FONDO EDITORIAL | ABSTRACTS OF THE 6TH IA VALSE-FOOD NETWORK INTERNATIONAL CONGRESS

UNIVERSIDAD DE LIMA

# PROMOTING BIODIVERSITY, SUSTAINABILITY, AND FOOD SECURITY THROUGH ANCESTRAL IBERO-AMERICAN CROPS

# Promoting Biodiversity, Sustainability, and Food Security Through Ancestral Ibero-American Crops
## Abstracts of the 6th Ia ValSe-Food Network International Congress

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*Nancy Chasquibol, Norma Sammán, Pedro Maldonado, Laura Mereles, Ma. Carolina Zúñiga, Ritva Repo-Carrasco, & Claudia Mónika Haros*
*(editors)*

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# PROMOTING BIODIVERSITY, SUSTAINABILITY, AND FOOD SECURITY THROUGH ANCESTRAL IBERO-AMERICAN CROPS

Ia ValSe-Food Network International Congress (6°: 2024: Lima, Perú)

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# Contents

# Foreword

This congress was organized by the Ia ValSe-Food Group (Ibero-American Valuable Seeds), the Institute of Agrochemistry and Food Technology, Spanish National Research Council (CSIC), Spain, and the University of Lima, Peru.

Andean grains are globally recognized for their high nutritional value, well-balanced composition of proteins, fats, and starches, as well as their rich content of essential amino acids, essential fatty acids, and nutraceutical properties. They represent not only a valuable cultural heritage rooted in the ancestral communities of Latin American countries but also a source of solutions to contemporary challenges such as healthy eating and the development of new foods that are low in calories, fats, and sugars.

The Ia ValSe-Food Network is aware of the significance of Andean grains and their role in promoting food security, biodiversity conservation, and climate change resilience. The network recognizes that ancient crops play a crucial role in preserving biodiversity and improving the resilience of agricultural systems.

Through the study and promotion of ancestral seeds, the Ia ValSe-Food Network contributes to the preservation of genetic biodiversity, research, development, and multidisciplinary associative innovation for the creation of healthy foods using ancestral Ibero-American crops. These efforts aim to integrate such crops into modern diets by partially or entirely substituting critical ingredients, fostering the development of innovative, healthy, sustainable, tasty, and socially accepted products.

The concept of the Ia ValSe-Food Network is to establish a framework that brings together scientific, technical, and industrial groups working in all areas related to ancient crops. The overarching goal of the network is to create a cooperative environment with the international scientific community and promote the production of safe, sustainable, tasty, nutritious, and healthy foods based on ancient crops, through collaboration among research sectors, institutions, industry, and society.

The aim of the International Ia ValSe-Food Network is to foster the sustainable development of science and technology based on the study of ancient seeds.

The parties commit to supporting each other in organizing and conducting scientific activities in a multilateral context through the following means:

- Carrying out joint research projects, workshops, and/or networks in areas of mutual interest.
- Jointly organizing scientific and cultural events, courses, conferences, seminars, symposia, networking events, and personnel training programs in areas of mutual interest.
- Exchanging faculty and researchers, administrative or technical staff for both long- and short-term stays.
- Training and jointly supervising PhD candidates and young researchers.
- Any other initiatives within the partners' competencies and aligned with the network's objectives that may be deemed of mutual interest.

*Nancy Chasquibol*
*Norma Sammán*
*Pedro Maldonado*
*Laura Mereles*
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Editors

# SESSION I

## AGRONOMY AND CROP DIVERSITY IN THE FACE OF CLIMATE CHANGE

# Adaptation of Andean grains to climate change

Angel Mujica, Gladys Moscoso, & Víctor Gonzales

Universidad Nacional del Altiplano, Puno, Peru

Currently climate change, which causes abrupt alterations and affects the basic elements of human life, is causing unexpected changes that have an unfavorable impact on food production: drought, floods, heat waves, extreme cold, deglaciation of snow-capped mountains, drying up of springs and wetlands, loss of agrobiodiversity, increased incidence of pests, diseases and weeds, which are affecting the structure, functioning of agroecosystems and causing social disorders, now having as a strategy the rapid adaptation and mitigation of these harmful effects, hence the Andean grains (quinoa, cañihua, kiwicha, Altiplanic maize and tarwi), play an important role, due to their enormous diversity and variability, wide adaptation to different agro-edaphoclimatic conditions and the development of morphological, anatomical, physiological, biochemical and phenological mechanisms developed during their phylogenetic and ontogenetic evolution, which allow us to adapt and withstand these environmental and climatic changes with relative success. To this end, numerous investigations have been carried out in the field, greenhouse and laboratory on the behavior and modifications shown to these adverse abiotic factors during different phenological phases of the crop. However, the ancestral Andean cultures have made environmental modifications such as the *andenes*, *warus*, *cochas*, *canchas*, harvesting and sowing of water and others as part of the Andean ancestral knowledge and knowledge to counteract, adapt and better mitigate these harmful effects of the climate and produce healthy, supernutritious food in such conditions supported by the use of biological climate indicators based on the valuable Ibero-American seeds that are currently being researched in the Ia ValSe-Food project.

Acknowledgements. This work was supported by the Escuela de Posgrado de la Universidad Nacional del Altiplano, Puno, Peru.

# The role of artificial intelligence in ecosystem conservation

Franci Suni-Lopez

Universidad de Lima, Peru

Artificial Intelligence (AI) has become a highly valuable tool for the conservation of vulnerable ecosystems, enabling new ways to analyze, monitor, and manage natural resources. This presentation focuses on demonstrating how AI methods are being applied to protect biodiversity and mitigate the effects of climate change, with a particular emphasis on specific studies in the Peruvian Amazon and across Latin America. The first case addresses the problem of deforestation in the Peruvian Amazon using image processing techniques with historical satellite imagery. This methodology allows for the detection of subtle changes in forest cover from year to year. The second study focuses on the classification of urban areas in Costa Rica, where satellite images and labeled datasets provided by local researchers were used. This research aims to train a classifier model capable of identifying changes in land use, particularly following natural disaster events. Both studies showcase the potential of AI not only to monitor and assess the state of ecosystems but also to predict and mitigate future damage. These AI applications enable detailed, real-time analysis of landscape changes, providing environmental managers and decision-makers with advanced tools to protect our most valuable ecosystems. This synergy between technology and conservation paves a promising path to address the environmental challenges of the 21st century, demonstrating that AI is not just a technical resource but also a crucial ally in preserving our natural environment.

Acknowledgements. This work was supported by the Artificial Intelligence Laboratory, Universidad de Lima, which provided advanced technological resources for the research activities.

# Impact of accelerated aging on lipid reserves, physiological and biophysical behavior in chia (*Salvia hispanica* L.) seeds

María Emilia Rodríguez[a,d], Ethel Pérez[b], Aline Schneider-Texeira[c], Lorena Deladino[a], & Vanesa Y. Ixtaina[a, d]

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The accelerated aging test is crucial for evaluating seed quality and longevity, simulating adverse storage conditions to assess conservation potential. This study investigated the effect of accelerated aging on the physiological, biochemical, and biophysical aspects of chia seeds. The accelerated aging revealed notable stress tolerance in white (WN) and mixed (MN) chia seed genotypes. Germination power decreased from 100 % to 0 % over 56 days, with reductions in radicle and hypocotyl length, increased abnormal seedlings, and dead seeds. Regarding seed lipid fraction, peroxide content significantly increased, ranging from 1.81 to 6.50 meq/kg for WN and 0.85 to 3.22 meq/kg for MN genotypes. Free fatty acids rose considerably, from 0.41 % to 2.95 % oleic acid for WN and 0.40 % to 3.18 % for MN. Total tocopherol content significantly decreased in both genotypes, altering the balance between pro- and antioxidant processes. Also, an increase in saturated fatty acids and a decrease in unsaturated ones were recorded. These changes compromise the membrane fluidity and permeability, reflected in increased electrical conductivity, ranging from 129.26 to 399.25 $\mu Scm^{-1}g^{-1}$ for WN, and 177.06 to 500.81 $\mu Scm^{-1}g^{-1}$ for MN. The DSC technique provided consistent information about these changes. Regarding FTIR analysis, two components distinguished aged from non-aged genotypes, accounting for 91 % of the variability. Vibrations at 3010, 2928, and 720 $cm^{-1}$, linked to lipids, enabled rapid detection of deterioration. These findings highlight the impact of oxidative stress on the viability and quality of chia seeds.

Acknowledgements. This work was supported by a Ia ValSe Food-Cyted (Ref. 119RT0567) grant, Universidad de Lima, Peru; Agencia Nacional de Promoción Científica y Tecnológica (ANPCyT) PICT 2020-00191; Universidad Nacional de La Plata (UNLP) (Proyecto X-901).

# Environmental impacts on the molecular determinants of quinoa seed nutritional quality

María Reguera[a], Isaac Maestro-Gaitá[a], Javier Matías[b], María José Rodríguez[c], Patricia Calvo[c], Miguel Redondo Nieto[a], Verónica Cruz[b], Laura Poza Viejo[a], Sara Granado Rodríguez[a], Sara González Bodi[d], José María García Mina[e], Ángel María Zamarreño[e], Gabriel Hassinger[a], & Luis Bolaños[a]

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The increasing occurrence and intensity of extreme weather events driven by global climate change are posing significant risks to crop growth and food production worldwide. High temperatures and water shortages, especially in regions like the Mediterranean, are expected to profoundly affect food security. Quinoa, known for its resilience to harsh conditions and the exceptional nutritional value of its seeds, has gained prominence globally. Despite its nutritional importance, the factors influencing the nutrient composition of quinoa seeds under various environmental conditions are not fully understood. This study hypothesizes that the adaptation of crops to environmental changes, such as water deficits and high temperatures, significantly affects seed nutritional properties, with plant-associated microbiota playing a crucial role. The research identified and characterized diverse metabolic and genetic pathways that regulate the nutritional qualities of quinoa seeds. Utilizing a multidisciplinary approach that includes plant physiology, molecular biology, genomics, and metabolomics, we investigated the phenotypic and molecular changes in different quinoa cultivars under varying environmental conditions. The results of this study are expected to provide insights into the complex molecular, regulatory, and signaling pathways that control source-sink interactions, thereby influencing the nutritional value of quinoa.

Furthermore, the findings could lead to the identification of genetic and molecular

markers linked to quality traits in quinoa. This knowledge will aid in developing quinoa cultivars that are better adapted to Mediterranean conditions, thereby improving their quality and competitiveness in both national and international markets.

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# Unity makes us stronger: Lessons in agriculture

Susana Vilariño Rodríguez & Monica Fernández Aparicio

Algodonera del Sur S.R.L., Seville, Spain

The challenge of producing food in the context of continuous climate change can only be faced with the implementation of new, resilient crops with high nutritional value. That is why, in 2011, we began to study the adaptation of quinoa varieties, fertilization, crop cycles, planting times, and intercropping with different species —in general, everything related to the agrotechnics of the crop. All this was done in collaboration with prestigious Spanish and international research centers and universities. Furthermore, in parallel, we studied the processes for the benefit of the seed and developed the analysis of critical points to establish quality standards and obtain the corresponding certificates. The result has been the creation of a profitable and efficient production system, which allows average yields of 4 t/ha and has placed Spain at the epicenter of quinoa production in Europe.

Acknowledgements. This work was supported by Algodonera del Sur SA, Seville, Spain, and the collaboration of Instituto de Agricultura Sostenible, Consejo Superior de Investigaciones Científicas, Spain.

# SESSION II

FOOD TECHNOLOGY AND INNOVATION.
BIODIVERSITY AND TRENDS.
SUSTAINABLE FOOD WASTE
MANAGEMENT

# Andean crops: Traditional and novel uses

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Quinoa (*Cheopodium quinoa*), kañiwa (*Cheopodium pallidicaule*), kiwicha (*Amaranthus caudatus*) and tarwi (*Lupinus mutabilis*) are native crops from the Andes highlands of South America. They play a key role in local diets due to their high nutritional value and adaptability to harsh environmental conditions. They are traditionally used in different culinary preparations such as soups and stews, as well as milled to flour. Quinoa and tarwi contain bitter compounds that require removal prior to consumption. As global consumption patterns increasingly favor healthier and environmentally sustainable foods, there is an important market potential for novel applications of Andean grains. In the first part of our research, we studied the effect of the partial or total substitution of wheat flour with Andean grain flours on the nutritional and technological properties of bakery products. In the second part of our research, we studied the effect of ultrasound technology on the techno-functional properties of proteins and fiber of tarwi. Due to its high protein and oil content (approx. 40%, and 20% respectively), tarwi is an excellent ingredient for protein isolate and the oil industry. After protein and oil extraction, the remaining residue ("okara") still contains proteins and fibers. We studied the use of tarwi okara in food emulsions and found that this ingredient has very interesting techno-functional properties. In conclusion, ancient Andean grains are promising novel ingredients in the bakery industry, as partial or total substitutes for wheat flour, and Andean lupin could be used as a natural emulsifying and stabilizing agent.

Acknowledgements. This work was supported by Consejo Nacional de Ciencia, Tecnología e Innovación Tecnológica, Peru, through the Prociencia Program, as part of Contest E041-2023-01 [Contract Nº PE501082513-2023-Prociencia].

# Innovation in nutraceutics: Nanoencapsulation of active ingredients

Alex Alvino

Merck Peru

The field of nutraceutics is undergoing a transformative evolution with the advent of nanoencapsulation technologies, offering promising solutions for enhancing the stability, bioavailability, and efficacy of active ingredients in functional foods and dietary supplements. This talk will explore cutting-edge advancements in nanoencapsulation, focusing on its potential to revolutionize the delivery of nutraceutical compounds. Nanoencapsulation involves incorporating active ingredients into nanocarriers, such as liposomes, polymeric nanoparticles, and nanoemulsions, which protect bioactive compounds from degradation and control their release. This technology addresses critical challenges in nutraceutics, including poor solubility, limited absorption, and rapid metabolism of active ingredients. By enhancing the bioavailability of vitamins, antioxidants, polyphenols, and other bioactives, nanoencapsulation can significantly improve their health benefits. The presentation will delve into various nanoencapsulation techniques, highlighting their mechanisms, advantages, and applications in the food industry. Special emphasis will be placed on Sigma-Aldrich technologies that are leading the way in this innovative field. Case studies will illustrate successful implementations of nanoencapsulation in enhancing the stability and bioavailability of specific nutraceuticals. Additionally, the talk will cover the regulatory and safety aspects of using nanotechnology in food products, ensuring innovations meet stringent food safety and consumer acceptance standards. Attendees will gain insights into the latest research and developments, understanding how nanoencapsulation can create next-generation nutraceutical products, paving the way for healthier and more effective functional foods.

Acknowledgements. This work was supported by Merck Life Science Latam.

# Strategies for the sustainable and integral use of quinoa and tarwi grains

Darío Marcelino Cabezas

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Food industry has undergone a significant innovation process, assisted by the implementation of ingredients derived from different plant sources. In this regard, alternative grains (pulses, pseudocereals, ancient grains, and small grains, etc.) have gained popularity due to their nutritional benefits and novel techno-functional properties. In accordance with this, different ingredients with elevated protein content (isolates and concentrates) have been developed from these grains. This process yields a residue rich in polysaccharides and high molecular weight proteins (okara and bran fractions). These byproducts, not utilized industrially, can be modified through emerging technologies like sonication to enhance their techno-functional properties. In this scenario, the objective of our research lines is to enhance the utilization of by-products derived from the industrial processing of quinoa (*Chenopodium quinoa Willd*) and tarwi (*Lupinus mutabilis*), thereby facilitating their potential incorporation into the formulation of various food matrices. The use of High-Intensity Ultrasound (HIU) enabled the extraction of insoluble fractions (okaras) from tarwi and quinoa, with compositional (protein and fiber contents) and conformational alterations, enhancing their emulsifying characteristics (minimize particle size, delay creaming and coalescence processes). Additionally, the application of HIU to quinoa bran enhanced the extraction of saponins and the emulsifying attributes of this byproduct. Finally, sonicated tarwi okara was used as an improver of technological quality in gluten-free bread, with volumes, crumb softness, and alveolar structural features comparable to a control that employs xanthan gum. Byproduct of quinoa and tarwi could be utilized as innovative additives, including its potential application in the emerging plant-based food market.

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# Production of kefir powdered milk beverage based on probiotic bacteria enriched with tarwi, kiwicha, and quinoa

N. N. Trujillo, N. A. Chasquibol, & S. P. Ponce

Carrera de Ingeniería Industrial, Facultad de Ingeniería, Universidad de Lima

The production of functional foods has gained increasing attention due to its health benefits and ability to improve the quality of life. Kefir is a fermented milk-based drink that contains a combination of beneficial bacteria and yeast. This work aimed to develop an alternative product based on kefir that also provides high nutritional value. The kefir powder dairy drink *(kefiranofaciens)* enriched with native ingredients such as tarwi *(Lupinus mutabilis)*, kiwicha *(Amaranthus caudatus)* and quinoa *(Chenopodium quinoa)*, offers a sustainable and nutritious option contributing to diet diversification. The resulting formula, developed with these ingredients, shows a high protein content (37.92 ± 0.02 g/100 g), outperforming commercial powdered milk products (25 g/100 g), generating a nutritional gap of 48% of the protein value. Other parameters were also determined such as ash 0.001 ± 0.0002 g/100 g, moisture 1.84% ± 0.02 g/100 g and water activity 0.86 ± 0.01. Several stages of experimentation were carried out, including the selection and cultivation of probiotic bacteria, the integration of native ingredients, and the freeze-drying process to preserve the viability of the microorganisms. This research aims to formulate a powdered milk drink with a higher protein content by adding tarwi, kiwicha, and quinoa.

Acknowledgements. This work was supported by Universidad de Lima, Peru.

# Comparative study of oil and residual cake properties from white, red, and black quinoa germs produced by wet and dry milling

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Quinoa seeds known for their nutritional value and beneficial bioactive compounds, have a high content of proteins and lipids. Processes such as dry milling, which focuses on the recovery of the anatomical parts of the grain (flour, bran and residues) and wet milling which offers the separation of the chemical components (starch, fibre, lipids and proteins) in fractions with great purity, can be applied to this grain with great efficiency. A factorial design $3^2$ was used to study the effect of quinoa variety and milling on the yield of germ-rich fractions, as well as the characteristics of oils and defatted residues. The independent factors were: A. Quinoa variety levels: white, red and black; B. Milling Process levels: whole flour (control), wet milling and dry milling. The quinoa oil was extracted from the whole flour, the whole germ from the wet milling and the residues from the dry milling using hexane solvent. The physico-chemical oil characteristics studied were: acidity index, refractive index, density, iodine index, saponifiable and unsaponifiable matter. Subsequently, the fatty acid composition was determined by CG-MS. In addition, the residual cakes were characterized in terms of proximate composition. The oil production from the germ obtained by wet-milling showed the highest yield, whilst the oil extracted from the residues displayed increased turbidity. The quinoa oils had similar characteristics to other commercial oils (density: 0.893-0.939 g/ml: saponification index: 172-192 mg koh/g; iodine index: 123-130 g i2/100g; refractive index: 1.473-1.476), with higher values of unsaponifiable matter (34.7-40.1 g/kg), and an increased amount of squalene in all oils. Similarly, linoleic acid (C18:2) was identified also in a higher quantity (51.3-59.4 %). Finally, the residual cake, which could contain up to 58.4% protein, could serve as an excellent ingredient to enhance food formulations.

Acknowledgements. The authors want to thank Universidad de Lima and the contract of Ana Ribera Castelló from the Investigo Program within the framework of the Recovery, Transformation and Resilience Plan – Government of Spain, in the Generalitat Valenciana. The accreditation of IATA-CSIC as Center of Excellence Severo Ochoa CEX2021-001189-S funded by MICIU/AEI /10.13039/501100011033 is also fully acknowledged.

# Development of a plant-based beverage with tarwi (*Lupinus mutabilis*), polysaccharides from cushuro (*Nostoc sphaericum*), and blueberries

Santos Calderón & Mauricio Bañón

Carrera de Ingeniería Industrial, Universidad de Lima, Peru

Plant-based or non-dairy milk alternatives are a fast-growing niche in the functional beverage development. Market research reveals that there has been upsurge demand for plant-based protein products by vegans and lactose intolerant groups. However, commercial plant-based beverage contain less than 1.5 % of protein and use colorants and commercials additives. Tarwi is native to the Andean regions of Peru, Bolivia, and Ecuador and has a very high protein (45 % ± 0.8) and oil content (14–24 %), as well as calcium, fiber, iron, and zinc, and does not contain gluten. Blueberries have an attractive flavor and color, and offer health benefits and cushuro is a microalgae with high protein (35 % to 42 %) and polysaccharides content (42 %). The objective of this research was to develop a plant-based beverage with tarwi (*Lupinus mutabilis*), polysaccharides from cushuro (*Nostoc sphaericum*) and blueberry extracts (*Vaccinium corymbosum*), compared with a control sample with carboxymethyl cellulose (CMC), a common thickening agent. The beverage was optimized and characterized using a design of rotatable central composite of surface methodology with nine formulations and four repetitions in center point. The effects of three independent variables were examined: tarwi milk (1g water / 3 g tarwi) (45 % to 55 %) content and polysaccharides from cushuro (0.05 % to 0.2 %) content. The variable blueberry extracts content serving as the differential factor between these two conditions. The response variables were protein (%) content and viscosity coefficient (mPa·s). The optimized beverage showed high protein (2.7 %) content, viscosity coefficient (23.05 mPa·s), Brix (2.5), pH (4.68) and acceptable sensory attributes using a 1-to-9-point hedonic scale with 67 % positive acceptance. This powdered beverage complied with the Peruvian normative NTP 203.111.2021. Thereby, the plant-based beverage could be a nutritious alternative to functional plant-based beverages.

Acknowledgements. This work was developed at Laboratorio de Alimentos Funcionales, Carrera de Ingenieria Industrial, Universidad de Lima, and supported by Universidad de Lima

# Enhancing the nutritional value of fresh pasta by incorporating protein- or fibre-rich chia by-products from defatted flours

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Chia seeds offer a significant potential for enhancing food formulations due to their high nutritional value. This study aimed to explore how the inclusion of chia seeds, whole chia flour, and chia by-products from oil extraction (fibre-rich (CF) and protein-rich fractions (CP)) influences the nutritional and technological quality of fresh pasta. Five formulations were produced: four with a partial substitution of wheat flour for each chia ingredient (seeds, whole flour, CF and CP) at 10 %, and a control (wheat flour). Chia by-products were found to contain adequate lysine levels for adults (1.24 and 2.33 g/100g of sample, in CF and CP, respectively), suggesting that their inclusion in food matrices would enhance the concentration of this essential amino acid, which is often limited in cereal products. Although pastas with CF and CP provided higher amounts of Ca (41.6 and 41.3, mg/100 g, respectively), Fe (0.99 and 1.29, mg/100 g, respectively), and Zn (0.37 and 0.54, mg/100 g, respectively) compared to the control (Ca: 11.4, Fe: 0.94, Zn: 0.28, mg/100 g), an increased inhibitory effect on mineral absorption was predicted due to the high phytic acid content in these fractions according to threshold molar ratios (phytate/mineral). Supplementation with chia ingredients would not only improve the nutritional value of food matrices in terms of soluble fibre and/or proteins with high biological value, but also facilitate the revaluation of oil extraction chia by-products. Moreover, from the perspective of identifying new plant-based proteins, CP could serve as a promising alternative to animal protein.

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# Development and characterization of Andean pseudocereal bars enriched with native collagen from pota (*Dosidicus gigas*) by-products

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In recent years, consumers have been increasingly concerned about their health. Therefore, the snack market is rapidly developing more innovative and functional products such as cereal bars. Quinoa (*Chenopodium quinoa*) and kiwicha (*Amaranthus caudatus*) are Andean pseudocereals with protein (10.90% - 11.35%) content and other functional components that reduce the risk of cardiovascular diseases and inflammatory illnesses. Peru is the world's second largest exporter of pota (*Dosidicus gigas*) with 476,5 million metric tons in 2023, however, only between 50% and 70% of it has been taken advantage of. Pota by-products such as skins, viscera and necks have significant protein content (70%) and are discarded. In this investigation, cereal bar formulations with pota by-products and Andean pseudocereals were optimized and characterized using a five-run simplex centroid mixture design. The effects of three independent variables were examined: collagen (2% - 8%) and binder (22% - 28%) on the sugar (%), protein (%) and antioxidant (µg Trolox/ g dry weight, dw) content as response variables. The optimized cereal bar (M6) showed high protein (21.27±1.51%) content, moisture (10.37±0.04%), ash (2.57±0.03%), fat (15.12±0.15%), carbohydrates (53.67±1.70%), total polyphenol (1570±267 µg Gallic acid equivalent /g dw) content, antioxidant activity (1656±77 µg Trolox/g dw) content, essential aminoacid - leucine (15.65±1.83 mg/g protein) content and higher *in vitro* digestibility (78.78 ± 1.40 %) than the control sample. The cereal bar had a positive sensory acceptability (aroma, color, taste, and texture) (88.89%) and complied with the Peruvian standards NTP-302 (2022) and Law No. 30021 (Law for the Promotion of Healthy Eating for Children and Adolescents, 2013). The functional bar emerges as a nutritious alternative in the food industry, which could serve as a preventive measure against non-communicable diseases and catering to the growing demand for healthier and more functional products. Furthermore, it proposes a sustainable solution using pota by-products, fostering a circular economy.

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# Hydrolysates and peptides with antimicrobial activity from kañihua (*Chenopodium pallidicaule* Aellen) Ramis and Cupi-Sayhua varieties

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Kañiwa (*Chenopodium pallidicaule* Aellen) cultivated in the Peruvian and Bolivian Altiplano has a high protein content. The objective was to obtain hydrolysates and antimicrobial peptides (AMPs) from kañihua Ramis (KR) and Cupi-Sayhua (KS) varieties. Methodology: Enzymatically hydrolyzed protein fractions were obtained, the inhibition of microbial growth was evaluated by spectrophotometry and diffusion in *Escherichia coli* (*E. coli*), *Staphylococcus aureus* (*S. aureus*) and *Candida albicans* (*C. albicans*) agar, and the hydrolyzed protein fractions were purified and characterized electrophoretically. Results: 216 hydrolysates were obtained from simulated *in vitro* pepsin-pancreatin digestion with degrees of hydrolysis (DH) values of 7-67 % compared to Alcalase of 13-54 %, where the majority were extensive ($p \leq 0.05$). Thus, 28 hydrolysates presented percentage inhibition (PI) ≥ 45 % for *E. coli*, *S. aureus*, and *C. albicans* ($p \leq 0.05$) compared to the controls. Three *in vitro* simulated digestion peptides were Glob 11S KS 2 h (1:50) with IP 75 %, 47 %, and 33 % for *S. aureus*, *E. coli*, and *C. albicans*, respectively; Glut KS 2 h (1:10) with IP 79 %, 56 % and 41 % for *E. coli*, *C. albicans*, and *S. aureus*; and Glut KS 4 h (1:10) with anionic loading showed PI for *C. albicans* of 70 %, *S. aureus* of 52 %, and minimum inhibitory concentration (MIC) of *E. coli* of 95 % ($p \leq 0.05$ ). The Alcalase Glob 7S KR 9 h (1:10) showed IP 54 %, 52 %, and 19 % for *E. coli*, *S. aureus* and *C. albicans*. Conclusions: Hydrolysates and AMPs from kañihua can be used as nutraceuticals, bio-preservatives, and novel ingredients in food design.

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# Protein hydrolyzed from sacha inchi (*Plukenetia huayllabambana*) press-cake: A new functional food ingredient

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Sacha inchi (*Plukenetia huayllabambana*) (SIPH) grows in the province of Rodriguez de Mendoza, Department of Amazonas, Peru. Sacha inchi oil contains high amounts of polyunsaturated fatty acids (PUFA), like α-linolenic acid (ω-3; 55.62 % to 60.42 %), tocopherols and sterols. PUFA could prevent metabolic diseases. The press-cake from SIPH has high amounts of proteins (39 %), which makes it highly desirable for industrial use due to the value-added products. The objective was to study nutritional and functional properties of the protein hydrolyzed (PH) from SIPH defatted press-cake (DPC). The hydrolysis conditions were time (1h), temperature (50 °C), pH (8), and enzyme alcalase 2.4 L (0.3 AU/g protein). The effects of these independent variables were examined on the degree of hydrolysis (DH %) as a response variable. The hydrolysates showed a DH (24.67 %), yield (29.4 %), higher protein (63.21 %) content more than DPC (48.31 %), lower lipid (0.05 %), higher ash (9.72 %) content compared to DPC. The hydrolysis process allowed to solubilize fiber and digestible carbohydrates, such as sugars. The PH showed higher protein solubility (98.43 %) at pH=8 than DPC (39.45 %). Also, the PH presented better techno-functional properties: foaming capacity (40.87 %), emulsifying capacity (21.25 %), higher solubility (99.0 %), and *in vitro* digestibility (73.26 %) than DPC. The PH showed higher amount of amino acids: arginine (89.64 mg Amino Acid/g Proteins), aspartic (63.69 mg Amino Acid/g Protein. /g.s), glutamic (60.12 mg Amino Acid/g Protein. /g.s), leucine (56.4 mg Amino Acid/g Protein. /g.s), and valine (37.7 mg Amino Acid/g Protein. Key/g.s), with higher antioxidant activity than DPC. The PH from sacha inchi DPC could be used as plant-based protein additive in different food and protein supplements.

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# *Moringa oleifera* pods: A plant part with great potential for food applications

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The effects of climate change in the Mediterranean basin are more than evident, with a reduction in precipitations and a continuous increase in the average annual temperature. As a result, traditional irrigated crops are compromised, struggling with these new environmental conditions and prompting the search for new ones with minimal water requirements and high temperature resistance. In this regard, *Moringa oleifera*, a plant native to southern India, stands out as a great alternative, be it for growing in a similar climate or for all its parts being edible with a high content of micro and macronutrients. Having such promising advantages, different parts of Moringa pods are characterized in this work. On one hand, the variation in the physicochemical properties, protein content, total antioxidant capacity and phenolic profile of *Moringa oleifera* pods at two stages of maturity were evaluated after boiling them at 100 °C for different lengths of time. The results obtained show that boiling could contribute to an improvement in the organoleptic properties of moringa pods and an extension of their storage and wider availability on the market. Additionally, oil was extracted from the seeds using a screw press at different temperatures, analyzing its quality parameters and fatty acids profile. The Moringa seed oil was found to contain high levels of unsaturated fatty acids, especially an Ω-9-fatty acid, oleic acid, with a content up to 77.8 %. Finally, the residue obtained after extraction was analyzed, characterized by its high content of proteins and antioxidants, making it an interesting ingredient to enrich food matrices.

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# Morphological, chemical and rheological characterization of Andean grain and tuber starches

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The crops produced in northern Argentina have the potential to be transformed into higher-value products or to be used as ingredients in food production. The major component of many of them is starch. The technological applications of the extracted starch and the flours that contain it determine their techno-functional properties, which are associated with the morphological structure and composition of the starch granules. This work aimed to characterize chemically, morphologically, and rheologically starches from legumes, tubers, and Andean grains. The raw materials were maize (capia and bolita varieties), potatoes (moradita, colorada, and Santa María varieties), and oca (amarilla variety). Starches isolated by chemical methods were analyzed, their chemical composition was determined, the morphology was evaluated by optical and fluorescence microscopy, and rheological properties by dynamic oscillatory test. The chemical composition of starches differs according to the species; significant differences in the size of granules were also observed by microscopy, the largest corresponding to oca. The starch granules showed differentiated internal structures depending on the species, such as growth rings, channels, and distribution of amylose and amylopectin within the granule. Tuber starches showed higher values in swelling power, and were statistically different in respect to maize and beans. About solubility, there were statistical differences between moradita potato starches and those of both types of maize. The oscillatory tests showed that the gels differ in strength (K') and type of molecular interaction (z'), indicating that the bean starch gels were the ones with the greatest strength and least dependent on the angular frequency, while z' indicated that in the starch gels of capia maize, colorada and moradita potatoes, physical interactions would predominate. Knowing the properties of starches allows us to predict their behavior and deduce possible applications in the food industry.

# Chia mucilage: Promising raw material for the development of edible packaging

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Chia mucilage is a gel obtained by soaking chia seeds in water. This gel comprises a mixture of xylose, glucose, and glucuronic acid and constitutes 6% of the seed. Due to its appropriate techno-functional properties, such as high emulsifying capacity, foam stabilizer, binder, and thickener, it is an excellent polymer for packaging development. Chia mucilage was used to develop a soluble and edible coffee bag, with the potential to dissolve at high temperatures in 1 min and biodegradability of 1 h in seawater and 40 days in soil. In addition, this biopolymer can be used as an auxiliary agent in the formation of packaging with industrial waste. Stick-type bale waste films were formulated with chia mucilage and the mechanical and structural characteristics were improved by the addition of the polymer. Another highlight is the use of chia mucilage in the formation of oral disintegrating films indicated for patients with swallowing problems. These films help transport bioactive compounds, such as vitamin C, and guarantee the action of vitamin C when stored for 35 days. Therefore, this biopolymer presents an excellent promise for the development of biodegradable and edible packaging, reducing environmental pollution caused by the inappropriate disposal of plastic packaging.

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# Changes in the chemical composition and bioactive compounds of quinoa seeds by germination

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This research aimed to evaluate the changes that occur in the composition of macronutrients and soluble compounds of quinoa grains at different germination times. The seeds were soaked in water, drained, and then germinated in mono layers inside closed containers during 12, 24, 48 and 72 hours and the germination was stopped by drying. Total solids, proteins, sugars, amino acids, fatty acids, in vitro protein digestibility and, antioxidants, in flours and soluble extracts were measured. Total soluble solids increased during the first hours of germination and decreased after 48 hours. Gradual reduction of carbohydrates is verified during the germination time; with a concomitant increase of protein and lipids content. while total minerals did not show modifications. The concentration effect due to metabolized carbohydrates seems responsible for the 33% rise in protein content after 72 h sprouting, but it is not enough to explain the almost 100% lipid increase for the same period. In general, amino acids, unsaturated fatty acids and antioxidants are raised during germination as well as protein bioavailability, constituting a good resource for food and food ingredients, intended for the general public, celiac, children, athletes, and elderly people.

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# Acceptability of tortillas and tamales with added sprouted chia flour

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Corn (*Zea mays*) is an ancestral food, culturally included in different forms in the Guatemalan diet. The most common form is in tortillas and tamales, which makes them suitable for incorporating other ingredients that increase their nutritional content. A sensory study was conducted with the aim of determining whether the appearance and texture of the tortillas and tamales remains acceptable when adding germinated chia seed flour (*Salvia hispanica L*). Germination was carried out for one day at 20 °C; it was prepared as flour and mixed with nixtamalized corn flour in a ratio of 10:90, and enough water to mold the tortillas; for the tamales, the same proportion of corn flour and germinated chia flour was used, water and 8.6 percent oil were added. The tortillas and tamales were prepared and cooked in a traditional way by experts. For the acceptability test, 52 real consumers were recruited, who signed the informed consent and subsequently evaluated the appearance and texture using a five-point hedonic scale (1 = I like it very much, 5 = I dislike it very much). The results indicate that the average acceptability of the appearance of the tortillas is 1.92 and the texture is 1.87. The average acceptability of the appearance of the tamales is 1.57 and the texture is 1.19. When comparing the acceptability of the appearance and texture of both preparations, a significant difference was found ($p < 0.05$), with the appearance and texture of the tamales being more acceptable.

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# Study of the rheological and structural properties of a cassava starch bread dough modified with alpha amylase and calcium lactate in partial substitution with lupine flour

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Bread made with cassava starch modified with alpha-amylase and calcium lactate lacks proteins and lipids, limiting its nutritional value. The addition of legumes such as lupine flour (LF) could enrich its nutritional value. The objective of this study was to evaluate the rheological and structural properties of a bread dough based on modified cassava starch (CS) with alpha amylase (AA) and calcium lactate (CL) and with partial replacement of lupine flour (LF). In this study, CS (*Manihot sculenta crantz*) of the variety INIAP 651 and LF (*Lupinus mutabilis Sweet*) were assessed. The CS was modified with AA 6 U/g and CL 6 mg/g and partial substitutions were made with LF (0, 5, 10, 15, 20 %) to obtain bread doughs. The specific volume (SV) of bread and Mixolab parameters: starch gelatinization (C3), amylolytic activity (C4) and starch retrogradation (C5) decreased with increasing HC, respectively, from 6.38 to 2.54 g/cm$^3$, from 1.11 to 0.72 Nm, from 1.06 to 0.67 Nm and from 1.34 to 0.92 Nm. The correlation coefficient between C3 and SV was 0.91 and between C5 and SV was 0.94. Absorbance ratios by FTIR at 1041/1014.5 cm-1 and 994.1/1014.5 cm-1 representative for molecular order and crystallinity, showed values from 0.64 to 0.72 and from 0.87 to 1.29, respectively. Molecular order values increased as substitution increased. Amylose content was 8.28–16.79 % for treatments with 0–20 % of substitution with HC. By synergizing the results of rheological and structural properties, a maximum substitution with HC can be made up to 10 %.

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# Development of hydrogel-type jam with chia (*Salvia hispánica L.*), blueberry (*Vaccinium sp.*) and cushuro (*Nostoc sphaericum*)

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In Peru, overweight and obesity affect 20 %-38 % of adults, increasing the risk of NCDs (type 2-diabetes, heart diseases, and others); a situation that emphasizes the need for healthy foods. Chia (*Salvia hispanica L.*) seeds contain high amounts of polyunsaturated fatty acid essentials (omega-3) (17 %-23 %), antioxidants, proteins and minerals, that prevent the NCDs. Chia grows in the regions of Arequipa and Puno in Peru, with a 4,098 tn of production in 2023. The chia mucilage is a soluble fiber with high water holding capacity that possesses techno-functional properties that would improve the properties of gelification and emulsification of foods: jams, ice-cream, yogurt, and others. Peru holds the world's first blueberry (*Vaccinium corymbosum*) exporter. This berry contains antioxidants and flavonoids. Cushuro (*Nostoc sphaericum*) is a gelatinous spherical blue-green alga that grows over 3000 masl on the Peruvian highlands and has good protein and polysaccharide contents. The work aimed to develop four hydrogel-type jams with chia mucilage (0.05 %-1.00 %) blueberries (36 %-40 %), and fresh cushuro (54 %-60 %), compared with a control sample containing pectin and sugar. The characterization of the hydrogel-type jams was: moisture (76.81±2.63 %), ash (0.185±0.05 %), protein (0.925±0.12 %), total carbohydrates (21.88±2.85 %), fat (0.195±0.05 %), antioxidants (247.92±99.9 mg Trolox/g), and phenolics content (2.35±0.11 mg GAE/g ms). Then, four weeks of storage, the Brix (17.40±10.61), viscosity (2950.63±1373.19), pH (3.12±0.02) and water activity (0.82±0.5) complied with the Peruvian applicable legislation (NTP 203.047) and healthy food legislation (Law 30021). The jam's validated functional properties could help reduce the percentage of NCD, promoting the food industry with healthy products.

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# Development of instant puree from native potatoes (*Solanum andigenum*) and black mashua (*Tropaeolum tuberosum*) fortified with black quinoa (*Chenopodium quinoa*)

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Peru's Andean region grows a diversity of seeds and tubers with high nutritional value and health benefits. Nevertheless, chronic malnutrition and obesity emphasize the need to take advantage of our agricultural wealth to improve public health and ensure sustainable development. The aim of this study was to develop an instant puree with native potatoes *(Solanum andigenum*) and black mashua *(Tropaeolum tuberosum)* fortified with black quinoa (*Chenopodium quinoa)*. This study employed a simplex centroid mixture design. The proximal composition of the three formulations developed were: moisture (9.37±0.13 % to 9.45±0.06 %) content, ash (3.35±0.01 % to 3.79±0.01 %) content, protein (8.9±0.1 % to 13.05±0.36 %) content and total carbohydrates (70.9±0.5 % to 75.1±0.5 %). Samples showed significantly higher antioxidants (6128±126 µg trolox/g dry matter (d.m.) to 15468±307 µg trolox/g d.m.), and phenolics (3444±241 µg gallic acid equivalent (GAE) /g d.m. to 5803±597 µg GAE/g d.m.) content than the control sample. Also, the results of the techno-functional properties of the samples were: Water absorption capacity (3.56±0.92 g H2O/g to 3.95±0.07 g H2O/g), solubility (14.45±0.07 % to 16.79±0.01 %) and *in vitro* protein digestibility (71.20±0.05 % to 72.14±0.03 %). The samples presented an adequate balance of amino acids compared to the control sample. Sensory characteristics were determined in fresh pure and rehydrated powders. Therefore, in a fast-paced world where convenience food options are part of a continuously expanding market, a nutritionally improved instant puree from ancestral crops is not only more nutritious and tastier but also contributes to sustainability and promotes culinary diversity.

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# Development of food hydrogels with Andean purple corn (*Zea mays* L.) extracts and cushuro (*Nostoc sphaericum*) polysaccharide: Rheological characterization

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Andean purple corn (*Zea mays L.*) is a ancient native Peruvian crop frequently used in Peruvian cuisine. Cushuro is a cyanobacteria from the Andean lakes of Peru. They have considerable amounts of bioactive compounds that can improve the physicochemical properties of foods. The objective of this research was to characterize the rheological and functional properties of food hydrogels developed with purple corn extracts, red prickly pear fruit pulp and cushuro polysaccharide (CP). Acid-soluble polysaccharides obtained from the *Nostoc sphaericum* variety, from Ancash, Peru, as well as Peruvian purple corn extracts were used. Food hydrogels at concentrations ranging from 0.5 % to 3.5 % (w/v) were elaborated by dispersing the polysaccharides in a 4:1 extract: pulp (v/v) ratio. Likewise, control samples with tara (*Caesalpinia spinosa*) gum (TG) were made. The effect of hydrocolloid concentration (0.5; 1.5; 2.5; 3.5 %) on the rheological properties was evaluated using a unifactorial design. CP and TG hydrogels exhibited shear-thinning nature, a concentration-dependent yield point (0.02 – 29.91 Pa; 2.01 – 508.39 Pa) and high antioxidant activity and phenolic content with no syneresis. Adding CP revealed thixotropic behavior with slow structural regeneration, while TG showed no thixotropy and a symmetric hysteresis loop. CP gels showed a fluid-like structure with viscoelastic properties (G”>G’) even in the highest concentration evaluated (3.5 %), contrary to TG gel that had a more solid (gel-like) structure (G’>G”) at a low concentration (1.5 %). These results showed a suitable rheological profile and desirable properties of the food hydrogels development for the functional food industry and processing.

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# SESSION III

## NUTRITION AND HEALTH PROMOTION. POLITICAL AND SOCIOECONOMIC PERSPECTIVES

# Phytates in Latin American seeds: Strategies to minimize their nutritional impact and positive health outcomes

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Phytic acid (or phytate), found in grains, legumes, and seeds, affects the bioavailability of essential minerals. In Latin America, where these foods are staple, phytic acid can significantly impact nutrition and public health by binding minerals like iron, zinc, and calcium, and reducing their absorption. This is crucial in regions with cereal- and legume-based diets, where deficiencies in these minerals can affect bone health, immune function, cognitive development and contribute to iron deficiency anemia. To counteract these effects, several strategies can be used during food preparation. Fermentation enhances phytic acid breakdown through microbial activity or endogenous phytase activation by lowering pH. Similarly, germination or sprouting can reduce phytic acid content as can soaking grains and legumes before cooking. Phytases break down phytic acid into lower myo-inositol phosphates and free phosphates, thereby improving the mineral availability in food products. This can be particularly useful in feed processing and food manufacturing. Another method less effective is extrusion, a high-temperature and high-pressure processing technique that can reduce phytic acid content and improve the nutritional profile of foods. On the other hand, lower myo-inositol phosphates, as products of phytic acid hydrolysis, not only enhance the bioavailability of essential minerals but also have positive effects on the regulation of key cellular functions, metabolism, and bone health. Their presence in a diet can provide additional benefits, contributing to reduced oxidative stress, improved metabolic health, and the maintenance of a healthy cellular balance. All these strategies not only improve the nutritional quality of foods but also help in addressing mineral deficiencies in populations heavily reliant on phytic acid-rich diets as is the case of countries of Latin America.

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# Pesticide analysis and detection of contaminants in food to ensure compliance with national and international regulations

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The use of pesticides to reduce crop damage and increase horticultural productivity has been implemented on a global scale for many decades. Due to their toxicity the potential migration of these chemicals into the human food and water supply chains presents considerable health concerns for the population at large. Therefore, the maximum residue level (MRL) permitted for pesticides in food, feedstuffs and water are strictly controlled by local (Senasa in Peru) and international regulatory institutions like the U.S. department of agriculture (USDA) or the commission department for health and food safety (SANTE) in Europe.

The EU has one of the highest food safety standards in the word, the Rapid Alert System for Food and Feed (RASFF) was established to ensure the exchange of information between members countries to support swift reaction by food safety authorities in case of risk to public health resulting from the food chain. During 2023 the number of alerts and notifications received through RAFF was 4205, of which approximately 22% correspond to chemical contamination or natural toxins, while the rest is distributed between biological, physical, metal and fraud contamination.

Currently the European regulation covers around 1100 pesticides used in agriculture and continue to increase, these include a wide variety of compounds in a range from low molecular weight and polar compounds (e.g. glyphosate) or small peptides (e.g. abamectin); due to this wide variety of pesticides, it is necessary to use gas chromatography and liquid chromatography, both with selective mass spectrometry detectors.

Triple quadrupole detectors are the gold standard for their sensitivity and specificity; however, the use of high-resolution mass spectrometers has been increasing in food safety laboratories due to their unique ability to screening an unlimited number of compounds and unique features like identify emerging contaminants or detecting food adulteration or fraud.

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# Determination of the health benefits of bioactive compounds of chia leaves (*Salvia hispanica* L.): Global evaluation of antioxidant capacity and its effect in vivo

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In the last decades consumers' interest in nutritionally balanced foods with health-promoting benefits associated has increased. Accordingly, the food industry has begun to pay attention to ancestral seeds and their derivative food products. *Salvia hispanica* L., commonly known as chia, was one of the most developed plants by the Aztec culture in pre-Columbian America. Each section of the plant had a utility, for example, the root was used to treat diarrhea, and infusions of the leaves to relieve headaches by also were used. Furthermore, they were used as poultices, to soothe sore areas by burns or blows. Nevertheless, the food industry commercializes only the chia seed, therefore, only chia seeds have been studied scientifically; instead, chia plant (leaves, root, stem) studies are limited, and so, the food industry is not exploiting its full potential. In this context, the objective of this work was to explore the health benefits of bioactive compounds present in discarded chia leaves. Firstly, the antioxidant capacity (AC) of sequential chia leaf extracts was evaluated by different methods (ORAC-FL, ORAC-PGR, and DPPH) and its antioxidant activity performance in human plasma. Secondly, the identification and quantification of bioactive compounds from chia leaf extracts was carried out by liquid chromatography (HPLC-DAD-MS); Finally, chia leaf extracts were subjected to *in vivo* assay (obese mouse assay).

The results showed that ethanolic extracts showed the highest AC values, and up to 18 bioactive compounds were identified in these extracts, with caffeic and rosmarinic acid being those present in the highest concentration. And finally, the oral supplementation with leaf extracts was able to reverse some aspects of liver damage.

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# Research on Andean farinaceous foods to obtain new functional foods

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Nowadays, overproduction, poor valorization of endemic foods, and the overpricing and importation of foreign foods are problems in the southern countries, including those in the Andes. Few studies about new functional foods from the Ecuadorian Andean matrix, such as farinaceous foods, are known. The objective of this work was to investigate nutritional, functional and sensory properties of the Andean farinaceous, particularly from Ecuador, to obtain new functional foods. For this contribution, food products and by-products from Ecuador have been used to obtain new functional foods, using local raw materials from kernels (quinoa), tubers (cassava and banana) and pulses (lupin). Chemical analyses were made for raw material and finished products i.e. gluten-free bread and germinated couscous. Enzyme-protein crosslinking analysis as well as hydrocolloids content optimization were made in gluten-free bread. In addition, loaf volume, crumb structure, dough characterization by Mixolab, pasting, textural and sensory analysis were performed. For germinated couscous, agglomeration yield, functional properties and sensorial analysis, among others, were performed. The results showed that new functional foods can be obtained from local matrices with maximized nutritional, functional and sensory properties. Also, these products have characteristics such as gluten-free, vegans, etc., that are sought by important segments of the current population.

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# Nutritional interest of *Geoffroea decorticans*, chañar: a native species from the province of Mendoza, Argentina

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Chañar (*Geoffroea decorticans*) (Gillies ex Hook. & Arn.) Burkart is a tree native to the drylands of South America, ancestrally used for its nutritional, medicinal and energetic properties. The importance of this species lies in the fact that it is adapted to conditions of water and salt stress and large thermal amplitudes, which gives it productive potential in scenarios of climate change. The objective of this work was to determine the nutritional and mineral contribution of native chañar fruits from the province of Mendoza, Argentina. Representative plants were selected, and the fruits were harvested manually. Moisture content and energy content were determined using official analytical techniques. Total mineral content, total protein, total fat, crude fiber and carbohydrates were evaluated on a dry basis. In the mineral fraction, nitrogen, phosphorus, potassium, sodium, calcium and magnesium were quantified. The results indicated adequate protein values (5.27±0.06 g %) and high crude fiber (19.27±0.46 g %) and carbohydrates (66.26±0.52 g %). This amount of fiber confers satiety, which is important to increase population intake. Although the mineral profile is adequate, it is necessary to further determine the factors that influence the bioavailability of each element. Although there are antecedents about the variation of nutritional properties depending on the geographic region, no studies were found at local level. It is considered that this research provides relevant information for the revaluation of ancestral species with nutritional value, considering the growing trend in the use of native plants in gastronomy.

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# Technological development of an instant product based on fermented purple corn (*Zea mays* L.) beverage

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The chicha de guiñapo (ChG) is an ancestral beverage produced in Arequipa, Peru. This traditional drink is made from purple corn (*Zea mays L.*), cultivated across various Peruvian regions. Purple corn is renowned for its high nutritional content and bioactive compounds, as antioxidants (20.5 ± 2.0 μmol trolox equivalents (TE)/g), total phenolic compounds (2.5 ± 0.3 mg gallic acid equivalents (GAE)/g), and anthocyanins (1.8 ± 0.2 mg/g). This research explores the technological development of an instant powder product derived from the ChG, emphasizing its cultural and gastronomic significance in Arequipa, Peru. The objective of this research was to convert the ChG into powder using spray drying technology. The process included boiling the guiñapo at 100 °C for one hour, cooling, and fermenting under controlled conditions for 5-7 days until achieving desired characteristics referenced from previous studies, such as pH, alcohol content (v/v), and Brix degrees. Upon achieving the desired fermentation characteristics, the ChG was centrifuged, filtered, and dehydrated by spray drying technology with the following parameters: air inlet temperature (165 °C), airflow (0.89 mL/min), feed flow (1.67 mL/min), and outlet temperature (93 °C). These optimal parameters were determined using Response Surface Methodology after 15 runs. Then, a fine purple powder was produced with 6.61 % moisture, pH 4.83, and 1.5 Brix. The results of proximal analysis before and after spray drying were carbohydrates (1.77 % to 82.67 %), ash (0.02 % to 4.91 %), protein (0.10 % to 5.81 %), alcohol (3.17 % to 0.64 %), respectively. This study highlights a successful innovation, integrating traditional practices with modern technology to preserve biodiversity, sustainability, and food security of ancestral crops, contributing to cultural heritage valorization.

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# Design of functional mayonnaise enriched with omega-3 from sacha inchi (*Plukenetia huayllabambana*) oil and chia (*Salvia hispanica* L.) mucilage

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Sacha inchi seeds (*Plukenetia huayllabambana*) are highly regarded for their nutritional richness, specifically their high omega-3 content. Omega-3 fatty acids are crucial for heart health, brain function, and reducing inflammation in the body. Chia seeds (*Salvia hispanica L.*) mucilage is recognized for its ability to create oil-in-water and water-in-oil emulsions. There is an increasing demand for innovative mayonnaise formulations that substitute traditional ingredients with healthier, plant-based alternatives. In response to this trend, this study aimed to develop a plant-based mayonnaise (PBM) by substituting egg yolks with chia seed mucilage (CSM) and using sacha inchi seed oils (SIO) and achieving sensory qualities akin to traditional mayonnaise. Five formulations of PBM were evaluated, with variation in CSM content (1 % to 3 %) and water content (43 % to 45 %) and using salt (0.5 %), Oil (48 %), pepper (0.5 %) and lemon juice (5 %). PBM was then evaluated on omega-3 (%) content, total fat (%) content, stability of emulsion (%), rheology and physicochemical properties. Formulation with 3 % of CSM resulted as the optimal option due to its emulsion stability (98.56 %) and rheology, very similar to traditional mayonnaise (99.13 %). PBM formulation with 3 % CSM showed the highest omega-3 fatty acid content of 55.36 % on 100g fat, compared with the 0.27 % found in traditional mayonnaise. PBM formulation with 3 % CSM also showed important characteristics such as phenolic content (310.814 μg GAE/g ms), Antioxidant activity (1991.79 μg trolox/g ms), Ph (4.24), Peroxide Index (11.92 meq-O2/Kg oil), Acidity Index (3.59 mg KOH/g), Shelf-Life Study and proximal composition. This study underscores the potential of chia seed mucilage and sacha inchi oil in mayonnaise formulations, addressing concerns associated with traditional options such as high fat content, low omega-3 levels, and dietary restrictions due to egg content.

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# Towards plant-based functional food ingredients: Enzymatic production of γ-aminobutyric acid from tarwi, cañihua and quinua real seeds' proteins

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Improving and adding health benefits to food has gained a lot of research interest lately to achieve more sustainable food systems. One interesting molecule has gained attention as a functional food ingredient: ɣ-aminobutyric acid (GABA), a bioactive compound with multiple physiological functions and positive effects on many metabolic disorders. It has also been shown to be a potent mediator in the gut-brain axis. GABA is the primary neurotransmitter inhibitor in the human cortex, and its metabolic precursor is glutamate. In Europe and the US GABA is already considered a "food constituent" and a "dietary supplement". Tarwi (*Lupinus mutabilis)* is a legume rich in proteins. At the same time, cañihua (*Chenopodium pallidicaule*) and quinoa (*Chenopodium quinoa)* are amaranthaceous, with much lower protein content but comparable to the cereal protein levels. These seeds are attractive for their nutritional and potential functional values. However, GABA has not been detected in these seeds. In this study, two recombinant isoforms of glutamate decarboxylases, GadA and GadB, from the probiotic strain *Levilactobacillus brevis* were used for the conversion of seeds' glutamate into GABA, both with and without a previous treatment with pancreatin. The produced GABA by GadA and GadB was higher in tarwi seeds, obatinig 1.99 ± 0.08 and 2.46 ± 0.16 (mg/g of dry seed) respectively, while in cañihua (0.27 ± 0.01 and 0.09 ± 0.01) and quinoa (0.25 ± 0.01 and 0.33 ± 0.02), it was significantly lower, consistent with those seeds' protein content. Combining GAD enzymes and pancreatin increased the production of GABA in cañihua (0.25 ± 0.1 and 0.26 ± 0.03) and quinoa seeds (0.55 ± 0.05 and 0.52 ± 0.06), enhancing their functional value.

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# Development of high protein cookies enriched with defatted sacha inchi (*Plukenetia huayllabamana*) cake and tarwi (*Lupinus mutabilis* Sweet) to combat child malnutrition

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In Peru, five of every ten children suffer from malnutrition, which increases the risk of developing non-communicable diseases (NCDs) at early stages of their lives. Sacha inchi (*Plukenetia huayllabamana*) cake is the byproduct of the oil extraction process of this native seed of the Peruvian Amazon and has high protein (58.8 %) and fiber (14.4 %) content. Tarwi (*Lupinus mutabilis* Sweet) is a Peruvian legume characterized by its high protein content (49.26 %) and high levels of tyrosine and tryptophan aminoacids. Thus, the purpose of this research was to develop high protein cookies enriched with defatted sacha inchi cake (DSIC) and tarwi (DT) as an alternative snack to combat child malnutrition. Five types of cookies were developed, along with one control sample, containing corn flour (50 % *w/w*), rice flour (20 % *w/w*), and varying the content of quinoa flour, DSIC flour and DT flour (0, 10 %, 30 % *w/w*). The addition of DSIC and DT increased the protein content from 12.13 % to 20.30 %, fat content from 6.76 % to 10.42 %, and ash content from 1.51 % to 1.89 % compared to the control sample. In contrast, the moisture content from 10.21 % to 10.78 %) and carbohydrate content from 59.73 % to 67.48 % decreased. Moreover, all cookies had a high in vitro digestibility (70.91 % to 74.17 %), relative high antioxidant activity (346 to 469 μg GAE/g cookie) and phenolic content (128.6 to 175.5 mg trolox/100g cookie). Sensory analysis showed that cookies enriched with DT were more appealing to the panelists than those enriched with DSIC and the control sample. Hence, these cookies could serve as a nutritional food alternative to help combat child malnutrition.

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# Highlights of the composition of plant foods from the dry Chaco for food safety

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The native species of the great biodiversity of Paraguayan Chaco have an important role in Food Safety and ecosystems sustainability. However, the nutritional value of many edible species is unknown, neglected and underused in the regional diet. This work aimed to determine the proximal and mineral composition, antioxidant potential of 14 native species from Paraguay. Wild fruits of *Cynophalla retusa*, *Neltuma alba*, *Anisocapparis speciosa*, *Capsicum chacoense*, *Cereus forbesii*, *Harrisia bonplandii*, *Sarcomphalus mistol*, *Capparis tweediana*, *Lycium cuneatum*, *Syderoxilum obtusifolium*, *Sarcotoxicum salicifolium*, *Passiflora caerulea*, *Ximena americana*, *Cocoloba spinescens*, from the Boquerón Department in the Paraguayan Chaco were analyzed. Fresh fruit were characterized on proximal analysis by methods AOCS (2000), total phenolics compounds (TCP) by Folin Ciocalteau and total antioxidant capacity (CAT) by ABTS. The results of the compositional analysis showed that several species (*A. speciosa*, *H. bonplandii*, *C. tweediana*, *L. cuneatum*, *S. obtusifolium*) have a great nutritional potential due to their content of micronutrients (greater than 5 % of the RDI of minerals), vegetal proteins (*C. retusa*, *C. tweediana*, *Neltuma spp*.) and carbohydrates (*C. forbesii*, *Neltuma spp*, *S. mistol*, *S. salicifolium*, *S. obtusifolium*). At the same time, the ABTS assay and TPC content demonstrate a great antioxidant potential. These data may be useful to outline public policies on food, biodiversity conservation and food systems sustainability. Based on knowledge and its revaluation, post-harvest methods, storage, processing and promotion, are challenges for development of new markets, healthy eating and new approach of its bioactive compounds.

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# *Curcubita moschata* seeds: Ancestral flavor and nutrition for current use

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Squash (*Curcubita moschata*) is a type of pumpkin that grows easily in corn fields in Guatemala. The sacred book of the Mayans includes it among the 15 foods of recognized nutritional value; today both the pulp and the seed are still used as food, the latter is marketed under the name *pepita*, which is obtained by hand by roasting the seed, grinding it and adding salt. *Pepita* is used as a flavoring and thickening ingredient in sauces or as an accompaniment to fresh fruit. In order to update the information on its nutritional composition, dried squash seed and *pepita* were purchased in popular markets in the north, center, west and southeast regions of Guatemala. The moisture content was determined in a convection oven, the protein by the Kjeldhal method, the fat by the Soxhlet method and the carbohydrates by difference. The results indicate that these foods are low in moisture and high in protein and fat, which is characteristic of oilseeds. In the dry seed, the protein content is 32.9 %, fat 32.07 %, ash 4 %, carbohydrates 1 % and moisture 5.67 %. In the *pepita* there is 29.21 % protein, 30.22 % fat, 6.24 % ash, 7.69 % carbohydrates and 4.65 % moisture. The nutritional differences between could indicate that the *pepita* sold in popular markets, something more than salt is added. When comparing these results with those reported in the food composition table for Central America, for the case of dry seed, differences are found in the percentage of protein, fat, carbohydrates and moisture.

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# Lupine (*Lupinus mutabilis* Sweet) peptides as ingredients of functional foods

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Lupine is an Andean legume with high nutritional value but after years it is still underutilized. It has a protein content similar to soya beans. The objective of the work was to evaluate the techno-functional and biological properties, in the protein concentration and in the hydrolysates derived from lupine flour (*Lupinus mutabilis* Sweet). Protein isolate was obtained after treating lupine flour, samples with alkali followed by isoelectric precipitation. Furthermore, peptide fractions were obtained after hydrolysis process with the application of a multienzyme and a protease in the protein concentrate. The percentage of solubility, emulsifying capacity, foaming capacity and foam stability were evaluated, and the antioxidant activity. It was found that the extraction yield and protein concentration was higher when applying ultrasound pretreatment of the enzymatic hydrolysis. The multienzyme showed a higher degree of hydrolysis. Likewise, the protein obtained by ultrasound showed a higher percentage of foaming activity, foam stability, emulsifying capacity and a higher percentage of soluble protein, at a basic pH value. In the case of antioxidant activity, the highest concentrations obtained in the flour sample and in the protein extracted by vortex and hydrolyzed with the multienzyme. These results provide valuable information on the techno-functional properties and biological characteristics to give uses as ingredient of functional products.

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# POSTER SESSION

# Evaluation of the use of chia mucilage as a biocoagulant in industrial effluent

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The growing demand for reducing the concentration of pollutants in water resources has constantly led to more studies focusing on more appropriate options for treating industrial effluents. Coagulation/flocculation is one of the most used techniques in effluent treatment plants due to its efficiency in removing constituents and its ease of execution. However, a disadvantage of this technique is that the use of chemical coagulants can generate harmful residues that remain after treatment and when discarded into the water body. Using natural coagulants (bio coagulants), such as chia mucilage, has many advantages over chemical coagulants, mainly biodegradability, low toxicity, low production of residual sludge, and low cost. Therefore, this study used chia mucilage as a bio coagulant agent in effluent from the fertilizer industry. Coagulation was conducted at 120 rpm for 5 min, flocculation at 30 rpm for 30 min, and sedimentation for 120 min. After the coagulation and flocculation stage, the treated effluent showed a significant reduction in turbidity (suspended solids), around 60 %, and in Chemical Oxygen Demand (COD). Furthermore, the pH suffered a slight reduction (3.02 to 2.62). About color, the luminosity was significantly increased (21.0 to 65.7), also demonstrating the efficiency in removing dissolved solids. Therefore, the efficiency of chia mucilage as a biocoagulant in effluents from fertilizer industries is notable.

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# Differentiating viable and non-viable *Salvia hispanica L.* seeds through shotgun proteomics profiling

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Exposure to elevated temperatures and high relative humidity accelerates seed aging, ultimately leading to loss of viability. In this context, certain proteins are crucial for preserving seed longevity. However, the proteomic response of *Salvia hispanica L.* (chia) seeds to viability loss has not yet understood. This study investigates the use of proteomics to uncover molecular responses to viability loss due to artificial aging in two chia genotypes, WN and MN. Using quantitative label-free proteomics analysis (LC-MS/MS), 1787 proteins were identified in chia seeds with 95 % confidence, including storage proteins, heat shock proteins (HSPs), late embryogenesis abundant proteins (LEAs), oleosins, reactive oxygen species (ROS)-related enzymes, and ribosomal proteins.

A relatively low percentage of exclusive proteins were found in viable versus non-viable seeds, but differentially abundant proteins indicated variations based on genotype and physiological status. Specifically, the WN cultivar showed 130 proteins with differential abundance between viable and non-viable seeds, while MN exhibited changes in 174 proteins. Both cultivars showed significant decreases in key proteins responsible for maintaining seed functionality, longevity, and vigor under high-temperature and humidity conditions, such as LEA proteins, HSPs, ROS-related enzymes, and oleosins. Notably, ribosomal proteins accumulated in MN but diminished in WN seeds. These findings highlight the importance of evaluating protein changes in viable versus non-viable seeds, offering valuable insights into the biological mechanisms underlying chia seed integrity during exposure to elevated temperature and humidity.

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# Impact of flour mixture composition on gluten-free pasta quality parameters

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This study investigated the effect of combining different gluten-free flours to obtain short-cut dry pasta. A centroid simplex mixture design was employed, considering three factors (rice flour -RF, buckwheat flour -BF, and yellow pea flour -YPF) and five response variables (hardness, acidity, optimal cooking time, water absorption, and solid loss during cooking). The ranges for RF, BF, and YPF were 40-60 % wt/wt, 20-40 % wt/wt, and 10-30 % wt/wt, respectively, with a fixed 10 % wt/wt chia expeller content, resulting in a total of 10 pasta formulations. Analysis of variance (ANOVA) was conducted, and regression models (linear, quadratic, special cubic, and complete cubic) were obtained, which were used to explain each of the mentioned response variables. The ANOVA results revealed that hardness, cooking time, water absorption, and solid loss were well-explained ($R^2$ >80 %, $p < 0.05$) by special cubic models. Acidity did not exhibit statistically significant models. For optimal cooking time (p=0.0174; R2adjusted=92.3 %), water absorption (p=0.0015; R2adjusted=98.5 %), and hardness (p=0.0000; R2adjusted=99.9 %), the model that best fit was the special cubic, while for solid loss, the lowest p-value (0.0105) was obtained for the linear model, but the R2 value was higher for the quadratic model (R2=79.09 %). To maximize hardness, the optimal formulation employed the lowest RF content (40 %) and intermediate levels of BF (30.9 %) and YPF (19.08 %), achieving a hardness level of 37.35 N. Thus, these results show the importance of analyzing the appropriate combination of flours to achieve specific blends to produce a food that incorporates different ingredients, as is the case with gluten-free pasta.

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# Characterization of instant soup powders containing amylose-chia oil fatty acid inclusion complexes

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The α-linolenic (omega-3) fatty acid is known for its beneficial effects on health. Chia (*Salvia hispanica L.*) seed oil represents a rich source (~65 %) of this essential fatty acid, but its incorporation into food formulations is restricted by its high susceptibility to oxidative deterioration. The linear component of starch, amylose, can interact with hydrophobic molecules forming inclusion complexes, which could act as delivery systems for sensitive compounds, such as essential fatty acids from chia oil. This work studies the incorporation of inclusion complexes of corn starch with high amylose content and chia oil fatty acids in instant powdered pumpkin soups, evaluating the physicochemical and flow properties of the powders. All samples displayed water activity and moisture content values below 0.6 and 7 %, respectively, significantly decreasing in the soup with inclusion complexes. The colorimetric measurement through the CIELab system revealed that the commercial soup had positive a* and b* values and a high L*, indicating a red and yellow color and high lightness. In contrast, soup powders containing inclusion complexes had lower red and yellow components and a higher lightness. Although the commercial soup exhibited a bulk density significantly higher than that of the powders containing complexes, no differences were found between the Carr index and Hausner ratio, indicating that the inclusion complexes did not modify the flowability of the powders. These results provide useful information for functional food development containing chia oil fatty acids, which are relevant for its acceptance and to ensure its flow behavior during processing.

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# Development of gelled emulsions as chia oil delivery system

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Chia oil is rich in essential fatty acids, representing ~85 % of total oil. Incorporating them into foods constitutes a challenge to increase consumption and obtain its benefits. With this aim, O/W emulsions (10:90 %w/w) were prepared to obtain emulsion gels. The continuous phase was prepared by mixing sodium alginate (1 or 2 % w/w), sunflower lecithin (1 % w/w), and water using high-speed homogenization (17 000 rpm, 2 min), gradually incorporating chia oil (10 % w/w) as the dispersed phase. This pre-emulsion was microfluidized (400 MPa, 3 cycles), then brea gum (1 % w/w) was added by ultrasonication (60 % of amplitude, 2 min). Freshly prepared emulsions were gelled using calcium gluconate (0.1M) under agitation for one minute. After 72 h of gelling at 4 °C, emulsion gels were characterized. The microstructure was analyzed by confocal fluorescence microscopy after staining samples with Nile red and Fluorescein Isothiocyanate (FITC). Concerning color, the ΔE value for emulsion gels varied from 0.09 to 1.26, with the highest value for emulsions with the highest alginate and brea gum concentrations. The pH value of gelled emulsions varied from 4.28 to 6.12, with the highest values for samples with brea gum. All formulations exhibited gel-like characteristics within the linear viscoelastic range, as the storage modulus (G') exceeded the loss modulus (G''). Emulsion gels underwent axial compression or back extrusion tests. Gradual decreases in hardness and elasticity were observed with brea gum addition. Chia oil-gelled emulsions offer an innovative technological alternative to enrich foods with functional and bioactive components.

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# Obtaining carotenoids and capsasinoids (*Capsicum chacoense*) with a green solvent (*Acrocomia aculeata* almond oil)

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*Capsicum chacoense* (wild red pepper) and *Acrocomia aculeata* almond (Paraguayan coconut) are little-used native Paraguayan fruits, which can be sources of important bioactive compounds. This work evaluated the Paraguayan coconut almond oil as a green solvent for the extraction of carotenoids and capsacinoid from the wild red pepper. Ultrasound-assisted extraction was performed (solvent ratio; 0.7g/mL, amplitude 80 %, for 17min). The freeze-dried red pepper fruit, coconut oil and coconut+red pepper oil were characterized by total carotenoids, total capsacinoid, total phenolic compounds (TPC), total antioxidant capacity (TAC), fatty acid (FA) profile and color. It was possible to extract 46.7 % of carotenoids and 42.5 % of capsacinoid present in the red pepper. However, only about 7 % of the TCP and TAC were maintained in the coconut+red pepper oil obtained by the ultrasound method. In the FA profile of red pepper oil, oleic acid and palmitic acid were observed as the main FA. Conversely, in coconut oil, lauric acid and oleic acid were observed as the main components. In coconut+red pepper oil, the same main FA were found, but in a lower percentage of lauric acid and higher percentage of oleic acid. Based on results, coconut oil is a green solvent for the extraction of lipophilic secondary metabolites such as carotenoids and capsacinoid. These can provide sensory characteristics such as color and flavor to coconut oil from *Capsicum chacoense*. In the oil obtained (coconut+red pepper), a significant difference on FA prolife was also seen where the majority FA was the oleic acid.

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# Utilization of bean (*Phaseolus vulgaris*) and quinoa (*Chenopodium quinoa*) flours in cookie production. Consumer acceptability

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Legumes and Andean grains are valuable sources of protein and essential amino acids, which complement well with cereals. Despite being produced abundantly in Argentina; their internal consumption remains low. The main objective was to develop a cookie optimizing the nutritional and functional quality based on the complementation of non-conventional flours from underutilized crops. Integral flours of white beans and quinoa were prepared by grinding and sieving. The theoretical protein quality of different mixtures was evaluated by the Digestible Essential Amino Acid Score (DIAAS) method, using FAO 2013 standard requirements outlined in "Dietary protein quality evaluation in human nutrition" (FAO Food and Nutrition Paper 92). The protein combinations of non-conventional quinoa (QF) and white bean (WBF) flours with wheat flour (WF) obtained DIAAS between 34 to 77 %. Considering the theoretical evaluation of the protein composition obtained, four cookie prototypes were designed, developed and compared to a control using 100 % wheat flour Dough and cookie weight, yield, baking loss, diameter, thickness, and expansion ratio (D/T) were measured. Protein and moisture were determined The DIAAS positioned the WBF:WF:QF 50:50:0 mixture as having the best protein quality and quantity. The diameter of the cookies increased with the decrease in thickness. They are a protein source, containing between 8.6 to 9.4 g/100 g cookie fresh weight. Moisture, weight, baking loss and yield ($p<0,05$) of all dough and cookies were significantly different from each other. A good sensorial acceptance the elaborated cookies showed. Bean and quinoa flours are a good nutritional option to combine with wheat flour and improve the protein quality of the products obtained.

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# Effect of the incorporation of dried moringa leaf powder on the physicochemical and sensory properties of snack crackers

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*Moringa oleifera*, a plant native to India with high nutritional value, offers an alternative for enriching food products. Its abundant antioxidants, proteins, and fibers make it an attractive choice. This study assesses the impact of substituting wheat flour with dried moringa leaf powder in snack crackers. These were prepared using 53 % (w/w) of wheat flour and substituting part of it with different replacement percentages (1, 2.5, 5, 5, 7.5 and 10 % (w/w)) of dried moringa leaf powder. The baked snacks were characterized in terms of moisture, aw, optical properties, mechanical properties, antioxidant capacity, total phenol content, protein content, and energy value. In addition, the acceptability of the crackers as evaluated by a sensory analysis. The results indicated that cracker thickness and volume remained constant across all formulations. As moringa incorporation increased, weight loss decreased. The high water-holding capacity of moringa leaf powder and its protein content contributed to increase moisture and reduce water activity in the crackers, resulting in decreased firmness. The snacks exhibited a greener color with brownish tones as moringa replacement levels rose. Antioxidant capacity (up to 251±13 mg Trolox E/100 g snack) and total phenol content (up to 1172±288 mg Galic acid/100 g snack) were higher with greater moringa inclusion, remaining stable after baking. The protein content increased, allowing all crackers to be labeled as a "protein source" since the energy value due to protein is higher than 12 %. However, judges found the color, aroma, and flavor attributes of the highest moringa content (10 %) crackers too intense. In conclusion, replacing up to 5 % of wheat flour with dried moringa leaf powder in snack crackers could enhance their nutritional profile while maintaining consumer acceptance.

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# Physicochemical properties of French fries after several cycles of frying with moringa or olive oil

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*Moringa oleifera* oil is characterized by its high content in oleic acid (ω9), very similar to olive oil. Moreover, it is rich in linolenic acid (ω6) and behenic acid, among other fatty acids. Furthermore, this plant has lower agronomic requirements and it withstands high temperatures. Given the current geopolitical and climatic situation, several of the commonly consumed oils have suffered a price increase, making them less affordable to the population. Therefore, the aim of this work was to compare the properties of French fries obtained with moringa oil and olive oil after several frying cycles, in addition to assessing their sensorial acceptance. Fried potatoes were characterized in terms of mass variation, moisture, water activity (aw), optical and mechanical properties. The results showed that potatoes fried with moringa oil lost less weight during frying, which was linked to the evaporation of water during the frying stage combined with the gain of oil. However, in all cases the aw was similar. Color was not affected by the type of oil used, but luminosity was lower after the third frying cycle in the case of potatoes fried with moringa oil. Mechanical properties were not affected by the type of oil applied. Finally, at the sensory level, the judges evaluated all samples above 5 points (on a 9-point hedonic scale), penalizing the attributes of the first-cycle moringa oil fries for being too low.

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# Evaluation of disintegration time in orally disintegrating films of chia mucilage and vitamin C

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Oral disintegration films (ODFs) have attracted great attention due to their efficiency, easy administration and rapid dissolution in the oral cavity for patients with swallowing problems or critical health conditions. Among the raw materials, chia mucilage (MC) stands out. Vitamin C (vitC) is a bioactive compound that plays crucial roles in maintaining the metabolism, energy, differentiation and state of proliferation of cells, and is often in deficit in the human body. Therefore, this study aimed to evaluate the disintegration time of ODF developed with MC and vitC. Films were developed with 1 % MC, 0.25 % glycerol and 1 % vitC. The disintegration time was evaluated at 1, 5, 15, 30 and 60 min for 7, 14, 21, 28 and 35 days at 30 and 40 °C. When adding vitC, a significant increase in disintegration time was observed due to the thickness of the films. Even with the increase in disintegration time, this happened below 60 s, classifying them as quick release films. The temperature of 30 °C (477.5 mg/g in 1 min and 220.6 mg/g in 60 min in 7 days) promoted a faster release of vitC in the times and days of storage than at 40 °C (411.3 mg/g in 1 min and 407.7 mg/g in 60 min in 7 days). Furthermore, as storage occurred, there was a decrease in release that did not undergo major changes during the 60 min. The results positively demonstrated that MC is a promising polymer for use in the delivery of vitC

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# Properties of the bread of chullpi maize (*Zea mays*) formulated with protein-tomato pectin conjugate

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The added value to Andean raw materials such as chullpi corn (*Zea mays*), grown in Jujuy, Argentina, could be the production of flours for the elaboration of gluten-free bread. The low starch content respects culli y bolita flour and the absence of gluten lead to low-quality bread. The addition of a protein-pectin conjugate could improve the textural and nutritional properties of chullpi's gluten-free cornbread (CCB). The objective was to improve the baking properties of chullpi corn flour, using a conjugate obtained previously by extrusion of a bean protein concentrate (BPC) and pectin extracted from the residue of the industrialization of tomato (TP). The infrared profile of the BPC-TP conjugate, ratio 2:1 (BPC:TP), showed a 67.3 % increase in β-sheet secondary structures and a 7.7 % decrease in α helix due to the interaction between the biopolymers. The CCB was formulated by replacing 22 % of chullpi flour with the conjugate. The percentage of weight loss (% PV) of the BPC-TP bread after baking was 9.8 % higher and the specific volume (SV; cm3/g) was 1.6 cm3/g lower than the CCB control. The analysis of the texture profile of the BPC-TP bread showed chewiness (g) and hardness (g) values of 2058.1 g and 243.4 g, associated with lower energy required to chew a BPC-TP bread compared to the CCB control ($p<0.05$). The result showed that the BCP-TP conjugate improves the texture of chullpi cornbread and increases the protein and soluble dietary fiber content which could potentially improve the nutritional profile rich.

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# Effect of alkaline extrusion temperature on rheological properties of Andean corn dough

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The application of alkaline extrusion in whole corn flour not only produces partial gelatinization of starch but also favors interactions between its components and releases natural hydrocolloids, modifying the rheological properties and suitability for application in gluten-free pastas or bakery products. The intensity of these modifications, and therefore their rheological quality, depend on the extrusion conditions. This work aimed to study the effect of alkaline extrusion temperature (70, 80 and 90 °C) at 40 % feed humidity; on the rheological properties of Cuzco corn flour and its dough. The increase in extrusion temperature had a significant effect ($p<0.05$) on the degree of gelatinization of the flours (increase from 31.74 to 71.64 %), which impacted their viscous properties. The degree of gelatinization, the formation of amylose-lipid-protein complexes and the soluble fiber content modified the rheological properties of the dough, decreasing the elastic modulus with increasing extrusion temperature. The most cohesive and elastic dough were obtained at a lower temperature (70 °C), which presented greater resistance to kneading. This study will expand the use of who le Andean corn flour in gluten-free dough to obtain pastas and/or bakery products, reducing the use of food additives.

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# Effect of extrusion and germination on antihypertensive and antioxidant properties of quinoa protein hydrolysates

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It is commonly stated that protein hydrolysates with higher hydrolysis degree (HD %) have better bioactive properties. Our study evaluated the influence of extrusion and germination pre-treatments of seeds and the HD % extent over antihypertensive (anti-ACE) and antioxidant (DPPH and chelating power activity) activities. Samples of native protein and hydrolysates (alcalase hydrolysis at pH 9, 50 °C) were prepared from extruded (EQPC0 %, EQH2 %, EQH5 %, EQH10 % EQH20 %), germinated (GQPC, GQH2 %, GQH5 %, GQH10 % GQH20 %) and un-processed (UQPC0 %, UQH2 %, UQH5 %, UQH10 % UQH20 %) seeds and tested for bio-functional *in vitro* assays. Results showed that the highest activities (IC50 protein mg/mL) were 1.53 (UQH20 %), 1.76 (EQH10 %) and 0.97 (GQH20 %). Overall, hydrolysates from germinated seeds and high HD% had better antihypertensive performance than extruded and un-processed seeds. Best antiradical properties were 0.72 (UQSPH2 %), 0.52 (EQSPH2 %) and 0.27 (GQSPH5 %). Thus, low-medium HD % had better antiradical activity. The chelating power improved remarkably ($p<0.05$) from 5.02 (UQPC0 %) to 0.76 mg/mL (UQH20 %) (>4-fold improvement) and a dose-response trend was observed, followed by EQSPH5 % (2.21), EQSPH10 % (1.55) EQSPH20 % (0.89). Germinated samples did not show significant differences (IC50 2.49-2.23 mg/mL). Hence, the chelating activity of protein hydrolysates improved significantly with HD% for un-processed and extruded samples. In conclusion, both treatments and the HD % affected the bio-functional properties. While pre-treatment of seeds by germination and high HD % were optimal for anti ACE activity, low or medium HD % were necessary for better antiradical activity, and high HD % of un-processed samples were suitable for chelating power activity. Results shows parameters such as processing and HD % should be designed according the desired purpose in functional food proteins and hydrolysates.

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# Effect of disinfection and drying of wild carob pods (*Neltuma sp.*) on the safety of the carob flour

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In the hostile and challenging environment of the Paraguayan Chaco, the wild carob pods (*Neltuma sp.*) are a valuable vegetable resource providing nutrition and significant economic opportunities for the local population by means of carob flour production. However, the microbiological quality of the carob flour is limited due to manual gathering. The main objective of this investigation is to find an efficient disinfectant and its minimum application level to obtain microbial stability in carob flour. The microbial load (total mesophilic aerobes, molds and yeasts, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella spp*) of the flour obtained by disinfection with citric acid (1 and 3 %) and sodium hypochlorite (1 and 3 %) was compared. Drying tests were carried out at time intervals of 2, 4, 6 and 7 hours on whole carob pods to obtain flour in a hot air circulating tray type dryer and humidity was used as a response variable in a thermobalance (desirable humidity <5 %). It is concluded that there are significant statistical differences between the method utilized (ANOVA, Kruscal Wallis, $p$ <0.5) and a combined process of disinfection with 3 % citric acid and hot air circulating tray type drying for 7 hours at 60 ºC is proposed to obtain an innocuous carob flour of high microbiological quality.

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# Evaluation of the baking properties of mixtures with cassava, quinoa and green banana starch flours with vital wheat gluten

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The role of gluten-free matrices, particularly those of Andean origin, in baking properties has not been well discriminated. The objective of the present work was to investigate the effects of different combinations of banana flour, quinoa flour, cassava starch and vital gluten on baking capacity and rheological properties. 6 mixtures with different contents of banana and quinoa flours (0:100, 20:80, 40:60, 60:40, 80:20, and 100:0) from Ecuador with equal contents of vital gluten and starch were analyzed. Breadmaking ability and dough characterization by Mixolab were analyzed. The increase in banana flour (5.4-87.0 %) and the reduction in quinoa flour (21.6-0 %) and cassava starch (60-0 %) contents in the presence of vital gluten (13 %) improved the specific baking volume of the mixtures (1.9-2.4 mL/g). This correlated with protein weakening (0.69-0.32 Nm) and starch gelatinization (0.87-1.90 Nm) assessed by Mixolab. The retrogradation of starch mixtures determined by Mixolab (1.23-2.44 Nm) showed a strong positive and negative association with banana flour and quinoa flour, respectively. This result was confirmed by analogous correlations with retrogradation (0.21-0.66 Pa.s). The variations in the rheological property results could be attributed to components of the mixture such as banana (water-soluble non-starch polysaccharides, fermentable sugars and soluble fiber) and quinoa (soluble fiber and polar peptides or lipids), which promoted a viscoelastic network well formed with vital gluten and therefore greater expansion of the dough. In addition, the polar lipids of quinoa could have inhibited the recrystallization of amylose. Instead, the reducing sugars in the banana could have accelerated its retrogradation.

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# Development of cookies enriched with quinoa (*Chenopodium quinoa*) and native collagen from pota (*Dosidicus gigas*) nape

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The giant squid (*Dosidicus gigas*) is a marine product of the Pacific Ocean, its by-products can be used to obtain bioactive products such as collagen, proteins, and others. The objective of this research was to develop cookies enriched with Quinoa (*Chenopodium quinoa*) and native collagen from pota nape high in protein content, minerals and antioxidants. Four formulations (4, 8, 12 and 16 % collagen) were developed and compared with control sample. The results showed higher protein (11.66±0.25 - 20.82±0.40 %) content, lower moisture (4.70±0.14 - 5.63±0.15 %), higher ash (2.96±0.14 - 3.83±0.09 %), lower fat (15.29±0.05 - 15.83±0.10) and lower carbohydrate (53.89±1.05 - 65.39±0.82 %) content than the control sample. Also, the cookies showed a significant content of polyphenols (618.61±24.06 - 934.52± 23.30 μg gallic acid equivalent (GAE)/g), antioxidant activity (8182±59 - 8369±73 μg trolox/g) and *in vitro* digestibility (70.82±0.13 - 73.62±0.51 %) than the control sample. The cookies also had a high minerals content: calcium (3893±194 mg/kg), potassium (3222±161 mg/kg) and magnesium (2108±105 mg/kg). In addition, the cookies presented an adequate balance of amino acids, principally of aspartic acid, glutamic acid, serine, glycine, threonine, arginine, alanine, proline, valine, phenylalanine, and leucine. The cookies complied with the Peruvian legislation of the Healthy Law about the promotion of healthy eating for children and adolescents (No. 30021, 2013) and with the microbiological requirements. Finally, the cookies showed a sensory acceptance of 77.8 % and a shelf life of 184 days determined by the Rancimat method. The native collagen from pota nape could be used with quinoa flour to develop functional foods to help reduce child malnutrition.

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# Compositional changes associated with successive boiling of wild *Cynophalla retusa* (Indian bean) pods collected from the Paraguayan Chaco

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*Cynophalla retusa*, known as "Indian bean", is an important traditional food for the ethnic groups of the Gran Chaco. However, its contribution of minerals in the diet is unknown and the toxic nature of the raw pods has been reported. The aim of this work was to evaluate the composition of minerals, oxalic acid and phytic acid contents in whole raw and cooked pods, with successive changes of boiling water every 1 hour for 4 hours in total, as well as the alkaloid content in the cooking water. Bivalent mineral composition determinations (Ca, Fe, Cu y Mg) were made, as well as phosphorus and antinutrient contents, such as phytic acid and oxalic acid to determine the mineral contribution. The presence of alkaloids was also determined in the cooking water. The raw pods (C. retusa) contained 6.67 % ash, with high content of Ca, Fe, Cu, Mg and P. Loss of minerals occurred with successive boiling and significant decrease of antinutrients, with significant change after each boiling (1, 2, 3, 4 hours). The presence of alkaloids was observed in the raw sample and the first cooking water, which showed loss of compounds after 1 hour boiling. Boiling improved the bioavailability of Ca by removing oxalic acid from the sample cooked in the fourth boil, however the phytic acid content was not reduced equally (only up to 40 %). Results show that C. retusa pods can be a source of minerals (Ca, Fe, Cu y Mg) under controlled conditions of cooking and decrease of antinutrients like oxalic acid. In perspective, this food source can be a viable alternative to increase Food Safety and nutrition, using one of many Paraguayan species that are little known, therefore domestication and conservation studies are necessary.

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# *In vitro* digestion of chia seed oil nanoemulsions

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Oil-in-water (O/W) nanoemulsions offer significant potential for protecting and delivering sensitive ingredients such as chia seed oil, which is rich in omega-3 fatty acids (approximately 64% α-linolenic acid, ALA). This research work aimed to study the *in vitro* fat digestibility of chia O/W nanoemulsions (Cas1000) with 10 % (w/w) of chia oil and 2 % (w/w) of sodium caseinate prepared by microfluidization (1000 bar, 3 passes) and characterized through their droplet size, superficial droplet charge, global stability. In terms of the *in vitro* fat digestibility, three different matrices were studied: a water solution of sodium caseinate, a chia O/W nanoemulsion, and a bulk chia oil. The particle size distribution, mean diameter, and microstructure were evaluated after *in vitro* stomach and small intestine simulation according to the INFOGEST method. Free fatty acids (% FFA) produced during lipolysis were quantified at the end of digestion through their neutralization by acid-base volumetric assay. The droplet size of the Cas1000 had slight changes during the gastric phase while a significant variation of this parameter was observed at the end of the intestinal phase. A higher % FFA was obtained in Cas1000 compared to bulk chia oil with values of 58.26 and 38.13 %, respectively. The ALA content in the lipid phase was quantified at the end of the gastrointestinal digestion process. The results indicated no significant changes compared to the initial oil, suggesting no losses of active compounds during digestion.

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# Morphological and physicochemical characterization of native beans reintroduced to the Andean zone of Jujuy, Argentina

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The objective of this work was to characterize the morphology and physicochemical properties of fifteen genotypes of native beans from the province of Jujuy, Argentina, ten of which are *ñuñas*. The morphological descriptors used were length, width, thickness and color. Water absorption capacity (WHC), popping yield (PY), proximal composition and 100-seed weight (100W) were also determined. The *ñuñas* presented rounded shapes, and in general were smaller than beans, since lower values of length and 100W were observed (9-12 mm and 31.4-48.8 g, respectively) versus (13-15mm and 40-55g) of beans. No differences were observed between both groups in width (8-7.5 mm), while thickness was more variable in *ñuñas* (5.8-7.3 mm versus 5.8-6.7 mm for beans). The *ñuñas* ranged in colors of whitish, brown, purple, and reddish, with a mottled, rhomboid bicolor, and tricolor patterns. The beans ranged from light brown to dark purple, either single-colored or with wide bicolored stripes. Darker colors might indicate the presence of polyphenols and anthocyanin. The physicochemical properties depended on the genotype, the *ñuñas* presented higher WHC (50-67 %) and PY (20-36 %). Regarding proximal composition, the protein content —a key characteristic of legumes—, varied between 18 and 25 % for all the varieties studied, while lipids ranged from 0.23 to 1.29 %. In conclusion, these different characteristics of each genotype could exhibit varying behaviors in response to treatments applied for industrialization. In the canning industry, high values of WHC are preferred, while PY describes the ability of *ñuñas* to expand when exposed to heat.

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# Some physical characteristics, nutritional value and amino acid profile of four Peruvian varieties of amaranth (*Amaranthus caudatus*)

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In Peru there are several varieties of *Amaranthus caudatus*, that have not yet been characterized. The objective was to evaluate some physical characteristics, nutritional value and amino acid profile of four Peruvian varieties. The variety used were: Oscar Blanco (OB), INIA 414 Taray (T) and INIA 430 Imperial (I) from INIA-Cusco and Centenario (C) from UNALM-Lima. Initially the instrumental color (L*, a* and b*) and the size of the raw grains were determined; subsequently, the proximal analysis was determined by AOAC methodology and finally the amino acid profile by HPLC according to retention time and areas, compared to the standards expressed in g/100 g of sample on dry basis. In the results, differences were observed in size ($p<0.05$), the smallest was OB (1.1 mm) and the largest was C (1.4 mm), in color, difference were found ($p<0.05$) in L* being the darkest OB (73.72) and the lightest C (77.71); in case of b* tending toward yellow C and I (27.65). In the proximal analysis differences ($p<0.05$) in proteins were observed highlighted I and T (14.9 %); fat content highlighted OB and C (6.90 %) and ash content was different finding that varieties I and C presented higher values (2.64%). No differences were found ($p>0.05$) in the content of crude fiber (4.25 %), carbohydrates (73.42 %) or amino acid profile, with the exception of serine and tyrosine, C variety presented a higher concentration (1.297 and 0.729 g/100g dry basis). The presence of lysine in the four varieties stand out, without significant differences, the OB presented a slightly higher amount with 0.65 g/100 g. This characterization is interesting to give these grains adequate application in different products such as baking and breakfast snacks.

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# Evaluation of the nutritional and physical properties of bread with addition of popped amaranth flour from four Peruvian varieties

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Since ancient times, amaranth has represented nutritional needs of the inhabitants of the Andes; raw grain flour has generally been used in baking; but popping could improve rheological and digestibility properties. Therefore, the effect of adding popped amaranth flour from four Peruvian varieties was evaluated: Oscar Blanco (OBP), Centenario (CP), INIA 414 Taray (TP), INIA 430 Imperial (IP) at four levels 0, 10, 20 and 30 %; the nutritional, rheological and physics characteristics of loaves of bread were evaluated. The nutritional value was determined by AOAC, viscosity profile by RVA (rapid viscosity analyzer), specific volume (VE), % alveoli area and instrumental color (L*, a* and b*). Breads were obtained with a significant increase in protein and crude fiber content and a decrease in carbohydrates at the highest level of substitution; at this same level, the physical characteristics of the breads differ significantly in VE, % alveoli area and instrumental color, as well as the viscosity profile, which change progressively according to the substitution. Adding of popped amaranth flour in breads improved the nutritional quality and average physical characteristics. The results suggest that breads made with popped amaranth flour could become an interesting proposal; however, it is necessary to continue studying the effect of phytates and minerals from these varieties on breads.

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# Isolation and structural elucidation of metabolites from *Stachys pusilla* (Wedd.) Briquet ("cancer grass"), phytochemical and antibacterial analysis of the hydroalcoholic extract

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*Stachys pusilla* (Wedd.) Briquet ("cancer grass") of the *Lamiaceae* family is traditionally used in wounds that are difficult to heal. Due to the limited chemical information available, a phytochemical study of the hydroalcoholic extract was carried out to isolate and elucidate, by NMR spectroscopy, the major secondary metabolites and to analyze the antibacterial activity of the extract, prepare a cream and evaluate its photoprotective activity. The samples were collected in Cusco, and taxonomically identified at the Natural History Museum (UNMSM). The entire plant was used, dried, ground, sieved and, by static maceration, extracts with hexane and ethanol were obtained. The hydroalcoholic extract was washed with a mixture of Hex:DCM:MeOH (2:1:1) and a series of column and thin layer chromatography were performed on the insoluble part. The fractions obtained were analyzed by NMR and, depending on the definition and intensity of the spectral signals, those of interest were purified. From the spectra (1H and 13C, DEPT 135, HSQC, HMBC, COSY) the structural proposal of three different molecules was determined: chlorogenic acid, verbascoside and 7-(6-O-acetyl-α-D-glucose β-D-- hexose)-3',5-hydroxy-4'-methoxyflavone. The cream, based on an aqueous fraction, exhibited 88.25 % photoprotection, while the hydroalcoholic extract presented moderate antimicrobial activity against strains of *Staphylococcus aureus* and *Pseudomona aeruginosa* with 40-42 % inhibition. These activities are directly related to the number of total phenols, being 94.05 mg GA/mL of extract. The higher its value, the fractions and/or the extract may become a possible candidate for future applications as a natural antioxidant.

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# Development of nuggets with quinoa (*Chenopodium quinoa*) and protein hydrolyzed from scallops (*Argopecten purpuratus*) visceral by-products

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Quinoa (*Chenopodium quinoa*) is a cereal native to the Andean regions of South America and is one of the best sources of vegetable proteins and amino acids. In Peru, are processed more than 89,872 tons of scallops, generating around 8 %-35 % by-products with a high protein, mineral and other bioactive compounds content. The objective of this work was to develop nuggets with quinoa and protein hydrolyzed of scallop's visceral by-products and to assess nutritional, sensory, and microbiological qualities. The protein hydrolyzed was obtained by optimization using the response surface methodology, with a degree of hydrolysis of 24.99 %, protein (71.67 %) content and a balanced amino acid profile according to FAO/WHO. Then, the protein hydrolyzed (4.2 %) was used to develop the nuggets with cooked quinoa (20.5 %), bonito (*Sarda sarda*) fish (54.2 %), egg white (21.1 %), salt and pepper (0.1 %), compared with commercial nuggets. The mixture was shaped, breaded and cooked at 180 °C for 15 min and stored at 4 ° C in aluminized bags. Nuggets showed a higher protein (16 %) content, low carbohydrate (45.74 %), ash (3.08 %), and low fat (4.54 %) than the control samples. The nuggets were accepted by the panel evaluators, complied with the microbiological requirements. Therefore, these nuggets can be a healthier alternative product to contribute with the reduction of child malnutrition.

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# Assessment of nutritional and technological properties of pasta enriched with quinoa flours and its fibres fractions obtained by the wet milling process

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The wet milling process facilitates the separation and extraction of the grain's chemical components (starch, fibre, lipids, and proteins). Utilising these quinoa fractions as functional ingredients, instead of whole flour, allows for the valuation of the potential of these co-products. Quinoa fibre-rich fractions (QFRF) provide a substantial source of dietary fibre with high techno-functional potential and nutritional value. This is associated with a higher level of bioactive compounds in the fibres, which have antioxidant capacity and could offer biological activity and health benefits. The aim of this research was to evaluate the impact of partially substituting wheat flour with 5-10 % QFRF (white, red, and black) on the nutritional and technological quality of fresh pasta. The results were compared to formulations of a) wheat flour (control) and b) a 25 % substitution level with whole quinoa flours. Incorporating a small proportion of QFRF increased the total dietary fibre (TDF) of fresh pasta by more than 50 % compared to the control, while its technological quality was not significantly adversely affected. The QFRF exhibited higher antioxidant capacity values than quinoa grain and a lower phytate content due to its solubilization in the steep water during the wet milling process. Consequently, the calcium and zinc in pasta with QFRF would be bioavailable according to the mineral bioavailability molar ratio, whereas in pasta with whole quinoa flour, mineral availability was compromised. The TDF of formulations enriched with QFRF was 23-42 % higher than those containing the corresponding whole quinoa flours. Therefore, consuming 100 grams of fresh pasta enriched with QFRF of quinoa can provide approximately 35 % of the recommended daily amount of fibre for adults, according to WHO/FAO and EFSA guidelines (25 g per day).

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# Development of cookies with quinoa (*Chenopodium quinoa*) and cushuro (*Nostoc sphaericum*) flours

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About 12.2 % of children under five years of age suffer from chronic childhood malnutrition in Peru. Cushuro (*Nostoc sphaericum*) is a viscous spherical microalga from high Andean areas of Peru (>3000 meters above sea level), and contain protein, polysaccharides and minerals. The objective of this research was to develop high nutritional value cookies with the inclusion of quinoa (*Chenopodium quinoa*) and cushuro (*Nostoc sphaericum*) flours. Cushuro was collected of the lakes in the district of Cotaparaco, Province of Ancash region-Peru. Three cookies' formulations were developed with quinoa flour (0 – 20 %), cushuro flour (0 – 15 %), and sweet potato flour (0 – 20 %) and compared with commercial cookies. The inputs were mixed, kneaded and baked at 170 °C for 15 min. The cookie selected had a similar carbohydrate (66.99±0.14 %) content and protein (6.83±0.04 %) than commercial protein cookies but a higher vitamin C (23.09±0.20 mg/100 g of cookie) content and vitamin B12 (1.32±0.15 μg/100g of cookie) content. Also, the cookie showed high minerals content such us: calcium (228.8 ± 18.30 mg/kg), phosphorus (214.1±17.1 mg/kg), magnesium (33.4±2.67 mg/kg), potassium (297.5±23.8 mg/kg) and iron (3.4±0.27 mg/kg), whereas the heavy metals were not detected. The cookie developed had a high sensory acceptance (93 %) and complied with the Peruvian legislation of the Healthy Law No. 30021 (2013) and with the microbiological requirements. A 50 g package of cookies could provide the daily requirement of calcium (14.3±1.14 %), phosphorus (21.41±1.71 %), magnesium (12.84±1.03 %), potassium (6.46±0.52 %) and iron (17.00±1.36 %) for children under 5 years according to the National Institute of Health (2022) and Institute of Medicine (1997). Quinoa and cushuro flour can be used as inputs to develop cookies to help reduce child malnutrition.

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# Estimation of cooking times and consumer preference for 35 varieties of Chilean beans (*Phaseolus vulgaris*)

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Beans are the main legumes for human consumption, providing nutrients and phytochemicals that have health benefits. The Plant Genetic Resources Bank of Instituto de Investigaciones Agropecuarias (INIA) Quilamapu Chillán, Chile, has 1200 bean accessions of which little is known about their culinary characteristics and consumer preference. The objective was to determine the cooking times and consumption preferences of 35 varieties of Chilean beans. The beans were provided by the Phytogenetic Bank of INIA Quilamapu, Chile, the cooking time was determined in a Mattson cooker with 25 needles after soaking (18 hours), and the preference survey was carried out with 325 people between 16 and 65 years of age in the regions of Ñuble and Biobío, Chile. The surveys indicated that the 10 varieties with the highest preference according to appearance were curi, mantequilla, pinto, cachiporra, plomo 100 días, hallado, sapito-qui 1269, blanco, rubí and sapito-qui 1273, with the variety plomo 100 días being the first preference. torcaza, sapito-qui 1273, and Manteca stand out for their cooking time (33-34 min). Most of the respondents (regardless of gender) stated that they consume beans 4 or more times a month, and consider that cooking time, cleanliness, lower price, soft texture, and packaging are relevant attributes, and for people over 30 years of age, it is essential to have new varieties when purchasing beans. The results obtained are valuable for a better understanding of bean consumption in the region.

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# Study of the release kinetics of capsaicin extracted from charapita chili from an O/W emulsion with sacha inchi oil and encapsulated in calcium alginate beads

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Capsaicin has multiple applications such as analgesic for muscle pain, anti-inflammatory, anticancer, antidepressant, and others. It is a lipophilic compound that produces irritation; therefore, for its application, it is necessary to encapsulate it in emulsions or biopolymers. The objective of this work was to prepare a direct O/W emulsion containing capsaicin extracted from charapita chili (*Capsicum frutescens*) with sacha inchi oil as the oil phase and encapsulated in calcium alginate beads intending to increase the useful life of the capsaicin. Capsaicin was extracted from charapita chili using ethanol as a solvent agent in a Soxhlet apparatus. The extract was dissolved in sacha inchi oil, in a ratio of 1:2, and added to a solution of calcium alginate (emulsifying substance), in a ratio of 1:4, through constant stirring at 500 rpm. To obtain the calcium alginate beads, the emulsion was dripped onto a 0.2 M solution of calcium chloride CaCl2 by using a peristaltic pump and then washed and dried in an oven at 40 °C for 1 h. To study the release kinetics of capsaicin, 5 g of beads were placed in a glass containing 500 mL of distilled water and alcohol in ratio of 1:3. The kinetics followed using UV/visible equipment at a wavelength .The release kinetic was described by Korsmeyer-Peppas model; the constants equation values were K=20.18 and n=0.32, where the value n ≤ 0.43 indicates that capsaicin release from the beads corresponds to Fickian diffusion and maximum release of capsaicin was obtained after 120 minutes. The emulsion obtained could be used to develop pharmaceutical products; meanwhile, the encapsulated emulsion in calcium alginate could be used in the formulation of functional foods to take advantage of the capsaicin from charapita chili and sacha inchi oil functional properties.

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# Chemical characterization of oils extracted from Andean seeds

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Tarwi and cañihua seeds, also known as Andean lupin (*Lupinus mutabilis*) and cañahua (*Chenopodium pallidicaule*), respectively, are a significant part of the diet of the Andean region, particularly in the highlands of Bolivia, Peru and Ecuador. These seeds are valued for their rich nutritional profile and potential health benefits, being an excellent source of high-quality protein, dietary fiber and polyunsaturated fatty acids. As a legume, tarwi is remarkably rich in protein and oils, making it a beneficial crop for food and cosmetic applications. Cañihua is an amaranthaceous relative of quinoa and grows under very harsh environmental conditions and is even more resistant to frost than quinoa. Cañihua has a very high content of carbohydrates and oil. Consumption of products containing tarwi and cañihua oil has been associated with potential health benefits, such as the reduction of cholesterol and triglyceride levels.

Vegetable oils extracted from tarwi and cañihua seeds are attractive for their fatty acid composition, antioxidant capacity, phenolic compounds and fat-soluble vitamins such as tocopherols. The work shows the chemical characteristics of tarwi and cañihua oils extracted with different solvents and the benefits they can provide. The values obtained for total antioxidant capacity (TAC) and total phenolic compounds (TPC) were 1.63 ± 0.20 mM Fe Eq and 6.12 ± 0.01 mM GAE, respectively, for oils extracted from tarwi seeds with ethanol. For cañihua oils the values obtained were 1.37 ± 0.45 mM Fe Eq for TAC and 2.99 ±0.03 mM GAE for TPC. These oils are rich in saturated, mono- and polyunsaturated fatty acids; the most representatives were C16:0 (palmitic acid), C18:1-n9 (oleic acid), C18:2-n6 (linoleic acid) for tarwi oils and C18:1-n9 (oleic acid), C18:2-n6 (linoleic acid), and C18:3-n3 (α-linolenic acid) for cañihua oils, each contributing to the unique chemical and functional properties of each oil.

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# Techno-functional potential of sonicated tarwi (*Lupinus mutabilis* Sweet) okara for emulsion development

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Tarwi (*Lupinus mutabilis* Sweet) processing generates a residue called tarwi okara (OK). This research evaluated the potential of sonicated tarwi okara for developing vegan emulsions with low oil content. Two sonication treatments were performed: one before the alkaline extraction of proteins (OKS1) and the other after (OKS2). Techno-functional properties, such as water retention capacity (WRC), oil retention capacity (ORC), emulsifying stability index (ESI), and swelling capacity (SC), were evaluated. Emulsions (O/W; 30:70) with 4 % and 6 % OK, OKS1, and OKS2 were prepared, and their stability was assessed through light scattering, particle size distribution, and flow behavior. Sonication increased all the techno-functional properties: WRC (27 %), ORC (37 %), ESI (577 %), and SC (31 %). The emulsion with 4 % OKS2 was stable for 24 h, similar to emulsions with 6 % OK, OKS1, and OKS2. Emulsions with 4 % OKS2 had a larger droplet size (D4,3:109.1 μm) than those with 6 % (D4,3:95.5 μm). All emulsions exhibited pseudoplastic behavior and fitted the Herschel-Bulkley model. The emulsions with 4 % and 6 % OKS2 showed higher initial shear stress and greater consistency. This study demonstrates that the sonication of tarwi okara significantly improves its techno-functional properties, making it suitable for the development of specialty foods such as healthy and sustainable vegan emulsions.

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