**Debate/presentation for 1st of April – topics Health, Biotechnology and Nanostructure**

1. **CNR interest**

**Debate 1**

**Title:** Structural Analysis of the UGGT and Trop-2 Mutant Complexes Associated with Rare Diseases

Pietro Roversi. Institute of Agricultural Biology and Biotechnology, National Research Council. Milano

pietro.roversi@cnr.it

**Abstract:** Building upon our previous findings that UDP-glucose glycoprotein glucosyltransferase (UGGT) recognizes and reglucosylates misfolded Trop-2 mutants linked to gelatinous drop-like corneal dystrophy (GDLD) , we aim to elucidate the structural basis of this interaction. Our approach involves co-transfecting mammalian cells with plasmids encoding UGGT and disease-associated Trop-2 mutants, followed by purification and structural determination of the resulting complexes. This study seeks to provide detailed molecular insights into the quality control mechanisms of glycoproteins and may inform the development of novel therapeutic strategies for rare diseases associated with Trop-2 mutations.

**Keywords:** Trop-2, UGGT, rare disease-associated mutations, glycoprotein quality control, protein complex structure

**Debate 2**

**Title:** Fermentation and bioactive compounds: the contribution of peptides to the health-promoting qualities of food

Laura Pucci & Elena Tomassi. Institute of Agricultural Biology and Biotechnology, National Research Council. Pisa

laura.pucci@cnr.it

**Abstact:**

The use of fermentation is a key strategy to enhance the bioavailability of functional compounds in cereals and microalgae. Microbial species play vital role in breaking down macromolecules, generating beneficial derivatives with diverse bioactivities that support human health.

The project aims to optimize the fermentation process of cereals and microalgae to improve the production of bioactive compounds and peptides with functional properties, including antioxidant, anti-inflammatory, antidiabetic, and anti-obesity effects.

The approach involves selecting different microorganisms, such as *S. cerevisiae, K. humilis, F. sanfranciscensis, E. faecium, P. pentosaceus*, and *L. mesenteroides*, to optimize the fermentation process. It also includes the identification of functional metabolites through mass spectrometry, the characterization of health benefits through biochemical and functional analyses *in vitro* and on intestinal cell lines, and the evaluation of bioactive peptides increase and stability during fermentation and following simulated digestion.

The fermented products could be used as components of high-protein foods and as nutraceuticals through peptide isolation and encapsulation.

**Keywords:** Microbial fermentation; bioactive peptides; functional foods

**Debate 3**

**Title:** Valorization of potato waste as a natural source of Glycoalkaloids for food, nutraceutical and agricultural applications

Laura Pucci & Elena Tomassi. Institute of Agricultural Biology and Biotechnology, National Research Council. Pisa

laura.pucci@cnr.it

**Abstract**

Projections from the Food and Agriculture Organization of the United Nations estimate that potato peel waste could reach 8,000 kilotons by 2030, generating approximately 5 million tons of CO₂ equivalent emissions. Rich in bioactive compounds, potato processing residues can be converted into high-value products, supporting sustainable production, consumption and the circular economy.

Glycoalkaloids are bioactive secondary metabolites abundantly present in potato peels, playing a key role in plant defense. Despite their potential toxicity at certain levels, the state-of-the-art research demonstrates their antimicrobial, antifungal and possible health benefits, including antiglycemic, hypolipidemic, antimalarial, anti-inflammatory and anti-tumor properties, highlighting their promise in various industrial sectors.

This project aims to determine the non-toxic dose of glycoalkaloids and explore their application in safe concentrations for edible coatings and nutraceutical formulations. To achieve these objectives, glycoalkaloids will be extracted using eco-friendly methods. Toxicity will be assessed through *in vitro* and *in vivo* studies evaluating cytotoxicity, neurotoxicity and potential health risks. The efficacy of glycoalkaloid-based antimicrobial coatings in extending food safety and shelf life will be tested through microbial growth assays, spoilage rate studies and sensory evaluations. While antioxidant, anti-inflammatory and antiglycemic properties will be performed via *in vitro* and *ex vivo* studies.

**Keywords**: Waste-to-value, Potato peel waste, Glycoalkaloids, Biofunctional properties, Shelf-life extension

**Debate 4**

**Title:** Molecular strategies to address Antimicrobial Resistance: understanding pathogen dynamics in livestock

Paola Cremonesi. Institute of Agricultural Biology and Biotechnology, National Research Council. Lodi

paola.cremonesi@cnr.it

**Abstract.** The fight against antimicrobial resistance (AMR), is one of the greatest challenges of the century. The improper use of antibiotics in human and veterinary medicine has led to genetic resistance in pathogens, causing infections in humans and livestock. As a result, resistant bacterial strains have emerged, some of which are immune to multiple or even all known antibiotics.

The molecular dynamics of emerging pathogens and antibiotic resistance in livestock are analyzed to understand and counteract the spread of animal-to-human diseases. Advanced molecular methods (ddPCR, WGS, NGS) are used to monitor and characterize microorganisms in farms, to study zoonotic transmission mechanisms, and to identify resistance-related target genes.

**Keywords**: antimicrobial resistance gene, one-health approach, microbiome and resistome

**Debate 5**

**Title:** Toxicity, efficacy and bioavailability evaluations of food compounds and contaminants on animal models.

Luisa Pozzo and Andrea Vornoli. Institute of Agricultural Biology and Biotechnology, National Research Council, Pisa

luisa.pozzo@cnr.it

andrea.vornoli@cnr.it

We conduct toxicological, efficacy, and bioavailability studies in vivo using rodent models. Our laboratory expertise consists in evaluating oxidative stress markers, enzymatic activity of the drug-metabolizing system, and Nrf2-dependent antioxidant enzymes. We perform biochemical assessments of oxidative stress and enzyme activity, characterized phenolic compounds using UHPLC-ESI-MS/MS, and analyzed gene expression related to inflammation (NFkB), antioxidant response (Nrf2), lipid/glucose metabolism, and drug metabolism. Histological and immunohistochemical analyses are also conducted.

**Keywords:** in vivo studies; food contaminants; bioactive compounds; drug metabolism; histopathology; molecular biology

1. **JSI interest**

**Debate 1**

**Title:** Applications of safe engineered bacteria

Aleš Berlec, *Biotechnology Department*

Email: ales.berlec@ijs.si

**Abstract:** Lactic acid bacteria can be genetically engineered to produce, secrete or display recombinant proteins, such as protein binders, enzymes or reporter proteins in constitutive or inducible manner. These bacteria can be applied in the treatment of inflammatory diseases and infections. They can also be incorporated into polymeric matrices to form smart materials which can be used for delivery or diagnostics. Bacteria can be inactivated to prevent their spread in the environment, while maintaining the functionality of recombinant proteins.

**Keywords**: Genetic engineering, bacteria, treatment.

**Debate 2**

**Topic:** Nanostructured materials + health

Slavko Kralj, Synthesis of Materials Department

Email: Slavko.Kralj@ijs.si

**Materials Synthesis Department** K8

**Abstract:** Anisotropic magnetic nanomaterials for exploiting magneto-mechanical effects in soft materials and surface nanostructuring.

**Keywords:** Anisotropic magnetic nanomaterials, magneto-mechanical effects, soft materials, surface nanostructuring.

**Debate 3**

**Topic: Health and biotechnology**

Marko Jeran, *Department of Inorganic Chemistry and Technology*

Email: marko.jeran@ijs.si

**Abstract:** The surfaces of various materials, especially for medical applications, play an important role in the design of many applications and innovations in modern medicine. In the course of developing innovative biocompatible materials, we want to present models of materials with pronounced hydrophobicity based on fluorinated surfaces. Using modern biochemical methods and chemical analysis of the elution of potentially toxic elements, we want to observe the relationship between biological model systems and the surface of the manufactured material. Cellular vesicles (EVs) of natural or biological origin and/or hospital microorganisms could serve as biological model systems. The interdisciplinary collaboration thus comprises the vertical integration of methods of synthetic chemistry and surface treatment in applications on selected models. The work will thus provide an in-depth insight into the interactions between the carrier element and the biological system and identify possible mechanisms.

**Keywords**: Biocompatible materials, hydrophobicity, fluorinated surfaces, biological model systems, surface treatment.

**Debate 4**

Topic: Artificial Intelligence

Matjaž Gams, Department of Intelligent Systems Email: matjaz.gams@ijs.si

More about: We are interested in Large Language Models research and development. Our HomeDOCtor is an LLM chatbot performing as an artificial home doctor 24/7 and in the measurements exhibits IQ of around 150 (available for Slovenian citizenship). We assume it is possible to design a chatbot performing as a dedicated professional with high IQ for majority of human domains.

Keywords: Large Language Models, HomeDOCtor, LLM Chatbot, Artificial Home Doctor, High IQ.