PhD Project Advertisement

Project title: Reducing Food Loss and Waste in the tomato products food chain

Project Number: FBS2024-026-Patriaca-cr

Lead supervisor: Dr. Andrea Patriarca, School of Water, Energy and Environment, Cranfield University.
Email: Andrea.Patriarca@cranfield.ac.uk

Co-supervisors:
Dr Alexey Mikaberidze, School of Agriculture, Policy and Development. University of Reading.
Dr MariCarmen Alamar, School of Water, Energy and Environment. Centre for Soil, Cranfield University.
Prof. Michele Suman, Barilla G.R. F.lli SpA/Barilla Acceleration Limited UK,

Project description:

Food loss and waste (FL&W) is crucial in achieving a net zero target. In 2011, the FAO estimated that 33% of the world's food production is lost yearly, accounting for 1.3 billion metric tons of food. Food wastage is the third biggest source of greenhouse gas (GHG) emissions, which stem from the energy and resources utilized in the entire food supply chain, encompassing production, processing, transportation, and retailing. Additionally, when non-recycled food waste is relegated to landfills, it increases methane emissions, a highly detrimental GHG. In this context, the UN Sustainable Development Goal 12.3 aims to halve food waste and reduce food loss by 2030.

FL&W occurs alongside the whole supply chain, from primary production through postharvest stages, processing and distribution, and finally, at the consumer level. In the case of fruits and vegetables (F&V), loss and waste amount to 45-55% of the world's production along the supply chain. Fungal diseases are a major contributor to food loss of F&V in pre- and postharvest stages and represent a growing concern in the agrifood sector since control with chemical fungicides is becoming increasingly restricted due to regulations. The impact of fungal invasions transcends primary production stages. It originates an additional source of waste in processing when the species can accumulate toxic metabolites (mycotoxins) in F&V that are not destroyed by thermal treatment.

The presence of several mycotoxins in food and feed is regulated by Food Safety Authorities and Agencies in different countries (FSA, UK; EFSA, EU; FDA, USA). Most food producers and processors are aware of the risk of mycotoxin contamination and suffer the economic impact not only in terms of FL&W but also under the additional costs of handling contaminated waste, testing and monitoring, insurance premiums and litigation. Unfortunately, the food industry faces new challenges every day since emerging mycotoxins are discovered and subjected to monitoring. Scientists and industry must partner in joint research efforts to mitigate these food safety menaces; prevention is vital to reducing FL&W.

Tomato products are a case in which a holistic prevention approach should be consistently applied along the supply chain. Tomato fruits for industry are field-grown and thus susceptible to contamination by various fungal pathogens, such as *Alternaria*. This fungus produces mycotoxins with genotoxic, cytotoxic, and mutagenic effects. Three of the 70 *Alternaria* toxins are recommended to be monitored in the EU and considered for forthcoming legislation, i.e., alternariol (AOH), alternariol monomethyl ether (AME), and tenuazonic acid (TeA). This measure will impact international commerce, affecting the UK and EU members.

Alternaria infects the tomato plant in the field but can continue spreading the disease in postharvest storage even under cold temperatures. When tomatoes are processed, the thermal treatment eliminates the fungus but not their toxins. AOH, AME and TeA have been detected in tomato products worldwide. Therefore, a holistic approach along the supply chain is the best strategy to reduce FL&W and guarantee food safety from field to fork.

The present project proposes developing strategies to reduce the postharvest incidence of the disease and provide early detection of the mycotoxins in the raw material destined for processing, designing baselines for industrial processing. Moreover, the treatment of contaminated waste will be explored for valorisation.

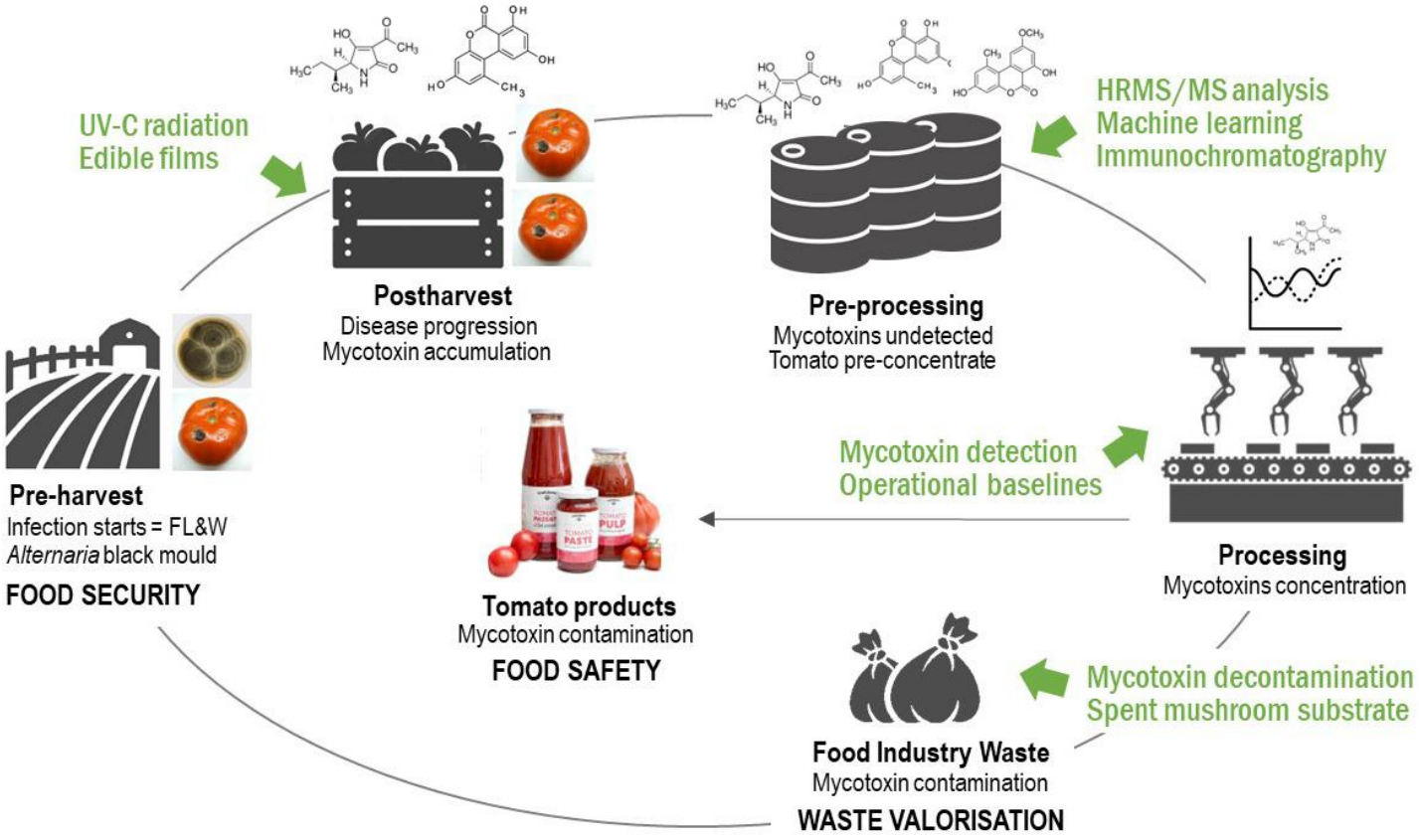

Figure 1. Schematic representation of the project **Reducing Food Loss and Waste in the tomato products food chain.** Text in green indicates areas of intervention across the tomato supply chain to reduce food loss and waste.

Training opportunities:

This project will give the student the unique opportunity to engage with different actors throughout the food supply chain and to train in the Barilla tomato sauce plant in Parma, Italy. The company collaborates closely with local primary producers, who will share their knowledge of agronomic practices and their challenges to combat food losses. The student will interact with technical staff to understand the stages of the tomato process and the influence of processing on mycotoxin contamination. A combination of technical, analytical, and management skills will be acquired.

This project will afford the student comprehensive and multifaceted training, encompassing a broad spectrum of areas. Interdisciplinary research will be developed through laboratory experiments combining mycology, plant pathology, ecophysiology, analytical chemistry, biochemistry, industrial biotechnology, modelling, and machine learning. Finally, a holistic vision across the food supply chain will provide the perfect insight for professional development in the food area for a future industrial, academic, or scientific career.

Student profile:

Students with background in food microbiology, mycology, plant pathology, food chemistry, biochemistry, biotechnology, or related disciplines are welcome to apply for this project. Training will be made available for the areas in which the student needs support. Enthusiastic students with background in the Agrifood sector and willing to develop additional and complementary skills are encouraged to apply.

Stipend (Salary):

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2023/24 this is £18,622 and it will increase slightly each year at rate set by UKRI.

Equality Diversity and Inclusion:

The FoodBioSystems DTP is committed to equality, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website.

In accordance with UKRI guidelines, our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration. **For up to date information on funding eligibility, studentship rates and part time registration, please visit the FoodBioSystems website.**

References:

1. United Nations Environment Programme, 2021. UNEP Food Waste Index Report 2021.
2. Qin Q, Fan Y, Jia Q, Duan S, Liu F, Jia B, Wang G, Guo W, Wang C, 2022. The potential of Alternaria Toxins Production by A. alternata in Processing Tomatoes. Toxins, 14(12), 827; https://doi.org/10.3390/toxins14120827.
3. Puntscher H, Marko D, Warth B., 2019. The Fate of Altertoxin II During Tomato Processing Steps at a Laboratory Scale. Frontiers in Nutrition 6, 92; https://doi.org/10.3389/fnut.2019.00092.