, on the stability of particle size in nanosuspensions containing 1% w/v of starch, and 1%, 0.01% or 0% w/v of sodium dodecyl sulphate (SDS) as stabilizer. Particle sizes in the obtained nanosuspensions were reduced from 376-432 nm to 160-200 nm after centrifugation and homogenization. The product formulated with 0.01% w/v of SDS showed the most stable particle size during storage. Hence, this latter formulation was selected to prepare Pickering emulsions. Oil droplets showed surface mean diameters and polydispersity indexes of 283.33±1.53 nm and 1.36±0.03, respectively, with no significant variations during storage for around two weeks. Finally, nanosuspensions containing 7% w/v of starch, and the above three concentrations of SDS, were filtered, centrifuged, homogenized and spray-dried to obtain redispersible powders able to stabilize Pickering emulsions. The most stable particle size after redispersion (385.83±5.85 nm) was obtained with the highest concentration of SDS. Moreover, SEM images revealed the presence of round-shaped particles with sizes below 1 µm. These results highlight that wet-stirred media milling can be applied as a green-method to produce new food-grade starch nanoparticles, which are able to deliver bioactive compounds from chia oil.

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PHYSICAL CHEMISTRY STUDY OF TEN PERUVIAN QUINOA SEEDS AND THEIR ARGENTINIAN OFFSPRING

P. Montoya[a], E. Calandri[a]*, F. Grasso[a] and A. Mujica[a]

[a]*Instituto de Ciencia y Tecnología de los Alimentos (ICTA), Universidad Nacional de Córdoba, Córdoba, Argentina*

***Corresponding author:** edgardo.calandri@unc.edu.ar

There are five well-recognized quinoa ecotypes in South America, those from valley, highland, salt deserts, sea level and tropical environments, that showing differences in tolerance to salinity, frost, drought and other types of abiotic stress. Due to latitude and climate conditions, sea level ecotype was widely adopted in the semiarid central region of Argentina, while in the northwest the high lands varieties and bigger grains were preferred. In the present work, a comparative study of ten Peruvian seeds were analyzed in parallel with their corresponding offspring harvested in Córdoba, Argentina. Protein, lipids, ash, saponins, water and carbohydrates content were determined. Saponins were between 0.18% to 4.78%, lipids 4.55% to11.37%, proteins 13.07% to 20.37%, ashes 2.73% to 4.97%, water 10.68% to 15.48% and carbohydrates 67.59% to 76.87% in dry base, for all seeds. When results of Peruvian vs Argentinian seeds were compared for the same variety, mostly differed, in some cases in a notorious way. For example, offspring of variety Chulpi and Salcedo-Inia shows much lower saponin content than Peruvians': 3.91%and 4.82% vs 2.21 % and 3.22%, respectively. Nevertheless, in other components such as proteins, differences though significant are not pronounced and tents to favor the Peruvians. These and the other results will be discussed.

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TEXTURAL PROPERTIES OF DOUGH AND BREAD ELABORATED WITH NATIVE FLOURS AND ADDED WITH EXTRUDED INTEGRAL FLOURS OF ANDEAN MAIZE

R. Miranda[a], A. Amaya[a], M. Lobo[a] and N. Sammán[a]*

[a] *CIITED Centro de Investigación Interdisciplinario en Tecnología y Desarrollo Social del NOA - CONICET. Facultad de Ingeniería, UNJu, Ítalo Palanca 10, Jujuy, Argentina*

***Corresponding author:** normasamman@gmail.com

The combination of the most suitable extrusion parameters to obtain flours with better baking properties remains as a subject of study, especially when using whole raw materials and different crop varieties. The objective of this work was to determine how the addition of extruded wholegrain flour from three races of Andean maize influences their native homologues, on the textural properties of dough and breads and their relationship with baking quality. Capia, Bolita and Chulpi maize razes were used, whose integral flours were extruded at 120°C, 20%H and 120 rpm. The proximal composition of the native flours and the hydration properties of the extruded flours were determined. Dough firmness, texture profile and specific volume of breads made with native (Control) and blend flours were determined. The greatest firmness of the dough was observed with Chulpi maize (blend) (48.96±1.27g) and its bread presented the least springiness (0.36±0.04) and was the less voluminous (1. 72±0.33cm3/g). On the contrary, the Capia dough (blend) presented lower firmness (23.45±1.45 g), and its bread had a higher specific volume (2.70±0.19 cm3/g) and the highest springiness (0. 61±0.02). Chulpi corn flour presented a low water absorption index (4.5±0.61g/g) due to the lower content of total carbohydrates. This indicates that dough firmness can affect post-bake volume development in blended flour formulations and that their composition has an important effect on bread properties.

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EFFECT OF GERMINATION ON THE NUTRITIONAL PROFILE OF WHITE AND RED QUINOA SEED FLOURS

L. M. Guardianelli[a]*, M. V. Salinas[a] and M. C. Puppo[a]

[a] *Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA), CCT La Plata (CONICET), La Plata, Argentina*

***Corresponding author:** luchoguardianelli@gmail.com

Quinoa (Chenopodium quinoa) is an Andean crop, which has excellent nutritional attributes: high protein content with a very good balance of essential amino acids, large amounts of unsaturated fatty acids, considerable amounts of calcium, iron, zinc and magnesium. Controlled germination is currently used in order to obtain grains and seeds with better nutritional characteristics. As a result of germination, substantial changes are produced in the biochemical composition of the grains: amylases remove starch reserves; proteins are hydrolyzed to oligopeptides and free amino acids, and the amino acid composition also changes. Triglycerides are hydrolyzed and the proportion of saturated/unsaturated fatty acids is modified; among other processes. Therefore, the objective of this work was to evaluate the changes in chemical components due to germination (0, 18, 24 and 48 h at 20ºC) of quinoa seeds from two varieties: red (RQ) and white (WQ). Centesimal composition, fatty acid profile (GC), minerals (ICP), aminoacids (HPLC) and structure of proteins (FTIR, SDS-PAGE) were studied. The results obtained suggest that the white quinoa flour germinated for 48 h is an interesting ingredient for using in wheat breads since it has more protein content than the other germinated ones and more lipids and dietary fiber than the non-germinated one. In the case of red quinoa, flour from seeds germinated for 24 h would be appropriate since it presented higher lipid content with a better lipid profile.

EVALUATION AND COMPARISON OF THE ANTIOXIDANT CAPACITY OF LEAF EXTRACTS OF VARIOUS GENOTYPES OF CHIA AND AMARANTH DRIED WITH DIFFERENT CONDITIONS

M. C. Zúñiga-López[a]*, G. Fuentes[a], G. Maturana[a] and C. Baginky[a]

[a] *Universidad de Chile, Facultad de Ciencias Químicas y Farmacéuticas, Chile*

***Corresponding author:** mczuniga@ciq.uchile.cl

Chia (Salvia hispanica L) and Amaranth (Amaranthus) are plants cultured by pre-Columbian civilizations in Latin America, and both seeds present an interesting nutritional profile, hence the principal reason for contemporaneous cultivation is seed production. Aerial chia parts are treated as waste while amaranth leaves have been used as salad ingredients in the last years. Recently, some phenolic compounds have been reported on the leaves of both plants giving a hint on their antioxidant capacity. This work purpose was to establish the antioxidant capacity of chia and amaranth leaves extracts, evaluating different genotypes (two of each) and drying processes (stove 35°C and lyophilization). On one hand results show a higher antioxidant capacity for chia leaves extracts than the amaranth leaves extracts, for all the genotypes evaluated. On the other hand, lyophilized extracts show a lower antioxidant capacity than stove-dried leaves extracts.

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NUTRITIONAL AND TECHNOLOGICAL PROPERTIES OF FRESH PASTA ENRICHED WITH CHIA COPRODUCTS

S. Aja[a] and C. M. Haros[a]*

[a]*Instituto de Agroquímica y Tecnología de los Alimentos (IATA-CSIC), 46980 Valencia, España*

***Corresponding author:** cmharos@iata.csic.es

Pasta is traditionally made from durum wheat semolina, but it can be substituted with other flour or semolina types and can contain other ingredients. The nutritional characteristics depend on the ingredients, but generally, pasta contains about 70% carbohydrate, mainly starch. Chia (Salvia hispanica) and their coproducts are well-known for their high nutritional value, containing essential fatty acids (omega-3 and omega-6) high mineral and vitamin content, and high amount of fibre. The purpose of this study was to investigate the effects of different chia coproducts (seeds, whole chia flour and coproducts from cold-pressing oil extraction such as flour rich in proteins or flour rich in fibres) on the pasta technological parameters (colour, textural and cooking properties), in their nutritional/functional characteristics (proximate composition, mineral availability and glycaemic index) and in sensory evaluation (hedonic scale of 9 points). The results showed a higher contribution of minerals Ca, Fe and Zn in formulations with chia coproducts comparing to the control sample. However, the bioavailability of Fe and Ca could be compromised, which was indicated by the phytate/mineral molar ratios' values. On the other hand, the glycaemic indexes were significantly similar to the control sample, with the exception of the samples with chia seeds. Regarding the technological characteristics and the preliminary sensory evaluation of the formulations with chia (at 10% of substitution) they did not show significant differences compared to the control sample. In this sense, the chia coproducts could be nutritional ingredients to be used in pasta enrichment without depletion of the product quality.

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EVALUATION OF THE TECHNOLOGICAL CHARACTERISTICS OF CHIA NANOEMULSION DURING STORAGE

S. S. Fernandes[a]*, M. M. Salas-Mellado[a] and M. R. Segura[b]

[a] *Escola de Química e Alimentos, Universidade Federal do Rio Grande, Av Italia Km. 8, 96203-900, Rio Grande, Rio Grande do Sul, Brazil*
[b] *Facultad de Ingeniería Química, Universidad Autónoma de Yucatán, Periférico Norte Km. 33.5, Tablaje Catastral 13615, Col. Chuburná de Hidalgo Inn, Mérida, Yucatán, México*

***Corresponding author:** sibele.fernandes@furg.br

Chia oil has a high content of omega-3 and omega-6, which are essential for the human body. However, their high unsaturation makes them very susceptible to oxidation. The encapsulation through nanoemulsions allows the preservation and incorporation of these fatty acids in foods. The objective of this work was to evaluate the oxidative stability of the technological characteristics of chia nanoemulsions. The chia oil nanoemulsion was produced in high-speed homogenization (10,000 rpm/15 min) using chia mucilage as wall material, chia oil, and Tween 20 (1.46%, 0.84%, and 0.42%) with and without ethanol. Nanoemulsions were stored for 28 days at temperatures of -18 °C, 4 °C, and room temperature (~25 °C). Weekly, syneresis, color, and rheology were determined. The nanoemulsions did not show syneresis when stored at -18 °C and the ethanol nanoemulsion did not show when stored at 4 °C. Instrumental color measurements suggested that there was some change in the chemical stability of the nanoemulsions during storage, with a progressive increase in b (yellowing) over time for the nanoemulsion without ethanol and at storage temperatures of 4 °C and 25 ° C for the ethanol nanoemulsion. When a shear rate was applied to the nanoemulsions, a break in the material structure was caused, which shows a shear-dependent behavior. The results obtained from this study indicate that chia oil nanoemulsions with chia mucilage and with or without ethanol can be used in food production to preserve the properties of chia oil and provide more nutritious foods.*

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OBTAINING INTEGRAL KURUGUA FLOUR WITH ANTIOXIDANT POTENTIAL AS INGREDIENTS FOODSTUFFS

L. Correa[a], M. Gamarra[a], K. Sanabria[a], E. Coronel[a], M. Martínez[bc], E. Calandri[bd], S. Caballero[a] and L. Mereles[a]*

[a] *Universidad Nacional de Asunción. Facultad de Ciencias Químicas. Dirección de investigaciones. Departamento Bioquímica de Alimentos. San Lorenzo, Paraguay*
[b] *Instituto de Ciencia y Tecnología de los Alimentos, Facultad de Ciencias Exactas, Físicas y Naturales (ICTA-FCEFyN). UNC, Córdoba, Argentina*
[c] *Instituto Multidisciplinario de Biología Vegetal (IMBIV, CONICET-UNC), Córdoba, Argentina*
[d] *Instituto de Ciencia y Tecnología de los Alimentos Córdoba (ICYTAC-UNC), Córdoba, Argentina*

***Corresponding author:** lauramereles@qui.una.py

The aim of this work was to study the drying process of the integral fruit of kurugua (Sicana odorifera Naud.), in trays with forced air, and evaluate its antioxidant potential. The experiments showed that fresh samples of whole kurugua can vary significantly in antioxidant activity, according to the fruit batch used. Statistical analyzes gave no significant difference on the antioxidant activity between the drying conditions studied, however, one of them (80°C and 5.8 m/s average air speed) presented the lower cost (2,2 US$ kW/h) and after 10 hours, it was enough to reach an aw level of 0.297, that inhibits microorganisms growth. It is known that low aw allows a longer shelf-life product, and precludes the proliferation of molds and yeasts. There was no significant difference in the concentration of β-carotene between 0-10 drying hours; however, the resulting flour showed a decrease in luminosity and color variation (b), with respect to the fresh samples, with a typical browning due to the effect of temperature and air drying. The bases for obtaining a dry product, integral kurugua flour, from experimental drying conditions will be discussed. A field of work is opened for future research on the sensory profile and its potential applications.*

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CHACO PRICKLY PEAR
(Cereus Forbesii OTTO EX C.F. FÖRST)
AN ANCIENT SOURCE OF NUTRIENTS, ANTIOXIDANTS AND DIETARY FIBER IN THE DIET OF INDIGENOUS POPULATIONS AND ITS POTENTIAL APPLICATION AS AN INGREDIENT IN DERIVED PRODUCTS

J. López[a], R. Villalba[a], S. Caballero[a], E. Coronel[a], P. Piris[a] and L. Mereles[a]*

[a] *Universidad Nacional de Asunción, Facultad de Ciencias Químicas, Dirección de investigaciones, San Lorenzo, Paraguay*

***Corresponding author:** lauramereles@qui.una.py

In regions with a majority population of people belonging to indigenous peoples, the solutions to nutritional challenges such as overweight and obesity can go through the implementation of public policies that encourage the use of local and ancestral crops, which would also entail the protection of food traditions However, these foods can be too added to diets as processed products with high nutritional value. This work describes the centesimal composition, mineral content and antioxidant potential of a wild prickly pear (Cereus forbesii Otto ex C.F. Först) from the Paraguayan Chaco, ancestral food of indigenous peoples, and the jam of this native fruit, a derived product, with the aim of making its nutritional potential known, its potential application in feeding programs and its incorporation in minimally processed foods. These foods mainly show an interesting contribution of micronutrients, soluble sugars, dietary fiber, and antioxidants as anthocyanins with an attractive color, that can replace critical nutrients such as artificial additives and excess sugars in the diet of the regional population. Knowledge of the nutritional and technological properties of regional foods will help strengthen and develop national and regional policies and programs for the development and promotion of local and indigenous products, within the framework of Food Safety.

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VARIATIONS IN THE COMPOSITION OF "ALGARROBAS" *(Prosopis sp.)* FLOURS FROM PARAGUAYAN CHACO

J.A. Denis Ibars[a], R. Villalba[a], K. Martínez[a], E. Coronel[a] and L. Mereles[a]*

[a] *Universidad Nacional de Asunción. Facultad de Ciencias Químicas. Dirección de investigaciones. Departamento Bioquímica de Alimentos. San Lorenzo, Paraguay*

***Corresponding author:** lauramereles@qui.una.py

Prosopis alba and Prosopis chilensis, popularly called carob trees in the South American Chaco, are arboreal species. Carob fruits are an ancestral food for human consumption, mainly in the form of flour. In recent years, the study of carob trees in Paraguay has been based on the development of silvo-pastoral systems for livestock or as animal feed, but very little is known about the compositional characteristics of the different varieties of carob that are part of the food systems, and that are used for the production of flours. The nutritional contribution, antioxidant potential and the preliminary evaluation of its safety at the microbiological level of flour from 3 autochthonous varieties samples of carob trees from the Central Chaco for human consumption as a potential food ingredient in processed foods are evaluated. Official AOAC methods were used. The carob flour samples presented low humidity (less than 6%) and water activity (less than 0.45). The flours of the 3 species analyzed presented significant differences in their content of carbohydrates, lipids, proteins, dietary fiber and, consequently, in their caloric value, high content of polyphenols and antioxidant potential by ABTS. Presence of mesophilic aerobes, total coliforms and yeasts in the samples was observed. These results demonstrate the great food potential of carob flour from Paraguayan Chaco, and indicate the need to address the food safety aspects of this type of wild-harvested food, to enhance their added value as ingredients foodstuffs in the diet of regional populations.

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THE EFFECT OF QUINOA GERMINATION ON ITS NUTRITIONAL PROPERTIES

P. Maldonado-Alvarado[a], J. Abarca-Robles[ab], D. J. Pavón-Vargas[a], S. Valencia-Chamorro[a] and C. M. Haros[b]*

[a] *Departmento de Ciencias de Alimentos y Biotecnología, Escuela Politécnica Nacional, Quito, Ecuador*
[b] *Grupo de Cereales, Instituto de Agroquímica y Tecnología de Alimentos(IATA-CSIC), Valencia, España*

***Corresponding author:** cmharos@iata.csic.es

The aim of this study was the evaluation of the effect of desaponification, soaking, germination and refrigerated storage on the phytase activity, phytic acid content, and nutritional properties of three varieties of quinoa: white, red and black. Desaponification and soaking, reduced the amount of minerals and the nutritional content. Germination of the seeds was carried out in desaponified samples. Quinoa nutritional values, phytase activity and phytic acid content, were measured during the first 7 days of germination plus 7 days on refrigerated storage. Germination increased fibre and protein content as well as the mineral contents. Germination significantly increased the phytase activity on all varieties and reduced the phytic acid content. The phytic acid content decreased during germination between 32 and 74%. Refrigerated storage had no significant effect on most of the factors studied. Germination boosts nutritional content and phytase activity while decreasing phytic acid content. Germination can be a simple method to reduce phytic acid in quinoa and may also improve the nutritional quality of this pseudo-cereal, with potential for use in functional foods and vegetarian diets.

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ABSTRACTS

NUTRITIONAL AND NUTRACEUTICAL ASPECTS

EFFECT OF COOKING ON THE CONTENT AND BIOACCESSIBILITY OF MINERALS IN QUINOA (*Chenopodium quinoa*), BUCKWHEAT (*Fagopyrum esculentum*) AND AMARANTH (*Amaranthus sp.*)

C. Motta[a]*, A. S. Matos[b], R. Assunção[c], A. Cláudia[a], C. Martins[a], P. Alvito[a] and I. Castanheira[a]

[a] Departamento de Alimentação e Nutrição, Instituto Nacional de Saúde Doutor Ricardo Jorge, INSA. IP, Avenida Padre Cruz, 1649-016, Lisboa, Portugal
[b] Departamento de Engenharia Mecânica e Industrial, UNIDEMI, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516, Caparica, Portugal
[c] Instituto Universitário Egas Moniz – Cooperativa de Ensino Superior Campus Universitário, Quinta da Granja, Monte de Caparica, 2829 - 511 Caparica

***Corresponding author:** carla.motta@insa.min-saude.pt

The cooked Andean cereals can be considered a good source of minerals, contributing to the recommended daily intakes as observed in previous works. This study evaluated the chemical and nutritional compositions of quinoa, amaranth, and buckwheat and his bioaccessibility throws an in vitro gastric digestion simulation to understand their dietary changes. ICP-OES was used to quantify the mineral profile, and the impact of cooking on bioaccessibility was evaluated using multivariate statistical analysis. In this context, the contents of some essential minerals (potassium, magnesium, calcium, zinc, copper, iron and manganese) were evaluated. The lowest cooking losses were noted for Calcium in Quinoa (67%), and the highest was found for zinc in buckwheat (73%). The calcium and manganese concentration varied considerably with boiling among Andean cereals. For copper, manganese, iron and manganese, was observed a higher bioaccessibility in cooked quinoa and amaranth. The lowest bioaccessibility was detected for phosphorus in boiled quinoa fraction (36%). The results highlight the need to consider the losses in bioavailability for minerals during digestion and the related influence on the estimation of proper nutrient intake. These results contribute to understanding the bioaccessibility of minerals in cooked Andean cereals and the changes in these nutrient contents through the boiling process. Other ongoing cooking processes lead to a scientific recommendation of the best cooking method for boosting nutrient intake.

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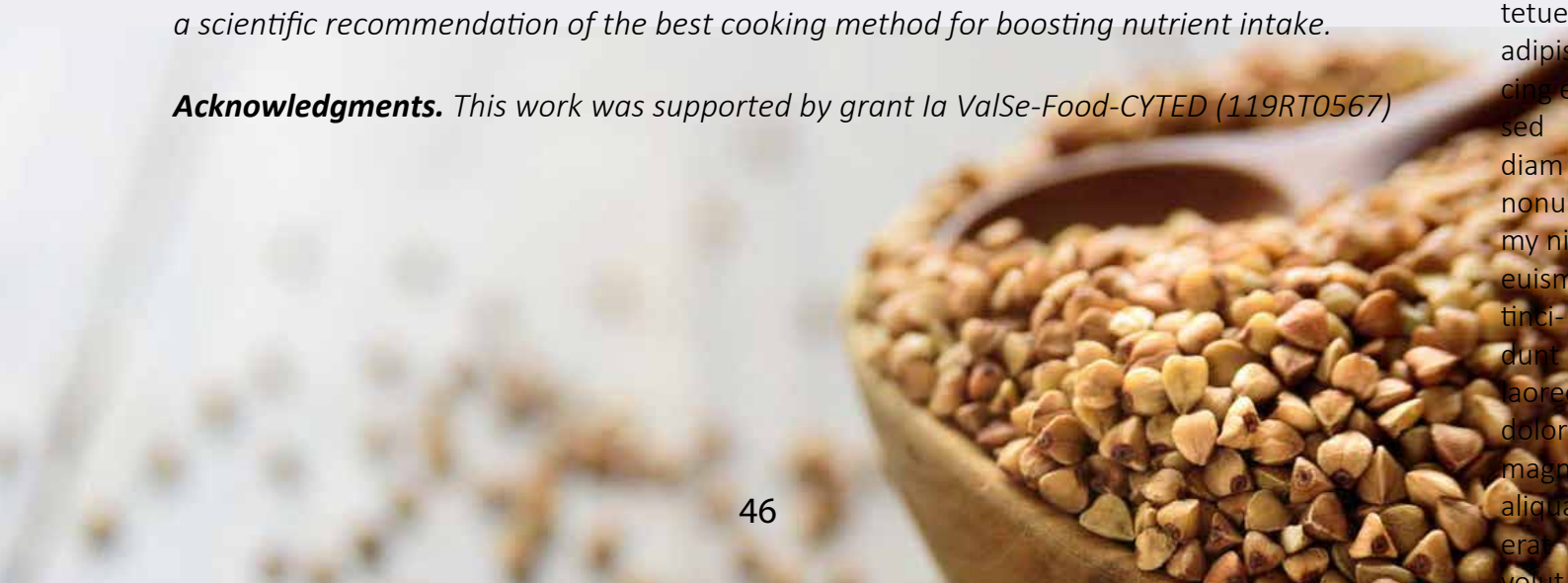

STUDY OF THE RESIDUE FROM *Salvia hispanica* (CHIA) SEED OIL EXTRACTION BY COLD PRESSING FOR REPURPOSING AS FUNCTIONAL FOOD TO PREVENT METABOLIC SYNDROME

G. Alarcon[ab], A. Valoy[a], A. Rossi[a] and S. Jerez[ab]*

[a] Instituto Superior de Investigaciones Biológicas (INSIBIO, UNT-CONICET), Av Independencia 1800 y Chacabuco 461, San Miguel de Tucumán, Tucumán, Argentina
[b] Facultad de Ciencias Naturales (UNT), Miguel Lillo 205, San Miguel de Tucumán, Tucumán, Argentina

***Corresponding author:** sjerez@herrera.unt.edu.ar

Despite its high nutritional value, the residue from chia seed oil extraction by cold pressing (cake or expeller) is still undervalued. Expeller is rich in proteins, fibers and contains about 7% of omega 3 α-linolenic acid (ALA). Considering that chia seed has been reported to improve insulin resistance among others cardiovascular risk factors, the aim of this work was to study the effects of a diet enriched with expeller on a rabbit model of metabolic syndrome. Nutritional analysis of the expeller was evaluated. Rabbits were fed either on standard diet (CD), on 18% high fat diet (HFD) or on HFD in which 20% of calories from fat were replaced by expeller (ED). At the end of 6-week feeding period, clinical, biochemical, and vascular reactivity studies were performed. Results: ED did not modify body weight or visceral fat, and reached to control the following parameters (one-way ANOVA was the test used and $p<0.05$ was considered statistically significant): fasting glucose (mg/dl; CD: 113±3; HFD: 1261±5; ED: 90±7), insulin resistance (AUCglu CD: 612±23; HFD: 676±17; ED: 517±38), triglycerides (mg/dl CD: 113 ± 14; HFD: 192±22; ED=98±22) and TyG index (CD: 8.3±0.2; HFD: 9.3±0.3; ED: 8.28±0.23). With respect to vascular studies, blunted norepinephrine response was found. In conclusion: results showed promising use of the expeller to develop functional foods that prevent metabolic syndrome. This may be a profitable way to reuse this agroindustrial waste.

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ARE AMARANTH GRAIN PEPTIDES ABLE TO BENEFIT THE CARDIOVASCULAR SYSTEM?

M. C. Añón[a]*

[a] *Laboratorio de Investigación, Desarrollo e Innovación en Proteínas Alimentarias (LIDiPA). Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA) (UNLP-CIC-CONICET). 47 y 116, La Plata, Argentina*

***Corresponding author:** mcacidca@gmail.com

Amaranth is a crop that has very interesting characteristics from the agronomic and nutritional point of view. Its grains are rich in carbohydrates, mainly starch, followed by proteins, lipids and fiber. In addition, it is a good source of minerals, vitamins and phytochemical compounds. There is numerous evidence indicating that amaranth has been and is used by different cultures not only as food but also as medicine. Its leaves and grains contain different components with beneficial properties for human health. Among them, it has been shown that grain storage proteins have encrypted sequences that, once released, exhibit bio functional properties that exert their action in different organic systems. Diseases of the cardiovascular system, CVD, are one of the chronic non-communicable diseases responsible for the largest number of deaths worldwide. In recent decades, it has been shown that peptides of different origin exhibit physiological activities that target this system. Among them are peptides derived from the storage proteins of amaranth grains that have antihypertensive, antithrombotic, and antioxidant activity. Results achieved in assays carried out in silico, in vitro and in vivo using different animal models have provided the necessary scientific basis to consider that there are amaranth peptides with the capacity to reduce the risk of contracting cardiovascular diseases. The mechanisms involved in the different biological activities, the potential responsible peptides and the possibilities of use in the elaboration of beneficial functional foods for the consumer will be discussed.

EFFECT OF AMARANTH-DERIVED-BIOACTIVE COMPOUNDS ON THE OXIDATIVE STATUS OF INTESTINAL CELLS

S. García Fillería[a], M. Rodríguez[a] and V. Tironi[a]*

[a]*LIDiPA, CIDCA, (CCT La Plata-CONICET, CICPBA, UNLP), La Plata, Argentina*

***Corresponding author:** valeriatironi@hotmail.com

The intestinal mucosa is constantly exposed to oxidants from the diet as well as to endogenously generated reactive oxygen species (ROS). The antioxidant activity of compounds derived from protein isolate, flour and a beverage obtained from amaranth (A. mantegazzianus) seeds on intestinal cells has been studied through in vitro and in vivo approaches. In vitro studies involved a simulated gastrointestinal digestion (SGID) process followed by analysis of the prevention of oxidative stress of H2O2-induced-Caco-2 TC7 cells. Peptides and probably other compounds (e.g. polyphenols) generated by SGID –the complete digest, their fractions separated according to their molecular masses, and some identified sequences- were able to decrease the intracellular ROS content, and modify the activity of cellular antioxidant enzymes (SOD and GPx) and GSH content. Some peptides were partially modified upon contact with intestinal cells and some intact and/or modified peptides could cross the intestinal barrier. Antioxidant activity could be exerted at the intestinal lumen, after interaction with the cell membrane, and/or inside the cell; as direct ROS scavengers and/or inducing signaling pathways that activate enzymes or antioxidant compounds. In vivo studies using an animal model (Wistar rats consuming a high-fat-diet added with amaranth flour or protein isolate) demonstrated that the ingredient type (namely the presence of different components), as well as the dose and duration of administration had an effect on diverse parameters related to the antioxidant status of the intestine (ROS, SOD, GPx, GSH). Amaranth flour showed greater effects when compared to the protein isolate.

PRODUCTION AND CHARACTERIZATION OF ANTITHROMBOTIC HYDROLYZATES FROM CHIA EXPELLER

T. Valicenti[a], B. Ozón[b], J. Rodríguez Gastón[ac], J. Cotabarren[b], A. Rosso[ac], W. D. Obregón[b] and M. Parisi[ac]*

[a] *Departamento de Ciencias Básicas, Universidad Nacional de Luján, Av. Constitución y Ruta Nac. N° 5, Luján, Buenos Aires, Argentina*
[b] *Centro de Investigación de Proteínas Vegetales (CIProVe), Departamento de Ciencias Biológicas, Facultad de Ciencias Exactas, UNLP, 47 y 115 s/N, La Plata, Argentina*
[c] *INEDES, Instituto de Ecología y Desarrollo Sustentable (CONICET-UNLu), Av. Constitución y Ruta Nac. N° 5, Luján, Buenos Aires, Argentina*

***Corresponding author:** monicaparisiunlu@gmail.com

Oilseed extraction has gained great importance in the market in recent times, generating as a secondary product of the extrusion-pressing process, a compact mass called expeller. In this work, it was proposed to take advantage of chia expeller as a source of protein hydrolysates, in order to evaluate the potential in vitro antithrombotic activity of chia proteins and the peptides encrypted in them. Hydrolysates with anticoagulant activity were generated by enzymatic hydrolysis with papain from the chia by-product of oil production. Both the isolate and the hydrolysate showed high anticoagulant activity for the extrinsic and intrinsic coagulation pathways, which is unusual since bioactive peptides generally affect only one of both pathways. Fro m the hydrolysate, three fractions were separated by ultrafiltration. The fraction with a molecular mass lower than 3 kDa presented the highest anticoagulant activity for both the APTT and TP assays, with an IC50 value 5 times lower than that obtained for the isolate. The impact of the digestive process on the bioactivity of the expeller proteins was also evaluated, and the anticoagulant activity increased both in the isolates and the hydrolysates under simulated gastrointestinal digestion conditions, indicating the presence of peptides with potential antithrombotic activity encrypted in the chia expeller, that could be released during the digestive process. Protein recovery as a resource from waste, in the perception of the Circular Economy, represents a challenge because allow the reuse of by-products in the supply chain, adding value to food due to its bioconversion into biopeptides of biotechnological interest reducing the risks caused by their environment disposal.

COMPARATIVE EVALUATION OF THE HYPOGLYCEMIC EFFECT OF PARTIALLY DEFATTED CHIA AND BASIL SEED FLOUR IN AN IN VITRO DIGESTION SYSTEM

H. Calderón-Bravo[ab], L. Zura[a], F. Stegmaier[a] and L. Muñoz[a]*

[a] *Facultad de Ingeniería, Laboratorio de Ciencia de Alimentos, Universidad Central de Chile, Santiago, Chile*
[b] *Departamento de Ciencia de los Alimentos y Tecnología Química, Universidad de Chile, Santiago, Chile*

***Corresponding author:** loreto.munoz@ucentral.cl

The hypoglycemic effect of partially defatted basil and chia seed flour (PDB and PDC) was evaluated in comparison with oatmeal flour (OMF) using an in vitro digestion system. Firstly, the nutritional and functional properties were analyzed and subsequently the hypoglycemic effect was evaluated. The PDB, PDC and OMF showed a total dietary fiber content of 45.19 ± 3.71; 40.59 ± 3.53; 11.72 ± 0.06 g/100 g of flour respectively, which correspond to 1.85 ± 0.30; 3.09 ± 0.61 and 4.07 ± 0.19 g/100 g of soluble fiber and 43.34 ± 1.97; 37.50 ± 4.99 and 7.64 ± 0.17 g/100 g of insoluble fiber respectively. The protein content corresponds to 22.18 ± 0.12; 30.79 ± 0.32 and 12.56 ±0.10 g/100g for PDB, PDC y OMF, respectively. This high amount of dietary fiber and proteins correlates with a water absorption capacity of 15.51; 28.74 and 1,39 g water/g sample for PDB, PDC and OMF, respectively which also could be related with the hypoglycemic effect. When the hypoglycemic effect was evaluated, the bioaccessibility of glucose was reduced by 48.24%; 30.35% and 17.4% when 2% of PDB, PDC and OMF was used. This behavior could be explained as the formation of aggregates between carbohydrates and proteins which can trap glucose, reducing its bioaccessibility. The use of these flour in the food formulation could offer an interesting opportunity to improve the food functionality in terms of its interaction with water and the improvement in the technological properties and could also help to reduce the glucose bioaccesibility providing a promising hypoglycemic effect.

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HEALTH BENEFITS PRODUCED BY THE CONSUMPTION OF BY-PRODUCTS FROM CHIA AND BASIL SEEDS

L. A. Muñoz[a]*, N. Vera[a], H. Calderon[a] and L. Zura[a]

[a] *Facultad de Ingeniería, Laboratorio de Ciencia de Alimentos, Universidad Central de Chile, Santiago, Chile*

***Corresponding author:** loreto.munoz@ucentral.cl

In recent years, the trend to consume healthy and safe food has once again put ancestral seeds as protagonists. In this sense, a fundamental component is dietary fiber, which has been recognized by the World Health Organization (WHO) as an important part of a healthy diet. In this context, the study of new sources of functional components from Latino American seeds is relevant today. Therefore, in the present work the main results of the effect of chia and basil seed by-products in different concentrations on the hypoglycemic effect by using an in vitro digestion system was analyzed. The by-products from chia and basil seeds, both the soluble fiber and partially defatted flours have the ability to form viscous dispersions and have the ability to absorb large amounts of water ranged between 12 and 30 g/100g sample. In this study, when the soluble fibre was used at 0.95%, the reduction of glucose bioaccessibility reached a 66.7%, while when the partially defatted flours were used at 2% the bioaccessibility of glucose was reduced by 30.35% at 48.24% for chia and basil seeds, respectively. On the other hand, when the soluble fibre from chia seed was analyzed, a significant effect on human gut microbiota was observed affecting the growth of some intestinal bacterial groups, such as Enterococcus spp and Lactobacillus spp, while when soluble fibre from basil seed was used, a clear inhibition of pathogens was observed and the growth Lactobacillus spp and Pediococcus was stimulated. These results highlight the potential functionality of the by-products obtained from chia and basil seeds to improve the glycemic profiles and suggest the dietary health benefits of this new source as an ingredient in functional foods

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NUTRITIONAL CHARACTERIZATION OF PARTIALLY DEFATTED CHIA AND BASIL SEEDS FLOUR: PROTEINS, AMINO ACIDS PROFILE AND MINERALS

H. Calderón-Bravo[ab], L. Zura[a], T. Herrera[b], F. Stegmaier[a], L. Puente-Diaz[b] and L. Muñoz[a]*

[a]*Facultad de Ingeniería, Laboratorio de Ciencia de Alimentos, Universidad Central de Chile, Santiago, Chile*
[b] *Departamento de Ciencia de los Alimentos y Tecnología Química Universidad de Chile, Santiago, Chile*

***Corresponding author:** loreto.munoz@ucentral.cl

Chia seeds have been described as a good source of nutrients because of their protein content which has all the essential amino acids, and elevated mineral content. On the other hand, Basil seeds haven´t been deeply described in terms of amino acid profile, and mineral content. In this study, the nutritional profile of two partially defatted basil (PDB) and chia (PDC) seed flours was described. The protein, ash, and mineral content, amino acid profile, and phytic acid, were determined. Protein content of PDB and PDC samples were 22,18 and 30,79 g/100 g, respectively. As to amino acid content, it was shown that 100 g PBD can provide around 50% recommended ingestion of histidine, phenylalanine/tyrosine, and methionine/cysteine for a person of 70 kg according to FAO/WHO criteria. Likewise, 100 g of PDC presented over 50% of lysine, isoleucine, and leucine, and over 85% of histidine, methionine/cysteine, and phenylalanine/-tyrosine. In both cases, the threonine content was over diary requirements. As for the ash content of PDB and PDC, these were 9.44 and 7.59 g/100 g, respectively. Whilst the minerals were 20,90(Ca), 7,13(Zn) and 5,59(Fe) mg/100 g for PDB, and 884,63(Ca), 9,38(Zn) and 6,94(Fe) mg/100 g for PDC. In addition, the phytic acid content in PDB and PDC were 1,94 and 3,36 g/100 g, respectively. Finally, relationship between phytic acid and minerals like Zn, and Fe indicated that these minerals present a low bioavailability, but Ca show high and medium bioavailability for PDC and PDB respectively.

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THE IMMUNOMODULATORY AND ANTIOXIDANT PROPERTIES OF CHICKPEA *(Cicer arietinum L.)* PROTEIN HYDROLYSATES

N. Rodriguez-Martin[a], J.C. Márquez-López[a], A. Villanueva[a], F. Millan[a], M.C. Millán-Linares[ab] and J. Pedroche[a]*

[a] *Departmento de Alimentos y Salud, Instituto de la Grasa, CSIC. Ctra. de Utrera Km.1, Sevilla, España*
[b] *Departmento de Bioquímica Médica y Biología Molecular e Inmunología, Facultad de Medicina, Universidad de Sevilla. Av. Dr. Fedriani 3, Sevilla, España*

***Corresponding author:** j.pedroche@csic.es

Chickpea (Cicer arietinum L.) is the third most important grain legume in the world in area coverage, volume of production and trade. The crop is primarily grown on the Indian followed by America as the second continent with highest chickpea production where USA, Canada and México are the main producers. It could be considered a cheaper, sustainable, and healthy source of nutrients with high content of immunonutrients. Furthermore, chickpea has a significant amount of proteins, and the chickpea protein hydrolysates (CPHs) production could release bioactive peptides with immunomodulatory properties. Moreover, monocytes are circulating blood cells involved in a variety of oxidative-pathological process related to inflammatory status. The study of CPH in monocytic cell line as THP-1 would be a relevant strategy to recognize antioxidant and anti-inflammatory hydrolysates. The specific goal of this study was to evaluate the immunomodulatory potential of CPH to identify novel ingredients for functional foods. A chickpea protein concentrate was hydrolyzed by Bioprotease-660LA under specific conditions. The resulting hydrolysates were evaluated to search potentially bioactive CPHs using In vitro cell-free experiments. The study led to the identification of one bioactive hydrolysate, which was used at two doses (50 and 100 µg/µL) on THP-1 cell line stimulated with lipopolysaccharide to evaluate the inflammatory status. ELISA and RT-qPCR techniques were used to analyses the levels of inflammatory cytokines production. Total superoxide dismutase (SOD) activity was also evaluated using a commercial determination kit. Our data showed that the selected CPH down-regulated the mRNA transcriptional levels of cytokines IL-1β and TNF-α in THP-1 cell line stimulated with lipopolysaccharide. Besides, CPH increased the SOD activity, in contrast to LPS control. This study suggests that CPH may improve inflammatory states and has a role in the SOD signaling pathways in THP-1 cell line.

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SUBSTITUTION OF CRITICAL INGREDIENTS OF COOKIE PRODUCTS TO INCREASE NUTRITIONAL VALUE

G. Myrisis[ab], S. Aja[a] and C. M. Haros[a]*

[a] *Instituto de Agroquímica y Tecnología de Alimentos (IATA-CSIC), Valencia, España*
[b] *Departamento de Ciencia de Alimentos y Nutrición Humana, Universidad Agrícola de Atenas, Atenas, Grecia*

***Corresponding author:** cmharos@iata.csic.es

In accordance with the current technological advances in the bakery industry, to increase the nutritional value of cookies without affecting their technological and sensorial parameters, critical ingredients of cookie products (flour, sugar, butter) were substituted by whole quinoa flour and by-products of chia (oil and fibre). Cookie dough was prepared according to the approved AACC method 10-52. To optimize the formulation of the cookie (% substitution of critical ingredients) and the baking conditions (temperature and time), factorial design and the response surface methodology were applied. The optimal formulation presented significantly higher amounts of protein content with improved the aminoacid profile, ash and fibre contents, while caloric values decreased compared to the control sample. Concerning baking conditions, 175 ºC and 10.75 minutes were found to be the most appropriate conditions for the control formulation. The same conditions were then applied to the optimized formula. As cereal products are one the sources of acrylamide and as many studies indicated its carcinogen potential, its concentration in the cookie products was investigated. The International Agency of Research on Cancer classified acrylamide as a probable human carcinogen (Group 2A). The results indicated that the acrylamide levels were lower than the limit concentrations of the regulation (EU) 2017/2158 (350 µg/kg). The results obtained showed that all cookies have acceptable technological and sensorial quality and the new one has highly nutritious properties and health benefits.

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NUTRITIONAL CHARACTERIZATION OF ANCESTRAL ORGANIC WHEATS: EMMER, KHORASAN AND SPELT

A. Athineou[ab], S. Aja[a], C. M. Haros[a]*

[a] *Instituto de Agroquímica y Tecnología de Alimentos (IATA), Consejo Superior de Investigaciones Científicas (CSIC), Av. Agustín Escardino 7, Parque Científico, Paterna, Valencia, España*
[b] *Departamento de Ciencia de Alimentos y Nutrición Humana, Universidad Agrícola de Atenas (AUA), Av. Iera Odos 75, Atenas, Grecia*

***Corresponding author:** cmharos@iata.csic.es

Nowadays, consumers show a growing interest in the consumption of foods made with ancestral grains, the main components of the diet of our ancestors. The ancestral grains come from millenary cultivars, and have now burst onto the international market as part of a nutritious and healthy diet. Some of these crops refer to ancestral wheats. The objective of this study was to determine the nutritional characteristics of ancient wheats compared to the modern one. Ancient crops such as emmer (Triticum dicoccum, knowing as "farro medio" or "farro"), khorasan (Triticum turanicum, the best known kamut) and/or spelt (Triticum aestivum ssp spelta, knowing as "escanda" or "farro grande") were the raw materials of the current investigation. Characterisation of wheat seeds/whole flours in terms of moisture, ash, total dietary fibre, proteins, and lipids, colour, phytates and phytase activity, minerals were determined. In general, these analyses do not support the suggestion that ancient wheats are generally more nutritious and/or healthy than modern wheats. The results support the consumption recommendation of the intake of whole grains (modern or ancients) to prevent non-transmissible illnesses. Nutritional quality of ancient seeds is generally higher than control and is similar to the organic cultivation.

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IMMUNONUTRITIONAL BENEFITS OF *Chenopodium quinoa*'s INGREDIENTS PREVENTING OBESITY-DERIVED METABOLIC IMBALANCES

H. Marcos-Pasero[a], A. Bojarczuk[b], C.M. Haros[c] and J.M. Laparra[d]*

[a] *Grupo de Ciencia de Alimentos y Salud, Universidad Internacional de Valencia (VIU), Valencia, España*
[b] *Institute of Agricultural and Food Biotechnology, Warsaw, Poland*
[c] *Instituto de Agroquímica y Tecnología de Alimentos (IATA), Consejo Superior de Investigaciones Científicas (CSIC), Valencia, España*
[d] *Grupo de Inmunonutrición Molecular, Instituto Madrileño de Estudios Avanzados en Alimentación (IMDEA-Food), Madrid, España*

***Corresponding author:** moises.laparra@imdea.org

Over 1.6 billion people (aged 15 years and above) worldwide are currently either overweight or obese, and this number is predicted to increase to 2.3 billion by 2050 (WHO). Excessive or impaired energy storage in the liver results incurs at a high risk of liver dysfunction and development of obesity, lipodystrophy, or cachexia, and impairs organismal homeostasis. Chenopodium quinoa seeds constitute a good source of immunonutritional compounds, enabling a selective functional differentiation and function of intrahepatic monocyte-derived macrophages. The latter, play a key role controlling adiposity associated with innate lymphoid cells (ILCs) that determine the induction of diet-induced obesity (DIO). Herein, two immune-conditioned mouse models—Rag2-/- and Rag2-/-IL2-/-—were used to examine the influence preventing DIO of a protein-rich fraction (PRF) and oil obtained from C. quinoa seeds. Variations in myeloid cells and precursors of ILCs were evaluated by FACS analyses as well as the hepatosomatic index to estimate liver inflammation. Only administration of C. quinoa PRF prevented alterations in the liver/body weight ratio either in animals carrying ILCs (i.e., Rag2-/-) or not (Rag2-/-IL2-/-). These effects were associated with significantly decreased variations in the hepatic triglyceride content. FACS revealed that PRF from C. quinoa favors the hepatic infiltration of myeloid enables a selective functional differentiation and function of intrahepatic monocyte-derived macrophages preserving tissue integrity and function.

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IN SILICO PREDICTION OF PEPTIDE VARIANTS FROM *S. hispanica* WITH ANTIMICROBIAL AND ANTIBIOFILM POTENTIAL

A.L. Madrazo[a] and M. R. Segura Campos[a]*

[a] *Facultad de Ingeniería Química, Universidad Autónoma de Yucatán, Periférico Norte Km. 33.5, Tablaje Catastral 13615, Colonia Chuburná de Hidalgo Inn, Mérida, Yucatán, Mexico*

***Corresponding author:** maira.segura@correo.uady.mx

Plants are known as a rich source of bioactive peptides, and a variety of plant peptides have been studied as potential alternatives to conventional antimicrobial, antibiofilm, and antioxidant agents in food products to prolong their shelf-life, which could pose potential health risks for consumers. In this study, it is per- formed the selection and optimization of peptides that are not currently reported in any database, derived from a chia peptide fraction. Computer-aided tools were used to identify multifunctional peptides with antimicrobial, antibiofilm, and antioxidant potential. Two peptide sequences (YACLKVK and KLKKNL) showing the highest probability scores for antimicrobial activity were identified from a total of 1067 de novo sequences in a chia peptide fraction (F<1 kDa). Subsequently, the peptides YACLKVK and KLKKNL were used to create scrambled libraries containing permutations of these sequences to explore the antibiofilm potential of different amino acid arrangements. The peptide variants with the highest probability scores for antibiofilm activity were subjected to optimization for the improvement of their activity. Finally, the optimized sequences were analysed to determine the presence of antioxidant fragments. This computational approach could be a solution for the screening of a large number of peptides with more than one function, allowing the development of multifunctional peptides as alternatives to traditional food preservatives.

Acknowledgments. This work was supported by grant Ia ValSe-Food-CYTED (119RT0567).

ABSTRACTS

PRODUCT DEVELOPMENT

DEVELOPMENT OF BREADS FORTIFIED IN CALCIUM AND HIGH PROTEIN CONTENT THROUGH THE USE OF BEAN FLOUR AND REGIONAL FRUITS

M.N. Bassett[ab]*, A.E. Gutierrez[b], M.E. Acuña[b] and A.M. Rossi[b]

[a] *Centro Interdisciplinario de Investigaciones, Tecnologías y Desarrollo Social para el NOA (CIITED) CONICET UNJu, Jujuy, Argentina*
[b] *Instituto Superior de Investigaciones Biológicas (INSIBIO), CONICET UNT, Tucumán, Argentina*

***Corresponding author:** natybassett@gmail.com

The World Health Organization recommends the consumption of pulses and considers them good allies to achieve food security and reduce malnutrition worldwide. Bread offers the possibility of incorporating ingredients to improve the diet without changing eating habits. The aim objective was to formulate and elaborate calcium-fortified bread, optimizing nutritional quality using protein supplementation with regionally produced ingredients, underutilized for domestic consumption. The variability of the protein quality of wheat flour and its mixtures with bean flour was studied. The proteins, fats, dietary fiber, ashes and moisture were determined using AOAC methods. Volume, texture and color using a Vernier caliper, a TA-XT-2 iHR Texturometer and a CR300 Minolta Camera colorimeter, respectively were also evaluated. The addition of calcium salts increased hardness, produced lighter crumb and crust, and did not affect volume. The addition of fruit pulp did modify the color and volume of the loaves. The moisture, protein, calcium and sodium content of the baked goods were 39g, 11.6g, 443mg and 320mg per 100g of bread, respectively. A sodium reduction of 30% was obtained with the consequent increase in calcium, both critical nutrients by default and excessive consumption, respectively. Breads produced are inexpensive, has higher content of good quality protein and calcium. Due to their ingredients, their nutritional and textural characteristics, could be incorporated into the diet of vulnerable groups. They will contribute to the prevention of chronic and/or deficiency diseases. In addition, the use of regional products origin will encourage local production and therefore the economy.

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RED AND GRAY BEANS *(Phaseolus vulgaris L.)* PROTEIN HYDROLYSATES. FOOD PROTYPES WITH POTA *(Dosidicus gigas)* BY-PRODUCT MEAL

N. Chasquibol[a]*, R. Alarcon[a], B. Gonzales, M. Tapia[a], A. Sotelo[a], B. García[b] and M. C. Pérez-Camino[b]

[a] *Instituto de Investigación Científica, Grupo de Investigación en Alimentos Funcionales.Universidad de Lima. Av. Javier Prado Este, 4600. Fundo Monterrico Chico, Surco-Lima, Perú*
[b] *Instituto de la Grasa-CSIC- Campus Universidad Pablo de Olavide Ed. 46- Crtra. Sevilla-Utrera km 1. Sevilla, España*

***Corresponding author:** nchasquibol@ulima.edu.pe

The bean (Phaseolus vulgaris L.), native to the central Andes of Peru, is known as the ñuña, numia, or Andean popping bean and are consumed as a snack food after a quick toasting process. The characterization of two varieties, red and gray ñuña bean was performed, through the determination of their proximate composition, total phenolics and antioxidant activity. Moisture content ranged from 12.67% (red ñuña bean) to 11.94 % (gray ñuña bean). Fat content varied from 1.77% (red ñuña bean) to 1.44% (gray ñuña bean). Protein content showed a high content with a range from 23.90% (red ñuña bean) to 26.81% (gray ñuña bean). Ash content ranged from 4.04% (red ñuña bean) to 3.88 % (gray ñuña bean). A high content of carbohydrates was found in the samples (from 57.60 to 55.94 %). The phenolic compounds were consistently higher according to particle size. The total phenolic content varied from 8589 µg GAE/g powder (red ñuña bean) to 3478 µg GAE/g powder (gray ñuña bean) and the antioxidant activity varied from 9879 µg trolox/g powder (red ñuña bean) to 5539 µg trolox/g powder (gray ñuña bean). Food prototypes were developed with optimized and characterized hydrolyzed proteins from ñuña beans and with pota (Dosidicus gigas) by-product meal with a high content of protein and omega-3 acids (~50% EPA+DHA on total fat).

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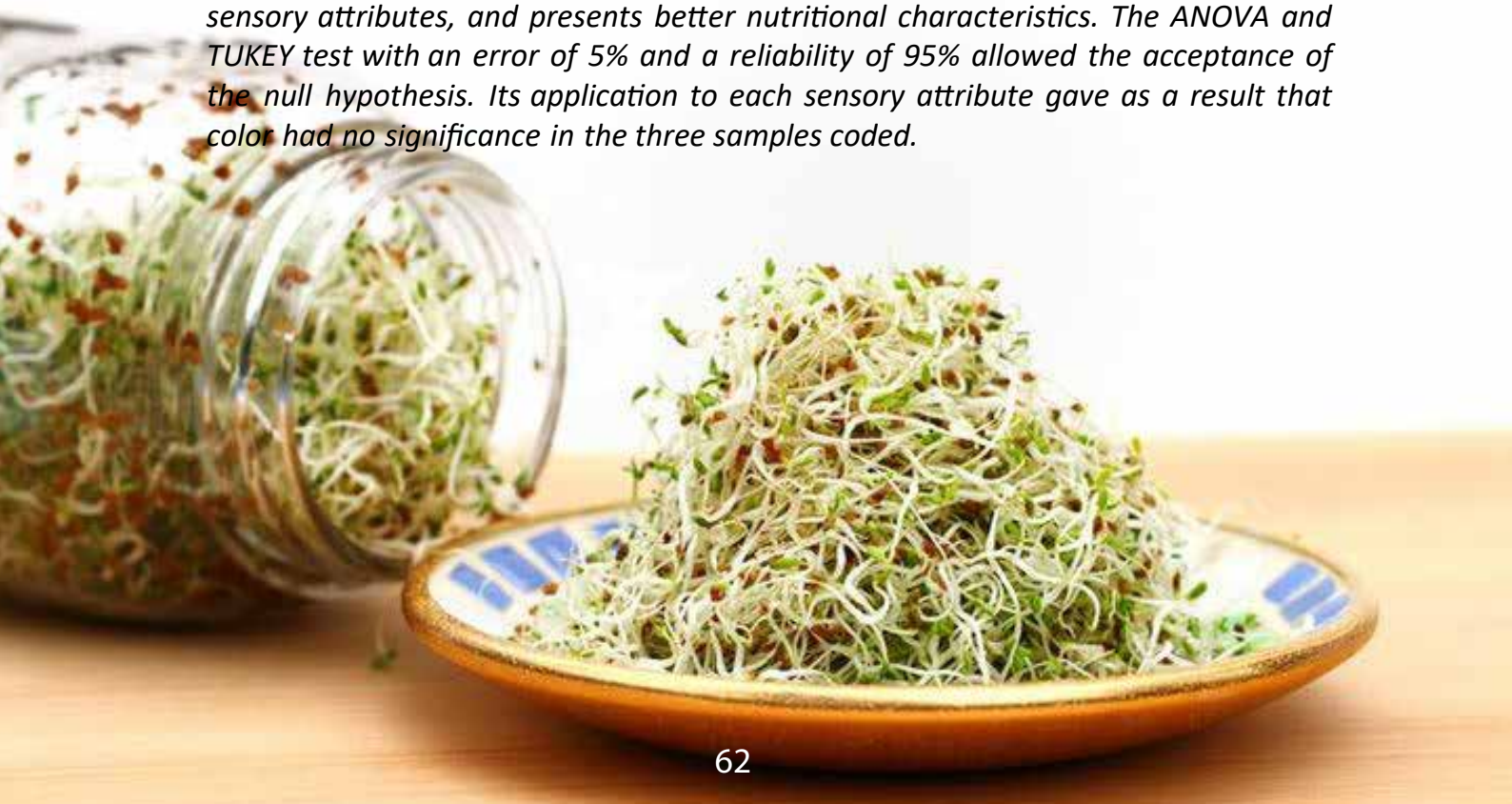
PREPARATION OF A NUTRITIOUS DRINK FROM CHIA *(Salvia hispanica* Lameacea*)* AND QUINOA *(Chenopodium quinoa* Willd*)* SPROUTS, DETERMINATION OF ANTIOXIDANT CAPACITY AND MICROBIOLOGICAL QUALITY

A. Y. Pampamallco Gallegos[a], P. D. Barrantes Colquehuanca[a], W. Paredes Ugarte[a]*, A. G. Viza Salas[a] and L. A. Aguirre Florez[a]

[a]*Universidad Nacional del Altiplano. Puno. Perú*

***Corresponding autor:** wilberparedes@unap.edu.pe

The research was carried out with the purpose of knowing, elaborating, analyzing and describing the nutritional properties of the chia and quinoa sprouts drink, and that these are sensorially accepted by consumers. This drink is an innovative alternative solution because it presents a high nutritional quality. The study is a cross-sectional and descriptive analytical study. Three samples with different percentages of sprouts were formulated and analyzed for macronutrient content, microbiological and antioxidant capacity, to later determine the acceptability of the beverage by applying the 7-point hedonic scale to 25 randomly selected university consumers. The antioxidant capacity was determined using the CUPRAC (CopperReducing Antioxidant Capacity) method, and the microbiological quality was determined by counting mesophilic aerobic microorganisms using the whole medium plate count method. According to the analyses that were carried out, it was concluded that product 3 (sprout drink with 30% of sprout), has greater acceptability in terms of sensory attributes, and presents better nutritional characteristics. The ANOVA and TUKEY test with an error of 5% and a reliability of 95% allowed the acceptance of the null hypothesis. Its application to each sensory attribute gave as a result that color had no significance in the three samples coded.



PREPARATION OF FRESH NOODLES WITH CHIA AND AMARANTH

P. Mezzatesta[a], J. Bailey[a], S. Farah[a] and E. Raimondo[a]*

[a]*Universidad Juan Agustín Maza, Mendoza, Argentina*

***Corresponding author:** emilia.raimondo@gmail.com

Current nutritional recommendations lead to reformulate traditional products, such as fresh noodles, in order to improve the nutrients they provide. In the case of fresh noodles, in order to improve the nutrients they provide, the objective of this work was to determine the variation of the nutritional profile of fresh noodles by partially replacing wheat flour by chia and amaranth flour. For this purpose, wheat flour was partially substituted with 15% chia flour and 11% amaranth flour, respecting the proportions of the rest of the ingredients (called FS) and fresh noodles with unsubstituted wheat flour, which is taken as the standard (F). Once prepared, protein, total fat, ash, moisture and fiber were determined by official analytical techniques; carbohydrates by difference, energy value by calculation and fatty acid profile by gas chromatography. From the analytical results it appears that protein increased from 7.76 g% (F) to 10.87 g% (FS), carbohydrates decreased from 51.68 g% (F) to 39.87 g% (FS) and fiber increased from 3.19 g% (F) to 8.68 g% (FS). Total fats increased from 13.18 g% (F) to 18.68 g% (FS), of which omega-3 fatty acids increased from 0.67 g% (F) to 4.03 g% (FS). Energy value varies from 356 kcal/100 g (F) to 369 kcal/100 g (F). With the partial substitution of wheat flour by chia and amaranth, it was possible to improve the nutritional profile of the noodles, being a feasible option for both industrial and home use.

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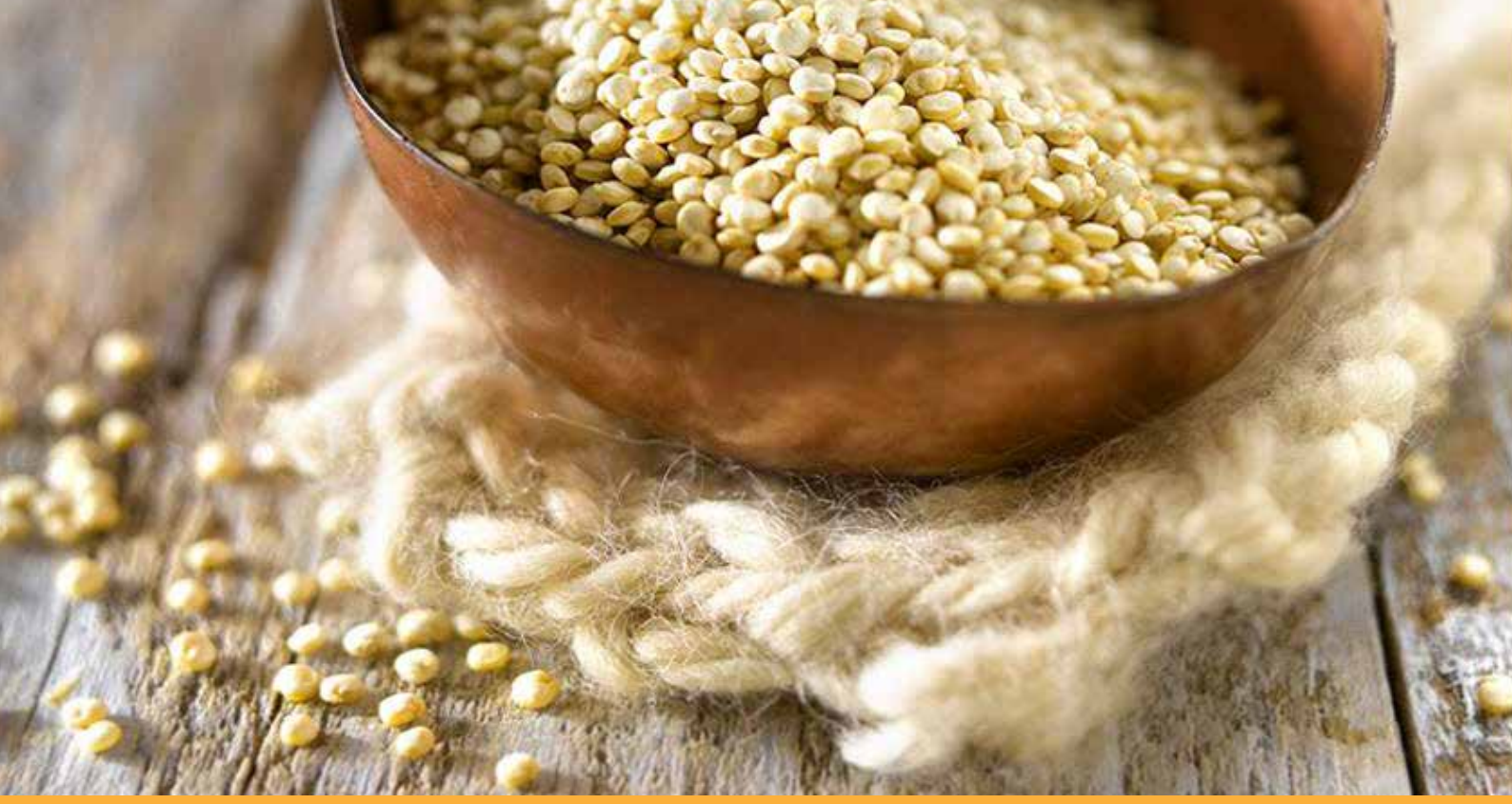

DEVELOPMENT OF A READY-TO-EAT FOOD FROM FREEZE-DRIED QUINOA SEEDS

S.A. Giner[ab] and R.M.Torrez Irigoyen[ab]*

[a] *Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA). Facultad de Ciencias Exactas, UNLP, 47 y 116 (1900)- La Plata, Buenos Aires, Argentina*
[b] *Facultad de Ingeniería, Av.1 Nº750, La Plata, Buenos Aires, Argentina*

***Corresponding author:** ricardo.torrezirigoyen@ing.unlp.edu.ar

Quinoa is a valuable seed mainly for its essential amino acid and mineral content. The objective of this work was to characterize the freeze-drying process of quinoa to produce a ready-to-eat food. Quinoa (var. CICA) were washed with water to eliminate the saponins and treated with steam to favour the starch digestibility. Following, the samples were arranged in stainless steel trays and frozen at -20°C. A freeze-dryer Mod. L-A-B4-C (Rificor, Argentina) was used for the drying. Experiments were carried out at different tray temperatures (Tb): 30, 40 and 50ºC. In each case, moisture content (W) vs process time curves were determined. To ensure storage stability, it was proposed to reach a water activity (aw) ≤ 0.45 in the final product. The results showed that an increase in Tb reduced the processing time, finding that at 50ºC a time of 1.5 h was sufficient to achieve a W of 0.02 kg water/kg dry matter and aw=0.123. Regarding nutritional properties, the main minerals were quantified: Calcium (Ca), Iron (Fe), Potassium (K) and Phosphorus (P) using the inductively coupled plasma technique (ICP-OES). The results (mg/ kg dry matter) were Ca: 601.9; Fe: 22.6; K: 4342.2; P: 3975.2. The total antioxidant capacity was determined by ABTS (µg Trolox/ g d.m.), FRAP (µmol Fe/ g dm) and total phenols (µg Gallic Acid Eq./ g dm). The values were: 574.6 in ABTS; 3.04 in FRAP and 569.6 in total phenols. Freeze-drying can be a suitable process to produce a dehydrated product with good nutritional profile.

GLUTEN-FREE COUSCOUS MADE FROM QUINOA SPROUTS: STUDY OF SHELF LIFE

M. Trujillo[a] and P. Maldonado-Alvarado[a]*

[a] Departamento de Ciencia de Alimentos y Biotecnología (DECAB). Escuela Politécnica Nacional (EPN). Quito, Ecuador
***Corresponding author:** pedro.maldonado@epn.edu.ec

Couscous is a traditional staple food of North African made of agglomerated granules from steamed wheat semolina. Couscous from germinated quinoa can improve several properties compared to couscous from ungerminated quinoa and traditional couscous. However, its shelf life has not been studied. The aim of this work was to determine the shelf life of a gluten-free couscous made from germinated quinoa. Desaponified quinoa of the Tunkahuan variety from Ecuador was used. Quinoa kernels were germinated, dried, milled, agglomerated, and finally steamed in controlled conditions. A designed particle agglomeration equipment was used to produce the couscous. The shelf life of the product was determined by accelerated testing. Product quality changes were evaluated during storage for 90 days in different types of packaging (cardboard, polyethylene polyester and metallized polypropylene) under different conditions (15, 25, 35 and 45 °C). The moisture content, water activity, free fatty acids, peroxide value showed a significant increase with time and temperature, while the maximum compression force showed a significant decrease. Analysis of total aerobes, total coliforms, molds, and yeasts showed that the product complies with the microbiological parameters established in the three types of packaging during storage. An increase in Aw and free fatty acids was found, whose kinetics of deterioration presented a first-order reaction. Aw activity was selected to estimate the shelf life of germinated quinoa couscous. Hence, the results suggest that the product can extend its shelf life at 20 °C up to 85 days and 136 days in cardboard and polyester polyethylene packaging, respectively.

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DEVELOPMENT OF FOOD PRODUCTS FROM CUBAN COWPEA BEAN

(Vigna unguiculata (L.) Walp.)

Y. C. Concepción[a]* and J. C. Domínguez[a]

[a]*Carretera al Guatao km 3 1/2. La Lisa, La Habana, Cuba*

***Corresponding author:** yannara@iiia.edu.cu

The largest Cuban production of cowpeas (Vigna unguiculata (L.) Walp.) occurs mainly in Las Tunas and Holguín. Cowpeas are a source of protein, dietary fiber, vitamins and minerals. Nowadays, the world population demands healthy foods with the inclusion of some ingredients that produce some beneficial effect for the organism. The scientific community is looking for some alternative sources of good quality proteins that include a good amino acid profile. So, this Cuban crop is a good option to include in some processed foods to guarantee good nutrition for special diets such as children, pregnant women and the elderly. In the world, there are some products (bakery products, vegan cheese, yogurt and fermented milks, among others) that experts recommend in order to increase the accessibility to the products elaborated from other legumes sources such as chickpeas, lentils, soybeans, among others. In Cuba, there is a project titled ''Development of food products from processing the cowpea bean'', where some experts have developed flours, pastas, baked products (cookies, bread and cakes), meat products of fine dough and fermented beverages from the cowpea bean. Therefore, the main objective of this conference is to show some prototypes of products made from the Cuban cowpea bean at the Food Industry Research Institute.

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AMARANTH: POTENTIAL BIOACTIVE FOODS ELABORATED WITH AN ANCESTRAL SEED

A. Scilingo[a]*, A.C. Sabbione[a], S. Suárez[a], F. Speroni[a], V. Tironi[a], M. Rodríguez[a], A. Quiroga[a] and M.C. Añón[a]

[a]*CIDCA (Centro de Investigación y Desarrollo en Criotecnología de Alimentos, CONICET–CIC–UNLP). La Plata, Buenos Aires, Argentina*

***Corresponding author:** aascilingo@gmail.com

Our work with amaranth has been going on for more than two decades and during this period we have addressed various aspects of this ancestral Mesoamerican grain. Its seeds are a good source of dietary fiber, contain proteins with an excellent amino acid balance and different macromolecules and phytochemicals with high biological value. Until now, three food matrices have been prepared in our laboratory. With whole amaranth seeds and using a colloid mill, we obtained a vegetable drink with high protein content (>3% w/v) and low lipid and starch content, that was stable for 30 days. This product presented, after being subjected to simulated gastrointestinal digestion (SGD), antihypertensive, antioxidant, and antithrombotic activity. Through dry milling, whole meal amaranth flour was obtained and gluten-free cookies were elaborated. These cookies maintained acceptable texture and colour characteristics for 21 days at room temperature. This product exhibited antihypertensive and antithrombotic activity after SGD. From the defatted flour, we obtained an amaranth protein isolate (protein content: 85% p/p) used to formulate an amaranth lemon ice cream. Under acidic conditions (60 min, 20°C), an endogenous aspartic protease modifies proteins, enhancing their foaming capacity. This ice cream presented greater creaminess and the same acceptance as that obtained using egg white as a foaming protein source (CATA sensory test); after subjecting it to SGD we detected in vitro antithrombotic activity. The basic knowledge generated by the research group has allowed us to develop three products that show the versatility and bioactivity of the components of this seed.


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