Innovations in Food Loss and Waste Management

BOOK OF ABSTRACTS

Ancona, 23-25 January 2024

UNIVERSITÀ POLITECNICA DELLE MARCHE

Department of Agricultural Food and Environmental Sciences

Dear Participants

Thanks for joining and taking your valuable contribution the #PostharvestAncona2024 congress, in which we will have the final meeting of PRIMA project "Innovative Sustainable technologies TO extend the shelf-life of Perishable MEDiterranean fresh fruit, vegetables and aromatic plants and to reduce WASTE (StopMedWaste, https://stopmedwaste.net/)" and Meeting of COST CA22134 Action "Sustainable Network for agrofood loss and waste prevention, management, quantification and valorisation (FoodWaStop, https://www.cost.eu/actions/CA22134/?fbclid=IwAR0cYjMCgVSWRByj4UenputYwc8Qa5NgDwqpomkpXAOiKaNA3GItoB7ZTbM#tabs+Name:Description)".

We are delighted to host you in Ancona for this important opportunity for networking and knowledge sharing. Speakers from over 30 Countries will present the latest innovations in terms of technologies, strategies, and approaches for reducing food loss and waste, which is a worldwide priority. We are confident that this conference will be a valuable experience for all participants. We wish you a pleasant stay in Ancona and a fruitful time.

The Convener
Gianfranco Romanazzi

The Organising Committee
Marwa Moumni
Lucia Landi
Annamaria Lucrezia D'Ortenzio
Simone Piancatelli
Sarah M. Makau
Mehdiye Tunc

The event was realized in cooperation with:

and thanks to the contributions of:

INNOVATIONS IN FOOD LOSS AND WASTE MANAGEMENT

CONFERENCE PROGRAMME

Ancona, 23-25 January 2024

Aula Magna
Department of Agricultural Food and Environmental Sciences, Università Politecnica delle Marche

Via Brecce Bianche, 10 – 60131 Ancona

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PROGRAM

23 January 2024

08:30-09:15	**REGISTRATION AND SETTING UP OF STOPMEDWASTE POSTERS**
09:15-09:30	***WELCOME ADDRESS***
09.30-09:45	**Gianfranco Romanazzi**, **Marwa Moumni** - *Marche Polytechnic University, Ancona, Italy*. Presentation of the PRIMA StopMedWaste project
09:45-10:10	**Gianfranco Romanazzi, Marwa Moumni, Lucia Landi, Lucrezia D'Ortenzio, Sarah Makau, Samuel Alvarez Garcia, Deborah Pacetti** - *Marche Polytechnic University, Ancona, Italy*. Chitosan, essential oils and ozone as tools for the management of postharvest decay of fresh fruits
10:10-10:35	**Annamaria Mincuzzi, Antonio Ippolito** - *University of Bari, Bari, Italy.* Integrated alternative control means against postharvest diseases of pomegranates and citrus fruit
10:35-10:55	**Mohamed Bechir Allagui, Mouna Ben Amara** - *National Institute for Agronomic Research of Tunisia (INRAT), Tunisia*. Essential oils and GRAS salts for preventing postharvest fruit rot and reducing the need for chemical fungicides
10:55-11:20	***Coffee break and poster session***
11:20-11:45	**Davide Spadaro, Giulia Remolif** - *University of Torino, Torino, Italy*. Effectiveness of antagonistic yeasts and essential oils in the control of postharvest diseases of fruit
11:45-12:10	**Pervin Kinay** - *UE, Turkey* and **Mahmut Kilic** - *ICACHEM, Turkey*. Effect of postharvest UV-C applications on postharvest decays on strawberry fruits
12:10-12:35	**María Bernardita Pérez-Gago, Verónica Taberner, Lluís Palou** - *IVIA, Spain* and **Clara Montesinos** - *DECCO, Spain*. Antifungal edible coatings to reduce decay and maintain postharvest quality of citrus, plums, and pomegranates
12:35-13:00	***General discussion***
13:00-13:15	***Feedback from International Advisory Board members***
13:15-14:30	***Light lunch and poster session***
14:30-15:30	**THE EXPERIENCE OF OTHER PRIMA AGROFOOD PROJECTS** **Fernando Perez Rodriguez** - BioFreshCloud **Laura Gasco** - ADVAGROMED **Priscilla Farina, Barbara Conti** - FedKito **Federico La Spada, Santa Olga Cacciola** - BiOrangePack
15:30-16:00	***Coffee break and poster session***
16:00-18:00	**VISIT OF THE CITY OF ANCONA**
19:30	**SOCIAL DINNER** (*Ristorante L'Ascensore*, Piazza IV Novembre)

24 January 2024

08:30-09:00 **REGISTRATION AND SETTING UP OF FOODWASTOP POSTERS**

09:00-09:15 ***WELCOME ADDRESS***

09.15-10:45 **Presentations of WG1 -** Prevention of food loss and food waste (Moderators: ***George Karaoglanidis*** and ***Fernando Perez-Rodriguez***)

Barbara Blanco-Ulate, *University of California, Davis, California, USA*. Improving shelf-life while ensuring fruit quality using gene editing

David Gramaje, *Instituto de Ciencias de la Vid y del Vino (ICVV), Spain*. Fungal trunk diseases: a global threat to grapevine health

Florence Fontaine, *University of Reims Champagne-Ardenne, RIBP USC INRAE, France*. Strategies studied for an ecofriendly management of grapevine trunk diseases

Erzsebet Karaffa, *Hungarian Chamber of Professionals and Doctors of Plant Protection, Hungary.* Endophytic *Trichoderma* strains increase preharvest quantity and quality of grapes

Piotr Kulawik, *Department of Animal Products Processing, University of Agriculture in Krakow ul. Balicka, Poland*. The use of multilayer chitosan/furcellaran mini/nanoemulsions with oregano essential oil for preservation of perishable food products

Annamaria Mincuzzi, *Department of Soil, Plant, and Food Sciences, University of Bari Aldo Moro, Bari, Italy*. Antifungal activity of Apulian macroalgal extracts

10:45-11:15 ***Coffee break and poster session***

11:15-13:00 **Presentations of WG1 -** Prevention of food loss and food waste (Moderators: ***George Karaoglanidis*** and ***Fernando Perez-Rodriguez***)

Paolo Guarnaccia, Fabio Gresta, *Department of Agriculture, Food and Environment, University of Catania, Italy*. How can agroecology contribute to the reduction of food waste and loss?

Stela Todorova, *University of Agriculture, Bulgaria*. Short food supply chains as drivers of sustainability in rural areas

Presentations of WG2 - Agrofood loss and waste management (Moderators: ***Slaven Zjalic*** and ***Lluís Palou***)

Lluís Palou, *Centre de Tecnologia Postcollita (CTP), Institut Valencià d'Investigacions Agràries (IVIA), València , Spain*. Antifungal edible coatings for postharvest disease control and quality maintenance of fresh fruits

Alessandra Di Francesco, *Department of Agriculture, Food, Environmental and Animal Sciences, Udine University, Italy*. Efficacy of wild *Aureobasidium pullulans* VOCs and application methods vs strawberry fungal pathogens

Giulia Remolif, *Dipartimento di Scienze Agrarie, Forestali e Alimentari (DISAFA), Università di Torino, Largo Paolo Braccini 2, Grugliasco, Italy*. Efficacy of antagonistic yeasts to control brown rot of nectarines and effect on the fruit microbiome

Selda Daler, *Department of Horticulture, Faculty of Agriculture, Yozgat Bozok University, Turkey*. The potential of smoke solutions from vineyard pruning wastes to mitigate heavy metal toxicity in grapevine saplings

Kata Ludman-Mihaly, *FruitVeB Hungarian Interprofessional Organization for Fruit and Vegetable, Hungary*. Cold storage may elongate the fresh consumption period of sour cherry (*Prunus cerasus* L.)

13:00-14:15 ***Light lunch and poster session***

14.15-15:45 **<u>Presentations of WG3</u> - QUANTIFICATION OF FOOD LOSS AND FOOD WASTE** (Moderators: ***Natalia Falágan*** and ***Lise Korsten***)

Rosa Rolle, *FAO*. FAOs work to address food loss and waste

Natalia Falagán, *Plant Science Laboratory, Cranfield University, Cranfield, United Kingdom*. Drivers of food loss and waste and the importance of quantification

Lise Korsten, *University of Pretoria*. Produce waste and losses in the informal sector in South Africa

Andrea Segré, *University of Bologna*. Waste watcher international observatory

Viktoriya Voytsekhovska, *Lviv Polytechnic National University, Ukraine*. Modelling the scenarios of development for Ukraine in the context of EU circular economy using fuzzy set theory

Miguel Elias, *MED-Mediterranean Institute for Agriculture, Environment and Development, Portugal*. Food waste quantification in Portuguese meat plants

15:45-16:15 ***Coffee break and poster session***

16:15-17:45 **<u>Presentations of WG4</u> - VALORISATION OF AGROFOOD WASTE AND A CIRCULAR BIO-ECONOMY** (Moderators: ***Jessica Girardi*** and ***Marwa Moumni***)

Sarah Milliken, *University of Greenwich, United Kingdom*. The valorisation of agri-food waste for a circular bioeconomy: highlighting policy incoherence through nexus thinking

Ivo Safarik, *Department of Nanobiotechnology, Biology Centre, ISBB, CAS, Na Sadkach, Ceske Budejovice, Czech Republic*. Magnetically responsive waste biomaterials for environmental technology applications

Arben Mehmeti, *University of Prishtina, Faculty of Agriculture and Veterinary, Bill Clinton, Republic of Kosovo*. Application of insect frass for the development of sustainable agriculture production in Kosovo

Magdalena Joka Yildiz, *Bialystok University of Technology, Poland*. Biowaste-based pellets as a promising feedstock for biochar production

Ioannis Trougakos, *Department of Cell Biology and Biophysics, Faculty of Biology, National and Kapodistrian University of Athens, Greece*. Natural products in the fight against ageing and age-related diseases

Semanur Yildiz, *Sustainable Food Processing Laboratory (SuProLab), Sakarya University, Sakarya, Turkey*. Optimization of ultrasound-assisted extraction of cold-pressed pistachio meal proteins

19:30 **SOCIAL DINNER** (*Ristorante Il Giardino*)

25 January 2024

09:00-10:15 **<u>Presentations of WG4</u> - VALORISATION OF AGROFOOD WASTE AND A CIRCULAR BIO-ECONOMY** (Moderators: ***Jessica Girardi*** and ***Marwa Moumni***)

Luis C. Duarte, *Institution LNEG-UBB, Portugal*. The pros and cons of upgrading fruits & vegetables wastes in the biorefinery framework

Eduardo Espinosa, *University of Cardoba, Spain*. Sustainable packaging solutions based on the circular valorization of agro-industrial by-products

Tulay Inan, *Sabanci University Nanotechnology Research and application Center (SUNUM), Turkey*. Preparations of multifunctional composites for electromagnetic interference (EMI) shielding applications using tomatoes wastes

Rajeev Bhat, *ERA-Chair in VALORTECH, Estonian University of Life Sciences, Tartu, Estonia*. Realisation of sustainable food systems by valorisation of agri-food wastes and by-products in support of circular bioeconomy concepts

Laszlo Abranko, *MATE - Hungarian University of Agriculture and Life Sciences, Hungary*. Assessment of beneficial impacts of plant bioactives on macronutrient digestion by digestion simulation

10:15-10:45 *Coffee break and poster session*

10:45-13:00 **<u>Presentations of WG5</u> - CROSS-CUTTING STRATEGIES AND SMART SYSTEMS FOR FOOD MANAGEMENT** (Moderators: ***Sandro Frati*** and ***Zeynep Zerrin Turgay***)

Zeynep Zerrin Turgay, *MIGROS*. Prevention of food waste in retail industry

Dov Prusky, *Department of Postharvest Science, Agricultural Research Organization, The Volcani Institute, Rishon LeZion, Israel*. Induced resistance in fruit and vegetables: the physiological effect

Gonzalo Mejia, *Universidad de La Sabana, Colombia*. Food loss and waste in central markets in Colombia perspectives from a comparative study

Elena Battini Sonmez, *Istanbul Bilgi University, Turkey*. Smart solutions for waste prevention with case study on fruit and vegetable

<u>Presentation of WG6</u> - NETWORKING AND DISSEMINATION, COMMUNICATION AND TRANSFER OF KNOWLEDGE (Moderators: ***Kata Ludman-Mihály*** and ***Luca Falasconi***)

Magdalena Bielenia-Grajewska, *Institute of English, University of Gdansk, Poland*. Communicative side of food loss and waste management

Achraf Ammar, *Johannes-Gutenberg-University of Mainz, Germany*. MEDIET4ALL Approach to support food waste prevention

Bekir Ayyildiz, *Yozgat Bozok University, Turkey*. Scientific studies on food waste in Turkey

13:00-14:30 ***Light lunch and poster session***

14.30-15:15 ***WG meetings in separate rooms***

15:15-16:30 ***General plenary discussion***

16:30-17:00 ***Coffee break and poster removal***

17:00-18:00 ***COST Management Committee Meeting (hybrid)***

POSTERS PRIMA STOPMEDWASTE

P01. ROMANAZZI G.[1], TZORTZAKIS N.[2], IPPOLITO A.[3], ALLAGUI M.B.[4], SPADARO D.[5], KINAY TEKSUR P.[6], PÉREZGAGO M.[7], KILIC M.[8], MONTESINOS C.[9], XYLIA P.[2], MINCUZZI A.[3], GARELLO M.[5], REMOLIF G.[5], PALOU L.[7], D'ORTENZIO A.L.[1], LANDI L.[1], MOUMNI M.[1]. *[1]Marche Polytechnic University, Ancona, Italy; [2]Cyprus University of Technology, Limassol, Cyprus; [3]Università di Bari, Bari, Italy; [4]Institut National de la Recherche Agronomique de Tunisie, Tunis, Tunisia; [5]Università di Torino, Torino, Italy; [6]University of Ege, Izmir, Turkey; [7]Centre de Tecnologia Postcollita, Institut Valencià d'Investigacions Agràries, Valencia, Spain; [8]Icachem Agro Ilac San, Adana, Turkey; [9]Decco Iberia, Valencia, Spain.* **Innovative sustainable technologies to extend the shelf life of perishable mediterranean fresh fruit, vegetables, and aromatic plants and to reduce waste: the experience of Prima Stopmedwaste project**

P02. ROMANAZZI G. AND MOUMNI M. *Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Via Brecce Bianche, 60131 Ancona, Italy.* **Chitosan and other edible coatings to extend shelf life, manage postharvest decay, and reduce loss and waste of fresh fruits and vegetables**

P03. FANESI B.[1], D'ORTENZIO A.L.[1], KUHALSKAYA A.[1], NARTEA A.[1], FIORINI D.[2], MOUMNI M.[1], LANDI L. [1], LUCCI P.[1], ROMANAZZI G.[1], PACETTI D.[1] *[1]Department of Agricultural, Food and Environmental Sciences, Università Politecnica delle Marche, 60131, Ancona, Italy; [2]School of Science and Technology, Chemistry Division, Università di Camerino, 62032, Camerino, Italy.* **Identification of volatile organic compounds as markers to detect *Monilinia fructicola* infection in fresh peaches**

P04. MOLINA-HERNANDEZ[1] J. B., LANDI[2] L., DE FLAVIIS[1] R., LAIKA[1] J., ROMANAZZI[2] G., CHAVES-LOPEZ[1] C. *[1]Faculty of Bioscience and Technology for Food, Agriculture and Environment, University of Teramo, Via R. Balzarini 1, 64100 Teramo, Italy; [2]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Via Brecce Bianche 10, 60131 Ancona, Italy.* **Understanding the mechanisms of action of atmospheric cold plasma towards the mitigation of the stress induced in molds: the case of *Aspergillus chevalieri***

P05. VISCHETTI C., FELIZIANI E., LANDI L., DE BERNARDI A., MARINI E., ROMANAZZI G. *Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Via Brecce Bianche, 60131 Ancona, Italy.* **Effectiveness of four synthetic fungicides in the control of post-harvest gray mold of strawberry and analyses of residues on fruit**

P06. RAJESTARY R., LANDI L., ROMANAZZI G. *Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Italy.* **Effects of commercial natural compounds on postharvest decay of strawberry fruit**

P07. LANDI L.[1], PERALTA-RUIZ Y.[2,3], CHAVES-LÓPEZ C.[2], ROMANAZZI G.[1] *[1]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Italy; [2]Faculty of Bioscience and Technology for Food, Agriculture and Environment, University of Teramo, Teramo, Italy;[3]Facultad de Ingeniería, Programa de Ingeniería Agroindustrial, Universidad del Atlántico, Puerto Colombia, Colombia.* **Chitosan coating enriched with *Ruta graveolens* L. essential oil reduces postharvest anthracnose of papaya (*Carica papaya* L.) and modulates defense-related gene expression**

P08. Álvarez-García S.[1,2], Moumni M.[1], Romanazzi G.[1] *[1]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Ancona, Italy, [2]Plant Physiology Area, Engineering and Agricultural Sciences Department, Universidad de León, León, Spain.* **Antifungal activity of volatile organic compounds from essential oils against the postharvest pathogens *Botrytis cinerea*, *Monilinia fructicola*, *Monilinia fructigena*, and *Monilinia laxa***

P09. Makau S.M.[1], Moumni M.[1], Landi L.[1], Pirozzi D.[2], Sannino F.[3], Romanazzi G.[1] *[1]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Ancona, Italy; [2]Laboratory of Biochemical Engineering, Department of Chemical Engineering, Materials and Industrial Production (DICMaPI), University of Naples "Federico II", Piazzale Tecchio, Naples, Italy; [3]Department of Agricultural Sciences, University of Naples "Federico II", Italy.* **In vitro evaluation of Chitosan hydrochloride and COS (Chito-Oligosaccharides)-OGA (Oligo-Galacturonides) on phytopathogenic fungi and Escherichia coli**

P10. Romanazzi G.[1], Yann Orçonneau Y.[2], Moumni M.[1], Yann Davillerd Y.[2], Marchand P.A.[2] *[1]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Ancona, Italy; [2]Institut Technique de l'Agriculture et de l'Alimentation Biologiques (ITAB), Paris, France.* **Basic substances, a sustainable tool to complement and eventually replace synthetic pesticides in the management of pre and postharvest diseases: reviewed instructions for users**

P11. Toffolatti S. L.[1], Davillerd Y.[2], D'Isita I.[3], Facchinelli C.[4], Germinara G. S.[3], Ippolito A.[5], Khamis Y.[6], Kowalska J.[7], Maddalena G.[1], Marchand P.[2], Marcianò D.[1], Mihály K.[8], Mincuzzi A.[4], Mori N.[4], Piancatelli S.[9], Sándor E.[8], and Romanazzi G.[9] *[1]DiSAA, Università degli Studi di Milano, Italy. [2]ITAB, France. [3]DAFNE, University of Foggia, Italy. [4]Department of Biotechnology, University of Verona, Italy. [5]Department of Soil, Plant and Food Sciences, University of Bari Aldo Moro, Bari, Italy. [6]Agricultural Research Center, Plant Pathology Research Institute, Egypt. [7]Department of Organic Agriculture and Environmental Protection, Institute of Plant Protection–National Research Institute, Poland. [8]Faculty of Agricultural and Food Science and Environmental Management, Institute of Food Science, University of Debrecen, Hungary. [9]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Italy.* **Are basic substances a key to sustainable pest and disease management in agriculture? An open field perspective**

P12. De Miccolis Angelini R.M.[1†], Landi L.[2†], Raguseo C., Pollastro S.[1], Faretra F.[1], Romanazzi G.[2] *[1]Department of Soil, Plant and Food Sciences, University of Bari Aldo Moro, Piazza Umberto I - 70121 Bari, Italy; [2]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Via Brecce Bianche, 60131 Ancona, Italy.* **Tracking of diversity and evolution in the brown rot fungi *Monilinia fructicola*, *Monilinia fructigena*, and *Monilinia laxa***

P13. Mincuzzi A.[1], Picciotti U.[1,2], Sanzani S.M.[1], Garganese F.[1], Palou L.[3], Addante R.[1], Marco Ragni M.[1] and Ippolito A.[1] *[1]Department of Soil, Plant, and Food Sciences, University of Bari Bari Aldo Moro, Italy; [2]Department of Marine Science and Applied Biology, University of Alicante, Spain; [3]Pathology Laboratory, Postharvest Technology Center (CTP), Spain.* **Postharvest diseases of pomegranate: alternative control means and a spiderweb effect**

P14. Mincuzzi A.[1], Sanzani S.M.[1], Palou L.[2], Ragni M.[1], Ippolito A.[1] *[1]Department of Soil, Plant, and Food Sciences, University of Bari Bari Aldo Moro, Italy; [2]Pathology Laboratory, Postharvest Technology Center (CTP), Valencian Institute of Agrarian Research (IVIA), Spain.* **Postharvest rot of pomegranate fruit in southern Italy: characterization of the main pathogens**

P15. ALOI F.[1,2], RIOLO M.[1,3,4], SANZANI S.M.[5], MINCUZZI A.[5], IPPOLITO A[5], SICILIANO I.[6], PANE A.[1], GULLINO M.L.[6], CACCIOLA S.O.[1] *[1]Department of Agriculture, Food and Environment, University of Catania, 95123 Catania, Italy; [2]Department of Agricultural, Food and Forest Sciences, University of Palermo, Italy; [3]Council for Agricultural Research and Agricultural Economy Analysis, Research Centre for Olive, CREA- OFA, Italy; [4]Department of Agricultural Science, Mediterranean University of Reggio Calabria, Italy; [5]Department of Soil, Plant, and Food Sciences, University of Bari Aldo Moro, Bari, Italy; [6]Agroinnova Centre of Competence for the Innovation in the Agro-Environmental Sector, University of Turin, Italy.*
Characterization of *Alternaria* species associated with heart rot of pomegranate fruit

P16. ALLAGUI M.B.[1], MOUMNI M.[2], ROMANAZZI G.[2] *[1]Laboratory of Plant Protection, National Institute for Agronomic Research of Tunisia (INRAT), Tunisia; [2]Department of Agricultural, Food and Environmental Sciences, Marche Polytechnic University, Italy.*
Antifungal activity of thirty essential oils to control pathogenic fungi of postharvest decay

P17. REMOLIF G.[1,2], GARELLO M. [1,2], SPADARO D. [1,2] *[1]Dipartimento di Scienze Agrarie, Forestali e Alimentari (DISAFA), Università di Torino, Italy; [2]AGROINNOVA, Centro interdipartimentale per l'innovazione in campo agro-ambientale, Italy.* **Screening and evaluation of antagonistic yeasts to control postharvest rots of strawberries**

P18. REMOLIF G.[1,2], SCHIAVON G.[1,2], GARELLO M.[1,2], BUONSENSO F.[1,2], SPADARO D.[1,2] *[1]Dipartimento di Scienze Agrarie, Forestali e Alimentari (DISAFA), Università di Torino, Italy; [2]AGROINNOVA, Centro interdipartimentale per L'innovazione in campo agro-ambientale, Italy.* **Efficacy of essential oil vapours in reducing postharvest rots of nectarines and effect on the fruit microbiome**

P19. DI MILLO B.[1,2], MARTÍNEZ-BLAY V.[1], PÉREZ-GAGO M.B.[1], ARGENTE-SANCHIS M.[1], GRIMAL A.[1], BARALDI E.[2], PALOU L.[1] *[1]Institut Valencià d´Investigacions Agràries (IVIA), Montcada, València, Spain. [2] Dipartimento di Scienze e Tecnologie Agro-Alimentari, Università de Bologna, Italy.* **Antifungal hydroxypropyl methylcellulose (HPMC)-lipid composite edible coatings and modified atmosphere packaging (MAP) to reduce postharvest decay and improve storability of 'Mollar de Elche' pomegranates**

P20. ALVAREZ M.V.[1,2], PALOU L.[2], TABERNER V.[2], FERNÁNDEZ-CATALÁN A.[2], ARGENTE-SANCHIS M.[2], PITTA E.[2,3], PÉREZ-GAGO M.B.[2] *[1]Grupo de Investigación en Ingeniería en Alimentos, Departamento de Ingeniería Química y en Alimentos, Facultad de Ingeniería, Universidad Nacional de Mar del Plata, CONICET, Mar del Plata 7600, Argentina; [2] Institut Valencià d'Investigacions Agràries (IVIA), 46113 València, Spain; [3] School of Agriculture, Faculty of Agriculture, Forestry and Natural Environment, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.* **Natural pectin-based edible composite coatings with antifungal properties to control green mold and reduce losses of 'Valencia' oranges**

P21. ASGARIAN Z.S.[1,2], PALOU L.[2], LIMA DE SOUZA R.F.[2], QUINTANILLA P.G.[2,3], TABERNER V.[2], KARIMI R.[1,4], PÉREZ-GAGO M.B.[2] *[1]Grapevine Production and Genetic Improvement Department, Iranian Grape and Raisin Institute, Malayer University, Iran, [2] Institut Valencià d'Investigacions Agràries (IVIA), Spain, [3] Vicerrectorat d'Investigació, Universitat Politècnica de València (UPV), Spain, [4] Department of Landscape Engineering, Faculty of Agriculture, Malayer University, Iran.* **Hydroxypropyl methylcellulose and gum arabic composite edible coatings amended with geraniol to control postharvest brown rot and maintain quality of cold-stored plums**

POSTERS COST FOODWASTOP

WG1. PREVENTION OF FOOD LOSS AND FOOD WASTE

P22. KARAOGLANIDIS G., TESTEMPASIS S. *Aristotle University of Thessaloniki, Faculty of Agriculture, Forestry and Natural Environment, Laboratory of Plant Pathology, Greece.* **Fungicide resistance in postharvest pathogens and its management as a tool to prevent food losses**

P23. SAR T., FERREIRA J.A., TAHERZADEH M. J. *Swedish Centre for Resource Recovery, University of Borås, 50190 Borås, Sweden.* **A study on the use of olive oil mill wastewater to produce protein rich fungal biomass**

P24. MINCUZZI A.[1], PICCIOTTI U.[1,2], SANZANI S. M.[1], GARGANESE F.[1], PALOU L.[3], ADDANTE R.[1], RAGNI M.[1], IPPOLITO A.[1] *[1]Department of Soil, Plant, and Food Sciences, University of Bari Aldo Moro, Bari, Italy; [2]Department of Marine Science and Applied Biology, University of Alicante, San Vicente del Raspeig, Alicante, Spain; [3]Postharvest Technology Center (CTP), Valencian Institute of Agrarian Research (IVIA), Montcada, Valencia, Spain.* **Spiderweb effect on pomegranate postharvest diseases**

P25. EJUPI F.[1,2], GECAJ R.[1] *[1]University of Pristina, Faculty of Agriculture and Veterinary, Pristina, Kosovo; [2]UBT Higher Education Institution, Pristina, Kosovo.* **Identification of food waste in supermarkets in several regions of Kosovo**

P26. KLEIN M., APPRICH S. *University of Applied Sciences Vienna. Austria.* **Influence of food waste through packaging design**

P27. ROTONDO P. R.[1], ACETO D.[2], DISTANTE S.[1], LAERA S.[1], AMBRICO M.[2], DILECCE G.[2], DONGIOVANNI C.[3], DI CAROLO M.[3], AMBRICO P. F.[2], FARETRA F.[1], DE MICCOLIS ANGELINI R. M.[1] *[1]Department of Soil, Plant and Food Sciences, University of Bari Aldo Moro, Bari, Italy; [2]Institute for Plasma Science and Technology, National Research Council, Bari, Italy; [3]Centre of Research, Experimentation and Training in Agriculture (CRSFA) Basile Caramia, Italy.* **Decontaminant effects of plasma activated fog (PAF) against postharvest fungal pathogens and pesticide residues on table grape**

P28. ĆUJIĆ NIKOLIĆ N., JANKOVIC T., ŠAVIKIN K., MILUTINOVIC M. *Institute for Medicinal Plants Research Dr Josif Pancic, Serbia.* **Sustainable road from chokeberry fruit waste to microencapsulated powders for nutraceutical, pharamaceutical or food application**

P29. DESOPO M.[1], TERLIZZI N.[1], INCERTI O.[1], SCHLOSSEROVA N.[1,2], MOSTACCI A.[1], CONVERTINI L.[1], FERRANTE P.[1], PICCA R.A.[3], SPORTELLI M.C.[3], DIFONZO G.[1], GENTILE L.[3], PALAZZO G.[3], CAPONIO F.[1], IPPOLITO A.[1], CIOFFI N.[3], SANZANI S.M[1] *[1]Department of Soil, Plant and Food Sciences, University of Bari Aldo Moro, 70126 Bari, Italy; [2]Department of Chemistry and Biochemistry, Mendel University in Brno, 613 00 Brno, Czech Republic; [3]Department of Chemistry, University of Bari Aldo Moro, 70126 Bari, Italy*. **Active packaging to reduce losses and wastes of fresh fruits and vegetables**

WG2. AGROFOOD LOSS AND WASTE MANAGEMENT

P30. ZJALIC S., LONCAR J., KOS T. *Department of ecology, agronomy and aquaculture, University o Zadar, Crotia*. **Occurrence of conidia of mycotoxigenic fungi in an experimental corn field in the Slavonia region**

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Innovative Sustainable technologies TO extend the shelf-life of Perishable MEDiterranean fresh fruit, vegetables and aromatic plants and to reduce WASTE

‘StopMedWaste’

Coordinator

Gianfranco Romanazzi

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Abstracts

ORAL PRESENTATIONS

PRIMA StopMedWaste

Presentation of the PRIMA StopMedWaste project

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Postharvest losses of fruit, vegetables, and aromatic plants have high economic impact in the Mediterranean area and contribute to food waste. One of the United Nations Priorities, the ZeroHunger Challenge, consists of cutting food waste by half by 2030. StopMedWaste Project (2020-2024) see the interaction of 8 Research Units (UNIVPM, Italy; CUT, Cyprus; UNIBA, Italy; INRAT, Tunisia; UNITO, Italy; UE, Turkey; IVIA, Spain; IKACHEM, Turkey; and DECCO, Spain) to join efforts to extend the shelf life of fresh fruit, vegetables, and aromatic plants by applying physical means, natural compounds and biocontrol agents. These treatments are being applied in the laboratory, under semi-commercial conditions, and in the packinghouses. The effects of these treatments on fruit quality, decay, and development of foodborne pathogens are under monitoring during storage, transportation and shelf life, to define their impact on food waste. Results achieved till now showed the beneficial effects of treatment with physical means (ozone, electrolysed water, UVc), natural compounds (chitosan, essential oils, bicarbonates and other antifungal edible coatings), and biocontrol agents in improving the quality of fresh fruit (citrus, pomegranates, peaches, nectarines, apricots, plums, sweet cherries, strawberries, table grapes), vegetables (tomatoes, cucumbers) and aromatic plants (spearmint, basil), that allowed to keep quality and reduce decay, and then waste. Training activities and seminars were organised in Italy, Cyprus, Tunisia, France to share gained experiences and best practices among players and stakeholders through the whole supply chain, including consumers. This dissemination was extended to the general public through social media (Facebook, Twitter, Instagram, LinkedIn, and YouTube channel). From StopMedWaste project there were 32 scientific articles published in scientific journals. StopMedWaste has been networking with PRIMA project as FedKito, BiOrangePack. The networking of StopMedWaste with other PRIMA projects contributed to the proposal of COST FoodWaStop COST CA22134 Action, that involves members from over 45 countries.

Keywords: Fruit and vegetables, Food quality, Food Security, Logistic solution

Chitosan, essential oils and ozone as tools for the management of postharvest decay of fresh fruits

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The rapidly increasing of the world population makes it challenging to ensure global food security and to provide sufficient production of highly nutritious and high sensory quality food in sustainable ways. Postharvest losses of fruit, vegetables and aromatic plants have high economic impact in the Mediterranean area and contribute to food waste. Every year approximately 88 million tonnes of food, equivalent to 170 million tons of carbon emission, is wasted in the EU. This waste mainly occurs from the field to the consumer and thus innovative sustainable technologies are needed to extend the shelf life of perishable Mediterranean fresh fruit, vegetables, and aromatic plants. As part of the StopMedWaste project, compounds such as chitosan, essential oils (EOs), and ozone have been applied to fresh produce at various postharvest stages to protect against various fungal pathogens. The mycelial growth inhibitory effect of chitosan and its derivatives were tested against *Alternaria* spp., *Botrytis cinerea*, and *Monilinia* spp. at varying concentrations. The effectiveness of commercial EOs in vapor phase extracts to control major fungal pathogens of stone fruits were evaluated. Ozone treatments were also applied to stone fruits at postharvest to reduce fruit decay and extend the shelf life. Subsequently, key genes involved in expression of signaling pathways, oxidative stress, abiotic stress, ethylene biosynthesis, and ripening were assessed. Finally, the volatile profile of whole peaches at commercial maturity level were analyzed by HSPME-GC-MS comparing them to the profile of non-inoculated fruits. Highly discriminant volatile compounds were identified as potential markers for smart packaging sensors for the early detection of fungal pathogen infection on peaches. These innovative control measures have demonstrated effectiveness in reducing fruit decay and extending shelf life and thus have the potential to reduce food waste.

Keywords: Carbon emission, food waste, innovative compounds, shelf life, sustainability

Integrated alternative control means against postharvest diseases of pomegranates and citrus fruit

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Pomegranate and citrus fruits are relevant crops in southern Italy, facing several postharvest yield and economic losses. Pomegranate losses are mainly caused by fungal pathogens (i.e. *Botrytis cinerea*, *Coniella granati*, *Alternaria alternata*) that infecting fruit during the blooming stage remain latent until optimal conditions; citrus are chiefly infected through injuries by postharvest fungi (i.e. *Penicillium* species). The research, developed within "StopMedWaste" PRIMA Project, set up an integrated approach based on alternative control means to reduce damage induced by the above-mentioned pathogens. Detailing, control of pomegranate diseases started in the field by spray of *Bacillus amyloliquefaciens* sbs. *plantarum* (strain "D747"), then harvested fruit were dipped in Neutral Electrolyzed Water (NEW) amended with calcium propionate and stored with/without gaseous ozone exposure. Effectiveness of different solutions of NEW combined with gaseous ozone was tested on lemon fruit too. Disease incidences, epiphytic population, and main qualitative parameters were periodically evaluated during cold-storage and shelf-life of both fruits. Results suggest that the integrated approach among different alternative control means is the best solution to control postharvest diseases of pomegranate and citrus fruits.

Keywords: Alternative control means, basic substances, calcium propionate, lemon integrated approach, ozone, neutral electrolyzed water, sodium bicarbonate, sodium metabisulfite, potassium sorbate

Essential oils and GRAS salts for preventing postharvest fruit rot and reducing the need for chemical fungicides

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Natural compounds, including essential oils and GRAS salts, are attracting increasing interest as alternative methods of preserving fruit quality to avoid losses for retailers and consumers. According to our analyses, and in terms of speed of fruit colonisation, *Penicillium digitatum* is the most important postharvest pathogen, mainly on citrus fruits, *Botrytis cinerea* is a serious pathogen on a large number of fruit types, followed by *Penicillium italicum* and *Alternaria alternata*. Nevertheless, all these fungal species are capable of producing considerable damage after long cold storage and during shelf life. Fruit wounds are the main factor in the spread of fungal rot. They are the cause of huge fruit losses in the postharvest period. All fruit with wounds must be sorted quickly before the fungal invasion begins. Certain essential oils such as cinnamon bark (*C. verrum*) and clove flower bud (*S. aromaticum*) were effective in reducing the mycelial growth of these fungi by 98.5% and 92.2% respectively at 500 ppm, showing undeniable effectiveness in vitro. The GRAS salts, in particular sodium metabisulphite, was effective *in vitro* and on fruit treated curatively at low dose (0.5%). Higher concentrations of this salt were phytotoxic. Further adjustments of these compounds for the treatment of commercial fruit are required to keep the efficacy observed in the laboratory. In this respect, innovative methods such as nanoencapsulation appear promising for the practical formulation of these environmentally friendly compounds, helping to reduce the need for chemical fungicides. This work was conducted within the framework of the PRIMA StopMedWaste project, which is funded by PRIMA, a programme supported by the European Union.

Keywords: Biological compound, decay, fungi

Effectiveness of antagonistic yeasts and essential oils in the control of postharvest diseases of fruit

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Postharvest decays are a major challenge during storage of fruit. Essential oils (EOs) and biocontrol agents (BCAs) could be promising alternatives to synthetic fungicides to reduce postharvest decay. The research aimed to find alternative solutions to fungicides to control postharvest pathogens of fruit crops, including strawberries and nectarines. *Metschnikowia pulcherrima* and *Aureobasidium pullulans* were identified as effective BCAs for controlling postharvest rots of strawberry, significantly reducing rot incidence and severity without compromising fruit quality. Microbiome analysis revealed insights into the fungal community shift in response to treatments. A similar approach was employed to control brown rot in nectarines, with yeasts such as *M. pulcherrima* and *A. pullulans* exhibiting efficacy comparable to chemical treatments. These BCAs did not adversely affect fruit quality and demonstrated promising potential for disease management. Additionally, the study explored the use of EOs as an alternative to synthetic fungicides for controlling storage rots in nectarines. Basil, fennel, and lemon EOs showed significant inhibition activity, reducing rot without compromising fruit quality. Microbiome analysis highlighted modifications in fungal genera abundance. While treatments effectively reduced *Monilinia* spp., basil EO appeared to favour the presence of *Penicillium* spp. These findings contribute to the development of sustainable strategies for postharvest disease management of fruit.

Effect of postharvest UV-C applications on postharvest decays on strawberry fruits

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Postharvest fungal decays on strawberries during storage and shelf life cause very important crop losses. UV-C light with a wavelength of 254 nm is actually used as surface treatment. In this study, the effects of UV-C light on postharvest strength of strawberry fruits were tested. The fruits were kept 10 cm under the light in the cabinet with a 30 Watt 0.36 A UV-C light source at 254 nm wavelength. The fruits, which were exposed to UV-C light at different times and UV-C doses, were packed in chalets and kept for 10 days in cold storage conditions at 0°C and 90% humidity. The results of the decay development on strawberry fruits after stored at 0°C and 90% humidity for 10 days in cold storage conditions rot and quality analyses of the fruits were carried out. Fruit were not inoculated. The decay development inhibited by 60,71% at the 3,11 kJ/m^2 UV-C doses measured from a height of 10 cm in the cabinet for 3 minutes by compare to control application.

Antifungal edible coatings to reduce decay and maintain postharvest quality of citrus, plums, and pomegranates

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Most of the fresh fruits are highly perishable and fungal postharvest diseases are among the main causes that contribute to fruit waste. Synthetic chemical fungicides are currently the main tool to control postharvest decay, but different health and environmental alerts have raised the need to find safe and eco-friendly alternatives. Among them, the development of edible coatings with antifungal activity (AECs) has been addressed in the StopMedWaste project to control decay and maintain fruit quality of citrus fruits, plums, and pomegranates during cold storage and shelf life. For this, specific objectives were to (i) evaluate the in vitro activity against target pathogens of different essential oils (EOs), natural extracts, and generally recognized as safe salts, (ii) formulate new composite AECs with hydrocolloid-lipid matrixes and selected antifungal agents and evaluate their curative activity on artificially inoculated fruit incubated at 20 ºC, and (iii) assess the effect of selected AECs on decay control and fruit quality during cold storage, followed by a short shelf-life period at 20 ºC. Overall, eugenol-enriched pectin-beeswax coatings performed best in terms of postharvest quality preservation and control of citrus green mold and sour rot. In plums, a hydroxypropyl methylcellulose (HPMC) coating containing geraniol showed the greatest potential to reduce brown rot and maintain fruit quality. The combination of a HPMC coating formulated with sodium benzoate and modified atmosphere packaging was the most promising treatment for pomegranate, as it reduced weight loss and decay during long-term cold storage and shelf life.

Keywords: Antifungal edible coatings, food-grade antifungal ingredients, postharvest decay, postharvest fruit quality

Experience of other PRIMA Projects

Enhancing Mediterranean fresh produce shelf-life using sustainable preservative technologies and communicating knowledge on dynamic shelf-life using food cloud services and predictive modelling (BioFreshCloud)

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The agri-food sector is key in the development of the Mediterranean region providing employment and economic-social benefits to the region. At the same time, it is also the main threat for its sustainability due to the high consumption and use of rural resources. The vegetable sector is the one connected to the largest amount of food losses, as reported by several surveys and scientific studies across Europe. BIOFRESHCLOUD aims to develop an integrated, innovative, and eco-friendly approach to assess optimal shelf-life and minimize food losses of strawberries and tomatoes produced in the Mediterranean region, by combining food bio-preservation technologies, food modelling, and Food Cloud tools. To this end, BIOFRESHCLOUD addresses the following specific objectives, i) developing active and eco-friendly packaging systems from agri-food residues; ii) extending shelf-life of tomatoes and strawberry by using bio-protective cultures and bio-active compounds in combination with eco-friendly packaging systems; iii) generating and validating mathematical models to predict microbial and sensory dynamics in the products, considering the impact of bio-active packaging systems and bio-protective cultures; iv) developing a cloud computing based systems for food transparency and dynamic shelf-life predictions to optimize logistic and retail and reduce food waste v) testing the BIOFRESHCLOUD solution in a real environment, involving food stakeholders from farm to fork.

Keyword: Predictive microbiology, cloud computing, valorization, biorefinary, food packaging, food modelling, biopreservation

The PRIMA project ADVAGROMED

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The significant factors contributing to biodiversity loss include the expansion and intensification of agricultural and animal production systems, leading to the conversion of natural habitats into agricultural land, widespread use of chemical inputs such as fertilizers and pesticides, and landscape homogenization. To address this issue and promote sustainability, incorporating agroecological practices into existing agricultural systems could provide a viable solution to conserve and enhance endangered farming biodiversity while simultaneously boosting ecosystem services. In this context, the aim of the ADVAGROMED (ADVanced AGROecological approaches based on the integration of insect farming with local field practices in MEDiterranean countries) PRIMA 2021 project is to develop a new, innovative, holistic agricultural production system based on agroecological principles and circular economy practices. ADVAGROMED introduces sustainable farming practice to increase the resilience of the agro livelihood systems. Using a multi-actor approach ADVAGROMED applies the Circular Economy / zero waste principle and uses by-products from local agricultural productions for rearing insects to deliver different products: 1) insect frass to be used as bio-product to improve soil fertility, deliver plant protection effects and enhance soil microbial biodiversity, by reducing mineral fertilizers and chemical pesticides, and 2) live larvae to feed local poultry breeds ensuring optimal animal performances, health and product quality (decreasing the use of imported feeds). Biodiversity is promoted at various levels, i.e. at farm level, by promoting the genetic variability of local crops and varieties/animal breeds, but also at a regional level by minimizing the negative impact of chemical inputs on the microfauna through the exploitation of insect frass as bio-products for sustainable soil fertilization and plant protection.

FrEsh fooD sustainable pacKaging In The circular econOmy

Acronym

FEDKITO

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Somewhere between 15 and 50% of fresh food (FF, such as fruits, vegetables, meat and dairy) produced on the global scale is lost after harvesting, post-farming and at storage stage. This percentage is greatly increased in developing countries, where the correct technologies for storage of FF are lacking. Quality and shelf life of FF are affected mainly by (i) mechanical damage, (ii) microbiological spoilage as well as (iii) insect attacks. These are the main causes of decay of fruit and vegetables, while, on the other hand, oxidation of unsaturated fatty acids can be considered the major non-microbiological factor that affects the quality and shelf life of meat and cheese. Generally, the susceptibility of FF to spoilage and deterioration of quality attributes increases during prolonged storage, also as a result of physiological and biochemical changes in the commodities. In countries where transportation inefficiencies, broken cold chains and non-optimal logistics affect the quality and durability of products, the problems are more evident due to the fact that asymptomatic fruits and vegetables, that may have been attacked by fungi and insect pests in the open field, could develop infestations during the storage (if preservation conditions are unsuitable). In the case of meat and dairy, the attack of insect pests depends on the hygiene conditions of slaughtering and maturing room respectively. Pests attack and fungal pathogens development not only reduces the market value of food, but also expose consumers to the risk of ingesting toxic metabolites, including mycotoxins.

The solution proposed with FEDKITO, for the above problems, is the use of chitosan (CHT) as liquid, spray, solid or innovative smart active packaging based on CHT aromatized with essential oils (EOs), together with biosensor technologies to protect FF from insect and fungi attack in any conditions and to extend the shelf life of perishable Mediterranean food products. CHT is an edible and biodegradable polymer derived from chitin deacetylation, with antimicrobial and antifungal activity and low gas permeability [carbon dioxide (CO_2) and oxygen (O_2)]. EOs added to CHT are known for their antibacterial, antifungal, insecticidal, and insect repellent properties. In addition, according to the circular economy criteria, CHT production within FEDKITO is obtained as a mean of reuse of FF by-products and waste (e.g. waste caused by selection of fruits and vegetables for the market). In fact, this polymer is obtained starting from the chitin-rich prepupae of the black soldier fly, *Hermetia illucens* (Diptera Stratiomyidae), reared on FF by-products and waste. FEDKITO proposal also targeted the use of devices for measuring mycotoxins, pesticides, residues and various FF quality characteristics, by validation of low-cost electrochemical paper-based biosensors and multiplexed user-friendly smartphone-based biosensors, that allowed real-time monitoring of FF quality during storage.

BiOrangePack - Smart and innovative packaging, post-harvest rot management and shipping of organic citrus fruit

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The BiOrangePack, a 36-month project launched in November 2020 and extended until November 2024, aims to tackle challenges in the Mediterranean agriculture sector, particularly focusing on the citrus fruit supply chain. Coordinated by the University of Catania and involving 14 institutions from six Mediterranean countries, the BiOrangePack Project's goal is to increase the efficiency, sustainability and competitiveness of the post-farming processing chain of organic citrus fruit, by intervening on points of weakness and the unresolved problems of this supply chain. To achieve this goal, the BiOrangePack Project pursues five key objectives, here illustrated together with the solutions proposed by the project. *i.* Reducing losses caused by post-harvest rots during storage and transportation by treating fruits with non-toxic, eco-friendly substances and bio-products; thus, BiOrangePack aims to reduce the losses from 30 to 0.5%. *ii.* Reducing the incidence of postharvest diseases and fruit contamination by detecting pathogens and mycotoxins; thus, BiOrangePack ensures compliance with stringent EU standards, supporting the EU's commitment to guaranteeing the safety and integrity of agricultural products. *iii.* Extending the shelf life of citrus fruits, the BiOrangePack Project addresses this by developing easy-to-use and biodegradable bioactive coatings, aiming to extend the shelf life of citrus fruits by at least 10 days. This contributes to reducing food waste and aligns with environmental issues. *iii.* Optimizing shipment efficiency: the project aims to increase shipment efficiency by 20% by implementing smart technologies; integrating ICT-based solutions and machine learning techniques, the BiOrangePack approach simplifies transportation processes, reducing product losses or damage during the shipment. *iv.* Optimizing the management of citrus industrial waste: by recycling citrus pulp to produce biodegradable biocoatings, the BiOrangePack Project targets an ambitious 80% reduction of industrial fruit transformation waste. By strategically addressing these objectives, the BiOrangePack Project fosters sustainable and competitive practices in organic citrus production and contributes indirectly to mitigate the effects of climate change on Mediterranean agriculture.

PRIMA project "Smart and innovative packaging, postharvest rot management and shipping of organic citrus fruit – BiOrangePack (CUP E69C20000130001)", a program supported by the European Union, for inspiring the author to develop nanomaterials from food waste

Abstracts

POSTERS

PRIMA StopMedWaste

P01

Innovative sustainable technologies to extend the shelf life of perishable mediterranean fresh fruit, vegetables, and aromatic plants and to reduce waste: the experience of PRIMA StopMedWaste project

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Postharvest losses of fruit, vegetables, and aromatic plants have high economic impact in the Mediterranean area and contribute to food waste. One of the United Nations Priorities, the ZeroHunger Challenge, consists of cutting food waste by half by 2030. StopMedWaste Project (2020-2024) see the interaction of 8 Research Units (UNIVPM, CUT, UNIBA, INRAT, UNITO, UE, IVIA, IKACHEM and DECCO) to join efforts to extend the shelf life of fresh fruit, vegetables, and aromatic plants by applying physical means, natural compounds and biocontrol agents. These treatments are being applied in the laboratory, under semi-commercial conditions, and in the packinghouses. The effects of these treatments on fruit quality, decay, and development of foodborne pathogens are under monitoring during storage, transportation and shelf life, to define their impact on food waste. Results achieved till now showed the beneficial effects of treatment with physical means (ozone, electrolysed water, UVc), natural compounds (chitosan, essential oils, bicarbonates and other antifungal edible coatings), and biocontrol agents in improving the quality of fresh fruit (citrus, pomegranates, peaches, nectarines, apricots, plums, sweet cherries, strawberries, table grapes), vegetables (tomatoes, cucumbers) and aromatic plants (spearmint, basil), that allowed to keep quality and reduce decay, and then waste.

Keywords: Foodborne pathogens, food losses, food security, pesticide residues

P02

Chitosan and other edible coatings to extend shelf life, manage postharvest decay, and reduce loss and waste of fresh fruits and vegetables

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Fresh fruits and vegetables contain high percentage of water and continue metabolic activity after being harvested, resulting in ripening, increased sensitivity to decay-causing fungi, and consequent loss and waste. Edible coatings are prepared from naturally occurring renewable sources and can contribute to reducing waste, respecting environment, and consumer health. Chitosan and other edible coatings form a thin layer surrounding fresh produce that acts as a protective agent, extending shelf life, and have the potential to control their ripening process and maintain nutritional properties of the coated product. This review discusses recent research on the application of chitosan and other edible coatings to prevent fungal decay, keep the quality, and reduce fresh product waste.

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P03

Identification of volatile organic compounds as markers to detect *Monilinia fructicola* infection in fresh peaches

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Monilinia spp. are among the main fungal pathogen affecting peaches, and they can cause severe pre- and postharvest losses. Development of smart packaging technologies (e.g., volatile indicators), facilitating infection detection and preventing other fruit from being contaminated, is still limited. In this study, we compared for the first time the aroma profile of whole healthy fresh peaches to *Monilinia fructicola*-artificially inoculated peaches, identifying discriminant volatile organic compounds (VOCs). More than one hundred VOCs were detected by applying head space solid-phase microextraction followed by GC-MS analysis. The level of methyl esters, hydrocarbons, lactones, and acids decreased in infected peaches indicating fruit aroma deterioration, while the concentration of ethyl esters and alcohols increased. In particular, the amount of ethanol and derived ethyl acetate reached a maximum of 24- and 20-fold increase in the infected peaches, respectively. Isobutanol, propyl acetate, and ethyl isovalerate were specifically emitted by *M. fructicola*-infected peaches. These compounds might serve as markers for the development of smart sensors allowing the detection of fungal infection.

Keywords: Chromatography, fungal pathogen, *Monilinia fructicola*, peach, sensors, volatiles

Fanesi B., D'Ortenzio A. L., Kuhalskaya A., Nartea A., Fiorini D., Moumni M., Landi L., Lucci P., Romanazzi G., Pacetti D., 2023. Identification of volatile organic compounds as markers to detect *Monilinia fructicola* infection in fresh peaches. *Postharvest Biology and Technology*, 206, 112581. https://doi.org/10.1016/j.postharvbio.2023.112581

P04

Understanding the mechanisms of action of atmospheric cold plasma towards the mitigation of the stress induced in molds: the case of *Aspergillus chevalieri*

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Aspergillus chevalieri is a xerophilic/xerotolerant fungus affecting dried food products. In this study the ability of non-thermal cold atmospheric plasma (CAP) at high power density (NO_x) to affect biological process inducing the stress responses of *A. chevalieri* species exposed for 5 min (5'CAP-NO_x) and 30 min (30'CAP-NO_x) were analyzed at 0, 1, 6, 12 and 48-h post treatment (hpt). At 48 hpt with 30'CAP-NOx, 84% of fungal growth reduction was observed. The membrane integrity estimated by confocal investigation after carboxyfluorescein diacetate/propidium iodide staining showed the dead surface mycelium layers exposed to the treatments. Reverse transcription-quantitative real-time PCR revealed an early downregulation, at 0 hpt, followed by upregulation or recovery starting to 1 hpt, of selected key genes involved in fungal stress responses. The cellular response to stress was confirmed by mycelial glutathione accumulation in the early phase after both CAP-NO_x treatments, at 0 and 1 hpt, followed by the strong glutathione reduction at 12 and 48 hpt using 30'CAP-NOx treatment. The ability of *A. chevalieri* to modulate metabolic profile according to treatments was underlined by volatilome investigation, which mainly involved lipid metabolism. This work highlighted the adaptative response mechanisms of *A. chevalieri* to overcome the CAP-NOx treatment.

Keywords: adaptative response, *Aspergillus chevalieri*, fungal viability, gene expression, volatilome

Molina-Hernandez J.B., Landi L., De Flaviis R., Laika J., Romanazzi G., Chaves-Lopez C., 2023. Understanding the mechanisms of action of atmospheric cold plasma towards the mitigation of the stress induced in molds: the case of *Aspergillus chevalieri. Innovative Food Science and Emerging Technologies*, 90, 103492. https://doi.org/10.1016/j.ifset.2023.103492

P05

Effectiveness of four synthetic fungicides in the control of postharvest gray mold of strawberry and analyses of residues on fruit

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Fungicides are usually applied on strawberries to manage gray mold, induced by the fungal pathogen *Botrytis cinerea*. In this study, four reduced-risk fungicides (formulations of pyrimethanil, PYR, 175 mL/hL; boscalid, BOS, 80 g/hL; combination fludioxonil, FLU, +cyprodinil, CYP, 110 g/hL) were applied before harvest for the management of post-harvest diseases of strawberries. The resulting fungicide residues on the strawberry fruit were also quantified. Strawberry fruits were harvested at 0, 4, 8, and 12 days following treatment (dft) and kept at 20 ± 1°C for 4 days or cold-stored for 7 days at 0.5 ± 1 °C, followed by a 4-day shelf life at 20 ± 1°C. All fungicides significantly reduced gray mold, according to the McKinney Index. At 0 dft and 4 days of shelf life, the FLU + CYP completely prevented post-harvest strawberry gray mold, while PYR and BOS reduced the disease by 88% and 42%, respectively, in comparison to the untreated control. For the duration of experiment, fungicide residues were always below the maximum residue levels, and FLU was the most degraded, thanks to the enzymatic pool of the strawberries. Monitoring fungicide residues in strawberries is essential to provide the consumer information on the safety of this widely consumed fruit. The present study points out the safety of strawberry fruits for consumers, even if the treatment strategy implies the use of fungicide mixtures before the consumption, with fungicide levels always being below the MRL.

Keywords: *Botrytis cinerea*, *Fragaria* × *ananassa*, fungicide residues, maximum residue level, postharvest decay

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P06

Effects of commercial natural compounds on postharvest decay of strawberry fruit

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Gray mold and Rhizopus rot, which is caused by *Botrytis cinerea* and *Rhizopus stolonifer*, respectively, are the most destructive forms of postharvest decay of the strawberry fruit. In this work, we tested the effectiveness of the control on the postharvest decay of the strawberry fruit (Fragaria × ananassa Duch cv. 'Monterey') following postharvest applications of six commercial natural compounds: chitosan-based coating compound (1% of 'ChitP', 'ChitS', 'ChitK', 'ChitO'), commercial essential oil (EOs) products based on grapefruit seed extract (0.5% of 'GraFr'), sweet orange (0.5% of 'SwOr'), a product that included eugenol, geraniol, and thymol EO, (0.4% of 'EuGeTh'), an organic compound as humic acid (0.5% w/v of 'HuAc'), and, lastly, methyl jasmonate plant growth regulator (1% v/v 'MeJA'). Strawberries were dipped in solution for 30 s and incubated at room temperature (20 ± 0.5 °C) or at cold storage conditions (4 ± 0.5 °C) following 4 days of shelf life at 20 °C. The treatments with 'ChitP', 'ChitS', and 'ChitO' provided ~30%–40% reduction of gray mold in cold storage conditions, while the 'MeJA', 'SwOr', and 'GraFr' with high activities of volatile substances were more effective at controlling gray mold at room temperature. 'HuAc', 'ChitK', and 'ChitO' were more effective at controlling Rhizopus rot in both cold storage (~50%) and room temperature conditions.

Keywords: Basic substances, *Botrytis cinerea*, *Rhizopus stolonifer*, strawberry

Rajestary R., Landi L., Romanazzi G., 2023. Effects of commercial natural compounds on postharvest decay of strawberry fruit. *Coatings* 13, 1515. https://doi.org/10.3390/coatings13091515

P07

Chitosan coating enriched with *Ruta graveolens* L. essential oil reduces postharvest anthracnose of papaya (*Carica papaya* L.) and modulates defense-related gene expression

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Anthracnose of papaya (*Carica papaya* L.) caused by the fungus *Colletotrichum* spp. is one of the most economically important postharvest diseases. Coating with chitosan (CS) and *Ruta graveolens* essential oil (REO) might represent a novel eco-friendly method to prevent postharvest anthracnose infection. These compounds show both antimicrobial and eliciting activities, although the molecular mechanisms in papaya have not been investigated to date. In this study, the effectiveness of CS and REO alone and combined (CS-REO) on postharvest anthracnose of papaya fruit during storage were investigated, along with the expression of selected genes involved in plant defense mechanisms. Anthracnose incidence was reduced with CS, REO, and CS-REO emulsions after 9 days storage at 25°C, by 8, 21, and 37%, respectively, with disease severity reduced by 22, 29, and 44%, respectively. Thus, McKinney's decay index was reduced by 22, 30, and 44%, respectively. A protocol based on reverse transcription quantitative real-time PCR (RT-qPCR) was validated for 17 papaya target genes linked to signaling pathways that regulate plant defense, pathogenesis-related protein, cell wall-degrading enzymes, oxidative stress, abiotic stress, and the phenylpropanoid pathway. CS induced gene upregulation mainly at 6 h posttreatment (hpt) and 48 hpt, while REO induced the highest upregulation at 0.5 hpt, which then decreased over time. Furthermore, CS-REO treatment delayed gene upregulation by REO alone, from 0.5 to 6 hpt, and kept that longer over time. This study suggests that CS stabilizes the volatile and/or hydrophobic substances of highly reactive essential oils. The additive effects of CS and REO were able to reduce postharvest decay and affect gene expression in papaya fruit.

Keywords: Chitosan, gene expression, essential oils, induced resistance, RT-qPCR

Landi L., Peralta-Ruiz Y., Chaves-López C., Romanazzi G., 2021. Chitosan coating enriched with *Ruta graveolens* L. essential oil reduces postharvest anthracnose of papaya (*Carica papaya* L.) and modulates defense-related gene expression. *Frontiers in Plant Sciences* 12, 765806. https://doi.org/10.3389/fpls.2021.765806

P08

Antifungal activity of volatile organic compounds from essential oils against the postharvest pathogens *Botrytis cinerea*, *Monilinia fructicola*, *Monilinia fructigena*, and *Monilinia laxa*

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Gray mold and brown rot, caused respectively by *Botrytis cinerea* and *Monilinia* spp., are fungal diseases responsible for significant losses during the storage of fruit and vegetables. Nowadays, the control of postharvest diseases is shifting towards more sustainable strategies, including the use of plant secondary metabolites. In this study, the antifungal activity of *Origanum vulgare*, *Thymus vulgaris*, *Thymus serpyllum*, *Melaleuca alternifolia*, *Lavandula officinalis*, *Lavandula hybrida*, *Citrus bergamia*, *Rosmarinus officinalis*, *Cinnamomum zeylanicum* essential oils (EOs) in vapor phase was tested in vitro against *B. cinerea*, *Monilinia fructicola*, *Monilinia fructigena*, and *Monilinia laxa*. For the experiments, a protocol using a volatile organic compounds (VOC) chamber was designed. Results indicate a dose-dependent inhibitory activity of all the tested EOs, with *O. vulgare*, *T. vulgaris*, and *T. serpyllum* being the most active ones, with minimum inhibitory concentrations (MIC) of 22.73, 45.45, and 22.73 µl/L, respectively, against *B. cinerea* and a range between 5.64 and 22.73 µl/L against the three *Monilinia* spp. Overall, *B. cinerea* presented lower sensitivity to vapor phase EOs than any of the *Monilinia* strains, except for the *C. zeylanicum* EO, which consistently showed higher inhibition against *B. cinerea*. Among the three *Monilinia* spp., *M. fructicola* was the least sensitive, while *M. fructigena* was the most sensitive. The use of VOC chambers proved to be a reliable protocol for the assessment of antimicrobial activities of EOs. These results suggest that the VOC emitted by the tested EOs are effective towards important decay-causing fungi, and that they could be used for the control of gray mold and brown rot in *in vivo* trials.

Keywords: Cinnamon, fumigation, lavender, oregano, rosemary, tea tree, thyme, VOC chamber

Álvarez-García S., Moumni M., Romanazzi G., 2023. Antifungal activity of volatile organic compounds from essential oils against the postharvest pathogens *Botrytis cinerea*, *Monilinia fructicola*, *Monilinia fructigena*, and *Monilinia laxa*. *Frontiers in Plant Science*, 14, 1274770. https://doi.org/10.3389/fpls.2023.1274770

P09

In vitro evaluation of Chitosan hydrochloride and COS (chito-oligosaccharides)-OGA (oligo-galacturonides) on phytopathogenic fungi and *Escherichia coli*

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Use of novel alternative compounds in agriculture is being promoted to reduce synthetic pesticides. An *in vitro* study was conducted to evaluate antimicrobial and antioxidant activities of chitosan hydrochloride (CH) and COS (chito-oligosaccharides)-OGA (oligo-galacturonides) at concentrations of 1%, 0.5%, 0.25%, 0.1%, 0.05%, and 0.025%. COS-OGA at 1% and 0.5% concentrations completely inhibited mycelial growth of *Alternaria alternata*, *Alternaria brassicicola*, *Botrytis cinerea*, *Monilinia laxa*, *Monilinia fructigena*, and *Monilinia fructicola*. Further, complete inhibition was observed with 0.25% COS-OGA for *M. fructigena* and *M. laxa*. Inhibition for *B. cinerea*, *M. fructicola*, *A. alternata*, and *A. brassicicola* at 0.25% COS-OGA was 86.75%, 76.31%, 69.73%, and 60.45%, respectively. *M. laxa* and *M. fructigena* were completely inhibited by CH concentrations of 1–0.25% and *M. fructicola* by concentrations of 1–0.5%. At CH 0.25%, inhibition for *M. fructicola*, *A. brassicicola*, *A. alternata*, and *B. cinerea* was 93.99%, 80.99%, 69.73%, and 57.23%, respectively. CH showed effective antibacterial activity against foodborne *Escherichia coli*. COS-OGA had higher antioxidant activity than CH when assessed by DPPH and hydroxyl radical scavenging assays. Our findings offer insights into the antimicrobial efficacy and mechanisms of action of these novel compounds, which have the potential to serve as alternatives to synthetic pesticides. *In vivo* investigations are required to validate the prospective application of these treatments for pre- and postharvest disease management.

Keywords: Antibacterial activity, antifungal activity, antioxidant activity, environmentally friendly compounds, sustainability

Makau S.M., Moumni M., Landi L., Pirozzi D., Sannino F., Romanazzi G., 2023. *In vitro* evaluation of chitosan hydrochloride and COS (chito-oligosaccharides)-OGA (oligo-galacturonides) on phytopathogenic fungi and *Escherichia coli*. *Horticulturae*, 9, 1275. https://doi.org/10.3390/horticulturae9121275

P10

Basic substances, a sustainable tool to complement and eventually replace synthetic pesticides in the management of pre and postharvest diseases: reviewed instructions for users

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Synthetic pesticides are widely used to protect crops from pathogens and pests, especially for fruits and vegetables, and this may lead to the presence of residues on fresh produce. Improving the sustainability of agriculture and, at the same time, reducing the adverse effects of synthetic pesticides on human health requires effective alternatives that improve the productivity while maintaining the food quality and safety. Moreover, retailers increasingly request fresh produce with the amounts of pesticides largely below the official maximum residue levels. Basic substances are relatively novel compounds that can be used in plant protection without neurotoxic or immune-toxic effects and are still poorly known by phytosanitary consultants (plant doctors), researchers, growers, consumers, and decision makers. The focus of this review is to provide updated information about 24 basic substances currently approved in the EU and to summarize in a single document their properties and instructions for users. Most of these substances have a fungicidal activity (calcium hydroxide, chitosan, chitosan hydrochloride, *Equisetum arvense* L., hydrogen peroxide, lecithins, cow milk, mustard seed powder, Salix spp., sunflower oil, sodium chloride, sodium hydrogen carbonate, Urtica spp., vinegar, and whey). Considering the increasing requests from consumers of fruits and vegetables for high quality with no or a reduced amount of pesticide residues, basic substances can complement and, at times, replace the application of synthetic pesticides with benefits for users and for consumers. Large-scale trials are important to design the best dosage and strategies for the application of basic substances against pathogens and pests in different growing environments and contexts

Keywords: European Union, fungicide residues; plant protection; Regulation EU 1107/2009

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P11

Are basic substances a key to sustainable pest and disease management in agriculture? An open field perspective

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Pathogens and pests constantly challenge food security and safety worldwide. The use of plant protection products to manage them raises concerns related to human health, the environment, and economic costs. Basic substances are active, non-toxic compounds that are not predominantly used as plant protection products but hold potential in crop protection. Basic substances' attention is rising due to their safety and cost-effectiveness. However, data on their protection levels in crop protection strategies are lacking. In this review, we critically analyzed the literature concerning the field application of known and potential basic substances for managing diseases and pests, investigating their efficacy and potential integration into plant protection programs. Case studies related to grapevine, potato, and fruit protection from pre- and post-harvest diseases and pests were considered. In specific cases, basic substances and chitosan in particular, could complement or even substitute plant protection products, either chemicals or biologicals, but their efficacy varied greatly according to various factors, including the origin of the substance, the crop, the pathogen or pest, and the timing and method of application. Therefore, a careful evaluation of the field application is needed to promote the successful use of basic substances in sustainable pest management strategies in specific contexts.

Keywords: Disease management, pest management, sustainable crop protection, integrated pest management, organic farming

P12

Tracking of diversity and evolution in the brown rot fungi *Monilinia fructicola*, *Monilinia fructigena*, and *Monilinia laxa*

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Monilinia species are among the most devastating fungi worldwide as they cause brown rot and blossom blight on fruit trees. To understand the molecular bases of their pathogenic lifestyles, we compared the newly assembled genomes of single strains of *Monilinia fructicola*, *M. fructigena* and *M. laxa*, with those of *Botrytis cinerea* and *Sclerotinia sclerotiorum*, as the closest species within Sclerotiniaceae. Phylogenomic analysis of orthologous proteins and syntenic investigation suggest that *M. laxa* is closer to *M. fructigena* than *M. fructicola*, and is closest to the other investigated Sclerotiniaceae species. This indicates that *M. laxa* was the earliest result of the speciation process. Distinct evolutionary profiles were observed for transposable elements (TEs). *M. fructicola* and *M. laxa* showed older bursts of TE insertions, which were affected (mainly in *M. fructicola*) by repeat-induced point (RIP) mutation gene silencing mechanisms. These suggested frequent occurrence of the sexual process in *M. fructicola*. More recent TE expansion linked with low RIP action was observed in *M. fructigena*, with very little in *S. sclerotiorum* and *B. cinerea*. The detection of active non-syntenic TEs is indicative of horizontal gene transfer and has resulted in alterations in specific gene functions. Analysis of candidate effectors, biosynthetic gene clusters for secondary metabolites and carbohydrate-active enzymes, indicated that *Monilinia* genus has multiple virulence mechanisms to infect host plants, including toxins, cell-death elicitor, putative virulence factors and cell-wall-degrading enzymes. Some species-specific pathogenic factors might explain differences in terms of host plant and organ preferences between *M. fructigena* and the other two *Monilinia* species.

Keywords: Biosynthetic gene clusters, effectors, phylogenetic repeat-induced point mutation, synteny, transposable elements

De Miccolis Angelini R.M., Landi L., Raguseo C., Pollastro S., Faretra F., Romanazzi G., 2022. Tracking of diversity and evolution in the brown rot fungi *Monilinia fructicola, Monilinia fructigena*, and *Monilinia laxa*. *Frontiers in Microbiology*, 13, 854852. https://doi.org/10.3389/fmicb.2022.854852

P13

Postharvest diseases of pomegranate: alternative control means and a spiderweb effect

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The pomegranate is a fruit known since ancient times for its beneficial properties. It has recently aroused great interest in the industry and among consumers, leading to a significant increase in demand. Consequently, its cultivation has been boosted all over the world. The pomegranate crop suffers considerable yield losses, especially at the postharvest stage, because it is a "minor crop" with few permitted control means. To control latent (*Alternaria* spp., *Botrytis* spp., *Coniella* spp., *Colletotrichum* spp., and *Cytospora* spp.) and wound (*Aspergillus* spp., *Penicillium* spp., and *Talaromyces* spp.) fungal pathogens, different alternative compounds, previously evaluated in vitro, were tested in the field on pomegranate cv. Wonderful. A chitosan solution, a plant protein hydrolysate, and a red seaweed extract were compared with a chemical control treatment, all as preharvest (field application) and postharvest treatments and their combinations. At the end of the storage period, the incidence of stamen infections and external and internal rots, and the severity of internal decay were evaluated. Obtained data revealed that pre- and postharvest application of all substances reduced the epiphytic population on stamens. Preharvest applications of seaweed extract and plant hydrolysate were the most effective treatments to reduce the severity of internal pomegranate decays. Furthermore, the influence of spider (*Cheiracanthium mildei*) cocoons on the fruit calyx as a possible barrier against postharvest fungal pathogens was assessed in a "Mollar de Elche" pomegranate organic orchard. Compared to no-cocoon fruit (control), the incidence of infected stamens and internal molds in those with spiderwebs was reduced by about 30%, and the mean severity of internal rots was halved. Spiderwebs analyzed via Scanning Electron Microscopy (SEM) disclosed a layered, unordered structure that did not allow for the passage of fungal spores due to its mean mesh size (1 to 20 µm ca). The aims of this research were (i) to evaluate alternative compounds useful to control postharvest pomegranate decays and (ii) to evaluate the effectiveness of spiders in reducing postharvest fungal infections by analyzing related mechanisms of action. Alternative control means proposed in the present work and calyx spider colonization may be helpful to reduce postharvest pomegranate diseases, yield losses, and waste production in an integrated control strategy, satisfying organic agriculture and the planned goals of Zero Hunger Challenge launched by the United Nations.

Keywords: Arachnida, biostimulants, *Punica granatum*, black heart, diseases, gray mold, fungicide, fungistatic, spiderweb, microorganisms

Mincuzzi A., Picciotti U., Sanzani S.M., Garganese F., Palou L., Addante R., Ragni M., Ippolito A., 2023. Postharvest diseases of pomegranate: alternative control means and a spiderweb effect. *Journal of Fungi*, 9, 808. https://doi.org/10.3390/jof9080808

P14

Postharvest rot of pomegranate fruit in Southern Italy: characterization of the main pathogens

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Pomegranate (*Punica granatum* L.) is an emerging crop in Italy and particularly in southern regions, such as Apulia, Basilicata, and Sicily, due to favorable climatic conditions. The crop is affected by several pathogenic fungi, primarily in the field, but also during postharvest phases. The most important postharvest fungal diseases in pomegranate are gray and blue molds, black heart and black spot, anthracnose, dry rot, and various soft rots. The limited number of fungicides allowed for treatment in the field and the lack of postharvest fungicides make it difficult to control latent, quiescent, and incipient fungal infections. Symptomatic pomegranates from southern Italy were sampled and isolated fungi were morphologically and molecularly characterized. The data obtained revealed that various species of Penicillium sensu lato (including *Talaromyces* genus), *Alternaria* spp., *Coniella granati*, and *Botrytis cinerea* were the main etiological agents of postharvest pomegranate fruit diseases; other relevant pathogens, although less represented, were ascribable to *Aspergillus* sect. *Niger*, *Colletotrichum acutatum* sensu stricto, and *Cytospora punicae*. About two thirds of the isolated pathogens were responsible for latent infections. The results obtained may be useful in planning phytosanitary control strategies from the field to storage, so as to reduce yield losses.

Keywords: *Alternaria*, *Cytospora*, *Colletotrichum*, *Coniella*, *Botrytis* postharvest diseases, *Punica granatum*, Talaromyces

Mincuzzi A., Sanzani S.M., Palou L., Ragni M., Ippolito A., 2022. Postharvest rot of pomegranate fruit in southern Italy: characterization of the main pathogens. *Journal of Fungi*, 8, 475. https://doi.org/10.3390/jof8050475

P15

Characterization of *Alternaria* species associated with heart rot of pomegranate fruit

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This study was aimed at identifying Alternaria species associated with heart rot disease of pomegranate fruit in southern Italy and characterizing their mycotoxigenic profile. A total of 42 *Alternaria* isolates were characterized. They were obtained from pomegranate fruit with symptoms of heart rot sampled in Apulia and Sicily and grouped into six distinct morphotypes based on macro- and microscopic features. According to multigene phylogenetic analysis, including internal transcribed spacer (ITS), translation elongation factor 1-(EF-1), glyceraldehyde-3-phosphate dehydrogenase (GAPDH) and a SCAR marker (OPA10-2), 38 isolates of morphotypes 1 to 5 were identified as *Alternaria alternata*, while isolates of morphotype 6, all from Sicily, clustered within the *Alternaria arborescens* species complex. In particular, isolates of morphotype 1, the most numerous, clustered with the ex-type isolate of *A. alternata*, proving to belong to *A. alternata*. No difference in pathogenicity on pomegranate fruits was found between isolates of *A. alternata* and *A. arborescens* and among *A. alternata* isolates of different morphotypes. The toxigenic profile of isolates varied greatly: in vitro, all 42 isolates produced tenuazonic acid and most of them other mycotoxins, including alternariol, alternariol monomethyl ether, altenuene and tentoxin.

Keywords: *Alternaria alternata*, *Alternaria arborescens*, four-gene phylogeny, morphotypes, mycotoxins

Aloi F., Riolo M., Sanzani S.M., Mincuzzi A., Ippolito A., Siciliano I., Pane A., Gullino M.L., Cacciola S.O., 2021. Characterization of *Alternaria* species associated with heart rot of pomegranate fruit. *J. Fungi*, 7, 172. https://doi.org/10.3390/jof7030172

P16

Antifungal activity of thirty essential oils to control pathogenic fungi of postharvest decay

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Essential oils (EOs) extracted from aromatic or medicinal plants are biodegradable, safe, and regarded as alternatives to chemical pesticides to reduce fungal species attacking different crops. In this study, thirty EOs at 0.5 mg/mL were evaluated for in vitro growth inhibition of the main postharvest fungi, which are *Alternaria alternata*, Botrytis cinerea, and Penicillium italicum. *Cinnamomum verrum* EO completely inhibited the mycelial growth of *A. alternata* and *B. cinerea*, and *Syzygium aromaticum* EO completely inhibited the mycelia of *A. alternata*. B. cinerea mycelial growth was completely inhibited by *Gautheria fragrantissima*, *Cymbopogon nardus*, Pelargonium asperum, and Cupressus sempervirens EOs. *G. fragrantissima* EO inhibited the mycelia growth of *P. italicum* by 98%. Overall, B. cinerea displayed the highest sensitivity to EOs than *P. italicum* and *A. alternata*. *G. fragrantissima*, *C. sempervirens, C. nardus*, *P. asperum*, *Mentha piperita*, *Foeniculum vulgare*, *C. verrum*, and *S. aromaticum* EOs showed the highest inhibition for these three pathogens. Minimum inhibitory concentrations were lower for *C. verrum* and *S. aromaticum* EOs, ranging between 0.31 and 0.45 mg/mL and 0.37 to 0.57 mg/mL, respectively, against the three pathogens. The tested EOs inhibited the in vitro growth of three of the main postharvest fungal pathogens. Further studies are needed to confirm these activities *in vivo*.

Keywords: Blue mold, essential oils, fruits, gray mold, shelf life

Allagui M.B., Moumni M., Romanazzi G., 2023. Antifungal activity of thirty essential oils to control pathogenic fungi of postharvest decay. *Antibiotics*, 13(1), 28. https://doi.org/10.3390/antibiotics13010028

P17

Screening and evaluation of antagonistic yeasts to control postharvest rots of strawberries

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Strawberries are highly perishable fruits and decay reduction is a major challenge during their storage. In this study, we selected some antagonistic yeasts by evaluating their efficacy in the control of postharvest rots of strawberries. The effect of the treatments on the fruit quality and microbiome was also assessed. In vivo screening trials were performed using yeasts taken from the collection of the University of Turin and using endophytes isolated from healthy strawberries. The most effective strains, belonging to the species *Metschnikowia pulcherrima* and *Aureobasidium pullulans*, were selected to be tested in efficacy trials. Both at the end of storage and after shelf-life, all treatments showed a significant reduction in rot incidence and severity compared to the untreated control. Moreover, results were comparable to those obtained for the control treated with the commercial product Noli (Koppert, *M. fructicola*). All treatments did not significantly affect the fruit quality. Microbiome sampling was performed after storage, and the results will provide information about the shift in the fungal community in response to the treatment application. Findings of this work provide new insights for the development of sustainable strategies for postharvest disease management and reduction of production losses.

Keywords: Antagonism, biocontrol agents, fruit, *Fragaria* x *ananassa*

P18

Efficacy of essential oil vapours in reducing postharvest rots of nectarines and effect on the fruit microbiome

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Essential oils (EOs) could be a promising alternative to synthetic fungicides to reduce postharvest decay. This work investigated the effectiveness of EO biofumigation using slow-release diffusers to control storage rots of nectarines, while also evaluating their effect on the fruit quality and microbiome. An in vivo screening trial was performed by treating nectarines, inoculated with *Monilinia fructicola*, with basil, fennel, lemon, oregano and thyme EOs. Fennel, lemon and basil EO showed the greatest inhibition activity after storage and were selected to be tested in efficacy trials using naturally contaminated nectarines. All treatments showed a significant rot reduction compared with the untreated control after 28 days of storage. Moreover, no evident phytotoxic effects were observed. EO vapours did not affect the overall fruit quality but showed a positive effect in reducing firmness loss. To determine the main compounds that might be responsible for antifungal activity, EO composition was analysed using GC-MS. Microbiome analysis showed that the abundance of some fungal genera was modified. Treatments were able to reduce the abundance of *Monilinia* spp., however basil EO seems to favour the presence of *Penicillium* spp. during shelf-life. Results provide new insights for the development of sustainable strategies for postharvest disease management.

Keywords: Biofumigation, metabarcoding, prunus persica, stone fruit

P19

Antifungal hydroxypropyl methylcellulose (HPMC)-lipid composite edible coatings and modified atmosphere packaging (MAP) to reduce postharvest decay and improve storability of 'Mollar de Elche' pomegranates

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Pomegranate exhibits important postharvest quality losses that limit its storage potential, caused mainly by weight loss, chilling injury and fungal diseases. In this work, we evaluated the effect of novel hydroxypropyl methylcellulose (HPMC) edible coatings (ECs) formulated with three different lipids (beeswax (BW), carnauba wax, and glycerol monostearate), as hydrophobic components, and two different GRAS salts (potassium bicarbonate (PBC) and sodium benzoate (SB)), as antifungal ingredients, to control weight loss and natural fungal decay of 'Mollar de Elche' pomegranates during storage at 20 °C. Afterwards, selected antifungal ECs and commercial modified atmosphere packaging (MAP) films were assayed alone or in combination to control natural decay and preserve fruit quality of pomegranates stored at 5 °C for 4 months plus 1 week at 20 °C. Results showed that ECs amended with SB reduced pomegranate latent infections caused by *Botrytis cinerea* and wound diseases caused by *Penicillium* spp. Moreover, MAP technologies were confirmed as an efficient mean to preserve freshness, prevent fruit shriveling and rind browning, and reduce fungal decay, thus extending storage life of pomegranates. The combination HPMC-BW-SB + MAP was the most promising treatment as it reduced weight loss and decay, without negatively affecting the fruit physicochemical and sensory quality.

Keywords: GRAS salts, fruit quality, non-polluting postharvest decay control, cold storage

Di Millo B., Martínez-Blay V., Pérez-Gago M.B., Argente-Sanchis M., Grimal A., Baraldi E., Palou L., 2021. Antifungal hydroxypropyl methylcellulose (HPMC)-lipid composite edible coatings and modified atmosphere packaging (MAP) to reduce postharvest decay and improve storability of 'Mollar De Elche' pomegranates. *Coatings*, 11(3), 308. https://doi.org/10.3390/coatings11030308

P20

Natural pectin-based edible composite coatings with antifungal properties to control green mold and reduce losses of 'Valencia' oranges

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Novel pectin-based, antifungal, edible coatings (ECs) were formulated by the addition of natural extracts or essential oils (EOs), and their ability to control green mold (GM), caused by *Penicillium digitatum*, and preserve postharvest quality of 'Valencia' oranges was evaluated. *Satureja montana, Cinnamomum zeylanicum* (CN), *Commiphora myrrha* (MY) EOs, eugenol (EU), geraniol (GE), vanillin, and propolis extract were selected as the most effective antifungal agents against *P. digitatum* in in vitro assays. Pectin-beeswax edible coatings amended with these antifungals were applied to artificially inoculated oranges to evaluate GM control. ECs containing GE (2 g/kg), EU (4 and 8 g/kg), and MY EO (15 g/kg) reduced disease incidence by up to 58% after 8 days of incubation at 20 °C, while CN (8 g/kg) effectively reduced disease severity. Moreover, ECs formulated with EU (8 g/kg) and GE (2 g/kg) were the most effective on artificially inoculated cold-stored oranges, with GM incidence reductions of 56 and 48% after 4 weeks at 5 °C. Furthermore, ECs containing EU and MY reduced weight loss and maintained sensory and physicochemical quality after 8 weeks at 5 °C followed by 7 days at 20 °C. Overall, ECs with EU were the most promising and could be a good natural, safe, and eco-friendly commercial treatment for preserving orange postharvest quality.

Keywords: *Penicillium digitatum*, citrus, essential oils, natural extracts, edible coatings, postharvest decay

Alvarez M.V., Palou L., Taberner V., Fernández-Catalán A., Argente-Sanchis M., Pitta E., Pérez-Gago M.B., 2022. Natural pectin-based edible composite coatings with antifungal properties to control green mold and reduce losses of 'Valencia' oranges. *Foods,* 11(8), 1083. https://doi.org/10.3390/foods11081083

P21

Hydroxypropyl methylcellulose and gum arabic composite edible coatings amended with geraniol to control postharvest brown rot and maintain quality of cold-stored plums

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In this study, the effect of hydroxypropyl methylcellulose (HPMC) and gum Arabic (GA) edible coatings amended with 0.2% geraniol (GE) were evaluated for the control of brown rot, caused by *Monilinia fructicola*, on artificially inoculated plums (*Prunus salicina* Lindl., cv. Angeleno) stored for 5 weeks at 1 °C. Brown rot is the most important pre- and postharvest fungal disease of stone fruits, causing severe economic losses worldwide. Geraniol is an important constituent of many essential oils that can be obtained as a byproduct from different industrial procedures, such as those of the juice industry. Fruit postharvest quality was also evaluated after 5 and 8 weeks of storage at 1 °C, followed by 3 days at 7 °C plus 5 days at 20 °C, simulating packinghouse, transport, and retail shelf-life conditions, respectively. HPMC coatings containing 0.2% GE reduced the incidence and severity of brown rot by 37.5 and 64.8%, respectively, compared to uncoated fruit after 5 weeks of storage at 1 °C. HPMC-coated plums, with and without GE, showed the highest level of firmness, the lowest change in external peel color parameters (L*, a*, b*, C*, hue), and the lowest flesh bleeding compared to uncoated control and GA-coated samples throughout the entire storage period, which correlated with a higher gas barrier of these coatings without negatively affecting sensory quality. Furthermore, the HPMC-0.2% GE coating provided the highest gloss to coated plums, showing the potential of this coating as a safe and environmentally friendly alternative to conventional fungicides and waxes for brown rot control and quality maintenance of cold-stored plums.

Keywords: Stone fruit, *Monilinia fructicola*, postharvest quality, antifungal edible coatings, cold storage

Asgarian Z.S., Palou L., Souza R.F.L.D., Quintanilla P.G., Taberner V., Karimi R., Pérez-Gago M.B., 2023. Hydroxypropyl methylcellulose and gum arabic composite edible coatings amended with geraniol to control postharvest brown rot and maintain quality of cold-stored plums. *Foods*, 12(15), 2978. https://doi.org/10.3390/foods12152978

Sustainable Network for agrifood loss and waste prevention, management, quantification and valorisation

FoodWaStop CA22134

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Abstracts

ORAL PRESENTATIONS

COST FoodWaStop

WG1. PREVENTION OF FOOD LOSS AND FOOD WASTE

Moderators:

GEORGE KARAOGLANIDIS, *Faculty of Agriculture, Forestry and Natural Environment Aristotle University Campus, Greece*

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Improving shelf-life while ensuring fruit quality using gene editing

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Fresh fruit losses in the supply chain vary between 25-50%, depending on the production area and postharvest technologies. Finding alternative ways to extend fruit shelf-life without reducing the quality is critical to ensure the accessibility and likeability of this commodity worldwide. In the case of tomatoes, fruit firmness is a significant factor in determining their shelf-life potential. We simultaneously knocked out two pectin-degrading enzymes, polygalacturonase (SlPG) and pectate lyase (SlPL), which are essential for tomato fruit softening. Our study revealed that the enzymes SlPG2a and SlPL act additively and significantly impact shelf-life. Additionally, fruit quality traits such as sugar: acid ratio, aroma volatiles, and skin color were either improved or not affected in the double CRISPR knockout PGPL when compared to the wild-type. Our research provides new insights into the influence of pectin backbone degradation on fruit physiology and postharvest quality, which can be used for crop improvement. Overall, we demonstrate the use of gene editing to extend fruit shelf-life and positively impact quality, which can significantly reduce tomato fruit losses and meet consumer expectations.

Keywords: Fruit texture, fruit aroma, gene editing, pectin, pectate lyase, polygalacturonase, postharvest quality, shelf-life

Fungal trunk diseases: a global threat to grapevine health

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One of the primary concerns of the grapevine nursery industry is a broad range of taxonomically unrelated pathogens associated with grapevine trunk diseases (GTDs), for which there are no effective remedies once planting material is infected. Due to the rapid expansion of wine regions, GTDs are escalating, as pathogens can be introduced during propagation, and diseases are often associated with poor planting practices and stress. Production practices in nurseries provide many opportunities for infection, through poor sanitation practices or introducing infected asymptomatic cuttings from mother vines. Control in nurseries is limited to hot water treatment and fungicide (biological or chemical) dips, with mixed results. In mature vineyards, the prevalence of GTDs has significantly increased with changes in production practices, loss of effective chemicals, predominance of susceptible cultivars and ageing of vineyards. Pruning wounds are the main infection portal for these pathogens and inoculum sources include a wide range of alternative hosts. Successful disease management requires a holistic approach from the nursery to the vineyard. In this presentation, I will provide an overview of how to approach the sustainable management of these diseases considering the restrictions on chemical use and the effectiveness of alternative control strategies.

Keywords: Disease management, fungi, pathogen, sustainable control, *Vitis vinifera*

Strategies studied for an ecofriendly management of grapevine trunk diseases

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Grapevine trunk diseases (GTDs) including *Botryosphaeria* dieback are a threat for global viticulture, inducing losses of the yield and affecting the perennity of vineyard. Both grapevine nurseries and established vineyards are susceptible to infections by *Botryosphaeria* pathogens due to several cuts and wounds during propagation process and grapevine pruning, respectively. In the last 10 years, ecofriendly strategies including biocontrol and the use of natural Plant Protection Products (PPPs) are developed as alternatives to better cope with environmental concerns. In that way, the efficacy of *Bacillus subtilis* as biocontrol agent has been evaluated and results have been promising for the sustainable management of GTDs in the short term, through complementary ways of protection. The induced resistance could therefore result from a direct antagonistic effect of *B. subtilis* on some GTD pathogens and/or indirect induction of plant defenses. Similar ways of protection have also been obtained with innovative PPPs such as LC2017, composed of 3.5% copper with the amphiphilic carrier hydroxyapatite and plant extracts. In a second time, both *B. subtilis* and the natural product were evaluated in combination with a commercialized BCA, *Trichoderma atroviride*. Altogether, the interesting outputs will be discussed in terms of GTD protection, either fungicide/ fungistatic effect, or elicitors of the grapevine immune responses.

Keywords: Control strategies, *Botryosphaeria* dieback, nursery, pathogen aggressiveness, plant immunity, vineyard

Endophytic *Trichoderma* strains increase preharvest quantity and quality of grapes

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Sustainable preharvest strategies improve product qualities, and they result in the reduction of pre- and postharvest loss. *Trichoderma* strains have been described to be effective biocontrol agents as well as plant biostimulants. Moreover, the application of endophytic strains provide sustained effect with reduced environmental risk. Here we report on endophytic *Trichoderma* strains isolated from healthy plants in Hungarian vineyard with serious grapevine trunk disease symptoms. They were identified as *Trichoderma gamsii*, *T. orientale*, *T. simmonsii*, *T. afroharzianum*, *T. atrobrunneum* and *T. harzianum* sensu stricto on the basis of their ITS1 and ITS2 and tef1 sequences. The growth potential of the strains was assessed at different temperatures. Strains with best growth characteristics and biocontrol potential were also tested in commercial vineyards. Both plant growth and harvested grape quantity and quality increased for several years after the treatment, reflecting usefulness of the endophytic *Trichoderma* strains in sustainable agriculture in general and integrated plant production in particular.

Keywords: Grape, IPM, sustainable pathogen control, *Trichoderma*

The use of multilayer chitosan/furcellaran mini/nanoemulsions with oregano essential oil for preservation of perishable food products

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The work presents the possibility of using edible coatings in the form of multilayer chitosan/furcellaran emulsions with oregano essential oil, applied through electrospraying as possible means for preservation of perishable food products. The coatings have shown to effectively reduce the microbiological counts during cold storage of fresh pork loin, Atlantic mackerel as well as salmon sushi. Moreover, the coatings also significantly improved the sensory scores of the product during storage and even showed antiretrogradation properties in stored sushi samples. The shelf-life extension was in the range of 8-9 days depending on the type of product. Therefore, the use such coatings could effectively improve the stability of perishable foods and thus reduce the amount of food loss.

Keywords: Edible coatings, chitosan, fish, meat, microbiology, multilayer emulsions, sushi

Antifungal activity of Apulian macroalgal extracts

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Pomegranate (*Punica granatum* L.) yield and economic losses are mainly caused by postharvest fungal pathogens. Main pathogens belong to *Alternaria*, *Coniella*, *Colletotrichum*, *Aspergillus*, and *Penicillium* genera against which in integrated and organic agriculture few control means are allowed. Therefore, great interest is devoted to the search for eco-friendly alternative antifungal compounds. Seaweeds, especially Rhodophyta and Ochrophyta-*Phaeophyceae*, are rich in bioactive compounds, like polyphenols, and already known as fertilizers and biostimulants. Often these are produced by oceanic genera (i.e. *Sargassum* and *Ascophyllum*) but our research focused on easily available Mediterranean macroalgae. Tested species were *Halopithys incurva* and *Laurenciella marilzae* within Rhodophyta division and *Codium vermilara* among green ones. Algal extracts were assessed for total polyphenolic amount and then tested for antifungal properties by microspectrophotometric assay. Potatoes dextrose broth was enriched in seaweed-extracts and inoculated with *Alternaria alternata*, *Coniella granati*, *Colletotrichum acutatum* sensu stricto, *Aspergillus welwitschiae*, and *Penicillium glabrum*. Fungal growth was measured at different time-point. Polyphenolic amount in the three species ranged between 3 and 57 g/mL of gallic acid equivalents. Except for *P. glabrum* at the tested concentration whole algal extracts completely suppressed conidial development. Results suggest that growth inhibition may be related to qualitative features rather than quantitative ones.

Keywords: Pomegranate, postharvest diseases, seaweeds, algae, seaweeds extract, antifungal activity, polyphenols, alternative control, in vitro trial

How can agroecology contribute to the reduction of food waste and loss?

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The current agricultural and food sectors, ranging from fertilizer manufacture to food packaging, are responsible for up to one-third of all human-caused greenhouse-gas emissions globally. These impacts are made worse by the fact that food loss and food waste reach about 20% of the food produced in the EU, which go hand in hand with the waste of resources such as land, water, and nutrients used to produce this wasted food. Agroecology is defined as the science of the relationships of organisms in an environment transformed by man for crop or livestock production. The scale of the application of agroecology has evolved from the field, to an agro-ecosystem, to finally food systems. The development of agroecology is strongly important, due to the interest in producing food through sustainable and regenerative systems, using resources more effectively, and minimizing negative environmental impacts. A sustainable food system is a food system that delivers food security and nutrition for all people in such a way that the economic, social, and environmental basis to generate food security and nutrition for future generations is not compromised. To accelerate the shift towards food security and nutrition, a new science of sustainable food systems is needed as well as practical changes in all processes and interactions involved in global food production. Agroecological systems use natural resources more sustainably and efficiently, and reduce the release of agrochemicals into air, water, and soil. Through the enhanced proximity between producers and consumers, agroecology helps raise awareness and reduce food waste, by redistribution to food bank charities, repurposing urban organic waste as animal feed or fertilizer, and promoting local markets where aesthetic standards and over-buy by consumers are not followed.

Short food supply chains as drivers of sustainability in rural areas

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Current food systems face major challenges in terms of sustainable development in social, economic and environmental dimensions. These challenges are related to the long-standing industrialization of agricultural production processes, the food industry and the associated longer and more transparent supply chains. The article was written in response to the question of the existence of short food supply chains (SFSCs) in Bulgaria and their contribution to sustainable rural development. Cases and interviews were conducted with farm owners as representatives of the SFSCs in the country. A description of the case of SFSC in an organic farm in Bulgaria - Sofina farm is presented. Various survey methods have been applied, including primary data collection, case study approaches, interviews with farm managers, as well as desktop research. The conclusions we draw from the study relate to future policies that need to be followed to improve the sustainability of rural areas, which must undoubtedly take into account regional differences between actors in supply chains, different types and organizational forms of SFSCs, as well as the requirements of consumers regarding the delivered food.

Keywords: Bulgaria, organic farms, rural area, Short Food Supply Chains (SFSCs), sustainable development

WG2. Agrofood loss and waste management

Moderators:

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Abstracts oral presentation of WG2. Agrofood loss and waste management

Antifungal edible coatings for postharvest disease control and quality maintenance of fresh fruits

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Alternatives to synthetic chemical fungicides are needed to reduce postharvest losses of fresh fruit caused by fungal pathogens. Among them, the development of edible coatings with antifungal activity is a technological challenge and a very active research field worldwide. The main advantage of these coatings is that they could provide a single solution for both physiological and pathological major postharvest issues. While some natural coatings such as chitosan or Aloe spp. gels show inherent antifungal activity, specific food-grade antifungal ingredients should be incorporated into composite matrixes of hydrocolloids (polysaccharides such as cellulose derivatives, alginates, pectins, gums, and peptides or proteins) and lipids to form synthetic edible coatings with antifungal properties. These ingredients include natural or low-toxicity compounds, such as inorganic or organic salts (e.g., carbonates, sorbates, benzoates, paraben salts) and essential oils or other plant extracts approved as food additives or generally recognized as safe (GRAS) compounds by competent authorities, and biological control agents such as antagonistic strains of some microorganisms.

Keywords: Alternatives to fungicides, composite edible coatings, GRAS compounds, postharvest disease control

Efficacy of wild *Aureobasidium pullulans* VOCs and application methods vs strawberry fungal pathogens

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Biological control agents (BCAs) have an environmentally friendly nature that makes them valuable for sustainable and eco-friendly postharvest disease management. This study evaluated the antagonistic potential of epiphytic yeasts isolated from local and wild fruits in Turkey. 375 yeast isolates were screened *in vitro* and *in vivo* and 32 were selected for molecular characterization (ITS and EF1α). The isolates were identified as *Aureobasidium pullulans* and their volatile organic compounds (VOCs) were used to control strawberry rots caused by *Botrytis cinerea* and *Colletotrichum acutatum.* Two different methods of application of VOCs were used: as first an agar medium as second hydrogel spheres. VOCs on both media were analyzed by SPME-GC-MS. Differences on the absolute area and number of VOCs were detected. Hydrogel spheres stimulated the production of VOCs, in particular alcohols, ketones, and alkanes. Spheres were used in *in vivo* assays, fruits were previously spray-inoculated with the two pathogens conidial suspensions (1×10^5 conidia mL^{-1}) and suddenly fumigated with yeasts volatiles. Results showed how BCAs application by hydrogel spheres can greatly reduce fungal incidence on fruit. Regarding wild yeasts, however, compared to BCAs isolated from 'domesticated' plants, seemed to produce a less complex volatilome.

Keywords: Biocontrol agents, biofumigation, metabolites, postharvest

Efficacy of antagonistic yeasts to control brown rot of nectarines and effect on the fruit microbiome

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Brown rot is one of the most important diseases affecting stone fruit. In this work, we selected some antagonistic yeasts by evaluating their efficacy to control brown rot caused by *Monilinia fructicola* on stored nectarines. Moreover, the effect of the treatments on the fruit quality and microbiome was assessed. A screening trial was set up by treating inoculated fruits with 14 yeast strains. The most effective (MS, *Metschnikowia pulcherrima*, AP47 *Metschnikowia fructicola*, FR4A, *Aureobasidium pullulans*) were subsequently tested in a semi-commercial trial. All treatments showed a significant rot reduction after storage and shelf-life. Moreover, at the end of the storage the efficacy of MS strain was comparable to that of the chemical treatment, making the antagonist as competitive as fungicides. All the tested BCAs did not affect fruit firmness, total soluble solids and titratable acidity. Microbiome analysis showed a good proliferation of the yeasts on the treated fruit both at epiphytic and endophytic level, together with a reduction of *Monilinia* spp. Moreover, the abundance of some other fungal genera was found to be modified. Results obtained showed that treatments with antagonistic yeasts represents a promising tool for disease management, while maintaining fruit quality.

Keywords: Biocontrol agents, metabarcoding, *Prunus persica*, postharvest

The potential of smoke solutions from vineyard pruning wastes to mitigate heavy metal toxicity in grapevine saplings

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Cadmium (Cd) pollution in soil poses serious threats to sustainable agriculture and human health. In the last two decades, smoke solutions (SS) produced from organic wastes of plant origin as an organic, environmentally friendly and low-cost production input have attracted attention for their growth promoting and abiotic stress alleviating properties. In this study, the potential of different concentrations of SS obtained from vineyard pruning wastes to alleviate Cd phytotoxicity in grafted grapevine seedlings was evaluated. For this purpose, smoke solutions were applied to the entire green surface of grapevine seedlings under Cd stress by pulverisation method. The results showed that Cd phytotoxicity adversely affects growth, physiological and biochemical processes in grapevine seedlings; on the other hand, SS applications have the ability to alleviate Cd phytotoxicity in grapevine seedlings by modulating antioxidative defence mechanisms and can be an economical solution that can ensure the continuity of the production process in viticulture activities. At the same time, it is thought that SS applications can be used to add value to the wastes of many different plant species with a wide production area, especially grapevine, and thus contribute to waste management, which is adopted as a priority policy goal in the world.

Keywords: Biostimulant, grapevine, smoke solution, vineyard pruning waste, waste management

Cold storage may elongate the fresh consumption period of sour cherry (*Prunus cerasus* L.)

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Europe is one of the largest sour cherry (*Prunus cerasus* L.) producers and it is the second most widely grown fruit in Hungary. Sour cherry has exceptional nutritional content, but its fresh consumption period is very short from June to July. In order to extend the fresh consumption period, in addition to the introduction of new cultivars with different ripening times, it is also necessary to develop new storage and packaging methods. The storage potential of three Hungarian sour cherry cultivars ('Érdi bőtermő', 'Petri', and 'Újfehértói fürtös') was studied. Six weeks cold storage at 0-2 °C with modified atmosphere packaging (MAP) and normal atmosphere (NA) was compared. 'Újfehértói fürtös' (also known as 'Balaton™') had the best cold storage potential. MAP storage had a positive affect for the proportion of intact fruit and fruit firmness. These results may contribute to the development a suitable postharvest storage method for sour cherry.

Keywords: 'Balaton™', 'Danube™', MAP storage, postharvest, stone fruit, tart cherry

WG3. Quantification of food loss and food waste

Moderators:

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LISE KORSTEN, *University of Pretoria, South Africa*

Abstracts oral presentation of WG3. Quantification of food loss and food waste

Drivers of food loss and waste and the importance of quantification

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Estimates of food loss and waste (FLW) at various stages of crop supply chains exhibit significant inconsistencies, primarily arising from methodological and systemic variations. A dearth of comprehensive evidence regarding the biological factors influencing FLW hampers the implementation of precise mitigation strategies. This talk focuses on the importance of quantification of food loss and waste in each stage of the supply chain with the aim of developing targeted solutions linked with their root cause. Using the United Kingdom as a case study, methods to obtain real-world data will be presented, in order to establish a framework to be implemented in different regions. Also, key drivers linked to this global challenge will be discussed.

Keywords: Decision-making, fresh produce, physiology, global supply chain

Postharvest losses of pepper and tomatoes from small-scale farms in Gauteng province, South Africa

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Bell peppers and tomatoes are crops of significant economic value, contributing over USD 10 billion to global trade annually. Despite their importance, reports indicate that nearly 20-30% of fresh produce is lost before reaching consumers, with small-scale farmers speculated to be facing higher losses due to resource limitations. This study therefore aimed to evaluate postharvest losses of bell pepper and tomato in small-scale production in Gauteng Province. The research involved eight tomato and four bell pepper farms, employing various production systems across three regions in Gauteng Province. Six-kilogram produce boxes were collected in triplicates on harvest day for loss identification and quantification, resulting in the analysis of 63 tomato and 24 bell pepper boxes. Tomato analysis revealed lower losses at the season's start, averaging to 65.6% and ranging from 44.3% to 100%. Notably, open, and semi-closed production systems experienced higher losses between 70% and 100%. Towards the season's end, losses ranged between 59.6% to 100%, averaging to 90%. Primary causes of harvest losses included blotchiness (29.4-50.7%), insects (24.9-44.9%), and mechanical damages (19.3-22.1%). Postharvest losses due to rot-related pathogens were more prominent between days seven and fourteen of storage, particularly for open-field fruits harvested during the rainy period, which exhibited the highest rates of rots (26%) and physiological damages (70%). Bell pepper analysis indicated a 21% loss at harvest, with deformities, moisture loss, and diseases contributing 50%, 20%, and 15% of the total losses, respectively. Storage losses (14 days from harvest) were attributed to moisture/weight loss and rots, with rot-related losses ranging from 13-25% across the four farms. *Fusarium* spp., *Alternaria* spp., and *Colletotrichum* spp. were the main identified postharvest pathogens accounting for 36%, 29%, and 22% of the total rot-related isolates respectively. The study therefore recommends pre and postharvest training for small-scale farmers to enhance their production practices and reduce postharvest losses, ultimately improving their overall production and income.

Keywords: Food security, postharvest loss, pre- and postharvest factors, rot pathogens

Waste Watcher International: an observatory on food and sustainability

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Food waste is recognized as one of the most important global manifestations of the inefficiencies of food systems. The UN Food System Summit 2021 emphasized the multiple impacts of food waste in terms of environmental and economic impacts. Its call for action has been further spotlighted by the UN Framework Convention on Climate Change's 26th Conference of the Parties, which emphasized how climate change responses require the coupling of public interventions with individual actions. Additionally, EUROSTAT estimated that in 2020, approximately 127 kg of food waste was generated per inhabitant in the EU.

A large part of the literature is dedicated to consumers having the responsibility for producing a higher proportion of food waste both in industrialized and non-industrialized countries. As a result, growing attention has been dedicated to the consumption stage, which has been recognized as an essential behavioral issue where multiple inter-related and competing drivers play an influential role.

In this context, the Waste Watcher International Observatory seeks to provide the community with knowledge and tools for investigating social, behavioral, and lifestyles dynamics behind household food waste. By focusing on the economic, social, and environmental impacts of the phenomenon, the Observatory stands to generate common and shared knowledge, to guide individual actions, private strategies, and public policies for food waste prevention and reduction, and improve food resources use efficiency.

Modelling the scenarios of development for Ukraine in the context of EU circular economy using fuzzy set theory

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Circular Economy (CE) is becoming one of the main trends for contemporary economic development, that will help to achieve the Sustainable Development 2030 Agenda, that is rooted in 5 P's: People, Planet, Prosperity, Partnership and Peace. Therefore, the issues related to the modelling of country progress towards CE path need particular attention from governments, scientific community and international organizations. One of the main problems of modern development is the negative result from economic activities of the processes of the natural environment's reproduction. The Scientific Advisory Council of the European Academies is largely focused on solving this problem. At the same time, the key point in the proposed decisions is the need to reassess economic activity based on the circular economy model. This model of the economy will ensure optimal use of material flows and significantly reduce waste. The transition to the principles of circular economy will reduce its destructive impact on the environment. According to statistical data, a hierarchical information model was built within the framework of the defined criteria for evaluating the development of the circular economy of European countries and Ukraine. Based on this model, in the context of a defined system of composite indicators, countries were clustered using the method of fuzzy k-means. For each of studied country the metrics were calculated by Mamdani fuzzy inference models. As a final result, ranking series were built in the context of a defined set of composite indicators, based on which conclusions are drawn for the studied countries on the subject of their transition to the principles of a circular economy.

Keywords: Circular economy, composite indicators, fuzzy modelling, mamdani's conclusion

Food waste quantification in Portuguese meat plants

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Food loss and waste is a problem that affects the world in several aspects: social, economic, and environmental. Results of the identification and quantification of food waste in the meat products sector will be presented. These results were obtained through a face-to-face survey and are part of a larger study on the reduction and recovery of food waste in four sectors of the agrifood industry: meat products, fruit and vegetables, bakery industry and dairy products, with the aim of obtaining a diagnosis of the agrifood sector in Portugal. During the year 2021, surveys were carried out in 11 companies in the meat products sector engaged in various activities: manufacturing meat products, slaughtering animals, packaging, and trading. The shown results refer to the situation of the companies in 2020. The size of the companies surveyed varies greatly, with the number of employees in each company ranging from 4 to 250 and sales. The highest amounts of waste reported occurred in the slaughtering and cutting industry (2.098 tons in 2020). In several cases, there are no available data. There is a greater concern with accounting for waste in companies that have a quality and/or food safety management system certification.

Keywords: Agrifood, food waste quantification, Portuguese meat industry

WG4. Valorisation of agrofood waste and a circular bio-economy

Moderators:

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MARWA MOUMNI, *Marche Polytechnic University, Ancona, Italy*

Abstracts oral presentation of WG4. Valorisation of agrofood waste and a circular bio-economy

The valorisation of agri-food waste for a circular bioeconomy: highlighting policy incoherence through nexus thinking

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The food waste pyramid is a hierarchical structure ranking different options for processing and utilising side-streams and residues according to their perceived sustainability and added value, with prevention considered the most preferred option, followed by reuse, recycling, recovery, and disposal. However, a specific option may encompass several categories, for example the treatment of waste in an anaerobic digester involves both recycling (use of the digestate as fertiliser) and recovery (of energy), and it is important to carefully assess the multiple life cycle impacts for specific options, rather than assuming higher or lower sustainability based on the pyramid categories. The food system is not isolated from other systems, and the cascading use principle of the food waste pyramid has implications for the availability of other resources, such as water and energy. Nexus thinking is a lens for analysing cross-sectoral integration to improve overall resource efficiency. This paper uses nexus thinking to highlight policy incoherence in the European Green Deal, by demonstrating the multifaceted connections and contextualities within which the valorisation of agri-food waste is embedded and suggests how the same lens may be used to identify valorisation pathways that are economically, socially and environmentally sustainable.

Keywords: Nexus thinking, policy, sustainability, valorisation

Magnetically responsive waste biomaterials for environmental technology applications

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Food, agriculture, marine and wood industries are responsible for the production of huge amounts of biological waste materials. In many cases, these materials can be used as efficient biosorbents or low-cost carriers. In order to improve their properties, appropriate modification can be very useful. Diamagnetic biological materials (e.g., prokaryotic and eukaryotic microbial cells, lignocellulose materials, soluble and insoluble biopolymers, macroalgae etc.) can be magnetically modified in order to obtain smart biomaterials exhibiting an appropriate response to external magnetic field. Magnetic modification of originally diamagnetic biological materials is usually based on the attachment of magnetic iron oxides nano- and microparticles on the surface or within the pores of the treated material. Magnetic modification can be performed using different procedures, e.g., by magnetic fluid treatment, mechanochemical synthesis and by direct or indirect microwave assisted synthesis. The most general magnetization procedure employs magnetic iron oxides nano- and microparticles prepared by microwave assisted synthesis from ferrous sulfate. Magnetically responsive biomaterials have been efficiently used as biosorbents for the removal of wide variety of pollutants (e.g., organic dyes, bisphenol A, aniline, heavy metal ions or radionuclides) from contaminated water resources.

Keywords: Biological waste, magnetic modification, magnetic biosorbents, pollutant removal

Application of insect frass for the development of sustainable agriculture production in Kosovo

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The latest innovative agricultural approaches, amongst others, target the transformation of large amounts of agricultural side streams into protein for animal feed and natural fertilizer (insect frass) using insects in a concept of circular bioeconomy. Production and the application of insect frass for chamomile and oregano in organic agriculture will be introduced for the first time in Kosovo. The main objectives are to explore the feasibility of local frass production by evaluating the value chain (sourcing, bio-conversion, application, sales) and the effects of its use on plant growth, yield, and soil health. The frass of the insect *Tenebrio molitor* (L.) - mealworm will be tested, whereas for production, the focus will be on licensing the production of *Hermetia illucens* (L.) - black soldier fly. The study focused on quantifying the impacts of the application of frass to organic crops such as chamomile and oregano in the open field and germination experiment in greenhouse. Definition of application parameters for mealworm frass as guidelines for farmers. Mapping the amount of side streams in agriculture production systems (pepper, watermelon, tomato, potato, apple, pear and cucumber) in Kosovo. Evaluation of the impacts of frass application on soil health. Also, the licensing of the import and rearing of *Hermetia illucens* (L.), and use of its products and byproducts (protein for animal feed and frass). In addition, research on the technical environment to build a bio-conversion unit for experimental production and marketing research will be conducted. This trend opens up new opportunities for sustainable agriculture production and a circular bioeconomy in Kosovo.

Keywords: Agricultural side streams, circular bioeconomy, medical herbs, regenerative agriculture

Biowaste-based pellets as a promising feedstock for biochar production

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Pellets possess higher densities compared to the raw materials from which they are derived, making them convenient feedstocks for continuous pyrolysis reactors. The utilization of pyrolyzed pellets, also known as biochar, greatly hinges on their physical and mechanical properties. These properties serve as vital indicators for assessing the feasibility of transportation, storage, and automation processes. The results of studying ten distinct biowaste pellets reveal a substantial correlation between the bulk density of pellets used in pyrolysis and the resulting bulk density of the biochar produced. Additionally, by quantifying the change in particle densities between the pellets fed into the reactor and the pellet-biochar produced, it becomes possible to accurately estimate the bulk density of the latter. These findings have significant implications, particularly in scenarios where limited data (samples) are available, as they enable the evaluation of transportation and storage costs associated with pyrolyzed pellets (biochar) in both industrial and scientific applications. Furthermore, the introduction of binders into the pelletization process may lead to an increase in the bulk density of the resulting biochar and enhance its resistance to damage during handling and transport. However, the effectiveness of this effect depends on the primary biomass used for pelletization.

Keywords: Agricultural waste, biochar, food waste, pellets, slow pyrolysis

Natural products in the fight against ageing and age-related diseases

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Ageing is a complex molecular process driven by diverse molecular pathways and biochemical events that are promoted by both environmental and genetic factors. Specifically, ageing is defined as a time-dependent decline of functional capacity and stress resistance, associated with increased chance of morbidity and mortality. These effects relate to age-related gradual accumulation of stressors that result in increasingly damaged biomolecules which eventually compromise cellular homeostasis. Nevertheless, the findings that genetic or diet interventions can increase lifespan in evolutionarily diverse organisms indicate that mortality can be postponed. Natural compounds represent an extraordinary inventory of high diversity structural scaffolds that can offer promising candidate chemical entities in the major healthcare challenge of increasing health span and/or delaying ageing. Our basic research in the fields of ageing and age-related diseases (e.g., cancer, neurodegeneration), along with our in vitro, cell-based and in vivo screening experimental platforms and disease models will be presented. Also, novel potential molecular targets for screening natural compounds for anti-ageing activity, as well as the idea that anti-ageing interventions represent a systemic approach that is also effective against age-related diseases will be discussed.

Keywords: Ageing, age-related disease, circular economy, natural product, valorization, waste

Optimization of ultrasound-assisted extraction of cold-pressed pistachio meal proteins

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The production of protein from plant sources is gaining popularity due to its potential to meet the nutritional needs of the increasing world population, respond to different diet preferences, and reduce the negative environmental impact of animal-based production. The residue from the cold pressing process of oilseeds and fruits emerges as an alternative plant protein source. Conventionally, protein extraction from plant tissues is conducted through alkaline extraction and isoelectric precipitation methods. However, the components present in plant tissues, such as cellulose, hemicellulose, and lignin, keep the protein yield low in traditional extraction methods. At this point, environmentally friendly and innovative technologies like ultrasound gain significant attention for effective valorization. Ultrasound can be integrated into extraction processes due to its acoustic cavitation mechanism on plant tissues. The primary objective of this study is to optimize the plant protein production process from the residue of pistachios after cold pressing using the ultrasound-assisted alkaline extraction (UAE) method. For this purpose, the Box-Behnken experimental design was employed to optimize protein extraction for maximal recovery. UAE at optimal conditions increased the protein extraction efficiency by 45% compared to the traditional method. Therefore, the use of UAE for protein extraction from plant by-products containing lignocellulosic components is considered an important strategy for the development of sustainable food production systems.

Keywords: Plant protein, pistachio press meal, ultrasound-assisted extraction, valorization

The pros and cons of upgrading fruits & vegetables wastes in the biorefinery framework

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The worldwide rising demand for fruits and vegetables (F&V) has resulted in an increase of associated industrial waste streams. This is due to the increased consumer demand for these types of products, but also for a change in consumer behaviour that is currently favouring the adoption of processed and packed F&Vs over the unprocessed counterparts, as formerly and traditionally used. Most of these waste materials do not have any significant utilization, being mainly conveyed to waste disposal or low-tech applications such as biogas or pellets production, as it is the case of some of the common food processing wastes, such as salad wastes or Extracted Olive Pomace (EOP) and nut's shells, respectively. Due to their putative large amounts and geographical concentration at industrial sites, the use of these residues as feedstock within the biorefinery framework can be a potentially advantageous alternative for their valorisation, and the comparative advantages of these materials as biorefineries feedstocks are presented and discussed using the Biotechnological Valorization Potential Indicator. Furthermore, this work presents and reviews results from previous projects focused on upgrading Mediterranean food wastes, comparing their upcycling potential within the food industry with their potential upgrade in the biorefinery framework. Despite the F&V wastes' dual potential, careful consideration must be given to the selection of targeted products, aligning them with potential markets and tailoring strategies based on the specific waste material, processing methods, and management conditions.

Keywords: Added-value products, bioenergy production, biomass fractionation processes, fermentation, mediterranean agrifood wastes, oligosaccharides, sweeteners, upcycling

Sustainable packaging solutions based on the circular valorization of agro-industrial by-products

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Globally, approximately one-third of all food produced for human consumption is either lost or wasted. From post-harvest stages to just before retail, around 14% of food is lost, tallying up to 931 million tons in 2019. This suggests that 17% of food globally goes to waste during these stages, not just posing ethical and economic issues but also draining the environment of its limited resources. Among the various factors contributing to this loss, the processing and packaging phase stand out as significant culprits, making intervention at this stage critical. While packaging plays a pivotal role in safeguarding and improving food quality, traditional plastic-based packaging creates concerns due to oil price fluctuations and its environmental impact. Therefore, the quest for bio-based packaging solutions sourced from renewable materials becomes imperative. This work focus on the development of different packaging solutions like films, bags, emitting sachets, absorbent pads, coatings, and rigid trays. These solutions revolve around using biopolymers, primarily derived from agricultural and agri-food residues, embracing a circular approach. Moreover, many of these packaging solutions are designed as active packaging, incorporating natural extracts rich in bioactive compounds sourced from agricultural and agri-food waste. This innovative approach has yielded promising outcomes, such as using nanofibers in small quantities for biopolymer reinforcement, exceptional antioxidant and UV-light barrier capabilities by integrating natural extracts, and the utilization of lignocellulose nanofibers, prolonging the shelf life of packaged meat or fresh cut vegetables.

Keywords: Active packaging, biorefinery, biopolymers, circular economy, valorization

Preparations of multifunctional composites for electromagnetic interference (EMI) shielding applications using tomatoes wastes

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In today's fast-paced digital world, electronic devices have become an unavoidable part of our lives, conducing to increasing EMI, which affect our health badly and as well as the sensitivity of miniature electronics. Therefore, developing highly effective multi-functional EMI shielding materials are of great interest and importance. This technology requires materials having high conductivity, permeability, permittivity, processability, and corrosion resistance while being cost-effective and environmentally friendly. Turkey is among the top ten tomato producing countries in the world and has produced 42% tomatoes alone in 2020 (13,2 million tons-the first place in vegetable agriculture) and naturally have important source of tomato wastes. There is a need to work towards producing value-added products using agricultural wastes since. It is among the priority issues in all the UN and EU strategy documents globally and in the 11th National Development Plan. In this work, Lignocellulosic components will be extracted from tomatoes wastes using Acidic Deep Eutectic Solvents (ADES) and low energy required methods of Microwave (MW), Ultrasound (US) and mechanical methods. MXene preparation-delamination and characterization, Electrospun, hollow MXene containing multi-functional composites will be used to prepare multifunctional EMI shielding materials to protect devices in the whole X-band range (8-12 GHz).

Keywords: Electromagnetic interference (EMI) shielding, lightweight, MXene, lignocellulose, nanofibers, electrospinning

Realisation of sustainable food systems by valorisation of agri-food wastes and by-products in support of circular bioeconomy concepts

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The concepts of circular bioeconomy and valorisation of agri-food wastes/by-products are the two interconnected perceptions that realistically support the Sustainable Developmental Goals of the United Nations (UN-SDGs). Valorisation focuses on eco-friendly conversion technologies (biorefinery approach) for value addition of inevitably occurring agri-food wastes/ by-products to obtain products for food and non-food applications (in cosmeceuticals, pharmaceuticals, bioplastics, etc). Whereas the circular bioeconomy concept is a well-designed economic system revolving around sustainable practices (maximizing the use of renewable biological resources with minimizing the generation of wastes) that need to be adopted in the entire agri-food sector. In the regional context, the combination of valorisation and circular bioeconomy concepts can support sustainable resource management and decrease environmental stress. Within this context, research activities were undertaken under the ERA-Chair in VALORTECH to support local demands. The concealed values of some of the locally generated agri-food wastes/by-products were identified and investigations were undertaken on obtaining various bioactive components and developing novel products of commercial value by application of green technologies. New streams for revenue generation/business opportunities contributing to regional economic growth were also identified. Some of the interesting results generated will be presented by stressing existing gaps and the future scope in this fascinating field.

Keywords: Biorefinery, circular bioeconomy, environmental stress, green technologies, sustainable food systems, waste/by-products valorisation

Assessment of beneficial impacts of plant bioactives on macronutrient digestion by digestion simulation

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A potential way of valorising agrifood waste and by-products is to perform isolation of specific fractions or groups of components from them in order to further use them as food ingredients. Resulting products is used to exploit their perceived or proven health-promoting functions. Evidence based verification of the actual bioactivity of such products is a complex task. A rapid and efficient way to perform preliminary verification of their bioactivity is to study their behaviour in in vitro digestion simulation models. Our research aims the better understanding of the effects of bioactive compounds on the digestion of macronutrients such as proteins, fats and carbohydrates. By inhibiting lipid digestion, it is possible to reduce the amount of bioaccessible fat in the digestive tract and thus its absorption into the bloodstream. Alternatively, extracts containing ingredients that may inhibit carbohydrate digestion, can be used to improve the glycaemic index of foods. Finally, there may be compounds that can enhance the efficiency of protein digestion. In addition, the digestion simulation process we use and the associated analytical methods can be used to rapidly and efficiently assess the nutritional value of proteins, even those extracted from agricultural by-products.

Keywords: Bioactives, digestion simulation, macronutrients

WG5. Cross-cutting strategies and smart systems for food management

Moderators:

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ZEYNEP ZERRIN TURGAY, *MIGROS, Turkey*

Abstracts oral presentation of WG5. Cross-cutting strategies and smart systems for food management

Prevention of food waste in retail industry

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Food waste and loss is a global consequence of the climate crisis especially affecting the lower income countries whose hunger rate is higher than 5% as reported by Global Hunger Index (GHI). Albite, one of the immediate remedies for improving food security is food banks, countries shall improve food availability and food quality parameters for achieving a long-term food security. In this paper we present effective mechanisms that can be employed by grocery retail chains for reduction of food waste while generating a positive impact for agricultural ecosystem. These mechanisms cover a wide range of systemic instruments including contracted agriculture, controlled and monitored logistic conditions and big data studies to enhance food safety and quality and improve the food waste consequently. We also provide a case study for a new state-of-the-art dynamic pricing based on quantitative microbiology for effective waste management.

Keywords: Dynamic pricing, food security, food availability, food safety and quality, systemic innovation

Induced resistance in fruit and vegetables: the physiological effect

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Harvested fruit and vegetables are perishable, subject to desiccation, show increased respiration during ripening, and are colonized by postharvest fungal pathogens. Induced resistance is a strategy to control diseases by eliciting biochemical processes in fruits and vegetables. This is accomplished by modulating the progress of ripening and senescence, which maintains the produce in a state of heightened resistance to decay-causing fungi. Utilization of induced resistance to protect produce has been improved by scientific tools that better characterize physiological changes in plants. Induced resistance slows the decline of innate immunity after harvest and increases the production of defensive responses that directly inhibit plant pathogens. This increase in defense response in fruits and vegetables contributes to higher amounts of phenols and antioxidant compounds, improving both the quality and appearance of the produce. This review summarizes mechanisms and treatments that induce resistance in harvested fruits and vegetables to suppress fungal colonization. Moreover, it highlights the importance of host maturity and stage of ripening as limiting conditions for the improved expression of induced-resistance processes.

Keywords: Induce resistance, fruits and vegetables, physiological effect

Food loss and waste in central markets in Colombia perspectives from a comparative study

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Food Loss and Waste (FL&W) in central markets worldwide pose a critical challenge, contributing not only to societal inequities but also exerting profound implications on food security and public health. FL&W may have a negative impact on sustainability, environmental health, and overall well-being. This study conducts an exploratory analysis of FL&W in a low-middle-income country (LMIC) context, focusing on Colombia. Central markets in Colombia play a central role in the supply chain, serving as primary providers for food processing companies, local businesses, and major public sector entities, including healthcare facilities and educational institutions. The ensuing presentation offers a comparative examination of FL&W practices in central markets across Colombia. By investigating central markets in key Colombian cities and scrutinizing market dimensions and supply chain dynamics, the research aims to improve the efficiency of food distribution, ultimately expanding outreach to vulnerable communities nationwide. The presentation pinpoints challenges, obstacles, and prevailing practices within an LMIC, with a specific emphasis on mitigating FL&W. Additionally, this work provides insights into the future trajectory of central markets in Colombia.

Deep learning algorithms for freshness assessment of fruits and vegetables

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According to the 2021 report of the UN FAO half of fruits and vegetables (F&V) produced on the planet were wasted. In 2022, the UNEP Food Waste Index Report stated that food waste is responsible for 8%-10% of global greenhouse gas emissions, and target 12.3 of the SDGs aims to halve food waste at the retail and consumer level, by 2030. That is, the issue of food waste must be tackled ASAP, by different partners and countries. To date, humans are mainly involved in the assessment of the level of freshness of F&V by scanning every item. This procedure is time-consuming and inefficient. Automatic systems for grading the level of freshness of F&V would be more effective because they work 24/7. Improved classification algorithms capable of recognizing the freshness level of F&V could be implemented in several automated systems, ranging from smart containers to intelligent fridges, that signal the level of freshness of F&V to the users. This research challenges the FruitVeg Freshness database, as it is the only collection of pictures with F&V having 3-classes of freshness values, i.e. fresh, medium, and rotten. State-of-the-art computer vision and deep learning algorithms are tested, and their performance is compared in exhaustive experiments.

Keywords: Artificial Intelligence, classification, deep learning, degree of freshness, fruit, vegetable

WG6. Networking and dissemination, communication and transfer of knowledge

Moderators:

KATA LUDMAN-MIHÁLY, *FruitVeB Hungarian Interprofessional Organization for Fruit and Vegetable, Hungary*

LUCA FALASCONI, *University of Bologna and Last Minute Market impresa sociale, Italy*

Oral presentation of WG6. Networking and dissemination, communication and transfer of knowledge

Communicative side of food loss and waste management

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The aim of this presentation is to draw the attention to the communicative side of food loss and waste management. The author wants to show the role of effective communication in sustainable nutrition. Communication is understood in the broad way, by taking into account both literal and symbolic dialogue as well as verbal and nonverbal communication. Apart from the broad theoretical discussion, the paper focuses on the research part which encompasses different written and spoken materials, such as, among others, interviews, brochures, leaflets, social media, and press articles. Regarding the language of research materials, the examples are taken form Polish, English, German and Italian to show differences and similarities in addressing diversified stakeholders in different countries. The author wants to discuss how effective communication may change the behaviour of various users and may lead to the proper treatment of food in the modern reality. In addition, the role of sustainable communication is presented by showing different aspects of challenges in food loss and waste management and how the effective use of e.g. metaphors may lead to the growing role of e.g. the sustainable fruit and vegetable value chain or the circular bio-economy.

Keywords: Communication, food loss, waste management

MEDIET4ALL Approach to Support FoodWaste Prevention

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Mediterranean diet (MEDIET) is considered the world's most evidence-based low processed eating pattern for promoting health and longevity while saving water and energy, reducing greenhouse gas emissions and conserving land. Unfortunately, due to the modern societal trends, adherence to MEDIET model is decreasing, while the consumption of takeout and ultra-processed foods and drinks (UPFDs), is exponentially growing, in all-ages, with alarming levels in many European-Mediterranean (EUR-MED) regions (e.g., UPFDs contribution to nutrient intakes 61% in Spain and 79% in Germany). Considering the (i) extended food supply chain of UPFDs including the multiple industrial processing and manufacturing stages, (ii) use of a large variety of components/additives which have potential dual detrimental impacts on the environment and health, and (iii) the use of extensive synthetic packaging, a major source of environmental waste with carcinogenic and endocrine disruptor properties; UPFDs seems to have the most harmful impact, not only on health but also on the environment. By tackling this rapid negative shift of dietary patterns from MEDIET towards UPFDs, MEDIET4ALL is suggested to support the FoodWaStop COST action. To this end MEDIET4ALL aims to implement best practices and innovative solutions to enhance the convenience, modernity, competitivity, and shelf life (e.g., using by-product and waste based-bio-packaging) of MEDIET and the adherence to its lifestyle at all-age levels in modern societies.

Keywords: Awareness campaign, mediterranean diet, minimally processed food

Scientific studies on food waste in Turkey

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Scientific studies on food waste in Turkey shed light on the country's consumption patterns, production processes, and distribution chains, revealing significant findings. According to various research, food waste is a notable issue in Turkey, with adverse economic, environmental, and social impacts. Food losses often occur during agriculture, harvesting, packaging, storage, and consumption stages. Studies emphasize that factors such as consumer behavior, retail industry practices, food industry policies, and education levels influence food waste. Furthermore, the promotion of conscious consumption habits and sustainable production methods is highlighted as potentially effective in reducing food waste. The outcomes of these scientific studies contribute to the development of strategies for reducing food waste by policymakers, businesses, and society at large. The reduction of food waste is considered a crucial step toward transitioning to a sustainable food system and more efficient use of resources.

Keywords: Food waste, consumer behavior, policymakers

Abstracts

POSTERS

COST FoodWaStop

WG1. PREVENTION OF FOOD LOSS AND FOOD WASTE

Abstracts posters WG1. Prevention of food loss and food waste

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Fungicide resistance in postharvest pathogens and its management as a tool to prevent food losses

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Postharvest pathogens possess a potential threat towards harvested crops, vegetables, and fruits during their transportation from field to farm, handling, and storage. The use of preharvest fungicides applied a few days before harvest or postharvest fungicides applied in the packinghouses remains the most important method to control them and safeguard crop yield and quality, despite efforts to develop novel management techniques. However, overtime, resistance to many of the most effective fungicides has emerged and spread in postharvest pathogen populations, compromising disease control. Fungicide resistance development is a serious and important postharvest problem which needs to be actively managed in the packing shed to minimize any potential losses. This review describes the development of resistance using case histories based on important postharvest pathogens (i.e. *Botrytis cinerea*, *Penicillium expansum*, *Penicillium digitatum* and *Monilinia fructicola*). Emphasis will be given on the molecular mechanisms associated with resistance that include either target site alterations or increased expression of efflux transporters. These mechanisms result in different and varying levels of resistance to fungicides. In addition, resistance management approaches based on robust scientific evidence will be discussed as they are vital to prolong the effective life of fungicides and represent important tools to prevent food losses caused by postharvest pathogens.

Keywords: Blue mold, chemical control, DMIs, gray mold, QoIs, SDHIs

P23

A study on the use of olive oil mill wastewater to produce protein rich fungal biomass

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While olive oil is an important food product in the Mediterranean Sea Basin, olive oil mill wastewater (OOMW) and olive pomace, which are by-products of olive oil, are released in excessive quantities. OMWW is an important source of environmental pollutants due to its slightly acidic pH, high contents of phenol and chemical oxygen demand (COD). To overcome this problem, it was aimed to investigate the potential use of OOMW as an alternative substrate for biomass production by filamentous fungi in this study. For the cultivation, three edible fungi (Aspergillus oryzae CBS 819.72, Neurospora intermedia CBS 131.92, and *Rhizopus delemar* CBS 145940) were tested. Among them, A. oryzae was found to be a promising fungus in biomass production containing 14.9% protein. The protein content of the biomass was improved to 44.9% (w/w) by adding a nitrogen source (sodium nitrate) and removing the suspended solids. Concomitantly, 35-44% of COD reduction was also obtained after the fungal cultivation. Thus, the potential use of olive oil mill wastewater for the cultivation of fungal biomass was determined and at the same time, its pre-treatment was provided. However, the content of the obtained fungal biomass should be determined and its usability as feed should be investigated.

Keywords: Valorization, bioconversion, single cell protein, waste water treatment

P24

Spiderweb effect on pomegranate postharvest diseases

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The rising popularity of pomegranates has sparked increased global cultivation. Pomegranate suffers significant post-harvest losses due to latent (*Alternaria* spp., *Botrytis* spp., *Coniella* spp., *Colletotrichum* spp., and *Cytospora* spp.) and wound (*Aspergillus* spp., *Penicillium* spp. and *Talaromyces* spp.) fungal pathogens. The spider *Cheiracanthium mildei* (Arachnida, Cheiracanthiidae) commonly nests in pomegranate calyxes. We evaluated spider cocoons putative influence on post-harvest fungal pathogens in an organic "Mollar de Elche" pomegranate orchard. Ripe fruit with spider cocoons inside the calyx and fruit without cocoons were harvested, packed, and cold stored; disease incidences were periodically assessed. We examined spiderweb structure by scanning electron microscopy (SEM) to clarify the mechanisms involved. Compared to control, the incidence of infected stamens and internal mould in those with spider webs was reduced by about 30%, and the average severity of internal rot was halved. SEM analysis unveiled the webs' layered structure acting as a physical barrier against fungal spores, with mesh sizes ranging from 1 to 20 µm. Harnessing these spider webs in pomegranate orchards could reduce post-harvest diseases, resulting in lower yield losses and waste, achieving organic farming goals and aligning with the Zero Hunger Challenge initiated by the United Nations.

Keywords: Biocontrol, *Cheiracanthium mildei*, spider, pomegranate, postharvest diseases

P25

Identification of food waste in supermarkets in several regions of Kosovo

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Food waste is a concerning global problem, and in developing countries like Kosovo, there is no data on food waste produced in supermarkets at the national level. This study aims to identify food waste occurrences in supermarkets across Kosovo and gain insights into the strategy of food waste management. To achieve this, a questionnaire consisting of closed-ended questions was used, and it was directed at supermarket managers. Data from 28 supermarkets across Kosovo's cities was collected and processed using Microsoft Excel. Our findings revealed that fruits and vegetables constitute the main group of food waste (46%), followed by milk and dairy products (25%), bread and confectionery (11%), meat and meat products (7%), eggs (4%), and other categories (7%). The main cause of food waste generation is the short shelf life of products (43%), followed by inappropriate ordering (29%), non-compliance with marketing standards (21%), and inadequate packaging quality (7%). The amount of food waste from 28 supermarkets was estimated at 490 kg per week, and the majority of managers were not aware of food waste's environmental impact. This research greatly contributes to assessing food waste in our country's supermarkets and highlights the urgent need for initiatives for a stable food chain.

Keywords: Food waste, food loss, retail sector, supermarket

P26

Influence of food waste through packaging design

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Packaging design is vital for protecting food during transportation, shelf-life extension and waste reducing. However, packaging can be a source of food waste if not designed effectively. One way to determine food waste by packaging design is emptiability. Emptiability refers to the efficiency with which a product or packaging can be emptied. It ensures that consumers can fully utilize the product and avoid unnecessary waste and environmental impact. Emptying efficiency hinges on various factors: shape, size, materials, and features like opening size and ergonomic design, as well as product viscosity. In the framework on a sustainability assessment of dairy product packaging in the DACH region food waste was used as an indicator for indirect environmental effects. A methodology for emptiability was developed and applied to various product categories in the segments drinking milk and yoghurt. The results show differences based on the packaging type, consumer handling and fat content. Yogurt cups exhibit residue disparities from 0.99% to 1.91%, with one cup retaining 32.00% due to design and size. Buttermilk residues quadruple without ""shake before opening" instructions. These differences in food waste based on design and handling and can be seen as a call for action towards product and packaging producers.

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Decontaminant effects of plasma activated fog (PAF) against postharvest fungal pathogens and pesticide residues on table grape

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Fruits and vegetables play a crucial role in human nutrition. However, they are notably susceptible to pathogens causing postharvest decay as well as to contamination with undesirable chemicals, like residues of pesticides. Low temperature plasma is proposed as novel promising technique against microbial and chemical contamination of produce. It can be applied either directly or indirectly through a plasma-activated medium, i.e. plasma-activated water (PAW) and plasma-activated mist (PAMi) or fog (PAF). These latter are rich of reactive oxygen and nitrogen species and can be applied during postharvest stages. In this study, PAF was generated using a device developed at CNR-ISTP and applied in conidial germination assays for major fungal pathogens, including *Alternaria alternata*, *Aspergillus carbonarius*, *Botrytis cinerea*, *Cladosporium* sp., *Monilinia fructicola*, *Penicillium* sp., *Rhizopus* sp. Complete spore inactivation was obtained after 3-5 min of treatments for most fungi, and *A. alternata* showed the lowest sensitivity. The efficacy of PAF against bunch rots was assessed on table grape, revealing a significant reduction in the percentage of rotted berries exposed to 10 min of treatment (up to 80% of efficacy). Furthermore, PAF reduced pesticide residues in bunches artificially contaminated with acetamiprid (-40%), abamectina (-90%) and several fungicides (-10 to -30%).

Keywords: Cold plasma, fungi, fruit rots, grapevine, postharvest decay

P28

Sustainable road from chokeberry fruit waste to microencapsulated powders for nutraceutical, pharamaceutical or food application

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Chokeberry, one of the richest polyphenolic fruit sources, especially anthocyanins, represent a natural nutraceutical, having important role in human nutrition due to the outstanding antioxidant potential. Processing of chokeberry juice generates waste by-product, cake residue containing high polyphenolics content, which can be extracted. Microencapsulation by spray-drying technology was performed in order to improve functionality, stability, and bioavailability of extracted polyphenols. Microencapsulation of chokeberry extract vs. chokeberry waste extract using different carriers was employed. Morphological and physicochemical characteristics of the obtained powders were analyzed. In vitro simulated digestion model was used as indicator of polyphenolics bioavailability and stability in gastrointestinal environment. Spray-dried powders demonstrated perspective to enhance functional, bioavailable properties and stability of chokeberry polyphenols, with the chokeberry waste fruit extract being superior. The chokeberry waste microparticles could be an auspicious additive for incorporation into food products, as well as pharmaceutical application since chokeberry waste extract demonstrated in vitro tyrosinase and acetylcholinesterase inhibition, antimicrobial, antioxidant activity, antihypertensive effect and relaxation of contractions in the isolated rat ileum. The recovery of valuable bioactive sources after the processing of fruit is not only important from an ecological and economic point of view. Therefore, it has been shown that waste products containing nutraceutical fractions can be a valuable source of bioactive substances through the use of widely used microencapsulation technology and low-cost and easily accessible carriers.

Keywords: Chokeberry, digestion, microencapsulation, polyphenols, waste

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Active packaging to reduce losses and wastes of fresh fruits and vegetables

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Due to the delicate nature of their tissues and the susceptibility to fungal pathogens, tomato and strawberry fruits cannot undergo many of the common postharvest treatments. Therefore, it would be particularly suitable for these products the use of active packaging to prolong the primary (storage and distribution) and secondary (domestic consumption) shelf-life. The aim of this project is to test new materials for active packaging; different variants of a bio-polymer packaging appositely added with bioactive metal ions (in the form of coordination polymers) or microparticles of metal salts or clays charged with the same ions will be developed. This is to exert a controlled ionic release and to confer an adequate antimicrobial character to the active packaging. In addition, the (bio)polymer matrices will be chosen with appropriate elastic modulus, to allow reopening and closing the package several times. Its effectiveness in terms of the mechanical performance of the polymer and the shelf-life of the product (qualitative parameters and development of rots) will be evaluated. The proposed packaging will be compared with the currently used materials.

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WG2. AGROFOOD LOSS AND WASTE MANAGEMENT

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Occurrence of conidia of mycotoxigenic fungi in an experimental corn field in the Slavonia region

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Mcotoxins, secondary metabolites of some fungi that are toxic to vertebrates, can occur on various plant materials, especially cereals and fruits. Cereal grains are the most affected by contamination. Due to their toxicity and the legal limits, contamination of food/feed with some mycotoxins such as aflatoxins (AFL) and ochratoxin A (OTA) can lead to food loss. The control of mycotoxin contamination is mostly based on the use of antifungals and other chemicals with all the negative consequences for the environment. As part of a project to reduce the use of pesticides in maize cultivation, the occurrence of conidia of AFL and OTA-producing fungi in the air, in maize cobs and on two insects, the European corn borer, *Ostrinia nubilalis*, and *Diabrotica virgifera*, which are known as possible vectors of fungal conidia, was monitored in an experimental field in the Croatian region of Slavonia. Monitoring took place in summer 2021 and 2022. Conidia of afla- and ochratoxigenic fungi were detected in all trials. Although the concentration was different in the two years, the concentration of AFL conidia was higher in both years. The concentration of both toxins on maize cobs after harvest was below the detection limit (0.1 ng mg^{-1}) in both years.

Keywords: Aflatoxin, mycotoxins, ochratoxin A

P31

Waste management after processing and storage of peanuts in a circular bioeconomy

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The peanut (*Arachis hypogaea*) is a cultivated plant whose seeds have a high fat content of 45 to 48%. If they are not processed properly, the fat oxidizes and the seeds are no longer usable and become waste. The peanut is found all over the world, from South America to Europe, Africa and Asia. The peanut fruit is a pod that grows underground and is the only legume of its kind. In the human diet, it is most commonly consumed as a delicacy called peanuts, in the form of salted, roasted seeds and even as a processed product in the form of butter. In order to improve the nutritional composition, but also to enable longer-term use, peanut kernels are processed by the thermal process of conduction drying - toasting which is also the most common process of this type, leaving behind the shells, which are waste, i.e. biomass. In this work, the content of water, ash, fat and starch in the seeds was analyzed. Heat treatment by conduction drying was carried out at temperatures of 150°C, 170°C and 190°C. The data obtained proved that there was no significant degradation of nutrients in the seeds after toasting. It was also demonstrated that peanut shells are a recyclable waste that can be recycled or disposed of according to the principles of the circular bioeconomy.

Keywords: Bioeconomy, peanut, processing, storage, waste management

P32

Present state and future of management of organic waste in lake Ohrid region (N. Macedonia) - importance for the protection of the lake

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Lake Ohrid occupies the farthest southwest part of Macedonia. The lake is oligotrophic, the oldest lake in Europe, with many endemic species. The ecological importance of Lake Ohrid has been acknowledged by the declaration of Lake Ohrid and town of Ohrid as UNESCO world heritage site in 1979 and 1980 respectively. Towns of Ohrid and Struga in N. Macedonia and Pogradec in Albania receive many thousands of visitors during the tourist season. All these indicate that having effective waste collection and waste management in the municipalities of Ohrid, Struga and Debrca, as parts of Lake Ohrid region in N. Macedonia, is of tremendous importance. The annual production of biodegradable waste from households in the municipality of Ohrid is about 1.500 m^3, and to that should be added the biodegradable waste from agriculture and the maintenance of green areas in the municipality. Currently, the treatment of the organic fraction in the above-mentioned municipalities is reduced to its collection, transportation and disposal together with other fractions of communal solid waste, and it is not separated. Organic waste generated in agriculture, due to the lack of coverage in the rural part of the municipalities for the collection of this type of waste, is usually thrown in inappropriate places or burned. Such ways of dealing with this type of waste are a great risk for the environment and directly contribute to soil, water and air pollution and are not in accordance with the legal regulations in the field of waste management in N. Macedonia. One of the key objectives of waste management in South-West Region of N. Macedonia is a reduction of the quantities of organic waste that ends up on the landfill and helping to remove the organic waste from the landfills, thus reducing the methane emissions and use organic waste as a resource for farming and gardening, and this would be realized through the implementation of: 1. Public campaigns for the promotion of composting; 2. Project for composting in the rural parts of the municipalities; 3. Primary selection of organic waste.

Keywords: Management, organic waste, Ohrid region

P33

Analysis of the quality of apples and oranges treated with sodium metabisulphite during cold storage

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The quality of fresh fruit after cold storage is of paramount importance to consumers and retailers. Natural compounds, including GRAS salts, are gaining interest as alternative methods for maintaining quality. Oranges var "Maltaise" and apples var "Golden" were treated with sodium metabisulphite by dipping at 0.5 % and, then stored for up to 60 days at 6°C. Results showed that oranges could be stored at 6°C for up to 20 days without significant fungal spoilage or impairment of physico-chemical quality. However, it is possible to extend the period to 40 days with low risk of *Penicillium digitatum* growth. On the other hand, apples could be stored for up to 60 days without any incidence of rot. However, changes in physiochemical properties such as pH, TSS, weight loss and hardness, were registered from 40 days onwards. Bioactive compounds such as phenols and flavonoids, fluctuated throughout the storage period of apples, suggesting that this fluctuation was due to the degree of ripening or oxidation of the fruit. Low temperatures and prolonged storage may also be involved.

Key words: Bioactive compounds, decay, quality, preservation, storage

P34

Efficacy of *Pythium oligandrum* and sodium metabisulphite in controlling postharvest fungal diseases of oranges, tomatoes and nectarines

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Fresh fruits are vulnerable to pathogens such as *Penicillium digitatum* and *Botrytis cinerea*, which can cause significant losses during cold storage. Less toxic natural compounds are currently being investigated to reduce the severity of these infections. We conducted a study on two compounds, the first a commercial fungicide (Polyversum formulated from a biological agent, *Pythium oligandrum*, and the second a GRAS salt, sodium metabisulphite (SMB). The aim was to assess their effectiveness in reducing rot on fruit, whether treated and stored at 6Â°C for 33 days plus 2-day shelf life or inoculated and treated then stored at room temperature (20 °C) for 5-6 days. For the inoculation trial, oranges were inoculated with *P. digitatum*, tomatoes and nectarines with *B. cinerea*. Results from the fruit assessed six days after inoculation (5 days after treatment) showed that those treated with SMB (0.5%, 1 min soak) showed rot inhibition of 50% on oranges, 69 % on tomatoes and 34% on nectarines, compared with the control (distilled water). For those with Polyversum (0.5%, 1 min soak), only nectarines showed 20% rot inhibition, while no efficacy was observed on tomatoes or oranges (similar to the control). For the trial with un-inoculated fruit assessed after shelf life, SMB proved the best, with no rot detected on any type of fruit. However, Polyversum recorded the highest rate of rot, mainly with tomatoes (100 %) and nectarines (33%). In terms of weight loss for the latter trial, tomatoes treated with SMB showed the lowest loss of 1.9%. Our results demonstrate the effectiveness of SMB against fruit rot. Polyversum, needs further tests to optimize its concentration and its method of treating the fruit.

Keywords: Inoculation, natural compounds, rots, storage

P35

Lignans extract from waste knotwood of norway spruce as a potential treatment against grapevine trunk diseases

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Grapevine trunk diseases (GTDs) represent a significant threat to the global wine industry. Currently, effective biological methods or chemical compounds for treating infected grapevines are lacking. In this study, we explored the use of an extract derived from the waste knotwood of spruce trees as a biological control against GTDs. The knotwoods are the waste of woodworking processes. Our in vitro experiment focused on the antifungal effects of the extract against prevalent GTD pathogens, including Cadophora luteo-olivacea, *Dactylonectria torresensis*, *Diaporthe ampelina*, *Diaporthe bohemiae*, *Diplodia seriata*, *Eutypa lata*, and *Phaeoacremonium minimum*. The in vitro experiment revealed a notable antifungal effect of the extract against all tested fungi, with inhibition rates ranging from 30% to 100% using a 1 mgÂ·mLâˆ’1 concentration. Subsequently, the extract's efficacy was corroborated through an in planta experiment. Commercial grafts of Vitis vinifera were treated with the extract and then planted. Ten days and 180 days after treatment, the total genomic DNA of grapevines was extracted. High-throughput amplicon sequencing (HTAS) was employed to compare the fungal microbial diversities of treated and untreated plants. The results demonstrated a 76.9% lower relative abundance of the genus *Diaporthe* and a 70% lower relative abundance of the genus *Phaeoacremonium* in treated plants 10 days after treatment. A similar trend was observed for the genus Cadophora 180 days after treatment, with treated plants exhibiting a 76% lower relative abundance of this genus compared to untreated grapevines.

Keywords: Bioprotection, GTD, grapevine, HMR, Norway spruce, waste management, 7-hydroxymatairesinol

P36

ONFOODS: New and re-emerging risks in the food system and sustainable mitigation strategies

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Agri-food product quality and safety could greatly be compromised by fungi able to produce toxic metabolites as well as by the residues of the conventional means used for their control. Several pathogenic fungi can produce different metabolites of a given mycotoxin, and in some cases more than one chemical type is produced. Moreover, climate change and food-processing systems contributed increasing the occurrence of toxigenic genera. Therefore, reducing the biological/chemical risk and guarantee food safety is of paramount importance, as well as finding novel sustainable control strategies that might fit the postharvest handling and transformation phases. Within this framework, ONFOODS aims at applying omics techniques to greatly strengthen the knowledge and better understand the possible hazards of eating food contaminated by well-known toxigenic genera (*Aspergillus* or *Penicillium*), still poorly studied genera (*Alternaria*), or not yet recognized genera (*Monilinia*). Next-generation sequencing methods and metabolomic approaches will be used to generate data to develop assays to detect specific outbreak strains or new/ emerging pathogens and metabolites, and to understand clearly/better the mechanisms underlying the production/accumulation of different mycotoxins. Multiple mitigation solutions will be investigated and applied during the postharvest and retailing phase offering new strategies/approaches according to the "multiple-hurdle" concept.

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P37

Biosynthesis regulation of metabolic markers and correlation with quality safety during fruit decay (BioQuaSa)

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The quality of fresh fruits depends extensively on their postharvest management. The extension of the shelf life and the reduction of postharvest losses of perishable fruits are affected by biotic and abiotic stresses which modify the physiological characteristics of the fruit. Therefore, examining molecular changes in postharvest fruits is a crucial aspect able to detect metabolic markers involved in fruit decay. In this project metabolomic and transcriptomic investigation of postharvest peach and apple fruit in response to fungal pathogen *Penicillium expansum* will be performed. This study can be a tool for further understanding the biochemical basis of postharvest physiology and in the identification of the biomarkers on the fruit affected by pathogen.

This work was conducted within the framework of the project BioQuaSa, which is funded by the Ministry of Foreign Affairs and International Cooperation

WG4. VALORISATION OF AGROFOOD WASTE AND A CIRCULAR BIO-ECONOMY

Abstracts posters WG4. Valorisation of agrofood waste and a circular bio-economy

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Valorization of agree-food waste through the extraction of ellagic acid

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Ellagic acid (EA) is a bioactive polyphenolic compound found naturally as a secondary metabolite in various fruits (pomegranates, raspberries, blackberries, and strawberries) and nuts (walnuts, hazelnuts, acorns, chestnuts, and pecans). EA serves as the precursor to the active compound Urolithin A, generated through the transformation of ellagitannins by gut bacteria. This compound is gaining attention for its antioxidant, anti-inflammatory, antimutagenic, and antiproliferative properties. After the production of raspberry juice and wine, the press cake contains over 60% of the total ellagitannins in the fruit, which are otherwise discarded as leftovers after squeezing. Considering the global increase in raspberry production and the fact that industrial processing generates 10-12% (w/w) pomace as a byproduct, there is significant potential to recover ellagitannin compounds from these byproducts. This study aims to investigate the effect of nature of green solvents (natural deep eutectic solvents and ionic liquids) on extraction of EA. It is crucial to note that the utilization of waste materials in industrial production is currently very low. Repurposing them as food ingredients or dietary supplements would add considerable value to what is currently considered waste in the industrial processing.

Keywords: Ellagic acid, ionic liquids, natural deep eutectic solvents

P39

Green technologies supporting the development of nutraceutics and agrochemicals from agrifood by-products

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The research aims to develop plant-derived formulations promoting human well-being and environmentally friendly agricultural practices by utilizing green technological processes that align with the principles of the circular economy, including recovery, recycling, and product life extension. Extracts will be obtained from selected crop by-products by using, among other, natural deep eutectic solvents. The physicochemical properties, metabolite profiling, and functional activity of extracts will be analyzed and compared to those obtained using conventional solvents. The information obtained will be used to design and synthesize new phytochemical formulations suitable for preserving the bioactivity, delivering the payload, and increasing bioavailability.

Keywords: Green agrochemicals, green solvents, metabolite profiling, phytocomplexes, waste valorization,

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Food waste, insects and alternative proteins: a sustainable trio for a full circular economy

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According to the Food and Agriculture Organization (FAO) of the United Nations, approximately one-third of all food produced for human consumption - roughly 1.3 billion tons - ends up as waste each year. This wastefulness not only squanders precious resources but also contributes significantly to greenhouse gas emissions. Decomposing food in landfills produces methane, a potent greenhouse gas that accelerates climate change. Addressing food waste is, therefore, a crucial step in mitigating environmental impact and promoting sustainability. Insects have emerged as a sustainable and protein-rich alternative in the quest to reduce meet the growing global demand for protein. Some insect species, in addition of being highly nutritious, are also very efficient in converting waste into nutrients. Therefore, integrating insects into the food system not only addresses the challenges of food waste but also offers a solution to the increasing strain on conventional protein sources. The intricate relationship between food waste and the use of insects fully applies the principles of the circular economy and is a perfect example of how to create a more sustainable and resilient global food system. Food waste becomes a valuable resource for insect farming, providing a sustainable source of feed. Insects, in turn, offer a versatile and eco-friendly protein source, while their frass (insect excrement) can be used as nutrient-rich fertilizer. This interconnected system reduces reliance on traditional agricultural practices, promotes resource efficiency, and mitigates environmental impact.

The PRIMA project ADVAGROMED aims to develop innovative and holistic food system based on agro-ecological principles and circular economy practices, to increase the resilience of the agro livelihood systems. ADVAGROMED uses by-products from local agricultural productions for rearing insects to deliver different products: 1) insect frass to be used as bio-product to improve soil fertility, deliver plant protection effects and enhance soil microbial biodiversity, by reducing mineral fertilizers and chemical pesticides, and 2) live larvae to feed local poultry breeds ensuring optimal animal performances, health and product quality (decreasing the use of imported feeds).

Keywords: Circular economy, frass insects, sustainable proteins, waste bioconversion

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The health and sustainability impact assessment in the context of a new bioindustry: the One Health concept in InsectERA

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One Health recognizes that the health of humans, domestic and wild animals, plants and the wider environment are intimately linked and interdependent. In this context, any action or stressor that compromises one of these components has the potential to affect the others, reinforcing the idea of One Health. One Health approach is an integrated, unifying approach that aims to sustainably balance and optimise the health of humans, animals, and ecosystems. The pandemic period that affected the world has raised awareness of the close interrelationship between human health, animal health and the environment. Therefore, the application of the One Health approach to minimise harm and maximise benefit from the co-management of human, animal and environmental health is fundamental to the development of efficient and effective strategies to address health issues at the human-animal-environment interface.

One of the major challenges we face today relates to agri-food systems. Indeed, the pressure of food production on the environment is increasing, mainly due to the growth of the human population and the resulting increase in food demand, changes in food consumption patterns and the intensification of production systems, especially to produce animal-based proteins. The need to transform food systems is therefore urgent and should be underpinned by decisions based on the simultaneous assessment and integration of overall health and sustainability impacts, considering economic, environmental, and social implications.

The InsectERA agenda, an "Agenda Mobilizadora" funded under the Recovery and Resilience Plan (PRR), brings together stakeholders from different sectors across the value chain who want to harness the potential of insects as bioindustrial tools and solutions. Several products will be developed in this new bioindustry. If all products may have an impact on human, animal and environmental health, the health and sustainability impacts will be assessed.

Keywords: Bio-industrial sector, agri-food systems, insects

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GREENVITISV: natural bioactive extracts from agrifood byproducts as circular green solutions for a zero waste approach in the agricultural sector

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Consumer preference for natural products over synthetic ones is prompting a shift towards eco-friendly agricultural practices. Producers are increasingly focused on managing surplus waste due to steep penalties for improper disposal. This focus compels them to explore alternative waste handling methods, with revaluation emerging as a particularly promising option. On this basis, the GREENVITISV project aims to produce eco-friendly products from grape marc, like phytosanitary-pesticide and antioxidant-preservative alternatives to synthetic chemicals, supporting the circular economy and EU Green Deal goals. The consortium of this project is formed by iGrape laboratory, Instituto de Ciencias de la Vid y del Vino (ICVV), and EstaciÃ³n de Viticultura e EnoloxÃ-a de Galicia (EVEGA). i-Grape's methods will generate natural bioactive extracts with well-established antimicrobial and antioxidant actions. BIOVITIS group at ICVV and EVEGA will assess the in vitro and in planta efficacy of extracts against the main grapevine fungal and oomycete pathogens; while VIENAP group at ICVV will evaluate the extracts as wine preservatives. This interdisciplinary knowledge will allow the project to reach the state of the art in natural food additive and phytosanitary products ensuring the compliance with the market requirements and applicable regulations.

Keywords: Antimicrobial and antioxidant actions, grape, extracts, pathogens, vineyard, wine

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An improved method to extract polyphenols from viticulture waste

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Wastes generated during vine cultivation (e.g., grapevine stems and leaves) are rich in bioactive molecules, especially polyphenols, therefore their valorization has received considerable attention in the last few years. This study aimed to assess the efficacy of an enhanced technique for extracting polyphenols from vine canes. The approach included a pre-treatment with a mixture of enzymes that degrade cell walls, followed by ethanol: water (1:1) extraction. Substrate concentrations ranging from 1g to 20g of vine cane were used to produce extracts by fluidized bed extraction (P1-P4) and heat extraction (V1, V2). These extracts were then compared regarding their total phenolic content (TPC), hydrolyzable and condensed tannins, antioxidant (DPPH test) and antibacterial activity on *E. coli* ATCC 8739. The extract obtained from 5g of dry vine cane (P2) showed the highest antioxidant activity at 85.64±0.22% and a high value for TCP (83.85±4.62 mg GAE/g dw), compared to extract V2 with TCP 53.1±3.10 mg GAE/g dw. The highest gallotannin content (16.26±0.03 mg tannin acid/g dw) was detected in the extract P4, while the condensed tannin were low in all samples. This preliminary work suggests the potential of viticulture waste for polyphenol-rich nutraceutical production.

Keywords: Grapevine canes, polyphenol-rich extracts, waste valorization

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Production of biodegradable polymers polyhydroxyalkanoates from renewable carbon sources using *Pseudomonas putida* strain for potential biomedical applications

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Polyhydroxyalkanoates (PHAs) are biopolymers synthesized by bacteria under unbalanced growth conditions. These biopolymers are recognized as potential biomaterials for future applications due to their biocompatibility and biodegradability characteristics, as well as the ability to be rapidly produced and strong mechanical strength functionality. This article aims to perform microbial fermentation using *Pseudomonas putida* strain to identify the amount of biopolymers, especially medium-chain polyhydroxyalkanoates (mcl-PHA), based on the type and amount of added precursors (waste food oils, oil extracted from coffee grounds and used motor oil).

Keywords: Biopolymer, polyhydroxyalkanoates, *Pseudomonas putida*, polyhydroxyalkanoates

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Computational screening of valuable chemicals from food waste to assess their health benefits

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Density functional theory derived methods and molecular docking techniques are useful approaches to evaluate, either bioavailability and potential pharmacological activity of various compounds issues form agrofood waste. Thus, accurate predictions of drug-like properties are achieved in order to establish further strategies to valorisation several valuable nature-based molecules in the nutraceuticals or drugs industry. In this study, structures of several polyphenol derivatives were investigated by using B3LYP/311G (d,p) level of theory using Spartan software (Wavefunction, Inc. Irvine, CA, USA). Results concerning molecular and QSAR descriptors especially related to the oral bioavailability and drug-like screening rules (Lipinski's Rule of Five and Veber's Rules) have been obtained and used to interpret their interest properties (solubility, permeability, lipophilicity balance, kinetic stability in physiological media, possible interactions with target proteins). Their drug-like potential was also evaluated by molecular docking simulations against tyrosine-regulated kinase 2, PDB ID: 5ZTN. The obtained findings could further be used to identify feasible anti-neuroblastic ligands derived from functional food components with neuroprotective potential.

Keywords: Bioavailability, in silico techniques, neuroblastoma, molecular docking

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In vitro evidences of the globe artichoke extracts efficacy against *Alternaria alternata*

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Artichoke (*Cynara scolymus* L., family *Asteraceae*) is an herbaceous plant native to the Mediterranean countries. It is well appreciated for its nutritional and chemical composition. However, during the industrial processing, about 80% of the total plant biomass is discarded, including leaves, stem and roots. Due to its high content of bioactive components, mainly phenolics, interest in artichoke waste has arisen. Phenolic compounds are known for their antioxidant and radical-scavenging activity. Their antimicrobial activity has been reported against several plant pathogens. The chemical profile of artichoke can differ depending on plant variety, agronomic practices, plant part used and extraction method. Thus, this study focused on the antifungal effects of leaf extracts collected from three genotypes of the artichoke Carciofo Ortano (Orte 1 F4 P10, Orte 2 F7P2 and Grato 1 P3), cultivated in the same field, and obtained using the same extraction method. Leaf methanol extracts were evaluated against *Alternaria alternata*, in in vitro bioassay, by measuring the inhibition of conidia germination. The HPLC-DAD and SPME_GC/MS techniques were performed to describe the chemical profiles of the extracts. Data obtained were consistent with the previous studies in which extracts of artichoke leaves were reported as antifungal products. However, our study showed that plant extracts derived from various genotypes had varying levels of bioactivity These results suggest that artichoke leaves might be a potential source of natural fungicides.

Keywords: Artichoke, *Alternaria alternata*, phenolic compounds

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How to design customer-centric circular business model to tackle food waste?

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Circular Business Models (CBM) are at the forefront of achieving sustainable development goals given their capacity to help firms to rethink their way to create, deliver and capture value whilst decoupling economic performances and environmental impact. Recently, they have been considered effective organizational solutions to address circularity also in agrifood domain and in food waste. Specifically, the current literature suggest different ways in which companies can generate value from food waste by producing energy, animal feed, new materials, or valuable products. However, the shift from a linear business model to a CBM still needs to satisfy the specific needs of customers, rather than merely make circular-driven products available; it is of vital importance that the value proposition of a CBM fits with its customer/consumer segment as well as the cost structure needs to be balanced by an appropriate revenue stream. This is actually one of the most relevant challenges for successful implementation of CE: for these business models to truly be impactful, they must not only be effective, but also adopted by a large proportion of the market. In this regard, consumersâ€™ needs, interests, and acceptance of circular business models represent a major barrier. This is particularly relevant, considering that firms often fail to implement circular business models on the market at scale: the market penetration of circular business models remains limited and this is a major problem in business innovation practice, while a knowledge gap about the underlying implementation challenges remains in the scientific literature. However, the current CBM literature is disregarding the role of customers/consumers in the design and implementation of innovative CBM thus resulting in a lack of customer focus. Consequently, the aim of this project is to explore the relationship between companies and consumers in designing innovative CBMs to solve the problem of food waste. Either it is tacking the waste-back to close the loop, or accepting the product made of recycle materials or simply adopting new responsible way of purchasing and consuming food, we think the consumer has a major role in defining a successful CBM to tackle food waste. To do that, a mix of qualitative and quantitative (surveys) methodologies could be used.

Keywords: Circular business model, customer-centric, customer value, food waste, market penetration

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Apple pomace as a new substrate for the preparation of water kefir after enzymatic degradation

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Apple pomace, consists of peel, seeds, stems and pulp, is the by-product of apple juice production. Due to large amounts, the utilisation and disposal of apple pomace poses an ecological, economical and logistical challenge. To find an innovative way of pomace utilisation, the production of water kefir using enzymatically degraded apple pomace is evaluated to prepare a healthy drink. Water kefir was prepared according to a pre-established recipe. The pomace was treated mechanically and enzymatically. The concentrations of fructose, glucose and sucrose during fermentation were analysed by HPLC-RI. Differences in taste between water kefir made from pomace and water kefir made from apple juice were analysed by sensory analysis. Fermentation was observed in the produced kefir. Sensory analysis showed a noticeable difference between water kefir made from juice and made from pomace. Both products indicated similar levels of consumer acceptance. This study has shown the possibility to convert apple pomace into water kefir with promising consumer acceptance.

Keywords: Apple pomace, product development, valorisation,water kefir

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Recovery of bioactive compounds from peach peels employing green extraction processes and their encapsulation in chitosan-based nanoparticles

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The aim of the present study was the recovery of phenolic compounds from peach (*Prunus persica* L.) peels, using Green Chemistry techniques and their subsequent encapsulation in chitosan nanoparticles. The recovery of phenolic compounds from peach peels was performed with ultrasound-assisted extraction (UAE) and optimized through response surface methodology (RSM). In addition, one-factor optimization was performed regarding the effect of cold atmospheric plasma (CAP) treatment on the recovery of phenolic compounds from peach peels in terms of treatment duration, material thickness and material surface-to-cold plasma distance. The produced optimized extract was then encapsulated in chitosan (3 mg/mL) nanoparticles via the ionic gelation method, using sodium tripolyphosphate (STPP) as cross-linker (0.5 mg/mL). The powdered nanoparticles were recovered through lyophilization at -80°C for 24 h. Based on the results, the optimized extraction conditions were determined at 17 min, 53% v/v ethanol, 70: 1 v/w solvent: solid ratio and pulse duration 0.9 on 0.1 off, while CAP treatment for 1 min, at 10 cm distance and 5 mm material thickness increased the phenolic compounds recovery. The extract was efficiently encapsulated in chitosan-based nanoparticles. The present study highlights the potential of peach peels valorization and their possible future application as potential natural antioxidants.

Keywords: Green chemistry, chitosan, delivery systems, peach by-products, phenolics

P50

Utilizing agricultural waste-derived bioactive compounds for innovative drug delivery systems: towards a sustainable circular economy

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Agriculture generates a significant amount of waste, including by products from hop cultivation and winemaking. These wastes are typically disposed or underutilized. However, they contain bioactive compounds with potential health benefits. Among these compounds, polyphenols have gained attention for their antioxidant, anti-inflammatory, and antimicrobial properties. The core of the PhD thesis is to contribute to the design, production and characterization of polyphenol-based nanoparticles delivering bioactive compounds obtained from waste, and to investigate and enhance their stability and bioavailability for drug delivery and nutraceutical applications. The use of neutron scattering for characterizing polyphenol self-assembled nanoparticles is a novel and promising route. Taking advantage of neutron scattering, we aim to learn about interactions, structure, and dynamics of these nanoparticles from natural compounds in presence of model membranes, small molecule drugs or nutrients such as vitamins and minerals. The unique and world leading ILL instrumental suite will be used to bridge the structural (Diffraction, SANS, imaging) and dynamics (ToF, Baxkscatering and NSE) information we ambition here. The results could lead to original complexes with improved properties of stability, diffusion, and permeability and related patents.

Keywords: Agriculture waste, biotechnology environment, membranes, polyphenols nanoparticles, structure, dynamics

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Exploring causes and potential solutions for food waste among young consumers

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The aim of the study was to team up with young people (aged 18-26) and identify situations and areas where food waste is generated, and to find ways for all stakeholders to help young households waste less food. In 2021-2022, a literature review on youth food waste habits and behaviour change was carried out. It included both scholarly articles on topics such as behavioural or food safety science as well as existing recommendations, such as ones published by the EU, national institutions or by NGOs. The review was soon followed by nine focus group interviews with young people who live on their own across three Nordic and Baltic countries (Denmark, Finland, Lithuania). The created guidelines are the summarised results of the analysis and can be seen as a guide for young people who want to reduce food waste. The structure follows the challenges presented by the young people and includes suggestions for action or further research for all stakeholders, including the retail sector, policymakers, NGOs, educational institutions and others. The opinions of the research participants are presented as direct and unedited citations that were collected during the focus group meetings. The solutions were developed by identifying the young peopleâ€™s needs, and by taking their opinions and suggestions into account.

Keywords: Food waste, nordic countries food waste, solutions for food waste, youth food waste

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Waste management in food industry using microorganisms

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The recycling of wastes in Food Industry helps for this sustainable development and for protection of the ecosystem too. Recycling of winery and vineyard wastes by using them as a growing source for edible mushrooms, the protection of vineyard ecosystems, also the phenolic removal in olive oil mill wastewater by some strains of mushrooms in respect to their phenol oxidase activity are some of the possibilities for waste management in Food Industry, using microorganisms. Taking into consideration that most of the edible mushrooms species requires a specific micro-environment including complex nutrients, the influence of all physical and chemical factors upon fungal biomass production and fruit body formation of *Pleurotus ostreatus* species has been studied by testing new biotechnological procedures. In this respect, the leading reasons for this case study is to valorize all the specific wastes of vineyard ecosystems and wine producing industry by edible mushroom cultivation to get useful products such as food and feed proteins. Phenolic compounds are present in wastes from several industrial processes. Olive oil mill wastewater is an effluent containing many of this compounds which are responsible for its black color and its phytotoxic and antimicrobial properties. Between the different fungi used in olive oil mill waste water treatment, in order to remove phenolic compounds Pleurotus presents the advantage of being an edible mushroom. Pleurotus spp. also appears to be able to grow in olive oil mill waste water without any addition of nutrients.

Keywords: Food Industry, microorganisms, sustainable development, waste management

WG6. NETWORKING AND DISSEMINATION, COMMUNICATION AND TRANSFER OF KNOWLEDGE

Abstracts posters WG6. Networking and dissemination, communication and transfer of knowledge

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Design of site-specific postharvest draft force measurement system and tractor platform for crop scouting

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This paper presents two separate projects in the field of soil and crop scouting. First, during plowing, a simple method of measuring draft force by four strain transducers was used. The difference in draft force is analyzed for six different passes during longitudinal plowing of the plot. The force is measured indirectly using four strain transducers. Values of the force are obtained by calculation after previous calibration and then measurements in the experimental field. The study highlights draft force in the function of soil resistance as an exceptionally important parameter in the analysis of agricultural soil and suggests the expansion of current routine in precision agriculture mapping. Second, different ways to detect changes in crop condition, especially nitrogen variability, are not equally good for all analyzes, so the detection of changes is influenced by spatial, atmospheric, spectral, and temporal constraints. There are a very small number of types of tractor platforms for crop scouting on the market, while massive and dimensional solutions with two side sensors and a hydraulic system for manipulating the platform wings dominate among them. The proposed new technical solution enables the installation of spectrometric sensors on a platform which is then aggregated and connected to the tractor at three points by means of its tractor lift system.

Keywords: Crop sensors platform, draft force, soil compaction and consistency, strain transducer, NDVI

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Sustainable solutions: revolutionizing food systems through innovative communication strategies

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In a world struggling with the challenges of food loss and waste, effective communication is the lever for driving change. This presentation explores a dynamic communication strategy designed to promote and implement innovations in food loss and waste management. With a focus on engaging stakeholders across the supply chain and beyond, we focus on key communication pillars that amplify the impact of sustainable solutions. Precision Agriculture, Interactive Packaging, Supply Chain Optimization, Conscious Consumption Campaigns, Circular Economy Awareness Initiatives

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Investigation of *Listeria monocytogenes* in Traditional Sharri cheese and its evaluation in terms of food safety

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Listeria monocytogenes is an important pathogen for public health that can spread widely, grow in refrigerators, and maintain its viability even under adverse conditions such as refrigeration, freezing, heating, and drying. Control of *L. monocytogenes* is extremely difficult for the dairy and other food industries; Because it persists in harsh environments due to its capacity to adhere and form biofilms, it is also a pathogen of extreme concern for the health of consumers. Additionally, detection of *L. monocytogenes* in foods can result in major economic losses, with the potential for costly product recalls, laboratory testing, and lawsuit.

Keywords: *Listeria monocytogenes*, recall, waste