Building a cell line engineering toolkit for Cellular Agriculture

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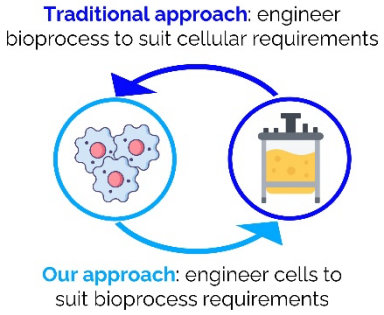
Project term: October 2024 – September 2028

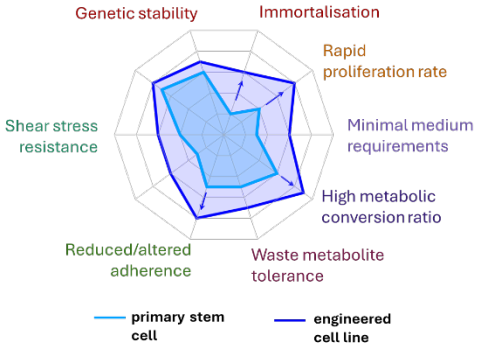
Description:

Cultivated meat seeks to develop alternative animal cell based food products that are environmentally friendly, ethically produced, and capable of faithfully replicating the flavour and nutritional profiles of conventional meat. Given that cattle production is among the least sustainable sources of animal protein [1], significant research and development efforts over the past decade have focused on creating efficient bioprocesses for bovine cultivated meat production. Primary adult stem cells are particularly promising for this application due to their accessibility and ability to differentiate into mature tissues like muscle and fat [2]. However, they present several challenges for large-scale culture, including limited lifespan in vitro, dependence on nutrient-rich and costly media, and an adherent phenotype, among others [3].



The advent of CRISPR/Cas technology has significantly advanced the field of genetic engineering, enabling the development of highly efficient and precise genome-editing strategies. While the potentially revolutionary impact of these tools for cell and gene therapy applications is well-recognised, their application to cultivated meat is lagging, largely due to strict regulatory frameworks for gene-edited novel foods in key regions such as the European Union.

My PhD project aims to test, optimise, and implement cell line engineering techniques using CRISPR/Cas (nuclease, base, prime and epigenetic editing) and recombinase technologies in bovine satellite cells. The goal is to tailor cell properties to meet the demands of the cultivated meat production bioprocess by modifying, silencing, or inserting genes that enhance cell growth under scalable conditions and contribute to a reduction in cost. Engineered cell lines with multiplexed genetic modifications will serve as critical tools for advancing downstream steps, including large-scale cell proliferation, differentiation and product development.



References:

[1] Global Salmon Initiative (GSI) Sustainability Report. Available from http://globalsalmoninitiative.org/sustainability-report.

[2] Martins, B., Bister, A., Dohmen, R. G. J., Gouveia, M. A., Hueber, R., Melzener, L., Messmer, T., Papadopoulos, J., Pimenta, J., Raina, D., Schaeken, L., Shirley, S., Bouchet, B. P., & Flack, J. E. (2024). Advances and Challenges in Cell Biology for Cultured Meat. Annual review of animal biosciences, 12, 345-368. https://doi.org/10.1146/annurev-animal-021022-055132

[3] Riquelme-Guzmán, C., Stout, A. J., Kaplan D. L., Flack, J. E., Unlocking the potential of cultivated meat through cell line engineering, iScience, Volume 27, Issue 10, 2024, 110877, ISSN 2589-0042, https://doi.org/10.1016/j.isci.2024.110877.