

Master Thesis Opportunity

“CRISPR-Cas9 and nutrition: developing a DMT1-knockout Caco-2 model for iron absorption studies”



Iron deficiency remains the most prevalent micronutrient deficiency affecting the lives of ~2 billion people. The use of novel approaches involving nutrient-dense sources is a promising way to reduce the prevalence and burden of iron deficiency. Microalgae are photosynthetic microorganisms that are nutrient-dense sources of protein, lipids, minerals, and vitamins. As such, they have the potential to reduce micronutrient deficiencies and nutritional anemias. To understand iron absorption from foods, the most widely used in vitro model is the Caco-2 cell line. Various transporters (e.g., DMT-1) and proteins are involved in intestinal iron absorption, which are utilized depending on the iron form in the food source.

And that's where your contribution will be important!

In this Master's thesis, you will help develop a DMT1-knockout Caco-2 cell model using CRISPR-Cas9. This cell line will then be used to investigate how intestinal cells absorb iron from microalgae grown in our laboratories and from selected commercial microalgae biomass.

The project will be structured in clear experimental milestones, from Caco-2 cell culture and CRISPR design to clone screening and validation. You will receive close supervision and support at every step, along with training in the required techniques.

The expected outcome is a validated or partially validated DMT1-deficient Caco-2 model and first experiments assessing whether DMT1 contributes to iron uptake from selected microalgae samples.

The project is highly focused on nutrition and molecular biology techniques.

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Your background:

- Interest in nutrition, intestinal absorption, molecular biology, or cell culture
- Basic laboratory experience and willingness to learn new techniques
- Previous experience with cell culture, PCR, Western blot, or CRISPR-Cas9 is an advantage, but not required
- Careful, reliable, and curious working style 😊

What you will learn:

- Mammalian cell culture using Caco-2 cells
- CRISPR-Cas9-based gene knockout strategy
- PCR-based clone screening
- Protein-level validation by Western blot
- Iron absorption assays in intestinal cell models
- How molecular biology can answer nutrition-related questions
- *In-vitro* human digestion with INFOGEST 2.0
- Experimental planning

Logistics

- Most of the work will be conducted in the SLA building of ETHZ in Schwerzenbach
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Start Date: September or when mutually agreed

Groups involved

- Nutrition and Metabolic Epigenetics Laboratory - Prof. Ferdinand von Meyenn
- Sustainable Food Processing Laboratory – Prof. Alexander Mathys
- Supervision: Dr. Fengzheng Gao and Agon Besimi

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