Student Lightning Talks - Abstracts

Name of Speaker: Janet Reid

Institutions/Affiliations: The University of Otago; Scion Research

Title: Nanocellulose source and morphology impact the mechanical properties of composite gelatine scaffolds

Authors: Janet Reid, Lyn Wise, Marie Joo Le Guen

Matrix stiffness is a key consideration in cell scaffold design, as the mechanical properties of a scaffold can influence cell migration, proliferation, and differentiation. Though the stiffness of a hydrogel scaffold can be altered by changing the concentration of the matrix polymer or altering crosslinking methods, these changes can come at the expense of scaffold porosity. Nanoparticle reinforced composites offer an alternative method of increasing matrix stiffness, as they can achieve tailorable mechanical properties while maintaining a porous microenvironment. Nanocellulose is a strong, biocompatible nanomaterial that is frequently used as a reinforcing agent in composites. It can have a variety of morphologies depending on its source and production method, ranging from short, rigid nanocrystals to long flexible nanofibrils. This study investigated the impact of nanocellulose source and morphology on the mechanical properties of composite gelatine hydrogel scaffolds. Kelp nanocellulose with a high aspect ratio produced the greatest increase in scaffold stiffness: a nanocellulose content of 0.25% produced 6-fold increase in compression modulus compared to neat gelatine, and 14-fold increase was achieved when nanocellulose content was increased to 1%. A smaller reinforcing effect was achieved with nanofibrils derived from a red *Agarophyte* seaweed, and wood-derived cellulose nanocrystals produced the lowest increase in stiffness. Finally, nanocellulose/gelatine composite microgels were successfully fabricated, indicating that these materials could be used to produce cell microcarriers or granular hydrogels with tailorable mechanical properties.

Name of Speaker: Emma Muir

Institutions/Affiliations: Massey University; Cawthron Institute.

Title: Self-aggregation for sustainable harvesting of microalgae for food applications

Authors: Emma Muir, Benoit Guieysse, Maxence Plouviez

Microalgae are a great source of vitamins, pigments, proteins and biologically active compounds. Species we consume include *Spirulina* and *Chlorella*, while others are also cultivated for pigments and vitamin production. However, commercial production of microalgae remains limited by costs and difficulty to scale. One reason is that cell-cell repulsion keeps microalgae suspended at low densities, and intervention is required to concentrate biomass for harvesting. Preconcentration steps, such as gravity sedimentation, are used prior to dewatering by filtration or centrifugation. Often, these methods are aided by chemical flocculation to improve efficiency. This can be costly, and the most efficient chemical flocculants are often unsuitable for food applications, due to contamination of biomass with metal compounds such as aluminium or iron. Self-aggregation has been proposed as a sustainable and economic alternative for chemical flocculation. Abiotic (e.g. pH) and biotic (e.g. predation) can trigger self-aggregation where single-celled microalgae form multi-celled colonies. If triggered on demand, the increased size of colonies would facilitate gravity-based harvesting processes without requiring expensive and contaminating chemical flocculants. Focusing on predation response, we produced extracts from dried *Daphnia* which triggered self-aggregation in the model *Chlamydomonas reinhardtii*. Our results confirmed that predator infochemicals successfully trigger self-aggregation in C. *reinhardtii* (up to 89%) and could be used as "bio-flocculants", replacing traditional flocculants to aid microalgal sedimentation at lower economic and environmental costs. Our current and future research focusing on infochemical characterisation, transcriptomics and metabolomics of aggregated cells will provide much needed knowledge about the infochemicals and the cellular mechanisms involved, respectively.

Name of Speaker: Yuan Wang

Institutions/Affiliations: The University of Auckland; Riddet Institute

Title: Development of plant-based 3D printed scaffolds for bovine satellite cell maturation in cell-based meat production

Authors: Yuan Wang, Jake Oh

Tissue engineering scaffolds are crucial for cell-based meat production as they provide a three-dimensional environment for cell attachment, proliferation, and differentiation. Sustainable and edible materials, as well as suitable fabrication methods, are significant concerns in cell-based scaffold research. In this study, we utilized plant proteins as bioinks and an extrusion-based 3D bioprinter to create suitable scaffolds for bovine satellite cells (BSCs) maturation. Plant protein solutions with different concentrations were first heated in water bath to form hydrogels and then working as bioinks during printing. The printing parameters were adjusted and optimized multiple times, based on different concentrations of bioinks, and a specific concentration of protein bioink achieved a highly organized scaffold structure, exhibiting good stability in an aqueous environment. Moreover, BSCs successfully adhered to and proliferated on the scaffold. Overall, these results demonstrate the potential of plant-based bioinks in creating stable and functional scaffolds for cell-based meat production, providing a sustainable alternative for future food technology advancements.

Aotearoa New Zealand
Cellular Agriculture Symposium 2025

Name of Speaker: Ang Jin

Institution/Affiliation: University of Canterbury

Title: Interaction between novel plant protein and satellite cells for cultured meat production

Author: Ang Jin

This study explores the hypothesis that plant proteins, enriched with positively charged amino acids and RGD peptides, enhance cytoaffinity by promoting the attachment of negatively charged satellite cell membranes. Elucidating the mechanisms of cell adhesion to plant proteins could inform the development of plant-based scaffolds and edible microcarriers for cultured meat production. This research assesses the adhesion properties of various plant proteins relative to collagen type I, using immortalized bovine satellite cells. Findings indicate that most tested plant proteins exhibit adhesion capabilities comparable to collagen type I, with peanut protein as a notable exception. Additionally, certain plant proteins support the differentiation of immortalized bovine satellite cells without disrupting cell sheet integrity. Proliferation rates on these plant-derived substrates were also evaluated. Future investigations will explore the synergistic effects of combining multiple plant proteins and their efficacy in 3D microcarrier culture systems. These results highlight the potential of plant-based scaffolds in tissue engineering and cultured meat production, advancing sustainable and ethical food solutions.

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Name of Speaker: Steffi Thomas

Institutions/Affiliations: University of Otago; The New Zealand Institute for Plant and Food Research Limited; AgResearch

Title: Application of cold-plasma to advance New Zealand's cell-based protein industries

Author(s): Steffi Anna Thomas, Sravani Gupta, Graham C. Fletcher, Gale Brightwell and Phil Bremer

Cellular agriculture faces several key challenges, including the cost of large-scale manufacturing using food-grade growth media, the vulnerability of cell lines to contamination, and the stringent food safety testing protocols. This research introduces a novel application of cold atmospheric plasma technology to address the challenges of contamination in cell culture that currently pose multifaceted and costly hurdles for cellular agriculture.

Cold atmospheric plasma, a technology which has applications in medical science, is being explored to promote healthy cell growth while simultaneously eliminating contaminants from cell cultures. This approach centres on plasma-activating cell cultures and media during the manufacturing of cell-based protein foods, eliminating the need for antibiotics to ensure sterility.

The research aims to provide valuable tools for the sustainable development of New Zealand's cell-based food sector, focusing on chemical-free, antibiotic-free methods that appeal to environmentally and health-conscious consumers. By leveraging the unique properties of cold plasma, the study seeks to contribute towards development of methods and process to improve food safety in cellular agriculture.

The challenge lies in identifying and generating optimal plasma chemistry to maximize antimicrobial activity while minimizing adverse effects on cell media and lines. This research promises to unveil fresh insights into cold plasma chemistry, offering potential applications across the food, veterinary, and health industries, thereby facilitating diverse adoption.