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INTERNATIONAL CONFERENCE ON SUSTAINABLE FOODS

Achieving the Sustainable Development Goals

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Book of Abstracts

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Title

International Conference on Sustainable Foods - Achieving the Sustainable Development Goals

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URL

https://icsf.morecolab.pt/

ICSF CONFERENCE

European consumers have become more attracted to food formulations with sustainable ingredients, as they are perceived as products of fine organoleptic properties with additional health promoting benefits. Moreover, it is necessary to maintain an effort to secure the 2030 target for all the UN Sustainable Development Goals, via both innovation efforts and dissemination of knowledge. Hence, a lot of R&D&I work has been done into a food value chain with innovative processes and new formulations that focus on the use of sustainable ingredients.

The International Conference on Sustainable Foods – Achieving the Sustainable Development Goals (ICSF) that takes place in Bragança, Portugal, aims to disseminate knowledge regarding innovative processes and the development of sustainable food products. It brings together researchers, industry professionals, and consumers to share innovative ideas in this field, and to present results from their work on this area with a special focus on the sustainable food innovation in the Mediterranean and the development of sustainable vegetable pulps formulations.

The **ICSF** also presents itself as an opportunity to disseminate the results of three key projects for the Mediterranean region: PRIMA **LocalNutLeg** and **Pulping,** and Interreg **Transcolab Plus**.

The **LocalNutLeg** project main goal is to empower local Mediterranean nuts and legumes with a legal registered trademark (Protected Designation of Origin (PDO), Protected Geographical Indication (PGI)) or autochthonous identity through the development of innovative plant-based added-value food products tied to recover the attractiveness of the Mediterranean diet. The project aims to identify local nut and legumes varieties linked to Mediterranean gastronomic cultures, providing alternative-protein and maximum amount of nutrients and bioactive compounds and adopting them in Mediterranean diets through their use in plant-based dairy analogues, potential plant-based flours for bakery and pasta and added-value traditional ready-to-eat meals.

The **PulpIng** project has 11 partners from 6 different countries and aims to stimulate and improve the sustainable valuation of pumpkin in African and European countries in an integrated and waste-free manner, using innovative processing and preservation technologies. The project is expected to generate an entire value chain, from nature to safe food products/ingredients, improving incomes, creating jobs, and promoting local economies in the Mediterranean region.

Transcolab Plus is the continuation of the successful TransCoLab project. As a follow-up, TransCoLab Plus project wants to seek solutions against the significant food waste generated in the cereal processing industries through the development of new by-products and new utilization processes. To meet this objective, the strengthened and dynamization of the already existing cross-border network is needed. It will result in the generation of new knowledge and development of innovative techniques based on sustainable practices. All of this, in turn, pursues having a positive impact in the economic sector and the population in the cooperation area.

The **ICSF** also includes the presentation of others international projects, represented by their respective coordinators, namely PRIMA Foundation Medacornet, Promedlife, Artisanefood,

Proximed, Trace-Rice, Inovfarmer.Med and Funtomp projects, and Horizon Europe Wasteless project. Submitted works were received, processed, divided into two main categories (Oral Communications and Posters), and later distributed according to the afore mentioned topics. In total, 6 oral communications and 56 Panel Communications was presented, joined by 3 Keynotes and 2 Plenary lectures.

The organizing committee would like to address words of appreciation to all for attending our conference, and we hope to see you again in future research events.

THE CONFERENCE COMMITTEE

Scientific committee

Alexandre Gonçalves (MORE, Portugal)

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João Barrreira (CIMO/IPB, Portugal)

Eliana Pereira (CIMO/IPB, Portugal)

Filipa Mandim (CIMO/IPB, Portugal)

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PLENARY/KEYNOTES/INVITED SPEAKERS INFORMATION

Session 1: Innovative and sustainable food ingredients and products

Isabel Ferreira

Title: *Science and Innovation in the AgriFood Sector*

Isabel Ferreira, former Secretary of State for the Enhancement of the Interior and Regional Development of the XXII and XXIII Constitutional Governments. Currently, she is a Member of the Assembly of the Portuguese Republic and Vice-President of the PS parliamentary group. She is a Principal Coordinating Professor of the Polytechnic Institute of Bragança, of which she was Vice-President, Director of the Mountain Research Center and Mentor of the MORE and AQUAValor Collaborative Laboratories.

She coordinated the Scientific Council of Natural and Environmental Sciences of the Portuguese Foundation for Science and Technology, was a member of the Advisory Board of the Science Foundation - Flanders (FWO), and a member of the Committee of Experts monitoring the European Framework Programmes H2020 and Horizon Europe.

She is one of the most cited researchers in the world (top 1%), having been distinguished in the last 9 years in the Essential Science Indicators index, one of the most prestigious indicators of research quality. Her work includes the publication of 4 international books, 60 book chapters, more than 900 scientific articles and several national and European patents, most of them resulting from technology transfer to industry, some of them being the basis for the creation of spin-offs.

She received several distinctions such as the Gulbenkian Prize for Stimulating Scientific Research; the recognition for the dissemination of Portuguese science in the world, and mentioned by Ciência Viva - National Agency for Scientific and Technological Culture, in the book Women in Science; In 2019 she received the European Social Innovation Award from the European Commission; in 2022 she was distinguished by Superbrands as a personality of excellence in the area of Science.

Ana Machado Silva

Title: *Sustainability and food innovation: a retailer's experience*

Ana Machado Silva is Area Coordinator for R&D and Incentives at MC, the largest food retailer in Portugal. She coordinates a team dedicated to the development of collaborative R&D and Innovation projects in the areas of food development, sustainability and energy transition. Several of those projects have tackled the challenges of improving food sustainability through science and innovative approaches. She has extensive experience in managing both National and European projects where universities, research centers, private companies and other stakeholders combine their expertise to tackle key challenges of the food value-chain. Ana is also a regular member jury of Ecotrophelia Portugal, a competition that fosters innovation and entrepreneurship in the European food sector and awards the best eco-innovative and sustainable food products.

Manuela Pintado

Title: *Agrofood Byproducts as a Source for New Food Ingredients for Sustainable and Healthier Diets*

Graduated in Pharmaceutical Sciences from the University of Porto and a PhD in Biotechnology from the Portuguese Catholic University. As an Associate Professor at the School of Biotechnology, she works at the interface between Microbiology and Health. She has developed numerous R&D+I projects (with national and international companies and scientific institutions) in the areas of valorization of by-products and waste, production and characterization of bioactive compounds, functional foods and natural antimicrobials. She is the Director of the CBQF Research Center - Center for Biotechnology and Fine Chemistry.

Title: *Advancing the Utilization of Plant-Protein-Rich Ingredients for a Sustainable Food Supply*

Laura Román is a Ramón y Cajal principal researcher working at University of Valladolid (Spain). Her current research efforts center on the understanding of the molecular details of structure formation in plant-based food systems. After completing her PhD in Food Engineering (University of Valladolid), she joined the University of Guelph (Canada), working on polysaccharides biochemistry and extrusion processing of plant-based food for a sustainable and nutritious food supply. Later, she joined Aarhus University (Denmark) with a postdoctoral fellowship funded by the Novo Nordisk Foundation, of which she was also principal investigator, broadening the scope of her research to understanding the functionality of plant proteins. In 2021, she won the prestigious L'Oréal-UNESCO For Women in Science research award, as one of the top 3 young women scientists in Denmark. In 2022, she received the internationally recognized Nils Foss Talent Prize as a young research talent for her work in the application of analytical technology to improve the quality of our food systems.

Beatriz Oliveira

Title: *Olive pomace: a sustainable source of health ingredients*

M. Beatriz P.P. Oliveira is Full Professor from University of Porto, Faculty of Pharmacy; Director of the Master Course in Quality Control; member of the EFSA Scientific Network for Risk Assessment of GMOs; and member of a specialized committee from ASAE. She is the Head of GRESA, a REQUIMTE / LAQV research group which includes PhD researchers and PhD and MSc students. She supervised several students as well as co-authored publications in international journals, in national journals, book chapters; and communications in national and international meetings. The developed work includes food science and security, environmental sustainability and evaluation of by-products focused on their valorization by environmentally friendly and sustainable methodologies. She has an extensive collaboration with companies in the food sector and several award-winning works. She has 4 granted patents and 3 under evaluation.

Nuno Mateus

Title: *Novel foods for new consumers trends*

Nuno Mateus graduated in Biochemistry and obtained his PhD in Chemistry in 2002 both at the University of Porto (Portugal). He has been teaching at the University since 2001 and is currently Full Professor at the Department of Chemistry and Biochemistry of the Faculty of Science at the University of Porto, where he has been teaching Food Chemistry and Industrial Biochemistry (among other courses). His field of research concerns food chemistry and biochemistry, essentially food polyphenols and in particular red wine chemistry. He has been collaborating with local industrial companies (especially Port wine companies) and has been involved in several research projects funded essentially by the Portuguese Government. One of his main areas of research deals with the bioavailability and biological properties of food phenolics towards some cancers and age-related diseases. He also started a line focused on the recycling pf polyphenols from industrial wastes to use them in novel cosmetic formulations. Presently, he is involved in the development of novel foods and ingredients by using sustainable approaches from natural resources.

José Teixeira

Title: *Ohmic heating – a sustainable technology for the extraction of bioactive compounds*

José António Teixeira is currently Professor at Biological Engineering Department, University of Minho He has a degree in Chemical Engineering from University of Porto (1980) and a PhD in Chemical Engineering also from University of Porto (1988). José António Teixeira has been developing his research activities in two main areas Industrial Biotechnology (including bioprocess development for the valorization of agro-industrial residues and new design bioreactors and continuous processing) and food biotechnology (including non-conventional food processing and food nanotechnology) (https://www.ceb.uminho.pt/People/Details/e822cb82-acf1-4e0e-b026-6a62b6ed83f4). José Antonio Teixeira is author/co-author of over 700 peer reviewed papers corresponding to an Hindex (Scopus) – 97 and has been named Highly Sited Researcher since 2018.

Session 2: Prima initiatives – Sustainable Innovation in the Mediterranean

Anastacia Mantzari

Anastasia Mantziari is Policy Officer at European Commission and DG Research and Innovation. The doctoral research focused on assessing the stability of probiotics in human milk during storage, determining the effect of human milk fortifiers (HMFs) on the adhesion properties of probiotics, and investigating the impact of HMFs, cold storage and pasteurization on the human milk microbiota composition.

Rosalinda Scalia

Rosalinda Scalia is Deputy Head of Unit for Bioeconomy & Food Systems. She is linked with the area of Research and Innovation with design and implementation of EU policy and programmes in the area of Food, Bioeconomy, Natural Resources, Agriculture and Environment research. She is also linked with Plant Health Policy (EU Plant Health legislation; EU official controls of the food chain; Free Trade Agreements), Plant stress effects and alleviation and Organic farming and crop science.

Mohamed Wageih

Project Officer @PRIMA Secretariat Barcelona. Certified STI professional and M&E Specialist from ILO with a track record of expertise in EU projects. Prior to PRIMA, he served as the Director of the Observatory of Business Innovation at a private University and held a pivotal role as an EU Project Coordinator at the Academy of Scientific Research. He was an R&I consultant at various Egyptian and European institutes. Over the years, he successfully developed a portfolio of over 25 EU-funded projects (EuropeAid, FP7, H2020, Horizon Europe, DG NEAR …) across Egypt, Europe, the Middle East and Africa, reflecting his deep understanding of international cooperation and R&I dynamics. Currently, I'm monitoring more than 45 projects spanning Europe and the MENA region. His visionary leadership has led to the creation of innovative tools such as PRIMA Intelligent Analytical Tool and PRIMA M&E Platform. He has enriched his knowledge through specialized internships at prestigious institutes (UNESCO, WB, DLR, Manchester Univ….) Moreover, he has co-authored several policy reports and a book chapter, represented PRIMA at numerous international conferences, and delivered various training sessions at EU-Mediterranean countries.

Maria Maia

Title: *The role of the Partnership for Research and Innovation in the Mediterranean Region (PRIMA) in Portugal*

Maria Maia is a senior scientific and policy officer, International Relations Department at Fundação para a Ciência e a Tecnologia, I.P. (www.fct.pt). Since 2009, Maria is following and participating in the Euro-Mediterranean policy dialogue on research and innovation and its implementation through several initiatives and partnerships, as PRIMA. She also participates in similar European Union science and innovation processes with other regions of the world. She is PT delegate to several European *fora* for International Cooperation on Science and Technology and participant in several European Partnerships. Maria holds experience of 16 years, as a researcher in agroecology and terrestrial ecology, in several research units in Portugal and The Netherlands, participated in dozens of European projects since the 5*th* Framework Programme in research and national research projects and a decade of experience as a consultant for several SMEs.

Ingrid Aguiló-Aguayo

Title: *LocalNutLeg - Developing innovative plant-based added-value food products through the promotion of LOCAL Mediterranean NUT and LEGUME crops.*

See more information about the project LocalNutLeg in https://localnutleg.eu/

Dr. Ingrid Aguiló is a Ramón y Cajal researcher in the Research group of Processed Fruits and Vegetables that belongs to the Postharvest Program of IRTA in Lleida. She has a PhD in Agricultural Engineering from the University of Lleida, specialized in the field of new technologies for the processing of plant-based foods. She carried out different postdoctoral stays in international centers such as INRA (France) and Teagasc (Ireland). She is closely linked to projects focused on the valorization of surpluses or co-products of the fruit and vegetable chain through the development of new ingredients that allow their integration into the food value chain. Among the different projects managed, the EU-Agrimax project stands out, in which different by-products from the tomato, cereal and olive industry have been valued, obtaining valuable food ingredients. Few years ago, she began the exploration of new sources of protein through the exploration of legumes and microalgae and their incorporation into the reformulation of foods. She is currently the coordinator of an EU-PRIMA (LOCALNUTLEG) project that explores the legumes and nuts of the Mediterranean region to develop products of high nutritional and gastronomic value rich in protein.

Pedro Babo

Title: *Medacornet – Rescuing acorns as a Mediterranean traditional superfood.*

See more information about the project Medacornet in https://medacornet.eu/

Pedro Babo graduated in Microbial Biology and Genetics in 2007 and completed his Master's degree in Molecular Biology and Genetics in 2008 from the Faculty of Sciences of the University of Lisbon in the study of genetic variability and agronomic characteristics of temperate rice. In 2010, he was awarded a doctoral scholarship from FCT, having established lines of research in endodontic regenerative therapies. During his academic career he published 29 articles (8 as first author) and 3 book chapters. From 2017 to 2021 he was a Guest Professor at the Univ. Minho, and since 2022 he has been a guest professor at the Univ. from Cuenca (Ecuador). He is co-founder and the scientific director of LANDRATECH.

Luana Bontempo

Title: *PROMEDLIFE - Novel food products for the promotion of Mediterranean lifestyle and healthy diet*

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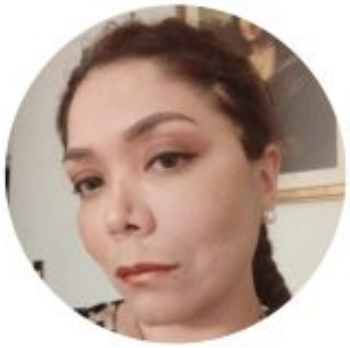
See more information about the project PROMEDLIFE in https://promedlifeproject.eu/

Luana Bontempo is a researcher at Fondazione Edmund Mach (Italy), where she is currently the Head of the Traceability Unit. She graduated in Pharmaceutical Chemistry and Technology at the University of Padua (2001). Subsequently, she got a post-graduated specialization degree in Chemical Methodologies for Survey and Analysis at the University of Padua (2004) and a PhD in Food Sciences at the University of Udine (2011). Her current research activity is mainly focused on developing analytical methods for applying stable isotope ratio analysis to characterize and trace along the production chain many foodstuffs, in particular products of high value (e.g. Geographical Indication's products). Recently she is also developing methods for applying stable isotope ratios to ecology (i.e. bird migration, ungulates trophic niche). She has published more than 80 ISI papers. She is currently involved in several national and European projects and is coordinating PRIMA ProMedLife project (https://promedlifeproject.eu/).



Ursula Gonzales-Barron

Title: *ArtiSaneFood – Innovative bio-interventions and risk modelling approaches for ensuring microbial safety and quality of Mediterranean artisanal fermented foods*

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See more information about the project ArtiSaneFood in https://www.ipb.pt/artisanefood/

Dr Ursula Gonzales-Barron is a Peruvian-Irish national. She is a Food Engineer (Honours graduated) from the National Agricultural University La Molina, Peru, and holds a PhD in Biosystems Engineering from University College Dublin, Ireland. She is currently Principal Investigator at the CIMO Mountain Research Centre (Polytechnic Institute of Bragança, Portugal) where she leads the "Food Safety and Quality Analytics" research team. She has published over 150 peer-reviewed articles, and has led several international projects funded by EU and EFSA. She is Editor in three peer-reviewed journals; and acts as President of the International Committee on Predictive Modelling in Food (ICPMF), as Expert Member in ISO/TC34/SC9/WG19 (International Organization for Standardization, Genève), and as Effective Member in the Normalization Technical Committee CT 061 (Microbiology in the Food Chains) of the Instituto Português de Qualidade (IPQ, Lisbon). Dr Ursula Gonzales-Barron has been an Expert Member of the Expert Consultation Meeting on Microbial Risk Assessment (JEMRA, 2019) and of the two JEMRA Expert Consultation Meetings on microbiological risk assessment of Listeria monocytogenes in foods (2022-2023) of the Food and Agriculture Organization of the UN (FAO). Dr Ursula Gonzales-Barron has been on two occasions a Consultant of the World Health Organization (WHO, 2022; 2023).

Manuela Pintado

Title: *ProxiMed – Exploration and implementation of products with alternative proteins in Mediterranean region*

See more information about the project ProxiMed in https://proximedprima.eu/

Graduated in Pharmaceutical Sciences from the University of Porto and a PhD in Biotechnology from the Portuguese Catholic University. As an Associate Professor at the School of Biotechnology, she works at the interface between Microbiology and Health. She has developed numerous R&D+I projects (with national and international companies and scientific institutions) in the areas of valorization of by-products and waste, production and characterization of bioactive compounds, functional foods and natural antimicrobials. She is the Director of the CBQF Research Center - Center for Biotechnology and Fine Chemistry.

Carla Brites

Title: *Trace-Rice - Tracing rice and valorizing side streams along Mediterranean blockchain*

See more information about the project Trace-Rice in http://trace-rice.eu/

Carla is senior researcher in Food Science & Technology at INIAV- Institute for Agrarian and Veterinarian Research in Portugal, specializes in developing appealing and healthy cereal-based products. Her approach encompasses leveraging genetic diversity, refining research methodologies, and pioneering value-added innovations to address shifting consumer preferences. With extensive experience in research project management, she integrates safety, nutrition, and sensory attributes to enhance the quality of products. Since 2014, Carla has contributed actively to European Bioeconomy research policy support, playing a key role in the H2020-SC2 Programme Committee and as a member of the Standing Committee on Agriculture Research (SCAR). Currently, she serves as a Research & Innovation officer within the Innovation & Knowledge Exchange team of EIP-AGRI, the European Common Agricultural Policy (CAP) Network. Engaged in various international and national consortia, Carla currently leads the TRACE-RICE PRIMA project, focusing on traceability, authenticity, contaminant mitigation, and innovative rice-based food production in the Mediterranean. Additionally, she actively participates in three Horizon projects: RefreSCAR, European Partnerships Agroecology, and FutureFoodS, with commitments extending until 2027.

Dulcineia Wessel

Title: *InovFarmer.MED - Improving Mediterranean supply chain through innovative agro-food business models to strengthen small-scale farmers competitiveness, using prickly pear and fig as case study*

See more information about the project InovFarmer.MED in https://inovfarmer-med.org/pt-pt/

Dr. Dulcineia Ferreira Wessel is a Professor of Chemistry at Polytechnic Institute of Viseu, Portugal. Her area of expertise is value creation of natural based materials for one-health. Valorization of endogenous resources in rural development and territory cohesion. DFW has implemented within 12 years, 11 RD&I projects at IPV, such as Waste2Value, Forest4Future-PP21, BagaConValor and Monitor2030, in cooperation with the industry, leading multidisciplinary teams at national and international level, fostering innovation and generated valuable knowledge that led to beneficial outcomes for small and medium-sized enterprises. Some main new ideas focused on valuing traditional agri-food products, biowaste and by-products towards a more circular and resilient economic ecosystem. Presently coordinator of the EU project InovFarmer.MED.

Mecit Oztop

Title: *FunTomP - Functionalized Tomato Products*

See more information about the project FunTomP in https://funtomp.com/

Prof. Mecit H. Öztop is a faculty researcher in the Department of Food Engineering at Middle East Technical University (METU), specializing in food processing technologies and sustainability. He got his PhD degree from University of California, Davis in 2012 and later returned to Türkiye . He has experience in valorizing food industry by-products, processing technologies and using non destructive analytical techniques to assess food quality and safety. Prof. Öztop is coordinating a PRIMA initiative FunTomP, focusing on functional tomato products that has the aim to reformulate traditional Mediterranean products using novel technologies. Recently he has been involved in another PRIMA project: ProxIMed that focuses on alternative protein production. Additionally, he has been coordinating the Marie Curie RISE project SuChAQuality and partner in the Staff Exchange project NMR Improv, aimed at improving food chain using non destructive techniques for food quality assessment. His work not only advances scientific knowledge but also promotes practical applications for sustainable food processing.

Session 3: InovaPulpIng – Development of sustainable vegetable pulps formulations

Lillian Barros

Title: *Development of Pumpkin Pulp Formulation using a Sustainable Integrated Strategy*

See more information about the project Pulping in https://pulping-prima.eu/

Lillian Barros is a Principal Researcher at the Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança and vice-coordinator of CIMO and vice-director of the Associate Laboratory SusTEC. She obtained her degree in Biotechnology Engineering (2002) at the Institute Polytechnic of Bragança and obtained her PhD "Doctor Europeus" in Pharmacy (Nutrition and Bromatology) at the University of Salamanca (2008). She has published more than 700 indexed papers, within the highest impact factor journals in Food Science and Technology area and has an 81 h-index. She has edited several books and book chapters, registered national and international patents, and is principal researcher of several national and international projects. Her scientific work has raised interest and has led to the supervision of several post-doc, PhD, and master students. She has received awards from several different organizations. L.B scientific production has been very relevant and has reached top positions in the world rankings (Highly Cited Researcher in Clarivate since 2016). Her research targets are mainly in the identification, separation, and recovery of functional molecules from different natural products.

Session 4: Current advances in sustainable foods

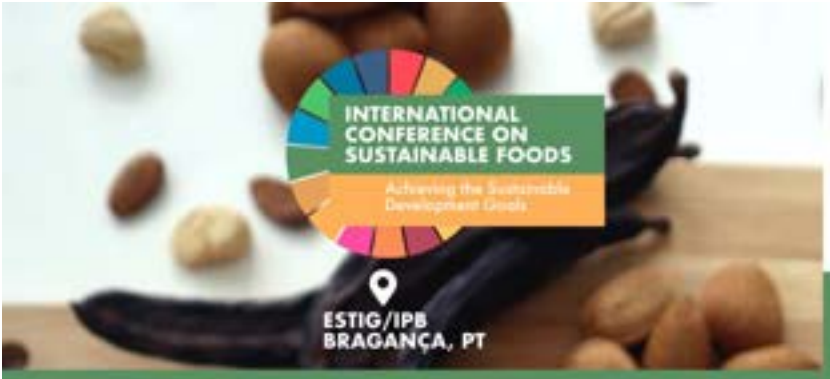
Ana Novo Barros

Title: *"Wasteless - Waste Quantification Solutions to Limit Environmental Stress"*

See more information about the project Wasteless in https://wastelesseu.com/

Graduated in Food Chemistry and a Master in Chemistry of Natural Products and Foods from the University of Aveiro, PhD in Chemistry from the University of Trás-os-Montes and Alto Douro. She took the Aggregation exams in Chemical Sciences in January 2017. She was director of several Bachelor's, Master's and Doctorate courses. She carries out her research in the area of valorization of by-products from the food industry, having supervised 3 post-docs, 11 PhD theses and 58 Master's theses. She has published more than 120 peer-reviewed scientific articles. She is currently President of the Food Chemistry Division of the Portuguese Chemical Society. She coordinated the R&D area at a cosmetics company for 1 year. She has coordinated several Scientific Projects, and is currently Coordinator of a European Project, Wasteless-Waste Quantification Solutions To Limit Environmental Stress, with a global amount of 5,5 million euros.

AGENDA



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July 24th

09:00 Opening session

Orlando Rodrigues (IPB)
Albino Bento (MORE CoLAB)
Getúlio Igrejas (ESTIG, IPB)
José Alberto Pereira (CIMO, IPB)
Lillian Barros (CIMO/IPB)
Alexandre Gonçalves (MORE CoLAB)

Session 1: Innovative and sustainable food ingredients and products

Moderator: João Barreira (IPB)

09:30
Isabel Ferreira (IPB and Member of the Portuguese Parliament)
Science and Innovation in the AgriFood Sector

10:00
Plenary Speaker: Ana Machado Silva (SONAE)
Sustainability and food innovation: a retailer's experience

10:30
Keynote Speaker: Manuela Pintado (UCP)
Agrofood Byproducts as a Source for New Food Ingredients for Sustainable and Healthier Diets

11:00 Poster Sessions / Coffee Break

Moderators: Márcio Carocho and Sandrina Heleno (IPB)

Invited Speakers:

11:15
Laura Roman Rivas (Universidad de Valladolid)
Advancing the Utilization of Plant-Protein-Rich Ingredients for a Sustainable Food Supply

11:30
Beatriz Oliveira (UPorto)
Olive pomace: a sustainable source of health ingredients

11:45
Nuno Mateus (FCUP)
Novel foods for new consumers trends

12:00
José Teixeira (UM)
Ohmic heating – a sustainable technology for the extraction of bioactive compounds

12:15 Discussion

12:30 - 14:00 Lunch

Session 2: Prima initiatives – Sustainable Innovation in the Mediterranean

Moderators: Carla Pereira and Tânia Pires (IPB)

14:00
Anastasia Mantziari (Policy Officer, DG Research and Innovation)
Rosalinda Scalia (Deputy Head of Unit for Bioeconomy & Food Systems)

14:20
Plenary Speaker: Mohamed Wageih (PRIMA Officer)

14:40
Maria Maia (FCT)
The role of the Partnership for Research and Innovation in the Mediterranean Region (PRIMA) in Portugal

15:00
Ingrid Aguiló-Aguayo (IRTA)
LocalNutLeg - Developing innovative plant-based added-value food products through the promotion of LOCAL Mediterranean NUT and LEGUME crops

15:20
Pedro Babo (LANDRATECH)
Medacornet – Rescuing acorns as a Mediterranean traditional superfood

15:40
Luana Bontempo (Fondazione Edmund Mach)
PROMEDLIFE - Novel food products for the promotion of Mediterranean lifestyle and healthy diet

16:00 Poster Sessions / Coffee Break

Moderators: Maria Gabriela and Adriana Molina (CIMO/IPB)

16:20
Ursula Gonzales-Barron (IPB)
ArtiSaneFood – Innovative bio-interventions and risk modelling approaches for ensuring microbial safety and quality of Mediterranean artisanal fermented foods

16:40
Manuela Pintado (UCP)
ProxiMed – Exploration and implementation of products with alternative proteins in Mediterranean region

17:00
Carla Brites (INIAV)
Trace-Rice - Tracing rice and valorizing side streams along Mediterranean blockchain

17:20
Dulcineia Wessel (IPV)
InovFarmer.MED - Improving Mediterranean supply chain through innovative agro-food business models to strengthen small-scale farmers competitiveness, using prickly pear and fig as case study

17:40
Mecit Öztop (METU)
FunTomP - Functionalized Tomato Products

20:00 Event Dinner

AGENDA

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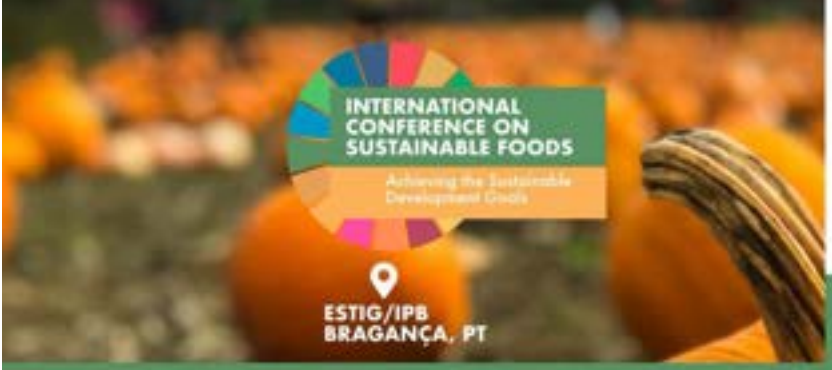

Organized by:

Session 3: InovaPulpIng – Development of sustainable products

Moderators: Luana Fernandes and Ermelinda Silva (MORE CoLAB)

July 25th

AGENDA

09:00
Keynote Speaker: Lillian Barros (IPB)
Development of Pumpkin Pulp Formulation using a Sustainable Integrated Strategy

WP1 – Defining agronomic conditions for pumpkin production
Spyridon Petropoulos (UTH)

WP2 – Sustainable recovery of compounds with preserving capacity from pumpkin by-products
Maria Gabriela (CIMO/IPB)

WP3 – Refinement and stabilization of the identified preserving compounds
Hanen Falleh/Riadh Ksouri (CBBC)

WP4 – Pumpkin fruit pulp formulation
Isabel Oliveira/António Nunes (Decorgel)

WP5 – Preservation studies and quality assessment during shelf-life
Oliver Schlüter /Luma Ribeiro (ATB)

WP6 – Waste and wastewater management and life-cycle assessment (LCA)
Alexandre Gonçalves (MORE)/Joana Pesqueira (FEUP)

Session 4: Current advances in sustainable foods
Moderators: Eliana Pereira and Filipa Mandim (IPB)

10:00 Keynote Speaker: Ana Barros (CITAB/UTAD)
"Wasteless - Waste Quantification Solutions to Limit Environmental Stress"

10:30 Oral communication 1: Andreia Granja (REQUIMTE)
A vegan-friendly nanotechnology approach to counteract vitamin B12 deficiency in plant-based diets

10:45 Oral communication 2: Florencia Parle (Universidade Valladolid)
Enhancing sustainable food structures: the role of plant proteins in their interplay with starch during hydrothermal processing

11:00 Poster Sessions / Coffee Break

11:15 Oral communication 3: Liege Aguiar Pascoalino (CIMO)
Apple pomace as a sustainable source of prebiotics

11:30 Oral communication 4: Muhammed Rasim Gul (Middle East Technical University)
Innovative and Sustainable Tomato Snack Bars: Utilizing Food Waste and Plant Proteins for Functional Products

11:45 Oral communication 5: Pedro Almeida (REQUIMTE)
Development of a chewing gum with Actinidia arguta extract as an innovative mitigation strategy for firefighters occupational exposure

12:00 Oral communication 6: Ana Saldanha (CIMO/IPB)
Valorization of Edible Mushroom Waste in Penne Pasta Production: Fermentation and Nutritional Enhancement

12:15 Discussion and Closing Session

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ORAL SESSION

Session 4: Current advances in sustainable foods

A VEGAN-FRIENDLY NANOTECHNOLOGY APPROACH TO COUNTERACT VITAMIN B12 DEFICIENCY IN PLANT-BASED DIETS

Andreia Granja[1]*, Ricardo M. Ferreira[2], Artur S. Silva[2], Jorge A. Saraiva[2], Susana M. Cardoso[2] and Salette Reis[1]

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The rise of plant-based diets has significantly impacted sustainability by reducing the demand for animal products and driving innovation in the food industry to create more eco-friendly alternatives [1]. However, without adequate supplementation, nutritional deficiencies such as vitamin B12 deficiency may occur, leading to serious health consequences. Therefore, vitamin B12 supplementation is essential in these dietary regimens [2]. Nevertheless, food fortification with vitamin B12 faces challenges such as limited solubility, stability, low absorption, and reduced bioavailability. In this study, vegan-friendly nanostructured lipid carriers (NLC) were specifically designed to encapsulate vitamin B12, aiming to enhance its stability and bioavailability for incorporation into plant-based food products. The NLC composition was rationally chosen, comprising a solid lipid (Compritol) with a high melting point to ensure particle stability during food production and passage through the gastrointestinal tract. *Opuntia ficus-indica* seed oil, obtained through magnetic stirrer-assisted extraction, was used as the liquid lipid, while L-α-Phosphatidylcholine derived from soybean was selected as the surfactant. The produced NLC demonstrated suitable particle size for oral administration, highly negative zeta potential, and an encapsulation efficiency of 55%. These nanoparticles remained stable under different high-temperature treatments and acidic pH conditions, indicating their potential for incorporation into food products during manufacturing. Furthermore, the NLC showed promise in protecting vitamin B12 from harsh gastric conditions, as evidenced by the simulated gastric digestion assays. Moreover, cytocompatibility studies conducted on the L929 cell line (ISO 10993-5) indicated that the NLC were cytocompatible up to a concentration of 17.5 µg/mL of vitamin B12, which is well above its therapeutic concentration. Overall, these findings highlight the promising role of the developed lipid nanosystems in enhancing vitamin B12 bioavailability, presenting a potential solution to mitigate nutrient deficiencies in plant-based diets.

Keywords: Plant-based diet, *Opuntia ficus-indica* seed oil, Vitamin B12, Lipid nanoparticles

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This work aligns with SDJ 3, by enhancing the accessibility of essential nutrients and SDG 12 through efficient use of resources and reduced environmental impact in the production and delivery of nutritional supplements.

ENHANCING SUSTAINABLE FOOD STRUCTURES: THE ROLE OF PLANT PROTEINS IN THEIR INTERPLAY WITH STARCH DURING HYDROTHERMAL PROCESSING

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The shift from animal-derived proteins to plant-based counterparts is essential for reducing the environmental impact of food systems, aligning with the goals of sustainable development of the United Nations. The shift to a diet more focused on plant proteins cannot be achieved without successfully incorporating these alternative proteins into our foods. This study focuses on the interaction between plant proteins and starches, essential biopolymers in the human diet, during food processing, contributing to SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). By understanding these interactions, this study aims to facilitate the integration of plant proteins into new sustainable food products. Two mildly refined plant protein sources (protein content: 45-50%) were characterized: sunflower protein concentrate (SPC), an oilseed where the protein is derived from oil extraction byproducts, promoting resource efficiency and waste reduction; and lupin protein concentrate (LPC), a legume rich in protein and fiber that enhances soil health through nitrogen fixation. The study evaluated protein interplay with two starch types, wheat starch (WS) and potato starch (PS), chosen due to their widespread use in the food industry and their different origin and architecture. To conduct a mechanistic study, the composition, structure and functionality of the matrices were analyzed: including the secondary structure, nativity, solubility, gelation, water absorption, and charge of the proteins, and molecular and size distribution, thermal and pasting properties of the starches. Subsequently, the interplay of starch-protein was evaluated during processing at high moisture, high temperature, and low shear conditions by incorporating 10% and 25% of each protein into a starch-rich matrix. In the resulting gels, the microstructure and textural properties were analyzed and compared to a starch control without protein (CS). Differences in network formation were observed in the mixed matrices, depending on the starch and protein source. Interestingly, in WS systems, higher protein concentrations led to higher peak viscosity (PV), indicating synergy between the proteins and WS. However, this trend was not observed in PS systems. Instead, LPC25% exhibited the lowest PV, while SPC25% showed higher PV than CS. For gel texture, all mixed wheat systems showed greater hardness than CS, especially SPC25%. However, in potato systems, all gel networks were weaker than CS, particularly those with LPC. These differences could be attributed to two main factors: the presence of negatively charged phosphate groups in PS that would repel the negative charges of the proteins, preventing starch-protein bond formation and weakening the gel structure in PS systems; and the absence of 7S proteins along with the higher presence of 11S proteins in SPC, which contribute to a more rigid and stable gel structure due to their hydrophobic nature and disulfide bonds. In contrast, LPC contains both types of proteins, with a higher proportion of 7S protein fraction, resulting in a weaker gel network due to their high hydrophilicity. This research underscores the complexity of protein-starch interactions during food processing, which is essential for developing sustainable food structures and facilitating the shift to a less resource-intensive plant-based diet. By improving nutrition, enhancing resource efficiency, reducing food waste, and mitigating climate change impacts, this study aligns with SDG 2, SDG 12, and SDG 13.

Keywords: Sunflower Protein, Lupin Protein, Starch-Protein Interaction, Hydrothermal Processing, Sustainable Food Structures.

Acknowledgments

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This study is closely aligned with SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). By exploring plant-based proteins as alternatives to animal-derived proteins, we address SDG 2 by promoting food security and improved nutrition through sustainable agricultural practices. The use of lupin, a legume, not only diversifies the diet but also enhances soil health through nitrogen fixation, contributing to sustainable food systems. Sunflower protein, a byproduct of oil extraction, exemplifies resource efficiency and waste reduction, core principles of SDG 12. Furthermore, understanding the interactions between plant proteins and starches can lead to the development of innovative, sustainable food products that reduce reliance on animal agriculture, thus lowering environmental impact and green house emission associated with the production of animal meat (SDG 13). This research supports the creation of more resilient and sustainable food supply chains, aligning with global efforts to ensure responsible production and consumption patterns.

APPLE POMACE AS A SUSTAINABLE SOURCE OF PREBIOTICS

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The properties of apple pomace (AP) are increasingly being studied to address companies' challenges in implementing a sustainable circular economy and to provide consumers with food options that positively impact their health [1]. Although abundant, AP remains underexplored surplus rich in valuable compounds [2]. This study focused on understanding the prebiotic activity of AP compared with known molecules with such potential and used as positive controls, namely glucose, inulin and fructooligosaccharides (FOS). The prebiotic properties were tested using an in vitro method. Three *Lactobacillus*, namely *Lactobacillus casei* (NCTC 6375), *Lactobacillus plantarum* (DSM 12028), and *Lactobacillus acidophilus* LA-5 (Probio-Tec, Denmark), and *Bifidobacterium animalis* spp. lactis Bb12 (Probio-Tec, Denmark) were used. Samples were diluted in MRS broth at a concentration of 2% (w/v) and further pasteurized (72-75 ºC for 1 min). The inoculum was suspended in MRS broth to achieve a concentration of probiotics of 5×10^5 CFU/mL. The absorbance was measured (620 nm) under incubation at 37 ºC for 48 hours and the results are expressed as optical density (OD). In all tested microorganisms (MO), AP exhibited OD values exceeding those of the positive controls, FOS and inulin, with values surpassing 2.5 in the stationary phase and the exponential phase beginning after 8 hours. Regarding LA-5, AP showed excellent results, surpassing glucose during the first 3 hours of the exponential phase. Thus, AP proved to be an effective carbon source for various strains, promoting their growth more effectively than well-known prebiotics such as FOS and inulin. These findings demonstrate the efficacy of AP in supporting the growth of diverse probiotic strains, highlighting its potential for inclusion in dietary supplements and health applications aimed at improving gut health and simultaneously contributing to the implementation of circular economy principles.

Keywords: Apple bio-residues, Bioactivity, Circular economy, Functional foods,Nutraceuticals.

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This work is deeply embedded in the Sustainable Development Goals (SDGs), particularly the SDGs 2 (Zero Hunger), 3 (Good Health and Well-being), and 12 (Responsible Consumption and Production). By addressing these global challenges, our research has the potential to make a significant contribution to sustainable development. One of the main objectives of the work is to develop a new functional food or functional ingredient to valorize the apple pomace, fitting in with SDGs 2 and 3 and promoting healthier life habits. Additionally, by encouraging a green, circular economy and valuing resources through a sustainable, underexplored bio-residue with compounds of interest and significant potential, this work also supports SDG 12. Introducing new processes and high-added-value products opens opportunities for exploring new markets and enhances the industrial sector's competitiveness.

INNOVATIVE AND SUSTAINABLE TOMATO SNACK BARS: UTILIZING FOOD WASTE AND PLANT PROTEINS FOR FUNCTIONAL PRODUCTS

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Sustainable food production requires innovative approaches to food waste and product development, vital for reducing environmental impact and ensuring food security [1]. This study explores the development of a tomato snack bar made from sustainable ingredients, focusing on the utilization of tomato waste and plant-based proteins. The product aims to contribute to the Sustainable Development Goals (SDGs) by promoting waste reduction and sustainable food systems. The tomato snack bars were formulated using tomato juice, pectin, salt, olive powder, tomato powder, and a blend of spices (thyme, basil, red pepper). Proteins sourced from sugar beet leaves (rubisco) and other plant-based proteins (pea and chickpea) were incorporated into the matrix. The ingredients were mixed, molded into snack bars, and dried using a microwave-vacuum system. Microwave-vacuum drying (MVD) combines microwave energy with vacuum conditions, enabling rapid and uniform drying at lower temperatures. This technique is especially effective for heat-sensitive foods, as the vacuum lowers the boiling point of water, reducing the risk of thermal damage and preserving nutritional and sensory qualities. MVD offers significant advantages over conventional drying methods, including shorter drying times, energy efficiency, and enhanced product quality. In this study, MVD was found to be more efficient than air drying, producing snack bars with superior physicochemical and sensory properties. Physicochemical analyses and sensorial evaluations indicated that microwave-vacuum drying resulted in lower moisture content, better color retention, and improved texture compared to air drying. The type of protein incorporated influenced color and texture, with rubisco protein being the least preferred in terms of appearance and taste. Air-dried samples had higher moisture content, darker color, and increased chewiness, which were less desirable. This study aligns with several SDGs, including SDG 2: Zero Hunger, SDG 3: Good Health and Well-being, SDG 12: Responsible Consumption and Production, SDG 13: Climate Action, and SDG 15: Life on Land. It does so by utilizing food waste, promoting healthy ingredients, encouraging sustainable practices, reducing energy consumption, and supporting biodiversity. This study highlights how sustainable ingredients and innovative drying methods can create high-quality tomato snack bars. The use of tomato waste and plant-based proteins reduces food waste and promotes renewable resources. Microwave-vacuum drying preserves nutritional and sensory qualities, offering consumers healthy and appealing snack options while contributing to sustainability goals.

Keywords: Sustainable food, Tomato snack bar, Plant proteins, Microwave-vacuum drying, Functional foods.

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VALORIZATION OF EDIBLE MUSHROOM WASTE IN PENNE PASTA PRODUCTION: FERMENTATION AND NUTRITIONAL ENHANCEMENT

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Mushrooms are essential for ecological recycling and a nutritious food source due to their high water, protein, carbohydrate, vitamin, and mineral content, along with low fat. They also offer potential medical and nutraceutical benefits [1,2]. Lactic fermentation is a common method used worldwide to preserve edible mushrooms, both wild and farmed. This technique uses lactic acid bacteria to prolong shelf life without the need of heat or chemical preservatives. Because metabolites and beneficial microflora are created during fermentation, fermented mushrooms have greater preservation, resistance to microbial deterioration, higher sensory attributes, and increased health benefits [2]. This project aimed to utilize edible mushroom waste, both before and after undergoing a lactic fermentation process, to incorporate it into a food product – specifically, penne pasta. Mushroom waste from *Agaricus brunnescens* species was fermented with the bacteria *Lactobacillus plantarum*, for 7 days at 20 ºC. The fermented mushrooms were then dried for 24 h at 40ºC, while the unfermented mushrooms where dried for 72 h. To upcycle fermented (F) and non-fermented (NF) mushrooms into penne pasta, three substitution levels of F and NF mushrooms (1%, 5%, and 10%) were used to replace wheat semolina. The semolina (control) and mushroom containing doughs and raw and cooked pasta were subsequently evaluated. F and NF mushroom dry powder incorporation resulted in a greater darkening of pasta in both the raw and cooked formulations, in a dose-dependent manner. The control pasta presented the highest b* value (yellowish color). Moisture for all examined samples showed no variations compared to the control, both in dry and cooked past. However, incorporation of F mushrooms decreased the pH of the semolina dough. F and NF mushrooms exhibited a higher Water-Binding Capacity (WBC) in the flour formulation samples with higher mushroom flour substitution. The optimum cooking time of the pasta varied between 8 and 10 min. The cooking time and firmness of the cooked dough decreased significantly with the increase in mushroom flour supplementation, and in fermented mushrooms there was a more pronounced decrease in these compared to the control, and an increase in the optimal cooking time, possible because of starch dilution, as corroborated in the viscosity and swelling analyses of semolina and mushroom mixtures. Furthermore, solids loss during cooking gradually increased with the addition of mushroom flour, especially in the pasta formulation containing 10% F mushroom flour, while there were no differences between samples in terms of swelling power. In conclusion, this study highlights the potential of using edible mushroom waste to improve the nutritional and functional properties of penne pasta through fermentation. Increased substitution of mushroom flour led to darker pasta, with reduced hardness, shorter cooking times, lower pH, increased fiber and protein content, and similar WBC and swelling. According to these results, fermented mushroom flour can be a useful component in the production of inventive and nutrient-dense food products that cater to health-conscious consumers and sustainability.

Keywords: Mushroom Fermentation, Food Preservation, Nutritional properties, Sustainable Practices.

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Alignment with Sustainable Development Goals (SDGs):
This effort promotes sustainable methods in food production by addressing many Sustainable Development Goals (SDGs). The project advances food security and healthy diets by utilizing fermented edible mushroom waste to enhance the nutritional value and usability of penne pasta (SDGs 2 and 3). Technological innovation in the fermentation and food-integration of mushrooms (SDG 9) minimizes waste and lowers greenhouse gas emissions linked to the breakdown of organic waste (SDG 13) promoting responsible production (SDG 12).

DEVELOPMENT OF A CHEWING GUM WITH *ACTINIDIA ARGUTA* EXTRACT AS AN INNOVATIVE MITIGATION STRATEGY FOR FIREFIGHTERS OCCUPATIONAL EXPOSURE

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Firefighting activity has been classified as carcinogenic to humans, since fires emit a complex mixture of pollutants, such as, polycyclic aromatic hydrocarbons (PAHs) and brominated flame retardants (BFRs). [1,2]. Several mitigation strategies have been implemented to promote firefighters' safety and minimize the occupational exposure, including better quality and fire resistance of personal protective equipment (PPE) and decontamination procedures of PPE, among others [3]. This work aims to explore a chewing gum (CG) as a convenient, affordable, and sustainable mitigation technology to retain the lipophilic fire-related pollutants and offer protective capacity against them. Three CG formulations (CGA, CGB, and CGC) with different proportions of natural excipients, namely absorbent mint oil, and *Actinidia arguta* extract, were developed in close collaboration with a renowned Portuguese company, based upon available scientific and technological knowledge. The formulations were characterized regarding texture profile, rheometry and sensory analysis (SA) conducted with a panel of military firefighters of the Special Protection and Relief Unit of the Republican National Guard. To evaluate the pollutants retention, a CG fraction was placed in contact with commercial saliva previously contaminated with 18 PAHs and 5 BFRs that were analyzed via HPLC and gas chromatography (GC), respectively. Overall, the formulations have similar texture profiles. Attributes such as hardness and adhesiveness decreased after chewing. Rheometric analysis reveals that all formulations have pseudoplastic behavior with slight thixotropy. The results of the SA support those found in the texture profile. Moreover, HPLC results attested the retention of 10 PAHs (with recoveries ranging from 26% to 76%), while the GC analysis demonstrated the retention of 5 BFRs (with recoveries from 35.1% to 99.6%).

Keywords: Chewing gum, Firefighters, Fruit extract, Occupational exposure.

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The integration of *Actinidia arguta* fruit extract in chewing gums has an innovative strategy to adsorb fire pollutants during firefighting activities, contributing to mitigate firefighters' occupational exposure in the oral cavity and promoting occupational health (SDG 3, 8).

POSTER SESSION

Topic: *Innovative and sustainable food ingredients and products*

INCORPORATING APPLE AND GRAPE POMACE INTO FOOD PRODUCTS FOR A SUSTAINABLE FUTURE

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Conventional food waste utilization policies have primarily focused on reducing or preventing waste generation, rather than harnessing waste as a valuable source of food and feed components [1]. However, the growing global population and resource scarcity have spurred a shift towards a circular economy approach to food waste management. This approach emphasizes recycling and extracting value from waste materials, reintegrating them into the food supply cycle. Essentially, it aligns with the core tenet principle of the circular economy: 'waste equals food' [1,2].
Currently, products incorporating apple and grape pomace have been developed in plant-based foods, bakery items, meat and fish products, and dairy products [3].
The objective of this work was to develop two bakery products incorporating apple and grape pomace for different target populations, thereby reducing waste and adding value to these by-products. Products analysis included the determination of phenolic content and antioxidant capacity using colorimetric methods, namely FRAP, DPPH, and ABTS, additionally, CIELAB colour space parameters (L*, a*, b*) were evaluated. A sensorial analysis was conducted with a panel of trained tasters, evaluating attributes such as flavour, texture, aroma, overall acceptance, and purchase intention. Standard food analysis techniques were also used to determine nutritional assessments. Furthermore, the analysis of carbohydrates encompassed both free sugars and polysaccharides. Control muffins and cookies were produced for comparison of all analysed parameters.
In conclusion, the incorporation of these by-products into muffins and cookies is a promising strategy for developing healthier and more nutritious bakery goods, as well as contributing to the valorisation of food industry by-products and suitability of the food sector.

Keywords: Food waste, Apple and grape pomace, Valorization, New food products, Circular economy.

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HARNESSING THE POWER OF GINGER FROM AZORES ISLAND: A SUSTAINABLE APPROACH TO HEALTH

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The global demand for natural products for therapeutic and cosmetic purposes is rising, with ginger emerging as a particularly promising option. Rich in bioactive compounds, mainly phenolic compounds, ginger extract is associated with beneficial biological activities, including antioxidant and anti-ageing effects. These properties make ginger invaluable for therapeutic applications and offer substantial health benefits. This study aimed to evaluate Azorean ginger's phytochemical properties, focusing on the identification and quantification of bioactive compounds using colorimetric methods (total phenols, *ortho*-diphenols, and flavonoids) and HPLC-MS. Additionally, it was assessed the antioxidant capacity (ABTS, DPPH, and FRAP methods) and the inhibitory effects on the enzymes elastase and tyrosinase to enhance the value of this natural product.

The results revealed that ginger samples from the Azores outperformed those from mainland Portugal, particularly in terms of *ortho*-diphenols and flavonoids. The Azorean sample showed significantly higher levels, with values of 168.45 mg gallic acid/g and 89.72 mg catechin/g, respectively, compared to the mainland sample (18.74 mg gallic acid/g, 14.70 mg catechin/g, respectively). The total phenol content was similar in both samples, averaging 18 mg gallic acid/g. In the antioxidant activity assays, the Azorean sample demonstrated superior results, with ABTS, DPPH, and FRAP values of 0.742, 1.033, and 0.427 mmol Trolox/g, respectively, compared to the mainland sample (0.030, 0.064, 0.114 mmol Trolox/g, respectively).

When it comes to potential cosmetic applications, Azorean ginger stands out. It has shown a remarkable capacity to prevent and control wrinkles and age spots. The Azorean extract, at a concentration of 0.32 mg/mL, inhibited elastase by 10% and tyrosinase by 55%, while the mainland extract required a concentration of 8 mg/mL to achieve similar results. These findings underscore the Azorean ginger's potential in the cosmetics industry, particularly in the treatment of diseases related to oxidative stress.

Relevance to UN Sustainable Development Goal 12: This study aligns with UN Sustainable Development Goal 12, which promotes responsible consumption and production. By utilizing ginger, a natural and renewable resource, and maximizing its biochemical potential, we contribute to more sustainable practices in both the health and cosmetics industries. Our research emphasizes the importance of sourcing and processing natural products to reduce environmental impact and support sustainable agricultural practices, thereby fostering innovation in the development of eco-friendly products.

Keywords: Azores, Phenolic compounds, Anti-ageing, Antioxidants, Oxidative stress.

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VALORISATION OF BREWER'S SPENT YEAST BY-PRODUCTS: SUSTAINABLE INNOVATIONS FOR ALTERNATIVE PROTEIN DEVELOPMENT

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Background: The food industry generates substantial food losses and waste, significantly impacting the environment. To address this, industries are exploring innovative strategies to valorise these by-products, recognising their potential as sources of valuable compounds. Among these by-products, brewer's spent yeast (SBY) is a notable residue from the brewing process. It has a rich nutritional composition and is high in proteins and carbohydrates. This makes SBY a promising candidate for use as a food ingredient, aligning with sustainability goals, promoting healthy lifestyles, and adhering to circular economy principles. This study aims to transform SBY into high-value ingredients suitable for incorporating protein-enriched food formulations.
Methodology: The investigation involves the compositional analysis of the SBY and explores the production of new fractions by combining an autolysis process with fractionation by membrane filtration to obtain functional fractions. Size exclusion high-performance liquid chromatography (SE-HPLC) analysis performed on the obtained fractions showed a chromatography profile with high diversity in the molecular size distribution. The obtained fractions were dried, and their bioactivities, including antioxidant capacities and phenolic content, were assessed.
Results: Our results demonstrate the successful production of a high-protein food ingredient from SBY, positioning it as a promising ingredient for formulating various protein-enriched foods. This study underscores the potential of utilising by-products to create value-added ingredients, contributing to the sustainability and circular economy goals within the food industry and providing reassurance about the feasibility of our research.

Keywords: BSY by-product, Protein-enriched foods, Sustainable process, Circular food systems.

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This work is in line with the United Nations Sustainable Development Goals (2030 Agenda), particularly Goal 3 (ensure healthy lives and promote well-being for all at all ages) and Goal 12 (ensure sustainable consumption and production patterns). Producing protein extracts from sustainable sources aims to improve access to high-quality protein, thereby creating healthier food options. Additionally, using by-products such as BSY promotes a circular economy in the food industry, enhancing both production and consumption sustainability.

CURRENT DEVELOPMENTS IN HEALTHIER PLANT-BASED ALTERNATIVES: NUTRITIONAL PROFILES, NUTRIENT BIOAVAILABILITY AND NOVEL FOOD TECHNOLOGIES

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The plant-based meat market has grown exponentially, being driven by advancements in product formulation and consumer demands for more sustainable protein sources. Studies show that despite higher costs, a segment of consumers consistently chooses plant-based alternatives over conventional meat influenced by health, environmental concerns, and sensory qualities [1], with the plant-based meat alternative market in the USA being worth US$939 million in 2019 and dairy substitutes market US$1.4 billion [2]. However, plant-based foods are very complex in terms of nutritional profile and absorption of nutrients, which can raise some health concerns [3]. This publication will explore recent developments in the nutritional profiles, nutrient bioavailability, and consumer insights regarding plant-based meat alternatives. Emphasis is placed on the comparative analysis of essential nutrients such as proteins, vitamins, and minerals in plant-based products versus their animal-based counterparts. Plant-based meat alternatives generally contain less saturated fat and cholesterol compared to animal meats. They are often higher in dietary fiber but can be lower in protein, zinc, and vitamin B12 [4]. Additionally, the paper investigates the bioavailability of these nutrients, such as iron and zinc, which is higher in animal meat compared to plant-based alternatives. Plant-based meats may also contain phytates and other compounds that inhibit mineral absorption [5]. Novel food processing technologies are also explored as they can provide strategies to improve the taste and nutrition of plant-based foods.

The findings highlight the potential of plant-based alternatives to meet dietary needs while showing areas for improvement in formulation and public education to optimize their health benefits.

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Framed within the context of the Sustainable Development Goals (SDGs), this research underscores the role of plant-based alternatives in promoting sustainable food systems (SDG2: Zero hunger and SDG15: Life on Land), improving public health (SDG3: Good health and Well-being), and reducing environmental impacts (SDG13: Climate Action).

EXTRACTION OF OLIVE LEAVES POLYPHENOLS USING NATURAL DEEP EUTECTIC SOLVENTS: A SUSTAINABLE APPROACH ALIGNED WITH 2030 SDGS

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Every year, around 1.3 billion tons of food waste are produced, causing important environmental problems [1]. Many studies claim that such waste is an inexpensive source of high-value compounds, such as phenolics, which can be use in the pharmaceutical or food industries. The production of olive oil and olives generates a large amount of waste, including olive leaves, which are accumulated during the pruning of olive trees. The extraction of phenolic compounds from olive leaves in an environmentally friendly way, using natural deep eutectic solvents (NADES), is a sustainable alternative and aligns with the 2030 goals on the efficient use of natural resources and the environmentally sound management of chemicals and all wastes throughout their life cycle.

Seven NADES, based on choline chloride, sucrose and glycine combined with different organic acids and alcohols, were tested to check the extraction efficiency of olive leaf polyphenols compared to conventional extraction with ethanol (70%). Extraction was carried out in a shaker at 50ºC for 1h. The obtained extracts were analysed by reverse phase high performance liquid chromatography with double detection by diode array spectrophotometry and mass spectrometry (HPLC-DAD-MS). Compounds were identified by their retention time, UV–vis and mass spectra, comparison with our data library and standards when available, and/or literature data [2,3]. The compounds were quantified from the areas of their chromatographic peaks recorded at 280 nm, 330 nm and 360 nm. Moreover, Folin Cicalteu and Ferric Reducing Antioxidant Power assays were performed.

The major compounds identified were oleuropein, luteolin-7-O-glucoside and verbascoside. Green obtained extracts had higher polyphenol content than ethanolic extracts, reaching values of 31.07 ± 0.48 mg GAE/g d.w. in the case of those based on glycine and lactic acid. However, in terms of antioxidant activity, the extract with the highest activity was the one formulated with choline chloride and oxalic acid (48.02 ± 1.40 mg Trolox eq/ml).

NADES are a sustainable and highly efficient alternative for the recovery of polyphenols from olive leaves. However, it is necessary to evaluate the safety of the extracts for incorporation in food formulations.

Keywords: Polyphenols, NADES, Green extraction, Circular economy, Olive leaves.

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BOOSTING THE ANTI-INFLAMMATORY POTENTIAL OF NARINGIN AS A NANO-NUTRACEUTICAL

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Inflammation is a biological defense response triggered by harmful stimuli that, although it plays a crucial protective role, under certain conditions, can be associated with various diseases. The World Health Organization (WHO) classifies chronic inflammatory diseases as major threats to global health. Polyphenolic compounds, such as naringin (NAR) found in grapefruit, have gained attention due to their diverse biological activities, including anti-inflammatory and antioxidant effects. Despite its therapeutic potential, the clinical application of NAR is limited by extensive in vivo metabolism, leading to low bioavailability. To overcome these challenges, in recent years nanotechnology has assumed an emerging role. Delivery systems based on lipid nanoparticles, allow the compounds of interest to be protected against degradation, improve their solubility and extend their circulation time. In this context, lipid nanoparticles were used to deliver NAR aiming at the development of nutraceuticals and functional foods with improved anti-inflammatory properties. In vitro studies demonstrate controlled release of NAR throughout the gastrointestinal tract and favorable cytocompatibility (THP-1 cell line). Furthermore, the developed nanoparticles have been shown to effectively modulate inflammatory mediators relevant in chronic inflammatory diseases, such as IL-1β and TNF-α [1].
Overall, the results demonstrated the benefits of lipid-based nanotechnology in improving NAR efficacy and highlighted the anti-inflammatory potential of this strategy to develop new effective nutraceuticals and functional foods.

Keywords: Inflammation, Lipid-based nanoparticles, Naringin, Nano-nutraceuticals.

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This work aligns with SDG 3 by enhancing naringin's therapeutic efficacy for better health outcomes and disease prevention, and with SDG 12 by using nanotechnology to improve nutraceutical efficiency and promote sustainable production.

IMPORTANCE OF RIBOFLAVIN IN PHYSIOLOGY AND HUMAN HEALTH

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Since the early twentieth century, studies on vitamins have uncovered their therapeutic potential beyond simply serving as essential micronutrients. One standout among these vitamins is Riboflavin, also known as vitamin B2, owing to its differential characteristics and ongoing relevance in promoting human health. Found abundantly in various foods, Riboflavin is a coenzyme in many critical enzymatic reactions essential for human metabolism, with crucial functions in energy production, red blood cell synthesis, and vitamins metabolism, highlighting its significance in maintaining the body's equilibrium. Furthermore, Riboflavin's influence extends to supporting neurological function, skin health, and overall cardiovascular well-being, with adequate levels associated with reduced risks of various health issues. However, insufficient intake or physiological stress can result in a deficiency, posing serious health threats and complications. This reinforces the necessity of maintaining appropriate Riboflavin levels for optimal well-being. Additionally, Riboflavin plays a vital role in bolstering immune function, further underscoring its importance in promoting human health and vitality. This article explores the multifaceted impacts of Riboflavin on health and emphasizes the critical need to sustain adequate levels for overall wellness.
At this stage, riboflavin research is carried out in underexploited natural sources, described as potential products for extraction with the aim of being used for food enrichment or as nutraceuticals.

Keywords: Riboflavin, Human health, Coenzyme, Metabolic function, Therapeutical potential.

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This work falls within SDGs 3 and 12, as our objective is to extract riboflavin from agri-food waste to use as an agent for Photodynamic Therapy and consequently improve health levels and quality of life.

MODULATION OF ANTINUTRITIONAL FACTORS IN LENTIL FLOURS AFTER DIFFERENT PHYSICAL PRETREATMENT TECHNIQUES

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Lentils (*Lens culinaris spp.)* are one of the oldest cultivated leguminous worldwide. Although lentils are recognized as a nutritious leguminous, which makes them a suitable option in vegetarian diets as an alternative to meat products, their composition and nutritional characteristics vary between different varieties. In addition, the overall composition and health benefits of lentils can be influenced by the presence of other components known as antinutritional factors (ANFs), which can exert effects contrary to optimal nutrition. The presence of ANFs can be modulated through various processing methods, some of which have been associated with improving the nutritional value of legumes by partial or total suppression of ANFs, as well as increasing certain nutrients, protein and fiber digestibility, and mineral bioavailability.
Thus, the aim of this work is to investigate the effect of different physical pretreatment techniques, namely soaking, cooking, germination and microwave roasting, on specific FANs (phytates, condensed tannins and trypsin inhibitors) in lentils. The results showed a significant influence ($p < 0.05$) of these on the total concentration of ANFs, with germination and cooking standing out as the most effective in reducing their presence in the overall lentil flours. Phytic acid was completely eliminated during germination, due to its degradation by the phytase enzyme activated during this process, while condensed tannins and trypsin inhibitors were more affected by cooking, where the catalytic enzymes and the thermolabile nature of the compounds are mainly responsible for their greater reductions.
The results obtained showed that all processing methods exerted some influence on the ANFs analyzed, allowing better inferences about the behavior of lentil flours in the formulation of new food products through different methods that can meet the current nutritional and health demands of today's society.

Keywords: Germination, Cooking, Condensed tannins, Phytic acid, Trypsin inhibitors.

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This work is closely interconnected with Sustainable Development Goals 2 (Zero Hunger) and 3 (Good Health and Well-Being) since lentils are considered a staple food around the world, being an essential food in developing countries, and also rich sources of micro and macro nutrients and bioactives essential to human health and well-being.

Exploitation of Sunflower (Helianthus annuus L.) Bioresidues: Nutritional Value and Chemical Composition

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Food waste contradicts sustainable development goals, causing significant social, environmental, and economic impacts. An example is sunflower (*Helianthus annuus* L.), with around 50 million tons produced globally in 2020 [1,2]. This production generates unvalued biowaste often discarded, resulting in economic losses. So, this study intended to value a large-scale biowastes from sunflower seed production, exploring the nutritional profile and chemical composition of different vegetative parts of the discarded plant: leaves and stems (FOG) and flowers (FLG) discarded after seed harvesting to promote the sustainability of the sector through innovative reuse strategies that increase the circular economy, within the value chain (SDGs 9, 12, 13 and 15). The evaluation of nutritional parameters (protein, ash, fat, and carbohydrate contents and energy value) of FOG and FLG, was evaluated following official methodologies (AOAC) and the chemical profile (free sugars and fatty acids) was determined by HPLC-RI and GC-FID, respectively. The samples of FOG and FLG exhibit significant differences in nutritional composition attributed to their distinct roles within the plant. FLG shows higher levels of fat (15.42±0.47 g/100g) and protein (12.48±0.22 g/100g) compared to FOG, which contains lower amounts of fat (1±0.03 g/100g) and protein (4.61±0.01 g/100g). FOG is rich in saturated and polyunsaturated fatty acids, crucial for plant structure and photosynthesis, whereas FLG predominantly features monounsaturated fatty acids. Regarding sugars, FLG exhibits higher levels of fructose, glucose, and sucrose than FOG, indicating a greater demand for these carbohydrates to support seed development. These differences underscore the biochemical discrepancies of each tissue to its specific function within the sunflower plant. However, these results highlighted the potential of sunflower flowers and leaves/stems that are discarded by the industry, showing optimal nutritional values and suggesting their utility for different industrial applications, especially for the development of innovative food and nutraceutical products.

Keywords: Sunflower biowaste, nutritional value, biowaste valorization, sustainability.

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CHEMICAL CHARACTERIZATION AND BIOACTIVITY PROPERTIES OF CRITHMUM MARITIMUM L. GROWN UNDER DIFFERENT FERTILIZATION REGIMES

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One of the most widespread wild edible plants (WEP) in the Mediterranean area is *Crithmum maritimum* L. (sea fennel or rock samphire). Its aerial parts are used in cuisine and popular medicine for their aromatic, antiscorbutic, diuretic, digestive, and carminative properties [1,2]. Sea fennel has recently been recognized as a "cash crop" and "emerging crop" in saline agriculture due to its high potential for adapting to soil salinization, erosion, and short-term water drought [1,3]. Therefore, agricultural domestication studies are emerging to boost its consumption and valorization [2-4]. The present study aimed to characterize the nutritional profile (crude protein, total fat, total fiber dietary, ash) through AOAC methods and carbohydrates by difference. The chemical composition, in terms of fatty acids (GC-FID), tocopherols (HPLC-FL), free sugars (HPLC-RI) and phenolic compounds (HPLC-DAD/ESI-MSn) of 7 samples of sea fennel (fertigated with different proportions of nitrogen (N), phosphorus (P), and potassium(K)) was determined; as also the bioactive properties of its hydroethanolic extracts, namely antioxidant (TBARS), anti-inflammatory and cytotoxic activities. Aerial parts of sea fennel grown with intermediate amounts of N and P demonstrated higher fiber and ash contents and lower carbohydrate and crude protein contents. On the other hand, the lowest N:P:K ratios resulted in higher polyunsaturated fatty acids percentages. Only the α-tocopherol isoform was identified, while the detected sugars included fructose, glucose, sucrose and raffinose. More than 74% of the total amount of phenolic compounds were phenolic acids, mainly caffeoylquinic acid derivatives. The hydroethanolic extract of aerial parts cultivated with high amounts of N:P:K demonstrated the lowest concentration (122±6 µg/mL) necessary to inhibit lipid peroxidation by 50% in TBARS antioxidant activity. The samples did not show activity at the maximum concentration tested (400 µg/mL) for anti-inflammatory and cytotoxic activities. In conclusion, our results demonstrate that customized fertilization enables the cultivation of sea fennel with enhanced content of potentially bioactive compounds.

Keywords: Sea fennel, Nutrient solution, Nutritional profile, Phenolic compounds, Antioxidant.

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This study not only highlights the nutritional and medicinal potential of sea fennel; by contributing to the development of health-promoting food sources (SDG 3) but also study supports responsible consumption and production by enhancing the nutritional value of crops, optimizing resource use, and reducing environmental impact through sustainable agricultural practices (SDGs 12 and 13).

ANTHOCYANINS OBTAINED FROM FRUIT RESIDUES AS A NATURAL COLORANT IN A BAKERY PRODUCT

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The food industry commonly uses artificial colorants to enhance the sensory quality of processed foods and to provide product diversity. However, growing health concerns and a preference for healthier eating are driving consumers to choose clean-label products, seeking natural alternatives [1]. Fruit residues generated during fruit processing contain valuable pigments, such as anthocyanins, carotenoids, and betalains, which can be extracted and applied as natural colorants for food. To obtain natural colorants from fruit residues, various extraction methods can be employed [2]. This study aims to explore the potential of diverse fruit residues, including *Sicana odorifera* (Cucurbitaceae) epicarp, *Nephelium lappaceum* (Sapindaceae) epicarp, *Eugenia brasiliensis* (Myrtaceae) peel, and *Eugenia involucrata* (Myrtaceae) peel, as sources of anthocyanin compounds for use as natural colorants.
To obtain anthocyanin-rich extracts, the optimization of anthocyanin extraction from the fruit residues was performed using two methods: heat-assisted extraction (HAE) and ultrasound-assisted extraction (UAE), with Response Surface Methodology (RSM). Subsequently, the anthocyanins present in each extract were identified and quantified by HPLC-DAD-ESI/MSn. Anthocyanin-rich extracts from each fruit bioresidue were incorporated into sequilhos, a typical Brazilian biscuit. The color and antioxidant activity (determined by DPPH (2,2-diphenyl-1-picrylhydrazyl) and Reducing Power assay (RP)) of the products were monitored for 15 days. Two controls were used to compare the results, one without the addition of any food colorant and another with the incorporation of a commercial natural colorant. As a result, samples remained relatively stable during storage, with minimal color variation over the evaluated period. Additionally, the incorporation of fruit residue extracts as natural colorants enhanced the antioxidant potential of the food products. These findings suggest that fruit bioresidues can be a valuable and sustainable source of natural colorants for the food industry.

Keywords: Food industry sustainability, Novel food ingredients, Natural additives, Bioactive molecules, Functional food.

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This research aligns with the Sustainable Development Goal 12, reducing the food waste generation.

ENHANCING NUTRITIONAL PROFILE OF CHICKPEA HUSKS VIA EXTRUSION: SUSTAINABLE APPROACH FOR LOW FODMAP DIETS

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Chickpeas *(Cicer arietinum L.)* are generally consumed pure or used to prepare snacks. The outer shell of this grain is typically discarded due to its rigid texture or sold at very low prices for an ingredient in animal feed [1]. Approximately 15% of chickpeas fibers are found in the husk, mostly consisting of soluble fibers, molecules that have been proven to help our body in eliminating sugars, fats, and cholesterol [2]. Extrusion is a sustainable and versatile processing technology widely utilized in the food industry that can potentially improve food digestibility, enhance it nutritional value and microbial safety, in addition to extended shelf-life of food products [3], [4]. Considering that the low FODMAP (fermentable oligosaccharides, disaccharides, monosaccharides and polyols) diet is designed to help people with irritable bowel syndrome (IBS) and/or small intestinal bacterial overgrowth (SIBO) [5], this study aim was to exploit the bio residue from the chickpeas industrial processing as an alternative source of vegetable fiber for these consumers. When we compared the fiber parameters between extruded and *in natura* chickpea husks, we observed that there were no significant differences between the contents (%) of Crude Fiber (6.07 and 4.98) and Acid Detergent Fiber (7.13 and 7.05). However, a significant difference was observed regarding Neutral Detergent Fiber content (%) between samples (12.28 and 28.33), evidencing that the extrusion procedure considerably reduced the hemicellulose content of the chickpea husk (from 21.28 to 5.15). Hence, extrusion, which is a simple and sustainable approach, was successfully applied to obtain dietary vegetable fibers to enrichthe diet routine of individuals under FODMAP diets. Therefore, future works will focus on developing new products for such audience.

Keywords: Biowaste valorization, Unusual raw materials, Gluten free products, Sustainable industrial processes, Restrictive diets.

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Considering the chosen industrial process and the valorization of the biowaste considered for this work, these two specific goals were selected.

EVALUATION OF THE NUTRITIONAL, CHEMICAL AND MINERAL COMPOSITION OF INTERCROPPED ALMONDS CULTIVATED IN CROATIA

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In recent years, crop diversification in agroforestry systems has been recognized as a sustainable strategy to improve land use efficiency, restore environmental balance, mitigate climate change, provide economic benefits and guarantee food security [1,2]. In addition, intercropping contributes in improving the nutritional quality of almonds, promoting biodiversity and the efficient use of agricultural resources [3] . This particular study aimed to evaluate the nutritional chemical, and mineral aspects of almonds to investigate the benefits resulting from crop interactions, using different almond cultivars like Ferragnès, Texas, AI, and Ferraduel. The centesimal composition of the samples (protein, fat, carbohydrates, ash, and humidity) was determined through the Official Methodologies of Food Analysis (AOAC), while also calculating total energy. The chemical composition was obtained through the quantification of the fatty acid content by GC-FID, organic acids using a UFLC-DAD system, and the soluble sugars through HPLC-RI. The results indicated that the Ferraduel cultivar had the highest moisture and carbohydrate content, with values of 6±0.2 g/100g fw and 30±0.1 g/100g fw, respectively. The Texas cultivar showed superior crude fat content at 54±0.2 g/100g fw, while the AI cultivar had the highest protein content at 19.2±0.4 g/100g fw. There was no statistically significant difference in ash content among cultivars. Regarding the chemical composition, the Ferragnès cultivar had the highest oleic acid content, and the AI cultivar had the highest sucrose content of 10±0.4 mg/mL. In terms of mineral content, the AI cultivar had the highest concentrations of magnesium, iron and zinc, with values of 114±0.3 mg/Kg, 62±3 mg/Kg and 31±1 mg/Kg, respectively. This approach helps promote sustainable agriculture while ensuring food security and environmental conservation, with potential for further improvements through additional research.

Keywords: Almonds, Intercropping, Food security, Sustainable.

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grateful for national funding by FCT, P.I., through the institutional and individual scientific employment program-contract for their contracts. C. Caleja is thankful for her contract through the project VIIAFOOD (PRR | Aviso n. º02/C05 -i01/2022; n. º de agenda: C644929456 -00000040).

This project aims to protect, restore and promote the sustainable use of terrestrial ecosystems, while working to reverse soil degradation and halt biodiversity loss through the implementation of agricultural practices that result in a significant reduction in environmental impact (Goal 15).

INNOVATIVE METHOD TO IDENTIFY ANTIDIABETIC PLANT INGREDIENTS AS PROTEIN TYROSINE PHOSPHATASE 1B

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There is no disputing the huge costs and time involved in screening plants as a source of functional ingredients, from extracting compounds to evaluating their biological activity (SDGs 7 and 13). In this context, computational tools are valuable for filtering and identifying natural compounds with greater potential for use in the food and pharmaceutical industry.
This work aims to use the DiaNat-DB database, a molecular database of known antidiabetic compounds from medicinal plants [1], and perform a virtual screening analysis using human Protein Tyrosine Phosphatase (PTP1B) as the protein target. PTP1B inhibition is a promising mechanism in treating type 2 diabetes because its inhibition is related to insulin sensitivity improvement and, consequently, glycemic control. The *in silico* virtual screening methodology was performed using the GOLD software for molecular docking and the PLP scoring function. Currently, the DiaNat-DB database consists of 360 antidiabetic compounds from 211 plants [1]. From the virtual screening analysis performed, three compounds from the DiaNat-DB presented the best predicted inhibition activity: 6,6",3'"-trihydroxy-7,3',7"-O-trimethylloniflavone, Damnacanthol-3-O-beta-D-primeveroside and Demethoxycurcumin with significant PLP scores of -69,00, -63,56 and -63,30 respectively. The PLP scores compared well with the PLP score obtained for Sulfamic Acid (-34,30), the control compound used in this study. These compounds were found in the plant species: *Salvia circinata*, *Morinda citrifolia* and *Curcuma longa*, respectively. This study presents an innovative method for identifying molecules and plants with potential antidiabetic activity as functional ingredients for the food and pharmaceutical industry.

Keywords: Virtual Screening, Natural Compounds, Innovative, Food ingredients and Natural compounds.

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ENHANCING RICE AUTHENTICITY AND TRACEABILITY THROUGH A DIGITAL FIELD DATA RECORDING APP

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Rice represents one of the most important crops worldwide, being a staple food for more than half of the global population[1]. The extensive scale of rice production highlights the need for a robust system to track paddy rice through the supply chain, ensuring safety, security, and promoting sustainable rice-based food production[2,3]. Integrated Production emphasizes natural resource management and prioritizes regulatory mechanisms, which are crucial for achieving these agricultural goals[4]. This approach requires meticulous documentation of farmer commitments and obligations[5].

Traditional paper-based data collection in rice production poses challenges, compromising accuracy and traceability. This study focuses on developing and implementing a digital tool (APP) for field data recording in integrated rice production. Utilizing ESRI's Survey123 software, the app aims to streamline data management, enhance accuracy, and facilitate real-time reporting, supporting farmers in adhering to integrated production standards and improving operational efficiency.

Field data from 13 farmers located in the Tejo (Tagus) river region in Portugal, collected in 2023, has been imported into the app. Additionally, real-time registrations for the 2024 campaign are currently underway for the Mondego and Tejo regions.

Future plans include integrating this digital solution into broader traceability frameworks, including blockchain technology, to enhance transparency and sustainability across the rice supply chain. This initiative represents a significant advancement in agricultural technology, ensuring efficient data management and compliance with stringent food safety standards.

Keywords: Rice authenticity, Rice traceability, Digital tool, Integrated production, Rice blockchain approach.

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This research aligns with several Sustainable Development Goals (SDGs) established by the United Nations.

SDG 9: Industry, Innovation, and Infrastructure – The development and implementation of a digital tool for field data recording represent significant innovation in agricultural technology. By modernizing data collection and management practices, the app improves efficiency and accuracy within the rice production industry. SDG 12: Responsible

Consumption and Production – The emphasis on Integrated Production promotes sustainable agricultural methods. By enhancing traceability and transparency through digital solutions, the study supports responsible consumption and production patterns, ensuring that food safety standards are met, and environmental impacts are minimized.

EXPLORING MOLECULAR DYNAMICS FOR THE DEVELOPMENT OF BIO-BASED HYBRID MOLECULES WITH APPLICATIONS IN COLORING AND PRESERVATION

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Although substantial progress has been made in food additives, ongoing controversies surrounding some of them have driven research into the next generation of safer and healthier options. These additives can come from natural sources and confer health benefits beyond coloring or preserving, among others. However, issues of stability, sustainability, and cost-effectiveness often constitute limiting factors, highlighting the need for innovative solutions [1]
Non-covalent complexation is a natural process and a crucial mechanism for stabilizing and enhancing blue, violet, and red colors in flowers, vegetables, and fruits. In this context, copigmentation with antioxidant and antimicrobial molecules can be explored. New cheminformatics tools and models can be used to support the development of unique dual-function hybrid compounds by predicting and verifying experimental results in order to develop new bio-based molecules as the next generation of food additives [2].
For that purpose, molecular dynamics (MD) simulations were conducted to evaluate the interaction between several natural molecules, used as colorants, and two natural antioxidants (ascorbic acid and α-tocopherol) by calculating their binding affinity (ΔG). System minimizations were performed using the Sander program from the AMBER18 software package. For the equilibrium and production phases, PMEMD was used, followed by analysis using CPPTRAJ, both from the AMBER18 software package. Among all colorants, the interaction with the antioxidant showing the highest average ΔG was α-tocopherol, particularly notable in the case of curcumin (-10.02). For ascorbic acid, the ΔG values were around zero. Based on these results, further studies will be performed to assess the potential hybridization between the curcumin molecule and α-tocopherol, as also the effectiveness of the hybrid as a dual-function additive.

Keywords: Natural food additives, Colorants, Preservatives, Copigmentation, Molecular dynamics.

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The mission and scientific challenge of this poster are aligned with Agenda 2030, specifically: the development of sustainable high-tech production systems for obtaining bio-based hybrid molecules with storage stability and high quality, ensuring food security and human nutrition (G2); recycling of agri-food waste and valorization of ugly/unsellable fruits/vegetables, reducing food losses along production and supply chains and enabling sustainable production and consumption (G12); and benefiting ecosystems and local populations through the promotion of sustainable exploitation of mountain crops (G15).

PHENOLIC COMPOSITION AND BIOACTIVITIES OF ACORN SHELL: AN EXPLORATORY STUDY

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Pedunculate (*Quercus robur* L.), holm (*Quercus rotundifolia* Lam.), and cork (*Quercus suber* L.) oaks are widespread across the Portuguese landscape, covering an estimated area of 1.151 million hectares, which represents about 36% of the country's total forested area [1]. Acorns from these oaks are nutrient-rich, exhibiting an abundant composition of starch, protein, fat, and essential minerals such as calcium (Ca), phosphorus (P), potassium (K), and magnesium (Mg) [2]. They also contain beneficial unsaturated fatty acids, particularly oleic acid and vitamin E, and biologically active compounds like phenolic compounds [2]. This study assessed acorn shells' phenolic composition and bioactive properties to determine their potential as a source of bioactive compounds for developing new bio-based products. Five acorn shell samples from different locations and species were analyzed. A total of 9 phenolic compounds were tentatively identified, including gallic and ellagic acids and their derivatives. Digalloyl hexoside was the compound detected in higher concentrations. *Q. suber* samples exhibited interesting antioxidant activity for the TBARS assay, with lower IC_{50} values than the positive control Trolox. The samples studied also exhibit antiproliferative activities, interfering with the proliferation of all tumor cell lines tested. Sample *Q. suber* demonstrated the most promising antibacterial capacity. The extracts from acorn shells reveal a significant potential, warranting further investigation into this species' samples.

Keywords: *Quercus* species, Acorn shell, Phenolic compounds, Antioxidant activity, Antiproliferative activity.

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This work supports the Sustainable Development Goals (SDGs) 3 and 8. It contributes to Goal 3 by seeking an extract from acorn shells with bioactive properties that can enhance food products, promoting health and well-being. It also contributes to Goal 8 by utilizing an unused by-product from trees that cover 36% of the national territory, aiding in the development and growth of a sustainable economy.

ANTIMICROBIAL PROPERTIES, CYTOTOXIC EFFECTS AND FATTY ACIDS COMPOSITION OF VEGETABLE OILS FROM PURSLANE, LINSEED, LUFFA AND PUMPKIN SEEDS

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Vegetable oils are fundamental components in numerous diets, including the Mediterranean diet, offering essential nutrients and important bioactive compounds that promote health [1]. Nowadays, food industry is striving to discover novel natural compounds to act as non-synthetic antimicrobial agents across the entire food supply chain, aiming to satisfy consumer preferences for healthier, chemical-free food options [2]. In the present study, the antimicrobial and cytotoxic activities, along with the fatty acid composition of four vegetable seed oils, e.g. flax, purslane, luffa, and pumpkin, were assessed. To this end, two linseed oils and one luffa oil were purchased commercially, while purslane and pumpkin oils were extracted from seeds cultivated by our team. The findings revealed a diverse fatty acid composition among the oils, with α-linolenic, linoleic, oleic, palmitic, and stearic acids being the predominant compounds. Specifically, linseed oils were rich in α-linolenic acid, luffa and pumpkin oils had a high content in linoleic acid, and purslane oil had a balanced composition with nearly equal amounts of both α-linolenic and linoleic acids. Luffa oil was the most effective against two cancer cell lines, HeLa (cervical carcinoma) and NCI-H460 (non-small cell lung cancer), while also exhibiting moderate toxicity against non-tumor cells (PLP2 cell line). In terms of antibacterial activity, linseed oil and pumpkin oil showed the greatest efficacy against most of the tested bacteria, notably *Enterobacter cloacae* and *Escherichia coli*, with MIC and MBC values comparable to those of the positive controls (E211 and E224). Luffa and pumpkin seed oils showed superior antifungal activity compared to the positive controls against various fungi, including *Aspergillus versicolor*, *A. niger*, and *Penicillium verrucosum* var. *cyclopium*. In conclusion, the results of this work indicated that the seed oils possess promising antimicrobial and cytotoxic properties, which could be partially attributed to their fatty acid compositions, especially the long-chain fatty acids containing 12–18 carbons.

Keywords: Seed oils, Antibacterial properties, Cytotoxicity, Antitumor activities, *Cucurbita maxima* L.

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This work is aligned with Goal 2 of the Sustainable Development Goals (SDGs) as it promotes the valorization of novel sources of vegetable oils, and Goal 13, since it introduces novel crops that can be adopted within the climate change scenario.

EXPLORING THE USE OF TURMERIC EXTRACT AS A NATURAL COLORANT IN ORANGE "QUEIJADAS"

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In the conventional bakery industry, artificial additives such as colors, flavors and preservatives are commonly used to improve product appearance, flavor, and shelf life. However, consumers are increasingly rejecting these additives in favor of healthier alternatives. This trend is driving the growing use of natural ingredients and "clean label" products in the bakery and pastry sector, which are notable for their absence of artificial additives [1]. Plant-based colorants obtained from leaves, stems, fruits, and flowers are emerging as promising alternatives due to their numerous health benefits and the growing global interest in these products [2]. The study investigated the replacement of artificial coloring with turmeric extract (*Curcuma longa L.*) in orange "queijadas", a typical Portuguese cake. Concentrations of 50 and 100 mg of turmeric extract per "queijada" were tested. Resulting in four formulations: with artificial coloring, without coloring, with 50 mg of turmeric extract and with 100 mg of turmeric extract. Colour and texture analyzes were carried out to evaluate the different formulations. The colour results show that the "queijadas" enriched with curcuma extracts have similar *L** and *b** parameters to those with artificial color, except for the *a** parameter. Internally, the 50 mg curcuma-based "queijadas" are more similar to the control. Externally, the 50 mg curcuma-based "queijadas" are closer to the *L** parameter, while the 100 mg curcuma-based "queijadas" are closer to the *b** parameter. In terms of texture, the curcuma-based "queijadas" are softer and less sticky than those with artificial color and without color. The 100 mg curcuma-based "queijadas" are the least hard, while the 50 mg curcuma-based "queijadas" are the least sticky. These results indicate that the turmeric extract improves the texture, making the product softer and less sticky. This encourages the replacement of artificial colors with natural alternatives without significantly impacting the sensory properties of the food.

Keywords: Bakery industry, *Curcuma longa* L., Healthier alternatives, Natural colorants.

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This work aims to explore natural matrices for safe incorporation into food, supporting food quality and safety, and developing high-quality products (Goals 3 and 12)

MULTIVARIATE CHEMOMETRIC ANALYSIS REVEALS DISCRIMINANT COMPOUNDS IN LUPINUS ALBUS L. CULTIVARS FROM DIFFERENT ECOTYPES

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Legumes are essential for human and animal nutrition, supporting sustainable agriculture by fixing atmospheric nitrogen and enhancing soil fertility[1]. However, climate change is expected to worsen the impact of abiotic stresses, affecting crop productivity. Crop diversification is one of the goals reinforced by common European agricultural policies to achieve greater sustainability, production, profitability, and climate change mitigation. Minor crops such as lupins have great historical and cultural importance at the regional level and they are well-adapted to Mediterranean regions' climatic conditions and soils and are more tolerant of abiotic stresses than other legumes[2]. Although lupins are considered a minor winter crop, there are also spring ecotypes. Their cultivars are ideal candidates for achieving high yields and being used as rotation crops year-round. This research aims to comprehensively analyse the chemical composition of different *Lupinus albus* cultivars: four winter and four spring ecotypes. A chemometric multivariate analysis was conducted to identify similarities and differences between the cultivars and ecotypes chemical profiles and to find authentication traits that are economically beneficial for farmers. In addition to the expected differences between the cultivars, the ecotype was the most discriminating grouping factor in the multivariate analysis. The heatmap and partial least squares-discriminant analysis (PLS-DA) showed significant differences in the chemical composition between winter and spring ecotypes. The winter ecotype cultivars have a higher concentration of carbohydrates, such as fructose, glucose and fibres. The α-Linolenic acid was the fatty acid characteristic of /the main fatty acid present in the winter ecotype cultivars. Regarding bioactive compounds, δ-tocopherol was associated with winter ecotypes and PCAF2, PCF9 and PCF10. The generated PLS-DA model was able to explain 47.6% of the total variability and showed two well-separated clusters between the two ecotypes. The most discriminant compounds were found to be arachidic and docosanoic fatty acids and the phenolic compounds PCF4, PCF7 and PCF8, which were present in higher concentrations in the spring ecotypes meanwhile PCF9 was in the winter ecotypes.

Keywords: Lupin, chemometric, Chemical composition, Legumes ecotypes.

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Studying and enhancing food production in the face of the climate crisis

BIOCHEMICAL CHARACTERIZATION OF BEETROOT VARIETIES

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Beta vulgaris L. subsp. *vulgaris*, commonly known as beetroot, is a vegetable species widely recognized for its fleshy taproots. The roots are very nutritious, with sucrose content being particularly notable among other essential macronutrients. Conversely, the leaves of beetroot are less commonly consumed raw or cooked in salads [1, 2]. The aim of this study was to assess the biochemical composition of the leaves and roots from three beetroot cultivars with different root colors (cv. Albina Vereduna, cv. Burpee's Golden and cv. Pablo F1). Chromatography techniques, and *in vitro* assays were employed to determine phenolic and betalain profile, and bioactive properties, respectively. Nineteen phenolic compounds were identified in the leaves, including derivatives of vitexin, isorhamnetin and quercetin, as well as derivatives of ferulic, sinapic and *p*-coumaric acids, with the total phenolic compounds content ranging from 23.2 to 34.3 mg/g of extract. The roots had a lower content of total phenolic compounds (0.130 to 0.150 mg/g of extract), including 8 individual compounds, which all were derived from ferulic, sinapic, *p*-coumaric and caffeic acids. A total of 6 betacyanins were identified in leaves and roots of the red beetroot (cv. Pablo F1), with the prevalence of decarboxy-isobetanin (1.29 to 18.18 mg/g dw, respectively). The roots of cv. Burpee's Golden demonstrated the presence of one betaxanthin, e.g. miraxanthin-V (0.140 mg/g dw). Leaves exhibited superior antioxidant capacity, as revealed by the TBARS assay, and all samples demonstrated significant antibacterial activity, particularly against *S. aureus*, *L. monocytogenes*, and *Y. enterocolitica*. Leaves stood out in terms of both chemical and biological properties evaluated. In conclusion, while beetroot is more widely recognized for its roots, its often-undervalued leaves could be further valorized as a nutritious ingredient in a balanced and diverse diet, promoting more sustainable eating practices and the circular economy concept.

Keywords: *Beta vulgaris* L., Proximal composition, Chemical profile, Bioactive properties.

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This work is aligned with Goal 12 of the Sustainable Development Goals (SDGs) as it promotes the valorization of beet leaves as a nutritionally and chemically rich food, disseminating the potential benefits of this often-undervalued ingredient, reducing waste generation and promoting more sustainable consumption practices and circular economy.

UNDERPINNING THE STRUCTURAL AND PHYSICOCHEMICAL CHARACTERISTICS OF DURUM WHEAT FLOUR (TRITICUM DURUM) TO REDUCE SEMOLINA BY-PRODUCTS PRODUCTION

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Durum wheat (*Triticum durum*) is a valuable cereal crop characterized by its endosperm hardness, and high protein and carotenoids content as compared to common wheat (*Triticum aestivum)*. Durum wheat is mainly used to produce high-quality semolina (~250-450 µm) for pasta making. However, grain milling into semolina also generates around 5% of durum wheat flour as a by-product, which is unsuitable for quality-pasta making due to its fine particle size (<180 µm). This work aims to understand the molecular and physicochemical differences of durum wheat flour (DWF), as compared to durum wheat semolina (DWS) and common wheat flour (*Triticum aestivum*) (CWF) to identify potential alternative food-applications of DWF. To further understand the effect of size reduction on the physicochemical properties of the semolina, semolina was re-milled and subjected to particle size fractionation to obtain semolina-based flours. To establish structure-function relationships, flours and semolina were characterized for particle size, nutritional composition, microstructure, gluten index, molecular size and unit chain length distribution (CLD) of amylose and amylopectin, damaged starch, hydration, pasting and thermal properties. The results indicated that DWF had higher protein content (17.49 g/ 100g dry basis) than DWS (14.69 g/100 g dry basis) and CWF (11.86 g/100 g dry basis), which should be related to the milling process, suggesting DWF may contain the outer parts of the grain endosperm, close to the aleurone layer. Differences in protein and starch distribution were also visible in confocal microscopy, with DWF exhibiting more protein-rich domains than CWF. Furthermore, DWF showed a lower gluten index than CWF, while gluten index in re-milled semolina was similar to CWF, remaining constant regardless of its particle size. All wheat flour exhibited similar CLD for amylose and long- and short-chains of amylopectin, although amylose content was slightly higher in durum wheat. Damage to the starch granules increased with particle size reduction (Re-milled DWS> DWF> DWS> CWF), which was accompanied by a decrease in starch molecular weight and an increased in water absorption, swelling power, and solubility. During hydrothermal processing, DWF exhibited a lower peak viscosity, which may be attributed to its higher protein content, and therefore lower starch content. In contrast, re-milled semolina flour demonstrated an increase in viscosity, although all values remained below than CWF. After heating and cooling, DWF, with similar particle size to CWF, exhibited less ability to build-up viscosity based on its lower setback and final viscosity. Likewise, calorimetric results showed DWF and DWS had a lower retrogradation enthalpy than CWF, indicative of less extent of amylopectin retrogradation, which may be associated with their harder endosperm. A decrease in this enthalpic transition was also observed with size-reduction and fractionation of DWS. The results highlight the importance of particle size and endosperm hardness in determining the quality of DWF, with significant implications to produce cereal-based products. The

understanding of the physicochemical differences between durum wheat flours can help implement new strategies to optimize semolina production and reduce its by-products generation and, at the same time, minimize food waste by integrating DWF into a circular economy as a source of starch in oriented food applications.

Keywords: Durum Wheat, Particle Size, Endosperm Hardness, Protein Quality, Thermal Properties, Starch Structure.

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Alignment with Sustainable Development Goals (SDGs):
This work is aligned with several Sustainable Development Goals (SDGs): SDG 2 (Zero Hunger), increasing the availability of nutritious food options and improving food security; and SDG 12 (Responsible Consumption and Production), emphasizing resource optimization, waste minimization and support for sustainable consumption and production. This research contributes to promote sustainable agricultural and industrial practices, which in turn reduce environmental impact and improve the food sector.

APPLICATION OF OPTIMIZED EXTRACT OF CITRUS SINENSIS OSBECK EPICARP AND OCIMUM BASILICUM L. LEAFS IN ORANGE-BASED FERMENTED BEVERAGE

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Aromatic plants and edible leftovers from the agri-food sector are of great interest to the industry due to the large amount of biologically active substances they contain [1]. Adding these elements to food products is an important market strategy, as they are often associated with various health benefits and are promising for health promotion. Additionally, they contribute to the circular economy and reduce environmental impacts [2-3]. In this perspective, the present study aimed to explore citrus residues, using an optimized extract from the epicarp of *Citrus sinensis Osbeck* (OE) and, an extract from *Ocimum basilicum L.* (BE) a popular spice of the Iberian Peninsula. From which five different fermented beverages (OE_0, OE_25, OE_50, OE_75, OE_100) were subsequently formulated to test the bioactive properties of the extracts both together and separately. These extracts were mixed in different concentrations in the formulations of the fermented beverages: OE_0 (100% BE), OE_25 (25% OE / 75% BE), OE_50 (50% OE / 50% BE), OE_75 (75% OE / 25% BE), and OE_100 (100% OE). The five beverages were produced according to Decree-Law no. 288/94, of November 14, using a concentration (w/w) of 8% nectar, with 50% of the nectar consisting of citrus juice and 50% of extracts, agave syrup, and plant extracts (OE and BE). The five formulations were then left to ferment for three days before being transferred to other containers for refrigeration to evaluate their shelf life over five days. Various parameters were evaluated, including pH (which remained stable), color (changes in ΔE), antimicrobial activity, and Brix degree (gradual decrease in sugar levels). The presence of microorganisms in the beverage was responsible for the reduction in Brix degree and may have affected the coloration, along with pH variations. The antimicrobial activity of these extracts was evaluated against a panel of selected microorganisms based on their importance to public health, using the microdilution method. It was observed that *Yersinia enterocolitica* and *Staphylococcus aureus* were the most sensitive to all extracts, while *Pseudomonas aeruginosa* showed no sensitivity to any of the extracts. This study aimed to advance better management of food industrial waste, as well as study the bioactive properties of the extracts; however, some scientific gaps still need to be filled since the insertion of the extract affected some of the evaluated parameters. Based on this premise, future research could be conducted to evaluate the acceptability of the sample through a non-trained sensory panel.

Keywords: Bioactive compounds, Functional properties, Shelf-life study, Natural ingredient.

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This work aims to utilize agro-food waste and valorize local plant matrices to develop safe, healthy, and natural food products in accordance with the UN Goals 3 and 12.

BY-PRODUCTS OF THE FOOD SECTOR AS A SOURCE OF NUTRIENTS: THE PARTICULAR CASE OF PEACH POMACE RESULTING FROM THE JUICE INDUSTRY

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One of the major problems faced by the agri-industrial sector is the management of the waste that comes from it. The lack of knowledge of the potential within these residues as raw materials in several industrial processes makes it difficult both to use them and to apply them in economically profitable processes [1]. The accumulation of biomass (husks, seeds and bagasse) generated annually by the sector results not only in the degradation of the environment, but also in the loss of compounds of high interest, with potential application in different industrial sectors, namely for the development of new food products, biofuels, pharmaceuticals and chemicals [2].
In this perspective, the nutritional and chemical characterization of the peach bio residue, *Prunus Persica* (L.) Batsch var. nurcipersica, resulting from the juice processing, was evaluated, in order to study its potential for industrial application. The centesimal composition (protein, ash, fat, and carbohydrate contents and energy value) was evaluated following official methodologies (AOAC), the chemical composition was determined thought several chromatographic methods, namely the free sugars profile was determined by HPLC-RI, organic acids by UFLC-PDA and fatty acids by GC-FID.
The results showed that water stood out as the main component, because the sample has a high moisture content, 83.68%. Furthermore, carbohydrates proved to be the macronutrient present in the greatest quantity; otherwise, and as expected, the assessment of protein content, ash and fat concentration showed considerably low values. Regarding the free sugars profile, four molecules were detected, two monosaccharides fructose and glucose, and two disaccharides sucrose and trehalose. Sucrose was the most abundant sugar, followed by fructose, glucose and, finally, trehalose, with much lower content than the others. The fatty acid profile detected the presence of five compounds, all with a representation greater than 1%. Alpha-linolenic acid (C18:3n3) stood out as the most abundant fatty acid. Finally, in the individual profile of organic acids, four organic acids were identified, namely oxalic, quinic, malic and fumaric acids, being the malic acid the majority.
Considering the results, this study allowed the valuing the waste of a raw material widely discarded by the food industry, making known their potential in compounds of interest, to create viable strategies for reincorporation into the value chain.

Keywords: By-products, Sustainability, *Circular economy, compounds of high interest*

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This work aims to align with objectives 2, 12 and 15 of the sustainable development goals by identifying bio-based functional ingredients to promote food and nutritional security, reducing food waste in production

BIOLOGICAL ACTIVITIES OF HYDROETHANOLIC EXTRACTS FROM SUMAC (RHUS SPP.)

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Rhus spp., commonly known as sumac, is a plant belonging to the Anacardiaceae family. It is traditionally used as a spice and flavoring agent and is widely used as a seasoning in Iran and Arab countries [1, 2]. Due to its valuable benefits, sumac has been used in traditional medicine for the treatment of several diseases. It is rich in a variety of phytochemicals, including flavonoids, tannins, polyphenolic compounds, organic acids, among others [3]. This study aimed to characterize the bioactive properties of the hydroethanolic extracts from the fruit, stem, and leaves of the *Rhus* spp. plant. The samples were collected in the region of the Portuguese city of Foz Côa, Portugal. The antioxidant activity was evaluated by DPPH radical-scavenging activity, reducing power, and inhibition of lipid peroxidation (TBARS). Our studies revealed that all parts of the plant have good antioxidant capacity. The leaf stood out in all methods, being the most effective part of the plant. In the DPPH assay, the leaf had the best result, with 1.63 µg/mL, while the stem presented 4.80 µg/mL and the fruit 6.04 µg/mL. In the TBARS assay, the leaf also demonstrated the best antioxidant capacity, with 2.02 µg/mL, compared to the fruit (4.28 µg/mL) and the stem (8.61 µg/mL). In the reducing power assay, the leaf once again stood out in relation to the other parts of the plant, with 5.47 µg/mL, followed by the fruit with 5.78 µg/mL. The stem presented the lowest antioxidant capacity, with 14.21 µg/mL. The results obtained showed better activity than the positive control, trolox, in all methods. The results indicate that the plant possesses a high antioxidant capacity, with this activity being more pronounced in the leaves, surpassing the fruits and stems. These findings hold significance in determine which parts of the plant may offer the most advantages in applications requiring antioxidant properties, such as in the food, pharmaceutical or cosmetic industries.

Keywords: *Rhus spp.,* Antioxidants, Phytochemicals, Bioactive compounds.

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C644929456-00000040), a project supported under the PRR (www.recuperarportugal.gov.pt), and financed by the European Union/Next Generation EU.
This work aims to explore natural matrices to safely incorporate them into food, supporting food quality and safety and developing high-quality products (Goals 3 and 12)

WOOD DISEASES OF KIWIFRUIT AND BIOCONTROL STRATEGIES

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Modern kiwifruit cultivation faces numerous idiopathic threats, including wood diseases (e.g., ESCA, elephantiasis, and silver leaf of kiwifruit), which impose significant limitations on both the production and quality of kiwifruit [1, 2]. These diseases are primarily characterized by the damage they cause to the wood of the trunk and branches, leading to a gradual and widespread weakening of the plant [2]. ESCA, also known as "Esca disease" or "Wood decay of kiwifruit," is a complex and destructive disease caused by a consortium of fungal pathogens [2]. This disease shares some characteristics with the esca of grapevines and is characterized by chronic and acute symptoms [3]. Current preventive measures rely on Cu-based pesticides, which exacerbate environmental issues, phytotoxicity, and the risk of pathogen resistance. Thus, it is urgent to find sustainable control alternatives.

EU restrictions on agrochemical use are encouraging research of green-based solutions to replace conventional agrochemicals and create a more sustainable agriculture. Thus, the main goal of KiwiBol (PTDC/ASP-PLA/2440/2021) was to find new agents to combat this disease. To do that, we isolated *Trichoderma* spp. from soils and rhizosphere of ESCA-symptomatic and asymptomatic orchards. Then, we investigated their antibacterial (against plant pathogenic bacteria) and antifungal activity (fungi of ESCA complex) *in vitro* using dual-culture method. The most promising *Trichoderma* spp. isolates (T003 and T033), showing strong biocontrol potential, were chosen for extract production and characterization to dissect the mechanism behind the antimicrobial activity. The analysis of its crude extract, using Liquid Chromatography Mass Spectrometry (LCMS), revealed the presence of peptaibols, a class of linear, amphipathic polypeptides from the fungal non-ribosomal peptide synthetase (NRPS) pathway [4]. In the future these could be directly or indirectly used to control this disease.

These experiments are crucial for selecting effective *Trichoderma* isolates that produce powerful antifungal peptaibols that could be applied as natural-based solutions and replace conventional agrochemicals. They will support further research, aiding in the development of new eco-friendly agents for wood decay control. As a next step, we intend to extract, and *de novo* synthesize these promising molecules and fully characterize their mode of action *in vitro* against fungi of ESCA complex.

Keywords: ESCA, Kiwifruit, Peptaibols, Biocontrol strategies.

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KIWIBOL is an integrated approach that will deliver a new and eco-friendly biotechnological tool (Peptaibols and/or *Trichoderma* spp.) to address Kiwifruit ESCA disease's management on Portuguese kiwifruit orchards. This will make KIWIBOL an appealing approach for future translation to the field and increase the efficiency of kiwifruit production.
https://www.un.org/sustainabledevelopment

FOOD PROCESSING BY PULSED ELECTRIC FIELDS: CHALLENGES AND SUSTAINABLE OPPORTUNITIES FOR INDUSTRIES

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Sustainability in the food industry requires innovation in both its processes and product ingredients as a strategy to provide consumers with not only high-quality food, but, above all, healthier and safer products, while achieving a better economic, environmental and social performance [1]. To satisfactorily respond to processing demand, innovative non-thermal technologies such as ultrasound, high-pressure processing and pulsed electric fields (PEF) have, recently, attracted interest due to their ability to ensure food safety with minimal alterations of relevant macro and micronutrients considering health and well-being promotion. PEF is based on the application of short-duration pulsed power to food products, typically with a field strength ranging from 1 to 30 kV/cm. This technology promotes cell electroporation, a phenomenon that induces greater formation of pores in the biomass cell membrane [2,3]. This study aimed to analyze three case studies developed at TAGUSVALLEY in Portugal, identifying two innovative approaches towards sustainable development in terms of product quality and process efficiency, namely, industrial forward-looking processes assisted by PEF. The first one, represents a business model redesign oriented to sustainability, consisting in the reconfiguration of the conventional olive oil extraction with PEF-assistance pre-treatment, which could have a positive impact on production efficiency, maintaining the extra-virgin classification [4]. The second one, focused on microbial inactivation by PEF for shelf-life extension and to ensure the safety and quality of Reineta Parda apple puree compared to conventional thermal pasteurization [3]. The third one also implies the utilization of PEF as a pre-treatment but, in this case, the strategy used was to improve freeze-drying efficiency on strawberries [5]. All approaches target sustainability performances and allow an improvement in food quality and process efficiency. Furthermore, a cost-benefit assessment of the PEF implementation was carried out for the first two case studies [4, 6]. The results showed that the incorporation of PEF (2 kV/cm, and 8.5 kJ/kg) in olive oil production reduced the malaxation step by 33% without compromising the yield or extra-virgin classification. This efficiency leads to a potential 12.3% increase in annual olive oil production, with a 12.3% and 36.8% rise in revenue and gross profit, respectively. Considering apple puree processing, PEF at 10 kV/cm and 57.2 °C, reduced *E. coli* counts by 5.8 log CFU/g, thus achieving the pasteurization status (at least 5 log CFU/g inactivation). The investment required on PEF equipment for upgrading pasteurization process under study showed an internal rate of return of 21.54% and a payback of 4 years. On the other hand, the scanning electron microscope images revealed a porous structure on freeze dried fruits, with the highest porosity observed in the samples pre-treated with PEF at 1 kV/cm, bipolar pulse of 15 µs, and 60 Hz. PEF significantly improved the freeze-drying efficiency since samples pre-treated with PEF had lower moisture (9.73%) when compared with samples without pre-treatment (10.48%). However, PEF pre-treatment did not impact the duration of freeze-drying process. In conclusion, this study can guide, support and provide solutions for small, medium, and large companies, in the innovation and adoption of more efficient and sustainable processes. PEF can help to surpass the challenges associated with thermal food processing methods, for instance, high temperatures and processing time, operational costs and alteration of food nutrient components.

Keywords: Oil-Extraction, Freeze-Drying, Microbial Inactivation, Novel processes.

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(PEF can contribute to a food system that aims for industrial innovation and sustainability)

ANTIOXIDANT ANALYSES OF LEMNA MINOR, AN AQUATIC PLANT OF EMERGING INTEREST FOR THE FOOD INDUSTRY

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Duckweed (*Lemna minor* L.) is a diminutive floating aquatic plant that holds significant economic potential across various industrial sectors. Its notable biomass yield, substantial protein content, and adaptability to diverse climatic conditions have spurred growing interest in its application within both animal and human food systems. Traditionally consumed in Southwest Asia, *Lemna minor* is now emerging as a novel food source in Europe.

This present work examines two antioxidant activity tests, namely thiobarbituric acid reactive species (TBARS) inhibition and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging, for two previously determined pH (6.5 and 9.5) and for three photoperiods (12, 8 and 4 hours).

For this purpose, the plants were subjected to a solid-liquid extraction in ethanol (80:20) 1g/mL for 1 hour, after which they were filtered and re-extracted, followed by a second extraction with fresh solvent. After the extraction, the supernatant was lyophilized, and the resulting powder was used for antioxidant activity assays.

The values of the TBARS and DPPH assays for pH 6.5 and 9.5 show significant differences of 0.74 ± 0.06, 0.57 ± 0.02, 1.05 ± 0.03, 0.61 ± 0.01, respectively. Thus, plants with higher antioxidant activity were those that were subjected to growth at pH 9,5, resulting in a lower EC_{50} value, which represents a lower concentration of extract needed to neutralize 50% of the oxidative species. For different photoperiods of 12h, 8h, and 4h, the analyses respectively demonstrated: 0.53 ± 0.03, 0.37 ± 0.03, 0.12 ± 0.002 for TBARS and 0.79 ± 0.01, 0.58 ± 0.06, and 0.54 ± 0.07 for DPPH. The highest antioxidant activity was found in the extracts of plants with lower light radiation, 4 hours, being significantly higher than at 8 hours. The lowest activity was found for 12 hours of radiation.

Thus, with respect to pH, the values are as expected, demonstrating that under an alkaline and highly stressful environment, the plant produces secondary metabolism compounds for its protection against this aggression, with these compounds being quite antioxidant. At an optimal pH for its growth, the plant focuses its energy on growth and reproduction, not needing to synthesize protective molecules. Regarding photoperiod, it is concluded that longer radiation time may not be among the factors that most contribute to the synthesis of secondary metabolism compounds.

L. minor plants can grow at pH levels significantly different from the optimal, as well as under various photoperiods, albeit more slowly. Despite this slower growth, they produce large quantities of antioxidant compounds, making them a potential source for these compounds in industries beyond the food sector.

Keywords: Floating plants, Antioxidant, Assays.

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This work fulfils several specific points in Food Supplement Production within the Sustainable Development Goals (SDGs), namely numbers 2,12,14. For SDG 2, it is a sustainable, protein-rich plant that helps combat hunger and improve food security. Regarding SDG 12, duckweed promotes sustainable agricultural practices with low environmental impact. For SDG 14, its ability to purify water supports the protection and restoration of aquatic ecosystems, enhancing biodiversity and ocean health.

INNOVATIVE BUCCAL FILMS ENRICHED WITH ACTINIDIA ARGUTA EXTRACT FOR ORAL MUCOSITIS PREVENTION: *IN VITRO AND EX VIVO* STUDIES

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Oral mucositis (OM) is a prevalent side effect of cancer treatments like chemotherapy and radiotherapy, characterized by disruption of oral mucosa integrity, inflammation, and pain [1,2]. Current treatment strategies for OM, which include oral care, pain management, and nutritional support, remain unsatisfactory [1]. This has led to the exploration of new active compounds from natural sources, such as *Actinidia arguta* fruits [2]. Commonly known as kiwiberry, *A. arguta* fruit is associated with various therapeutic properties, including antioxidant, anti-inflammatory, and anticancer effects, owing to their rich content of phenolic compounds, vitamins, and organic acids [3]. The aim of this study was to develop buccal films containing *A. arguta* fruit extract as active ingredient to prevent OM symptoms. The films were prepared by solvent casting using 1% HPMC K100 LV EP, 2.5% glycerin, and *A. arguta* fruit extract as solvent, obtained through Ultrasound-Assisted Extraction [3]. Various parameters of the films were assessed, including physical features (weight: 194.8 mg; thickness: 0.37 mm; disintegration time: 15.05 min; moisture content: 10.53%; swelling capacity: 55.95%), mechanical properties (resistance to extension: 10.11 N; elongation percentage: 36.10%; Young's modulus: 0.0034 MPa), and antioxidant/antiradical activities (TPC = 6.46 mg GAE/g film; FRAP = 49.45 µmol FSE/g film; ABTS = 3.74 mg AAE/g film; DPPH = 4.90 mg TE/g film). *In vitro* cell assays confirmed the absence of negative effects on HSC-3 and TR146 oral cell lines. Importantly, the bioactive compounds release profile was evaluated using a buccal *in vitro* cell model (comprising TR146 cells) and an *ex vivo* assay with porcine buccal mucosa, coupled with LC/DAD-ESI-MS quantification. The results demonstrated high permeation rates for rutin (88.32%), quercetin-3-O-glucoside (84.95%), and catechin (79.74%). Overall, these findings underscore the significant potential and safety of buccal films containing *A. arguta* fruit extract for preventing OM.

Keywords: *Actinidia arguta*, Buccal *in vitro* model, Porcine mucosa *ex vivo* assay, Antioxidant compounds, Oral diseases.

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The integration of *Actinidia arguta* fruit extract into buccal films for preventing OM leverages the nutritional and therapeutic benefits of natural resources (SDG 2), aims to improve health outcomes for cancer patients (SDG 3), and promotes sustainable and responsible use of natural products in pharmaceutical development (SDG 12).

HARNESSING CHESTNUT SHELLS AS A SUSTAINABLE INGREDIENT RICH IN ANTIOXIDANT COMPOUNDS: AN IN VITRO DIGESTION APPROACH

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The interest in natural sources rich in antioxidants has drastically raised over the last decade and their employment in the design of novel sustainable foods has arisen as a hot research topic [1]. Chestnut (*Castanea sativa*) shells (CS), an underexploited food by-product, have been explored due to their phytochemical composition and bioactivity using eco-innovative extraction technologies [2]. Nevertheless, their potential human health benefits rely on the phytochemicals recovered and their digestibility [1]. Therefore, *in vitro* digestion models have been implemented to predict the bioaccessibility and bioactivity of CS.

This study aimed to repurpose CS as a sustainable ingredient for food and nutraceutical products by exploring the bioaccessibility and bioactivity of phenolic compounds upon *in vitro* gastrointestinal digestion, as well as the metabolomic profiling of digested and undigested samples by LC-ESI-LTQ-Orbitrap-MS.

The results evidenced an increase in total phenolic and flavonoid contents, antioxidant/antiradical properties, scavenging potential against reactive oxygen and nitrogen species, and acetylcholinesterase inhibition during *in vitro* gastrointestinal simulated digestion. Metabolomic profiling unveiled biotransformation reactions during gastrointestinal digestion, especially in phenolic compounds (46% of total compounds annotated), lipids (22%), phenylpropanoids (9%), organic acids (7%), carbohydrates (5%), nucleosides (5%), amino acids (4%), and alcohols (1%). Phenolic acids (gallic, syringic, and hydroxyphenylacetic acids) and flavonoids (epicatechin) were the major polyphenolic classes identified. Through multivariate analysis, the heatmap-positive correlations pointed out the contribution of secondary metabolites to the CS bioactivity upon digestion. Taken together, these findings sustain the valorization of CS as a promising nutraceutical toward the implementation of Sustainable Development Goals.

Keywords: *Castanea sativa*, Simulated digestion, Bioactivity, Metabolomics, Sustainability.

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The present work fits the United Nations Sustainable Development Goals 2, 3, and 12, focusing on the valorization of a food by-product with health-promoting effects for industrial purposes towards a circular economy approach and applying sustainability principles.

INNOVATION IN SUPERFOODS FOR HEALTH AND NUTRITION: NUTRITIONAL CHARACTERIZATION OF AGARICUS BLAZEI MURILL ENRICHED WITH β-GLUCANS

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Several studies highlight mushrooms as beneficial food additives, rich in protein, minerals, and vitamins, offering a nutritious alternative to meat. β-Glucans (β-g), found in fungal cell walls, enhance food processing and exhibit immunomodulatory, anti-inflammatory, and antioxidant properties. *Agaricus blazei* Murill mushrooms are particularly noted for their potential in preventing cancer, diabetes, and cardiovascular diseases, especially when enriched with β-g. Research shows that β-g can reduce glucose and insulin levels, and *A. blazei* β-g also demonstrate potential as an antitumour agent [1]. This study analysed the nutritional components of two samples of *A. blazei* extract enriched with β-g, aligning with Sustainable Development Goals (SDGs) 3 and 9. SDG 3 aims to improve well-being by exploring the nutritional benefits and health properties of *A. blazei* extracts, advancing knowledge of nutritious food alternatives and promoting better dietary habits. SDG 9 aims to foster innovation and resilient infrastructure, supported by this study's development of new extraction and enrichment processes for mushroom-based products, enhancing their functional properties and nutritional value. The extraction process involved hydroalcoholic percolation of dried *A. blazei* cultivated in sawdust, followed by freeze-drying and the addition of mushroom fibre as a secant, conducted by HNFood® (São Paulo, Brazil). Nutritional value tests were performed according to AOAC procedures, and sugar composition was analysed using an HPLC system coupled with an RI detector. The study evaluated two samples: one extracted for over a year (cv) and another one with one year (cn) of storage, to assess their potential as functional and nutritional foods. The observed differences in the nutritional profiles of *A. blazei* extracts can be attributed to variations in soil or cultivation, which likely caused the higher ash content in cv (24.16 g) compared to cn (15.56 g). Lipid levels were similar. Mannitol and trehalose were higher in cn (41.74 g and 3.07 g) than cv (29.77 g and 2.15 g) per 100 g extract, with cn also having more fructose. These differences may stem from genetic or fermentation variations. Protein content was slightly different, with cv at 41.59 g and cn at 41.34 g per 100 g extract. These varied nutritional profiles of *A. blazei* extracts show their potential to enhance food nutrition and health benefits, emphasizing their dietary versatility.

Keywords: Mushrooms, β-Glucans, Nutritional profiles, Functional Food, Health benefits.

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ESTIMATING HIDDEN INFESTATIONS IN RICE BY MEASURING CARBON DIOXIDE LEVELS

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Infestations by *Sitophilus* species cause significant quantitative and qualitative losses in the rice value chain, impacting producers and consumers. Most of the *Sitophilus* life cycle occurs inside the grains, where adult insects chew a hole in the grain lay eggs, and seal the hole with a gelatinous plug, making infected grains indistinguishable by the naked eye [1].
The amount of carbon dioxide (CO_2) in rice storage is largely correlated to infestation, due to the insects' respiration rate [2]. Therefore, it is possible to estimate hidden infestations in rice by measuring CO_2 levels. This method can be effective in detecting hidden infestations and preventing waste. Earlier phases of grain weevils produce more CO_2 than adults making this approach particularly useful [3].
In this study, an oxygen (O_2) and CO_2 portable sensor (CheckMate 9900, PBI Dansensor) was used to estimate infestation levels, by measuring these values daily (%) until insect adults were visually detected. Six replicates of 10g of untreated rice were infested with 10 insects each. After 10 days, the insects were removed, and the respiration rate was recorded.
The results showed that CO_2 levels gradually increased throughout the weevils' life cycle and started to decrease at the adult stage. This indicates that modern sensors can accurately predict and detect an incipient or ongoing hidden infestation.

Keywords: Rice, Early infestation, *Sitophilus*, CO_2.

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This study is related to the Sustainable Development Goals (SDGs), **12**. Responsible Consumption and Production, since we hope to reduce food waste by reducing rice grain losses with new methods, capable of detecting internal/early infestation, and 9. Industry, Innovation and Infrastructure, because this methodology could be useful to apply in the industry, in rice storage, to control infestations.

COMPARATIVE ANALYSIS OF ANTIMICROBIAL PROPERTIES OF DIFFERENT HONEY VARIETIES AGAINST MULTIDRUG-RESISTANT BACTERIA IN CHRONIC WOUNDS

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Multidrug-resistant bacteria is a worldwide challenge and concern [1]. Biomaterials have been investigated as powerful resources to fight against these microorganisms without promoting causing side adverse effects [2]. In Diabetic foot ulcer (DFU), honey has been shown to be effective for the treatment of resistant bacteria and chronic wound management due to its anti-inflammatory and antibacterial properties [3]. However, few studies investigated the relationship between the pollinic content from different types of honey and antimicrobial activity. This study aims to investigate how the different floral sources present in different honey samples might influence their antibiofilm activity. Pollen contents were assessed in seven different types of honey from the region of Trás-of-Montes (Portugal). The honey samples were tested at three concentrations: i) 1xMinimum Inhibitory Concentration (MIC), ii) 5xMIC, and iii) 10xMIC, against biofilms of Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Candida albicans. The honey type-4 had removed even 78.4% of Candida albicans biofilm, being higher than honey type-5 (8.87%), type-8 (27.5%), type-9 (21.5%) and type-10 (46.3%). For E. coli, honey type-4 removed 57.2% of biofilm, being greater than type-10 (28.5%). Honey at 10xMIC was more effective in inactivating biofilm metabolism in Candida albicans, Klebsiella pneumoniae, and Pseudomonas aeruginosa. Regarding pollinic content, Castanea sativa was the predominated pollen in all types of honey. A moderate correlation was observed between pollen content and biofilm removal according to Principal Component Regression, with Erica sp. and Sedum sp. showing a negative correlation and Corrigiola telephiifolia, and Jasione montana showing a positive correlation with antibiofilm activity. The lower pollen concentrations of Erica sp. and Sedum sp. and higher concentrations of Corrigiola telephiifolia, and Jasione montana found in honey type-4 might suggest promising antimicrobial features to treat DFU.

Keywords: Honey; *Castanea sativa*; Bacterial resistance, Antimicrobial, Biofilms.

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This work aligns with Goal 3 of the 2030 Agenda by promoting good health and well-being through innovative medical treatments, and Goal 12 by supporting responsible consumption and production of natural medicinal resources.

UNLOCKING NUTRITIONAL AND FUNCTIONAL BENEFITS OF FAVA BEANS THROUGH SOLID-STATE FERMENTATION: A SCIENTIFIC APPROACH

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With the increase in the consumption of vegetable proteins, such as those from legumes, there is also the need to innovate in their consumption, not only in how to prepare or cook them, but also how to fully exploit their intrinsic nutrients. One method to accomplish this could be through fermentation[1]. Solid-state fermentation consists in inoculating the legume or legumes of interest with one or several microorganisms, among them fungi, yeasts and lactic acid bacteria. Koji (*Aspergillus oryzae*), Tempeh (*Rhizopus oligosporus*), and Red-Oncom (*Neurospora sitophila*) are all traditional fermented foods that utilize fungi to enhance their nutritional value and flavor[2]. The fermentation process not only preserves the food but also enhances its nutritional content. Fungi increases the bioavailability of nutrients, adds beneficial compounds, and often reduces antinutritional factors[3], playing a crucial role in traditional diets and food culture. In this study, the Sofia fava bean (*Vicia faba*) variety from the Catalan region of Spain was inoculated with different strains of microorganisms for fermentation. Then were mixed with water in a 1:3 ratio, adjusted to pH 4.5 and left to soak for 24 hours. The skins were then removed, and beans were cooked in water at pH 4.5. Subsequently, they were dried at 30°C for one hour and inoculated according to the specifications of each microorganism, incubating them at 30°C for at least 24 hours until a mycelial layer was observed. Beans were divided into two batches: one was frozen for later freeze-drying and the other was dried at 70ºC for 24 hours, then ground and subjected to techno-functional and nutritional analysis. The emulsifying capacity of both Tempeh and Koji was remarkable (between 30 and 33%), as well as their water and oil retention capacity (87 and 67% respectively), which were increased in the freeze-dried batch (89 and 75% respectively) of the beans. In nutritional terms, the beans inoculated with Tempeh showed better results in terms of total phenolic content(3.40mg/g) and antioxidant capacity (132.44 mg/g). Protein levels were similar in all beans with different strains ranging from 32-35%.

Keywords: Solid-state fermentation, Fava beans, Red-Oncom, Koji, Tempeh, Valorization, Functional properties.

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ENZYMATIC AND THERMAL SUGAR EXTRACTION METHODS FROM APPLE POMACE – LOWERING SUGAR LEVELS AND MODIFYING SWEETNESS

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Vegetable and fruit by-products constitute 44% of global food waste. Apple byproducts (skin, flesh, seeds, and stems), which are increasing due to consumer demand for apple juice or cider, are largely wasted or underutilized, despite being rich in dietary fiber, phenolic compounds, proteins, and inorganic salts. Recent processes have focused on extracting polysaccharides and oligosaccharides from these by-products, primarily for fermentation and bioethanol production, with limited use as functional ingredients in the food, pharmaceutical, and cosmetic industries. Objective: This work aims to obtain natural ingredients with sweetening power from apple pomace (skin, flesh, seeds and stems). It aims to evaluate the effect of hydrolysis conditions, namely enzyme concentration (XA: 0,5% to 3%), substrate/solvent ratio (XB: 1/2 to 1/10), and duration (XC: 1h to 4h), on sugars obtained from apple pomace through four Box-Behnken Designs and determine the enzyme (Viscozyme® L or Pectinex® Ultra SPL) and substrate state (fresh or 30 days frozen) optimal conditions to maximise the ºBrix.
Enzymatic hydrolysis using citrate buffer followed by thermal hydrolysis in an autoclave was performed to release sugars from apple pomace. The supernatant was separated by centrifugation, and sugar content was measured with an ATAGO® Pocket refractometer. Four experimental designs (I, II, III, and IV) were used, considering three independent factors (XA, XB, XC) at three levels (-1, 0, 1). A total of 15 assays, including three central point repetitions, were conducted. The Box-Behnken design and statistical analysis were carried out using Stat- Ease 360 Software. Results: The results variance of the four experimental designs was well explained by three different models, two-factor interaction (2FI) (Eq (I)), Quadratic (Eq (II)), and Linear (Eq. (III) and (IV)), since it had statistical significance ($p < 0.05$) and a lack of fit that was not significant. Furthermore, the R2 and the predicted R2 indicated that the model explained >98% of the observed data and >97% of the predicted values. The ºBrix was affected by all the factors and their interactions in experimental design (I) and (II), and was only affected by the substrate/solvent ratio (XB) in experimental design (III), and also affected by enzyme concentration in experimental design (IV). Conclusion: Extracting sugars from apple pomace is an effective and affordable method to incorporate fruit by-products into various food products, thereby promoting the development of healthier options. This approach aligns with the circular economy framework, offering significant environmental benefits by reducing pollution and economic benefits through the valorization of by-products. The study's statistical models evaluated the impact of enzyme concentration (XA), substrate/solvent ratio (XB), and hydrolysis duration (XC) on °Brix. Further research is needed to optimize sugar concentration, yield, and sweetness index from apple by-products.

Keywords: Apple By-product, Pomace, Sugar extraction.

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EXPLORING BIOACTIVE COMPOUNDS IN LETTUCE WASTES AND LOSSES

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Population growth and the increasing demand for balanced diets represent a challenge for agriculture in providing sustainable and nutritious foods. The intensification of agriculture generates significant waste and losses (WL) [1,2]. Lettuce (*Lactuca sativa* L.), a commonly consumed vegetable, suffers notable losses due to management practices and adverse transport and storage conditions [3]. This work aims to determine phenolic compounds and antioxidant activity in WL of different varieties of L. sativa, to valorize and repurpose these matrices. Samples from varieties crispa (curly leaf, lollo rossa), capitata (iceberg), longifolia (little gems, romaine), and crispum (frisée) were lyophilized, then extracted by decoction and ethanol/water maceration. Phenolic compounds were identified using HPLC-DAD-ESI/MS_n; antioxidant activity was assessed through DPPH (Free radical scavenging effect), Reducing Power, TBARS (Inhibition of lipid peroxidation) assays, and anti-bacterial activity was tested using food-borne bacterial strains. In both extracts tested, lollo rossa variety contained the highest levels of phenolic compounds, with hydroethanolic showing the greatest concentrations (29.77 mg/g extract). Quercetin malonyl hexoside was the main phenolic compound (15.3 mg/g extract), while anthocyanins totaled 1.20 mg/g extract, with cyanidin-O-hexoside (0.497 mg/g extract) and cyanidin-3-O-(6"-malonyl)glucoside (0.706 mg/g extract) predominating. In addition, the decoction extract of this variety showed the best results in terms of antioxidant activity in the following assays: TBARS (0.08 mg/mL), DPPH (0.104 mg/mL), and Reducing Power (0.2 mg/mL). Hydroethanolic extracts from curly-leafed, iceberg, little gems, and romaine varieties displayed notable antibacterial activity against Yersinia enterocolitica (MIC value 0.007 mg/mL). Overall, the biochemical characterization of L. sativa WL highlights their potential as a source of valuable bioactive compounds and supports a sustainable approach to managing agricultural residues.

Keywords: Waste and losses, Sustainability, Bioactive compounds, Antioxidant activity.

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This work offers sustainable solutions for bio-waste, leveraging innovative technologies to promote a circular economy and enhance food safety. It aligns with the 2030 Agenda goals by reusing agri-food waste, developing new products, and reducing waste generation (goals 12.5; 12.a). It also supports the vegetable industry in reducing industrial waste through innovation and research (goals 9.4; 9.5).

POTENTIAL USE OF FREEZE-DRIED OF GRAPEVINE LEAF EXTRACTS IN PRODUCTION OF SORBET AND ICE-CREAM

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While wine and grapes are the most known and valuable grapevine products, several waste products derive from this industry, such as must, grape water and leaves, the last being one of the most abundant waste products in vineyards [1,2]. The increasing search for healthier diets as well as new food with health promoting characteristics, has drawn attention to grapevine leaves in the last few years [3]. However, the consumption of grapevine leaves are not edible, they must undergo some culinary preparation is quite challenging. The main of this study was to develop sorbet and ice-cream used freeze-dried grapevine leaf extracts. Grapevine leaf was lyophilized, blended with sugar syrup added water until reached 45ºC and macerated in vacuum bag during 24h/4ºC. Extracts obtained were formulated (1) rice+coconut drink with yuzu ice-cream, (2) almond drink with yuzu ice-cream, (3) sorbet without yuzu and finally, (4) sorbet with yuzu. º Brix, pH, consistency, sensorial analysis were determined for both ice-cream and sorbet formulations. Sorbet without yuzu displayed negative score in overall appreciation compared with all others. Panellists preferred almond drink with yuzu ice-cream that revealed better acidness and sweetness balance. In view of these results, the incorporation of grapevine leaf extracts into ice-cream and sorbet could represent a promising strategy for valorization these waste products, however formulations required improved of sensorial attributes.

Keywords: Grapevine leaf, Ice-cream, Sorbet, Culinary innovation, Food waste.

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A wider inclusion of this disregarded by-product in the human diet or its use as a source of bioactive compounds is a good strategy, not only to introduce an added value to a waste product but also to come upon the European Union and United Nations' demands towards more sustainable agricultural approaches and circular economy (Goals of the 2030 Agenda for Sustainable Development).

CHEMICAL PROSPECT OF DIFFERENT ANNONACEAE SPECIES

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Plants from the Annonaceae family (the Soursop family) occur in tropical to subtropical regions of all continents and comprise 122 genera and ca. 2440 species. Some economically important plants from the genus *Annona*, including species such as *Annona muricata* L., *Annona squamosa* L. and *Annona senegalensis* Pers., traditionally used as food, wood, firewood, medicines, and cosmetics [1]. This study aimed to provide a chemical characterization of A. *muricata*, A. *senegalensis*, and A. *squamosa* fruits, promoting their use as food and medicine by local populations in emerging countries. AOAC procedures and chromatographic techniques were employed to determine the proximal (lipids, ash, proteins, carbohydrates and energy) and chemical (free sugars, tocopherols and fatty acids) compositions of the fruits, respectively. A. *senegalensis* showed to be higher in proteins (15.56 g/100g dried weight, dw), followed by A. *muricata* (7.31 g/100g dw) and A. *squamosa* (5.17 g/100g dw). Fructose, glucose, and sucrose were identified in both species with A. *squamosa* holding the higher content of fructose and glucose (16.88 g/100 g dw and 13.07 g/100g dw, respectively), followed by A. *muricata* (11.50 g/100g dw and 12.70 g/100g dw, respectively), and A. *senegalensis* (9.80 g/100g dw and 8.63 g/100 g dw, respectively). Also, 24 fatty acids were identified, among which C16:0 (31.20%) were present primarily in A. *muricata*, and C18:1n9c in both A. *squamosa* and A. *senegalensis* (24.48 and 44.77%, respectively). Regarding tocopherols, the alpha isoform was detected in all species, with A. *muricata* and A. *squamosa* presenting the highest amounts, while gama- and delta-tocopherol were only detected in A. *senegalensis* (0.81 and 0.57 g/100g dw, respectively). These results validate and support the use of these species as a source of nutrients with potential benefits to be included in the population's daily diet.

Keywords: Nutritional value, Chemical composition, *Annona*, Food sustainability.

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The approach presented by our study, as well as the data provided on Annona species native to Africa, allow for the optimization of the use of natural plant resources in this region, contributing to achieving some of the Sustainable

Development Goals of the 2030 Agenda. Study provides data for promoting alternative food sources, thus meeting goals 2 (Zero Hunger) and 3 (Health and Wellbeing). Furthermore, the information provided will enable the sustainable use and maintenance of target plant species, thus fulfilling Objective 15 of the agenda (Life on Earth).

SUSeeds - BIODEGRADABLE COATINGS FOR VEGETABLE SEEDS

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Agricultural systems with intensive use have imposed high pressures on natural resources, with significant consequences on biodiversity, water scarcity, soil exhaustion, and the growth of emerging pathogenic species which, consequently, also compromise food security [1]. Transitioning to sustainable agriculture demands the development of high-productivity practices that utilize renewable resources. Agricultural innovations, such as implementing new agricultural technologies and introducing improved seeds and tools, are crucial to ensuring sustainability and increasing production [2]. To keep the balance between the food demand and the protection of the ecosystems, it is imperative that sustainable high-productivity methods can be adopted, using renewable resources and efficient practices. The utilization of biopolymers in agriculture offers a promising alternative to petroleum-derived polymers [3]. Biopolymers and derived coating materials are attractive due to their low ecological footprint and inherent biodegradability by microorganisms or natural processes. Furthermore, these materials exhibit biocompatibility and possess additional functionalities like antibacterial and antifungal properties, potentially enhancing agricultural product quality. The present research focuses on the design of new multifunctional films or capsules based on biodegradable biopolymers to coat the surface of different types of vegetable seeds. The aim is to rationally design new multifunctional biodegradable formulations and derived materials for applications in the seed industry. This work presents the main results achieved on the use of biopolymer-based formulations for vegetable seed coating, emphasizing the importance of implementing sustainable practices from the early stages of cultivation to improve productivity and environmental management.

Keywords: Seed coating, Biodegradable formulations, Seed quality, Vegetables.

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SDG 2 directly addresses achieving food security and promoting sustainable agriculture and SDG 13 proposes sustainable agricultural practices that reduce greenhouse gas emissions and protect ecosystems.

SUSTAINABLE EXTRACTION OF BIOACTIVE COMPOUNDS FROM EUCALYPTUS GLOBULUS LEAVES

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This study aims to value eucalyptus (*Eucalyptus globulus*) leaves to obtain an extract rich in antioxidant, antimicrobial, and anti-proliferative properties. Eucalyptus leaves were extracted using ultrasound-assisted extraction with a green solvent (ethanol:water), optimized through Response Surface Methodology combined with a Genetic Algorithm. Variables such as extraction time, solid/liquid ratio, ethanol proportion, and sonication power were adjusted to maximize yield and the content of phenolic acids, flavonoids, and total phenolic compounds. It was observed that the extraction process is favored by the sonication effect, long contact time and higher ethanol concentration, as it improves the solubility of the compounds and the diffusivity of the solvent. Given the wax barrier present in the leaves, the cavitation process is essential for obtaining phenolic compounds. However, there is a decrease in the content of phenolic compounds when the maximum sonication power is used for longer periods. The extracts were analyzed by high pressure liquid chromatography and mass spectrometry (HPLC-DAD-ESI/MS), revealing a high concentration of gallotannins, flavonoids, and phenolic acid derivatives. Bioactivity assays revealed maximum antioxidant concentrations in cell-based assays between 5.12 to 6.85 mg/mL (EC_{50}), antimicrobial efficacy against Gram-positive and Gram-negative bacteria (MIC values of 0.6 mg/mL for *Yersinia enterocolitica* and 0.3 mg/mL for *Staphylococcus aureus*), and high antifungal activity against *Aspergillus fumigatus*. Additionally, the extracts demonstrated antitumor potential (AGS, Caco-2, MCF-7), low toxicity in primary hepatocyte cells (PLP2) and monkey renal cells (Vero), and the ability to inhibit inflammatory markers in murine macrophages (RAW 264.7). These results highlight eucalyptus leaf extract as a promising natural additive with multiple applications, primarily in the food industry as a natural preservative and flavoring agent, due to its antimicrobial and antioxidant properties, distinctive taste, and potential health benefits.

Keywords: Eucalyptus leaf, Genetic algorithm, Ultrasound-assisted extraction, phenolic compounds, Bioactivity.

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The exploration of the potential of eucalyptus leaf extract as a bioactive agent proposed in this work is directly linked to the SDGs "3: Health and Well-being" and "12: Responsible Consumption and Production", since the use of these agro-industrial residues, the The use of low toxicity solvents and low environmental impact extraction methods promote the sustainable production of natural additives that can improve public health and reduce the environmental impact of the food industry.

CHEMICAL AND NUTRITIONAL QUALITY OF DIFFERENT PUMPKIN VARIETIES FROM ALGERIA

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Pumpkins are widely cultivated and consumed in Algeria, with different cultivars offering various nutritional benefits.[1,2] This research aimed to comprehensively analyze the composition of three raw cultivars that are popular in Algeria (Cucurbita maxima (Gold nugget Pumpkin), *C. moschata* (Butternut Squash), and *C. moschata* (Musquée de Provençal Squash)), highlighting differences, in nutritional profiling across various fruit parts (peel, pulp, fibers, and seeds).
The results revealed considerable differences in nutrient composition amongst the pumpking cultivars and the fruit parts. However, *C. moschata* (Musquée de provence squash) had significantly more, protein, ashes, fat and carotenoids while C. maxima being the richest cultivar in polyunsaturated fatty acids and carbohydrates, particularly in the fibers part, the saturated fatty acid were predominant in the peels, pulp, and fibers across all cultivars. Moisture content was different from each part with high values for the soft fruit parts and the mineral content analyzed by atomic absorption spectrophotometer and X ray Fluorescence revealed considerable diversity between the cultivars.
The antioxidant activities were also evaluated by four methods: DPPH inhibition, ABTS inhibition, FRAP assay and CUPRAC assay and the results showed considerable differences amongst the cultivars and the fruit parts. The internal parts of the pumpkin fruit (fibers and seeds) are the one that revealed the lowest IC_{50} and the *Cucurbita moschata* (butternut squash) cultivar is the best in terms of the recorded activities.
In conclusion, this study sheds light on the profiles of Algerian pumpkin cultivars and underscores their potential health benefits due, to varying nutrient compositions.

Keywords: Pumpkin cultivars, Nutritional profiling, Carotenoids, Mineral content, Antioxidant activities.

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COMPARATIVE ANALYSIS OF γ-ORYZANOL PROFILES IN THE BRAN OF EXOTIC RICE VARIETIES

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γ-Oryzanol (ORY) is a bioactive compound found in the rice bran lipid fraction, known for its significant health benefits [1]. Struturally ORY is a mixture of ferulic acid esterified with phytosterols and triterpene alcohol primarily comprising campesterol ferulate (CampF), ß-sitosterol ferulate (SF), cycloartenol ferulate (CAF), and 24-methylenecycloartenol (24MCAF) the four steryl ferulates identified which account 95% of ORY. Pharmacokinetic studies in rats have shown the presence of intact ORY in the bloodstream post-administration indicating its bioavailability [2]. Each component of ORY exhibits unique bioactive effects; for instance, 24MCAF, the predominant compound has demonstrated strong inhibitory effect on tumor cells growth, potentially due to its antioxidant properties [3]. Identifying and quantifying individual ORY compounds becomes important for determining the bioactive profiles of different rice varieties which is beneficial for breeding programs aimed at enhancing specific health benefits.
This study explores the variability of ORY compounds in the bran of 7 exotic rice varieties sourced from International Germplasm Bank (IRRI). These varieties differ in in type, shape, and color as well as in their genetic background [4,5]. High-resolution liquid chromatography (HPLC) was used to quantify the ORY content and its four main components [6].
Significant differences ($p<0.05$) were found among ORY compounds, across the rice varieties. The Azucena and Arabon varieties exhibited the highest CAF content at 40.6% and 41.6 % respectively. The NSICRC7 variety was notable for its high 24MCAF content (68.8 %), followed by Bora variety with (47.2%). For CampF and SF, the Maluit variety stood out with 13.7 and 14.4 % respectively. The NSICRC7 variety showed the lowest levels of CAF (16.7%), CampF (6.9%) and SF (6.1%). In conclusion, distinct ORY profiles were identified among different rice varieties highlighting the potential for selecting rice varieties based on their bioactive compound profiles. These findings could inform breeding programs aimed at enhancing specific health benefits through targeted ORY profiles.

Keywords: Rice bran, γ-Oryzanol compounds.

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This summary supports SDG 2, 9, and 12 by highlighting rice's role in food security, innovation, and sustainability.

VALORIZATION OF LYCIUM CHINENSE MILL. (GOJI) PRUNING WASTE FOR THE DEVELOPMENT OF ADDED-VALUE FOOD PRODUCTS

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Lycium chinense Mill. (LC), known for its goji berries, is widely used alongside *Lycium barbarum L.* in Chinese cuisine and traditional medicine, due to its richness in bioactive compounds, particularly polysaccharides, phenolic compounds, carotenoids, vitamins, and minerals, which are claimed to be associated with antioxidant, immunomodulatory, hypoglycemic, hypolipidemic, anti-aging, neuroprotective, and cardioprotective effects [1]. Global goji cultivation includes organic cultivation by Portuguese producers, who focus on fresh fruit sales to distinguish their products from goji berries grown in conventional agricultural mode by Chinese producers [2].
The pruning of LC shrubs stimulates fruit production but also generates significant amount of pruning waste annually that has no applicability or commercial value. Therefore, it is essential to investigate the composition and biological potential of this biowaste to develop novel products [3]. This study is focused on the phytochemical characterization of LC pruning residues through sequential extraction of solvents with increasing polarities, particularly of phenolic compounds and pigments, along with the screening of antioxidant activity of the resulting extracts. In addition, an aqueous extract of LC pruning residues was used as a new ingredient in gum formulations.
Sequential extraction studies revealed that LC pruning waste is rich in bioactive compounds, particularly phenolic compounds and pigments. Notably, the aqueous extract exhibited higher phenolic content (55.3 mg GAE/g of extract by Folin-Ciocalteu assay) and better antioxidant activity (645.9 mmol TE/g of extract by ABTS radical scavenging capacity assay). This extract was rich in phenolic compounds such as quinic acid, caffeic acid, quercetin, and proanthocyanidins, confirmed through HPLC analysis, laying a foundation for potential food supplements.
Formulation of gums with aqueous extract of LC pruning waste exhibited similar quality parameters (pH and humidity) to commercial gums, showing additionally significant phenolic content and antioxidant activity by Folin-Ciocalteu assay (55.7-59.6 mg GAE/g of gum) and ABTS radical scavenging capacity assay (63.5-68.1 mmol TE/g of gum) assays. This study advances knowledge of the phytochemical characterization of LC pruning waste, promoting its utilization and valorisation through sustainable practices and innovative ecological product development, thereby fostering environmental consciousness.

Keywords: *Lycium chinense Mill.*, Pruning waste, Phenolic compounds, Antioxidant, Gum.

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The work is aimed to contribute to the minimization of food losses and waste along the production and supply chain (Goal 12), as also to foster the commercialization of food products that ensure the health and well-being of the population (Goal 3).

COMPARATIVE ANALYSIS OF ANTIOXIDANT ACTIVITY IN YERBA MATE (*Ilex paraguariensis* A.St.-Hil.) USING DIFFERENT SOLVENTS AND EXTRACTION METHODS

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Yerba mate (*Ilex paraguariensis* A.St.-Hil) is known for its antioxidant and anti-inflammatory properties, attributed to its abundant bioactive compounds, such as polyphenols [1]. The present study aimed to test different solvents (water vs. hydroethanolic solution) and extraction methods to evaluate their efficiency in extracting polyphenols in view of selecting the best one for future optimization of the extraction. For that purpose, maceration at 40 ºC and room temperature for 1h with re-extraction after one additional hour, ultrasound-assisted extraction (UAE) for 15 min at 125, 250 and 375W and microwave-assisted extraction (MAE) for 15 min at 250, 500 and 750W were employed. The extracts were freeze-dried and subsequently analyzed for total phenols (TP) content and antioxidant activity. *In vitro* assays were employed to determine antioxidant efficacy through 2,2-Diphenyl-1-Picrylhydrazyl (DPPH) free radical scavenging, Thiobarbituric Acid Reactive Substances (TBARS) and Reducing Power (RP) assays, and TP were measured spectrophotometrically. Regarding the DPPH assay, it was observed that hydroethanolic extracts obtained higher EC50 values across the different extraction techniques, with UAE at 2375W for 15 minutes yielding an EC_{50} of 23±3 µg/mL, followed by MAE at 750W for 15 minutes, with an EC_{50} of 24±2 µg/mL. For reducing power, the EC_{50} values ranged from 94 to 127 µg/mL. MAE with H_2O at 750W exhibited the best performance in the TBARS assay (88 µg/mL), followed by maceration with water at 40ºC. MAE and UAE achieved the highest phenolic contents in hydroethanolic extracts, expressed in GAE/mL, ranging from 105 to 135 mg GAE/mL. These preliminary findings underscore UAE and MAE, particularly with 80% ethanol, as efficient methods for extracting antioxidants from yerba mate, highlighting potential applications in functional foods and supplements. Future research will focus on optimizing extraction protocols using advanced experimental designs to maximize bioactive compound benefits.

Keywords: Yerba Mate, Extraction methods, Phytochemicals, Bioactive compounds.

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This work aims to explore natural matrices to safely incorporate them into food, supporting food quality and safety and developing high-quality products (Goals 3 and 12)

BETAINE-BASED SOLVENTS FOR A GREEN POLYPHENOLS EXTRACTION FROM DATE SEEDS

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Date seeds (Phoenix dactylifera L.) are rich in bioactive compounds such as polyphenols, which help to revalorise this food waste. Conventional extraction methods often use synthetic solvents, which raise health and environmental concerns. This study investigates the use of 5 betaine-based Natural Deep Eutectic Solvents (NADES), in particular molar ratios: Betaine:Ascorbic Acid (Bet:AA, 2:1), Betaine:Glucose (Bet:Glu, 1:1), Betaine:Malic Acid (Bet:MA, 1:1), Betaine:Urea (BetU, 2:1) and Betaine:Glycerol:Glucose (Bet:Gly:Glu, 4:20:1), and Ethanol:Water 50% (EtOH 50%) as a control.

For the extraction of polyphenols, both conventional (heating and stirring, HS) and two non-conventional extraction methods (ultrasound-assisted extraction bath, UAEb, and ultrasound-assisted extraction probe-type, UAEp) were used.

The optimal extraction conditions by Response Surface Methodology (RSM) for HS were a ratio of 1/3 (g/mL), a temperature of 45 ± 5 °C and a duration of 45 minutes. For UAEb and UAEp the same conditions were used as for HS. The power was 100 W in UAEb and 350 W in UAEp. For UAEp, the effective sonication time was 17.5 minutes to avoid exceeding 45 °C.

Extracts were analyzed for Total Phenolic Content (TPC) using the Folin-Ciocalteu method.

For all solvents, the best extraction method was UAEp, which gives a higher yield of polyphenols. With this method, the amounts extracted varied between 460 and 213 mg GAE/100 g for Bet:U and Bet:Gly:Glu, respectively. In all cases, the best extractant was Bet:U (460, 457 and 348 mg GAE/100 g for UAEp, HS and UAEb, respectively).

Overall, the TPC depends on the type of solvent and the extraction method. For all extraction methods, Bet:U, Bet:AA and Bet:Glu are the best options as effective and sustainable solvents for the extraction of polyphenols from date seeds. NADES presents natural components and environmentally friendly properties with potential for green extraction processes in the food and nutraceutical industries.

Keywords: Sustainable extraction, Betaine, Date seeds, Green solvents, Polyphenols.

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Plan de Recuperación, Transformación y Resiliencia

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AGENCIA ESTATAL DE INVESTIGACIÓN

Our work is based on the sustainability of date seeds, because it's a food waste that can provide to population, both nutritional and multiple nutraceutical applications in food and cosmetic industries.

GREEN SOLVENTS FOR LUPIN DEBITTERING: A SUSTAINABLE TWIST TO IMPROVE LUPIN-BEER SYNERGY

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Andean lupins have been widely cultivated in the Andean highlands for soil enrichment, animal feeding, and as a food crop. Their seeds are nutrient-rich, containing about 50% protein and 20% oil. However, the presence of toxic quinolizidine alkaloids (QAs), such as sparteine, lupanine, and 13-OH-lupanine, limits their industrial applications. Conventionally, QAs are removed from lupin beans via water leaching, a process called debittering, which consumes a large amount of water (51 kg of water per kg of debittered seeds), resulting in contaminated wastewater. Therefore, there is a growing need to improve the debittering process of Andean lupin grains by exploring alternative and sustainable techniques that minimize the generation of toxic waste.
The main objective of this work is to investigate the debittering of lupin beans using supercritical carbon dioxide ($scCO_2$) and natural green solvents (ionic liquids and eutectic systems) as co-solvent additives. These neoteric solvents offer solutions to many sustainability and toxicity concerns associated with traditional solvents. Initially, the predictive tool COSMO-RS was applied to screen the best solvents for the extraction of QAs. Subsequently, a set of candidates were selected to be evaluated as solvents in the solid-liquid extraction of QAs from Andean lupin beans. Following this, the best systems were applied as co-solvents in the supercritical carbon dioxide extraction. Overall, this study showed that solutions of organic acids are promising solvent candidates for more efficient debittering processes.
Through this research, we aim to develop a novel separation method based on the use of green solvents to debitter the Andean lupin beans by removing the toxic alkaloids, and to unveil efficient and environmentally conscious strategies for maximizing their use in the food industry.

Keywords: Sustainable Food Processing, Lupin Beans, Green Solvents, Supercritical extraction.

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By developing sustainable debittering methods for Andean lupin beans using supercritical carbon dioxide and natural green solvents, the research aims to enhance food security and nutrition, reduce water usage and contamination, foster industrial innovation, promote efficient resource use, and minimize environmental impact. This comprehensive approach supports the advancement of sustainable agriculture and food processing practices.

UNLOCKING THE POTENTIAL OF MINOR EXPLORED FRACTIONS OF BACOPA MONNIERI: AN OPTIMIZATION STUDY

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A return to nature and its richness in molecules is of interest to various areas, including pharmaceuticals and food industries [1,2]. *Bacopa monniera (L.) wettst*, also known as "Brahmi", is one of the many plants used in Ayurvedic medicine for its numerous therapeutic effects. These are associated with its bioactive compounds, particularly saponins [3]. However, few studies have focused on the phenolic portion of this plant. Therefore, this study aimed to optimize the extraction of phenolic compounds from B. *monniera* using a central composite design, determine its phenolic profile through LD-DAD-ESI-MSn and the antioxidant activity using the thiobarbituric acid reactive substances (TBARS) and the oxygen radical absorbance capacity (ORAC) methods. For the optimization, the effect of time (10 min - 120 min), temperature (25º C – 80 ºC), and ethanol:water ratio (10:90 – 90:10) on the total phenolic compounds (TPC), total flavonoids (FT) contents, and the antioxidant activity (ORAC) was assessed. The results showed that the ethanol:water ratio had a stronger influence on the studied responses, while time did not impact them. The best extraction conditions for 0.5 g of sample were 10 mL of solvent ethanol:water at a ratio of 72:26 (v/v) and a temperature of 51 ºC for 10 minutes (POBM). Tests on successive extractions revealed that two successive extractions were adequate for an efficient extraction. As for the chromatographic profile, phenylethanoid derivatives and flavonoids were found in the sample. TBARS assay resulted in an EC50 of 0.077 mg/mL and ORAC assay in 4561.7 µmol. Eq. Trolox/g sample. The optimization enabled faster, more efficient, and greener preparation conditions for B. *monniera* extracts. In addition, POBM showed promising antioxidant activity. Therefore, our findings pave the way for further studies to understand the role of phenolic compounds from B. *monniera* as a possible tool for the pharmaceutical and food industries.

Keywords: Phenolic compounds, Maceration, Optimization, Central composite design.

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The work carried out was aimed at obtaining an extract using a faster technique and a greener solvent than that traditionally used for the plant under study. The extract obtained shows promising for use in the pharmaceutical or food industries, so that we can move towards a healthier and more sustainable lifestyle.

TECHNO-FUNCTIONAL PROPERTIES OF THE WHEAT GERM FROM "HARINA TRADICIONAL ZAMORANA" QUALITY LABEL AS AFFECTED BY THERMOSTABILISATION

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The wheat germ is a part of the grain embryo that is usually removed during flour extraction because, although it is nutritionally rich [1], due to the presence of unsaturated fats together with both hydrolytic and oxidative enzymes, it rapidly develops rancidity [2]. Among the stabilization methods that have been applied to improve the use of wheat germ, thermostabilisation is one of the most widely used because it inactivates lipase preventing lipid oxidation. However, the effects on wheat germ, especially on the functional properties, have been less studied as they depend on the wheat composition which in turn is related not only to genetic and wheat growing conditions but also to the flour extraction process [3].

Therefore, the aim of the present work was to evaluate the modification of techno-functional properties of the wheat germ obtained during the extraction process of the flour "Harina Tradicional Zamorana" Quality Label after applying a thermal stabilization treatment consisting of roasting in a drying oven at 155ºC for 40 minutes.

The properties studied included water and oil holding capacity (AOAC), water solubility index, swelling capacity, foaming capacity and stability and finally gel formation and emulsifying activity and its stability at different pHs (3, 5, 7 and 8).

The results showed that the thermostabilisation of wheat germ resulted in a decrease in the oil retention capacity, in the foaming capacity and in the stability of the foams formed. Furthermore, the hardness of the gels formed at pH 3 and pH 7 were lower after the stabilisation process. On the other hand, the stabilised germ showed a better emulsifying capacity at pH 3 and pH 8, although the stability of the emulsion formed did not show statistically significant differences at any pH value. Finally, the heat treatment did not affect the water retention capacity or the swelling capacity of the germ.

In conclusion, the thermostabilisation process significantly affected the techno-functional properties of the germ. In addition, a strong influence of pH on these properties was observed.

The improvement of the emulsifying and the preservation of good water-holding and swelling capacity of the stabilised germ may be of particular interest for some industrial applications such as those related to the formation of meat emulsions limiting possible rancidity problems.

Keywords: Water/oil holding capacity, Foaming capacity, Emulsifying activity, Gel formation, Swelling capacity.

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The investigation of the properties of wheat germ for its possible use as a raw material is part of the management of by-products in the industry. It is therefore aligned with SDG12 to ensure sustainable consumption and production patterns, specifically target 12.2, which aims to achieve the sustainable management and efficient use of natural resources.

THE EFFECT OF ORGANIC PRODUCTION ON NUTRITIONAL AND TECHNO-FUNCTIONAL CHARACTERISTICS OF HEMP FLOUR

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Hemp growing is attracting interest as a sustainable crop owing to its role in soil regeneration [1], its low water and input requirements [2] and its high efficiency in trapping carbon dioxide contributing to global warming reduction [3]. Hemp flour has high levels of protein, fat, minerals, fibre, essential fatty acids, bioactive compounds and minerals [4]. Despite significant differences on these characteristics have been observed due to the influence of variety, growing conditions and processing processes, the label of commercial products do not include this information. On the other hand, although it is known that organic production is related with positive effects on environment there is still a lot of controversy about the higher nutritional value of organic foods when they are compared to the conventional foods [5]. Therefore, the aim of this work was characterize to type of commercial hemp flours, organic vs conventional, in terms of nutritional composition and techno-functional properties.

Two commercial hemp flours were purchased by e-commerce. Protein, total fat, ash, fibre and total carbohydrates were analysed. Fatty acid analysis was performed by gas chromatography and mineral analysis by ICP-MS. Bioactive components: total phenols, total flavonoids and total flavanones and dihydroflavonols as well as total antioxidant capacity were also analysed. Techno-functional properties studied included water and oil holding capacity, water solubility index, swelling capacity, foaming capacity and stability and gel formation.

Results showed that organic hemp flour showed higher levels of carbohydrates, fibre and ash and lower contents of total protein and fat, being the levels of C18:3n6 also significantly lower. Regarding minerals, organic production increased the content of Na, Mg, P, Ca, Cu, Zn and Fe decreasing the levels of Cr, Ni and Mn. As far as bioactive compounds are concerned, TPC was higher in organic flour, without differences for the rest of the parameters. The colour of the organic flour was lighter with significant higher value of a* and lower value of b*. Finally, organic flours did not differ from conventional flour in their water and oil holding capacity, foam formation and stability and gelling index but the swelling capacity was higher.

In conclusion, hemp flours were characterized by its higher carbohydrate, specifically fibre, and lower total fat values because they are marketed partially defatted, being this fat mainly unsaturated. It is noteworthy the high contents of minerals, specially K and P, and the good bioactive profile. Organic flours showed good nutritional characteristics with even better mineral and bioactive profile than conventional without differences in techno-functional properties. Therefore, organic flours are a good alternative for both consumers and industrial applications.

Keywords: Chemical composition, Fatty acids, Minerals, Colour, Bioactive compounds.

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The investigation of the properties of organic hemp flour is aligned with SDG2, specifically with 2.4 target because cultivation of this crop in an organic system helps to ensure sustainable food production systems and to implement resilient agricultural practices that help maintain ecosystems, that strengthen capacity for adaptation to climate change and that progressively improve land and soil quality

DEVELOPMENT OF CEREAL BARS WITH BEEHIVE PRODUCTS

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Beekeeping is an ancient practice that involves raising bees to produce honey, wax, and other derivatives. This activity is significant both economically, generating income for numerous rural communities, and environmentally, as bees play a crucial role in the pollination of plants. This pollination is essential for maintaining biodiversity and food production. Moreover, according to the Apimondia Report, beekeeping contributes to all the Sustainable Development Goals [1]. Honey, pollen, and propolis are bee products with recognized biological and therapeutic properties. The relationship between these products and human health has been the subject of study in various areas of science, including medicine, biology, and nutrition [2]. Honey is a food naturally rich in antioxidants, vitamins, and minerals, with antimicrobial and anti-inflammatory properties [3]. Pollen, on the other hand, is a source of proteins, amino acids, essential vitamins, and minerals, and is recognized for its immunomodulatory properties [2]. Propolis is a resinous product produced by bees, known for its antibacterial, antifungal, and anti-inflammatory properties [4]. The growing search for food products with functional characteristics has been widely discussed in the scientific literature, reflecting consumers' concern with promoting health and well-being [5]. Additionally, the food industry has increasingly invested in research and development of new products with functional properties to meet this growing demand [6]. In this context, cereal bars with honey, pollen, and propolis can be an excellent option for a healthy and nutritious snack. Together, these ingredients can help strengthen the immune system and improve general health. Moreover, cereal bars are a great way to satisfy hunger and maintain energy throughout the day. They are a practical option to take to work, school, or outdoor activities. The aim of this study was to develop cereal bars with honey, pollen, and propolis, evaluating different formulations and their sensory acceptance by consumers. Tests were carried out on the texture, color, taste, and overall acceptability of the bars, comparing different proportions of ingredients such as cereals, honey, propolis, pollen, dried fruit, and nuts. The results showed that the bars with a higher proportion of honey had a softer texture and greater sensory acceptance by consumers. This indicates that these bee products could be promising functional ingredients in cereal bars.

Keywords: Beekeeping, Functional food, Propolis, Pollen, Honey.

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Beekeeping can be related to the seventeen Sustainable Development Goals, but the most important ones are 2, 3 and 12. Zero hunger and sustainable agriculture: beekeeping contributes directly to the production of sustainable food by promoting the pollination of crops. The cereal bars developed offer a nutritious option, helping to combat hunger and malnutrition. Health and well-being: beekeeping products such as honey, pollen and propolis have biological and therapeutic properties that promote health and well-being. Cereal bars enriched with these ingredients can improve consumers' overall health by strengthening the immune system and providing a healthy nutritional option. Responsible consumption and production: The production of cereal bars with bee products promotes sustainable agricultural practices and the responsible use of natural resources. It also responds to the growing consumer demand for foods with functional properties and health benefits, promoting conscious and responsible consumption.

EFFECT OF SODIUM CHLORIDE CONCENTRATION ON THE ENZYMATIC ACTIVITY OF CARDOON FLOWER (CYNARA CARDUNCULUS L.) INFUSION USED AS A VEGETABLE COAGULANT FOR CHEESEMAKING

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Cynara cardunculus L. flower pistils have been used as a traditional coagulant in cheesemaking in Portugal and Spain for centuries, particularly in cheeses with Protected Designation of Origin (PDO) status. [1] Recently recognized for its safety by EFSA, the enzyme's use has been officially approved. [2] Despite extensive research, there remains uncertainty regarding the factors that affect the coagulation mechanism. Sodium chloride is commonly added during maceration to prepare cardoon flower extracts, although the exact amounts of water and salt are often unspecified. While it's assumed that salt doesn't impact enzyme extraction, a certain ionic concentration is necessary to enhance enzymatic activity, as solutions made with only water tend to be less active. [3]

This study aims to evaluate the effect of sodium chloride concentration (0 to 20% m/v) on the enzymatic activity of cardoon infusion. Coagulant extracts were prepared from 0.04 g/L of *C. cardunculus* L. pistils with sodium chloride. Milk clotting activity (MCA) was measured using an adapted IDF 199/ISO 23058 method and an Optigraph to assess enzymatic coagulation properties via near-infrared signal changes. [4]

The study demonstrates that sodium chloride concentration significantly influences the enzymatic activity of the cardoon infusion. Flower extracts with 5% NaCl exhibited the highest enzymatic activity, enhancing both MCA and enzymatic coagulation properties, making it an optimal concentration for extraction and preservation. On the other hand, a 20% NaCl concentration inhibited enzymatic activity, leading to reduced coagulant performance, although it likely results in better microbial preservation over time. Further exploration, including testing these formulations on different types of milk, such as sheep's milk commonly used in PDO cheeses, could yield valuable new insights.

Keywords: *C. cardunculus* L., Vegetable coagulant, Milk clotting activity, Extraction process.

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(The work aligns with SDG 9 by enhancing traditional cheesemaking with scientific innovation, optimizing the use of *Cynara cardunculus* L. flower extracts. It supports SDG 12 by promoting the responsible and sustainable use of natural coagulants, reducing reliance on synthetic alternatives, and improving the environmental footprint of cheese production.)

COAGULATION KINETICS OF SHEEP MILK FROM ALENTEJO: A STUDY WITH CARDOON FLOWER EXTRACT AND CYMOSIN RENNET

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The Iberian Peninsula, known for its diverse cheese production, uses cardoon flower (*Cynara cardunculus* L.) extracts as a coagulant, especially in some traditional Portuguese cheeses with Protected Designation of Origin (PDO) status. These extracts show distinct differences in milk coagulation compared to commonly used rennet or chymosin, that can be important for cheese properties which are defined as early as milk coagulation. This study aims to assess the kinetics of sheep milk coagulation, providing a valuable tool for monitoring and improving traditional cheese manufacturing processes.

Twenty-eight samples of sheep milk from four producers in Baixo Alentejo, Portugal, were used to compare the milk coagulation process using cardoon flower extract and microbial origin chymosin (Maxiren, DSM, Netherlands). The chemical composition of these samples (fat, protein, lactose, total solids, and non-fat solids), pH, and acidity were determined over six collection dates using the Milkoscan 133B (Foss Electric, Denmark), potentiometry, and titration (NP-470, 1983), respectively. The technological behavior of the milk during coagulation was evaluated by determining the coagulation capacity, adapted according to ISO 23058:2006/IDF 199, and using the Optigraph (Alliance, France). The tests were conducted in duplicate.

Preliminary results corroborate previous findings [1,2], highlighting that the type of coagulant significantly affects the coagulation properties of sheep milk, an important factor in cheesemaking. it was observed that curds formed with the addition of cardoon extract tended to be less firm than those obtained with the chymosin solution, which can be related to the higher non-specific proteolytic activity of cardoon aspartic proteases. While coagulation time and curd firmness are influenced by the coagulant's specificity, other variables like milk composition also impact these properties, as evidenced by the observed variability in curd evolution monitoring, which ultimately affects cheese quality.

Keywords: *Cynara cardunculus* L., Vegetable coagulant, Cymosin, Kinetics, Milk coagulation.

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(This study aligns with SDG 9 and SDG 12 by exploring cardoon flower extracts as an innovative alternative coagulant in cheese production, fostering sustainability in agricultural practices and promoting responsible consumption patterns and by investigating sustainable alternatives to rennet coagulants, it aims to minimize environmental impact in cheese production.)

FROM WASTE TO WORTH: ADDRESSING STRATEGIES TO VALUE ONION AND ZUCCHINI BY-PRODUCTS

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Fruit and vegetable by-products originate throughout the food chain and are usually underutilized. However, they still contain significant amounts of macro and micronutrients. Additionally, they are rich in bioactive compounds, such as phenolic compounds, which show a broad spectrum of biological functions. In this context, addressing strategies to value these by-products is essential to promote their reintegration into the industry and, consequently, waste reduction and circular economy [1,2]. Therefore, the goal of this work was to determine phenolic compounds through LC-DAD-ESI-MSn and screen the bioactive potential of hydroethanolic extracts from two commonly discarded vegetable by-products: onion peel (Allium cepa L.) and zucchini (Cucurbita pepo L.). The bioactive action was evaluated using in vitro 1,1-diphenyl-2-picrylhydrazyl (DPPH) and thiobarbituric acid reactive substance (TBARS) assays for antioxidant activity, α-glucosidase and α-amylase inhibition tests for antidiabetic activity, and the antimicrobial activity was tested against a panel of bacteria and fungi of high relevance in the food sector, using the microdilution method. Ten phenolic compounds were identified in onion peel extract, totaling 296.99 ± 0.17 mg/g extract, while five were identified in zucchini extract, summing 9.14 ± 0.01 mg/g extract. In both extracts, quercetin glycosides were the major phenolic compounds identified. The onion peel extract exhibited higher antioxidant activity than the zucchini extract in both assays and was the only one to inhibit α-glucosidase in antidiabetic tests. On the other hand, both samples had similar antibacterial activity to synthetic preservatives, but only the onion peel extract had comparable antifungal activity. These findings highlight the strong potential of onion peel extracts to benefit food and nutraceutical products. Although the results from zucchini extract were less significant, its notable antibacterial activity make it also a potential candidate for further exploration as a natural ingredient in food and nutraceutical formulations.

Keywords: Circular economy, Phenolic compounds, Bioactivity, Natural ingredient.

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This work aims to align with objectives 2, 12 and 15 of the sustainable development goals by identifying bio-based functional ingredients to promote food and nutritional security, reducing food waste in production chains and promoting sustainable use and restoration of terrestrial

EDIBLE COATINGS WITH POLYSACCHARIDES AND BIOACTIVE COMPOUNDS FROM EXHAUSTED OLIVE OIL POMACE TO EXTEND THE SHELF LIFE OF STRAWBERRY

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A model of the economy uses residues as resources to be valorized, joining the 2030 Agenda of the United Nations under the heading of circular economy, which includes "zero waste production" [1]. The use of by-products as a source of bioactive compounds with economic added value is one of the objectives of a circular economy. Actually, 1 ha produces 2500 kg of olives annually, and 40–70 kg of olive pomace is produced for every 100 kg of olives [2]. The exhausted olive pomace (EOP) is the by-product generated after the air drying and subsequent hexane extraction of residual oil from the olive pomace. The EOP contains phenolic compounds, such as hydroxytyrosol, tyrosol and catechol, known by their antioxidant, anti-microbial, anti-inflammatory, anti-diabetic, anti-carcinogenic and anti-HIV properties [3]. The casting method was used to produce the coating based on alginate and polysaccharides from the EOP, and enriched with the phenolic compounds also extracted from the EOP. The extracts were obtained by solvent extraction (hydroethanolic 90 %, 50 °C) assisted by ultrasounds [4]. This edible coating was applied to the strawberries, and microbiological assays were performed to determine the proliferation of pathogenic native microflora that is naturally responsible for the deterioration of the fruits. Tests for psychrophilic bacteria, mesophilic aerobic bacteria, *Enterobacteriaceae* and total coliforms, yeast and molds were carried out.
In this work is in the frame of two SDGs, through the use of a by-product to increase its value and the extension of the shelf life of a perishable fruit, such as the strawberry.

Keywords: Edible coatings, Strawberry, Exhausted olive oil pomace, Phenolic compounds, Microbiological assay.

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VALORIZATION OF PEACHES AND NECTARINES BY ASSESSING THEIR ACCEPTABILITY AND SUITABILITY FOR MINIMALLY-PROCESSING

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The stone fruit (*Prunus persica)* sector in Catalonia (Spain) is affected by overproduction, stable consumption, reduced exports and low prices. Along with the development of new varieties, more suitable for fresh consumption, valorization through processing into products that maintain their nutritional properties and are more attractive to the consumer is an opportunity for the sector. The objective of this work was to valorize stone fruit through the evaluation of the suitability for minimally-processing (fresh-cut) of 10 nectarine and peach varieties. The fruit was harvested and stored at 0.5°C and the physicochemical quality of each variety: firmness, total soluble solids (SST), pH, titratable acidity (TA) (Nicolau-Lapeña et al., 2019) and ripening index were determined. The fruit was then processed, and fresh-cut product was stored at 5°C for 10 days. Subsequently, the fresh-cut products were evaluated both sensorial (Hernández-López et al., 2021) and nutritionally (polyphenol content and antioxidant capacity) (Prieto-Santiago et al., 2024). Regarding sensory acceptability, peach varieties presented higher scores than nectarines. However, the fresh-cut products from peach varieties had a shorter shelf-life. Despite having the best nutritional properties (between 2- and 10-times higher values), the shelf-life of the fresh-cut product from 'Diablotina' did not exceed 6 days. The varieties 'Big Top' and 'Luciana' had an acceptable shelf-life (up to day 8). In addition, the application of an antioxidant coating (NEC, Agricoat Naturseal LTD, Bershire, England) improved the visual appearance, acceptability scores and nutritional properties (antioxidant activity and polyphenol content) of the fresh-cut product from 'Big Top '. However, this treatment could also result in a glassy appearance and artificial sweet flavors, especially at the end of the product's shelf-life, as occurred to 'Luciana'. The evaluation of the processing suitability of nectarine and peach allows the valorization of stone fruit, driving the agri-food industry supply chain towards a sustainable approach that favors not only responsible consumption and production, but also waste reduction.

Keywords: Stone-fruit, Fresh-cut, Nutritional quality, Visual appearance, Shelf-life.

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The stone fruit sector is highly affected by overproduction and stable consumption, generating a large amount of waste. Together with the development of new varieties, valorization through processing into products that maintain their nutritional properties and are more attractive to the consumer is an opportunity for the agri-food sector, leading to waste reduction and encouraging responsible consumption. Therefore, this work "Valorization of peaches and nectarines by assessing their acceptability and suitability for minimal processing" is aligned with 12 ("Responsible consumption and production") of "the Sustainable Development Goals (SDGs)".

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