Session 7 – "Muscle biology and Biochemistry"

The role of metabolomics in advancing meat science presented by **Dr. Arvind Subbaraj**, New Zealand

Meat constitutes a globally important food source, and despite recent trends in lab-grown, plant- and insect-based alternatives, meat consumption is projected to increase over 50% by 2050. Meat production and quality are largely driven by on-farm factors such as breed, feed and farm management practices, and post-mortem factors such as storage, ageing, spoilage and display, which ultimately determine consumer preference and post-prandial health outcomes. Technological advancements in meat research across the value chain, including the -omics sciences, therefore aim to propel the future of meat science towards a better understanding of underlying biochemical mechanisms. Metabolomics refers to the unbiased measurement of metabolites i.e., small molecules, in a biological sample and denotes the final readout of cellular activity. A comprehensive coverage of the metabolome, while not exhaustive, comprises polar metabolites such as amino acids, organic acids, nucleosides, amines etc., semi-polar metabolites such as alkaloids, flavonoids, phenolic acids and steroids, non-polar metabolites largely represented by lipids (lipidomics), sugars (glycomics) and volatiles (volatilomics). Mass spectrometry (MS), with or without chromatography systems, is widely used to decipher the metabolome. Current trends in metabolomics technologies include the adoption of non-halogenated solvents for metabolite extraction, multidimensional chromatography, data independent acquisition of fragments, ion mobility for enhanced molecular characterisation, spatial and single-cell resolution of metabolites, tools for data integration (multi-omics) towards a systems understanding, the exponential growth of spectral libraries (e.g. >900K authentic standards in METLIN), and the advent of machine learning for spectral matching and modelling, culminating in assigning activity roles to metabolites that directly modulate a phenotypic response. In this context, metabolomics has found widespread applications in meat science. A map of the beef carcass lipidome has been established; Metabolites discriminating cuts from grass- vs grain-fed animals compared to a plant-based alternative were identified, and their impact on the human plasma lipidome was studied; Consumer preference driven by flavour metabolites showed differential liking of lamb meat by Chinese and New Zealand consumers; Metabolites that control colour stability of lamb meat influenced by ageing, storage and display were demarcated; Volatile fingerprints of different methods of cooking beef were analysed; and metabolite fingerprints have been assessed for various meat quality parameters. These studies along with other compelling cases will be presented to rationalise the role of metabolomics in advancing meat science.



Arvind Subbaraj, PhD, *Researcher at AgResearch Ltd., New Zealand*

Arvind has over 10 years' experience working on metabolomics analyses of the various components of the farm-to-fork value chain, comprising soil, plants, animals, animal products (meat and milk), and their impact on human health. He therefore provides biochemical interpretation of the effects of both on- and off-farm practices on meat quality, and has published research on meat colour stability, flavour, cooking, breed and feed effects, consumer preference and consumption. He will discuss application of metabolomics technologies for meat science in the context of the value chain, and in comparison to plant-based alternatives. As a principal investigator he has led or has been involved in government funded programmes including the National Science Challenge on High-Value Nutrition, Pastoral Genomics, and private sector collaborations with the Meat Industry Association of NZ, Australian Meat Processor Corporation, and NZ-based meat companies. He is currently working on metabolomics applications for sustainable production under climate resilient systems.