PhD Thesis Defenses

On **Friday April 5th 2024 at 15.30am** at the classroom **Patrizio Damigella**, Via Santa Sofia 100

International Doctor Candidate

Monia Federica Lombardo (XXXVI cycle)

Will discuss her PhD theses titled

COPPER-ALTERNATIVE PRODUCTS FOR THE CONTROL OF CITRUS FRUIT PATHOGENS AND THEIR IMPACT ON BENEFICIAL CARPOSPHERIC MICROBIAL COMMUNITIES

Thesis Abstract

Citrus cultivation represents one of the most important industries worldwide, with the Mediterranean countries serving as major citrus producers. *Colletotrichum* spp. and *Alternaria alternata* currently pose threats to Mediterranean citriculture, causing severe preharvest fruit symptoms of anthracnose and Alternaria brown spot respectively, and leading to substantial economic losses. The management of these pathogens is increasingly problematic, particularly in organic citrus orchards where disease management largely relies on the use of copper-based antimicrobials. With limitations in the use of Cu compounds imposed by the European Commission, due to the demonstrated noxious effects on environment, alternative control strategies are needed. This need is particularly emphasized in Sicilian citrus farming, which holds a prominent position in organic production worldwide. Consequently, the research for sustainable strategies is highly advocated, and should explore multiple possibilities, such as alternative formulations or the investigation and promotion of the beneficial members of the fruit microbiome. In this context, the multidisciplinary research activities of the Ph. D. thesis focused on: (i) identifying alternative biological products able to reduce or phase out copper-base antimicrobials in citrus farming; (ii) evaluating the effectiveness of alternative products across different citrus orchards in pluriannual trials; (iii) understanding the microbial composition of citrus fruit carposphere, delineating core members, and elucidating the beneficial component; (iv) assessing the impact of alternative and copper treatments on the fruit microbiome; (v) establishing a collection of bacterial strains with antagonistic traits belonging to the core microbiome using an integrated and innovative approach. Overall, the obtained results provide evidence of the effectiveness and sustainability of alternative products. Alternative products emerge as promising substitutes to copper-based antimicrobials in managing citrus fungal diseases for a large-scale use and as promoters of a beneficial fruit microbiome. Furthermore, key information on the microbiome composition of citrus fruit carposphere were uncovered, widening its limited knowledge. An innovative and integrative study approach is proposed by integrating cultivable-dependent and cultivable-independent tools as an effective method to elucidate microbiome potential in disease management strategies. Finally, a collection of high-specialized biological control agents is available for future research.

Advisor:
Prof. Gabriella Cirvilleri

Co-advisor:
Prof. Cristina Restuccia

On **Friday April 5th 2024 at 17.00am** at the classroom **Patrizio Damigella**, Via Santa Sofia 100

Double Degree Candidate With the Federal University of Viçosa

Domenico Fabrizio Nicosia (XXXVI cycle)

Will discuss his PhD theses titled

DEVELOPMENT OF A PLANT-BASED MILK-CLOTTING ENZYME AND A DEBITTERING MICROBIAL CULTURE FOR THE FORMULATION OF HALAL-CERTIFIED HEALTHY CHEESE

Thesis Abstract

In recent years, there has been a significant shift in consumer preferences towards healthier and more diversified food options, with a particular emphasis on products derived from vegetable sources. This evolving trend is driven by an increased awareness of the link between diet and well-being, as well as a growing desire for sustainable and ethically sourced food choices. Consumers are becoming more health-conscious, with a heightened awareness of the impact of their dietary choices on overall well-being. The emphasis on plant-based diets, rich in fruits and vegetables, is supported by numerous studies linking diets to reduced risks of chronic diseases, to improved cardiovascular health, and to enhanced longevity. The modern consumer is increasingly seeking variety and novelty in their food choices, moving beyond traditional products. Vegetable-based products offer a diverse array of flavors, textures, and culinary experiences, appealing to consumers looking to experiment with their senses. The availability of innovative plant-based alternatives to traditional animal products, such as plant-based substitutes, has resulted in significant changes also in the dairy industry. In detail, the dairy market needs the search for animal rennet substitutes, because of the growth of vegetarian's market niche as well as the request for Kosher and Halal foods. The role of milk-clotting enzymes is crucial in cheesemaking; among them, animal rennet is the most ancient milk-clotting enzyme and still the most widely used biocatalyst in cheesemaking procedures. The clotting properties of animal rennet are due to chymosin, an aspartic protease extracted from the abomasum of new-born ruminants with high specificity for cleaving k-casein Phe_{105}-Met_{106} bond. However, the changed perception of the consumer, coupled to a diminishing supply of animal rennet, are responsible of the high demand for alternative milk-clotting enzymes. Several new vegetable sources of milk clotting enzymes have been investigated in the last twenty years and the development of new plants derived milk-clotting enzymes is now in progress. Plant enzymes are generally extracted by aqueous maceration of different plant organs, such as flowers, seeds, roots or leaves, followed by several different homogenization procedures. One innovative milk-clotting enzyme is Actinidin (EC 3.4.22.14), a cysteine protease extracted from kiwifruit (*Actinidia deliciosa*), that represents an interesting alternative to chymosin for milk coagulation. Previous studies demonstrated that the actinidin forms milk clots under the typical conditions used in cheese manufacturing. Nevertheless, plant proteases are characterized by a high proteolytic activity that generates bitter flavours in the final product. To reduce the bitter taste caused by the strong proteolytic activity, strains of Lactic Acid Bacteria (LAB) with high aminopeptidase activity are promising. Specific aminopeptidases (like Pep X and Pep N) are able to hydrolyze the bitter peptides formed during cheese ripening.

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