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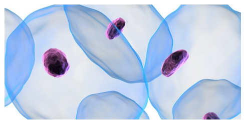

Quantitative analysis of an individuals diet on their metabolism and health 2: Glucose levels

Supervisors: Maria Suarez Diez, Robert Smith

Contacts: maria.suarezdiez@wur.nl + robert1.smith@wur.nl

Type of thesis: Computational

Required competences: Knowledge of ordinary differential equations (ODEs), their analysis, and ability to simulate systems in MATLAB or Python are desired skills.

Acquired competences: Model analysis and reduction methods. Parameter sensitivity analysis. Relating simulations to experimental data and understanding how to derive experimental hypotheses from models.

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Description

Diets and food consumption have a large impact on human metabolism. The wrong diet and the associated metabolic changes can lead to adverse individual health consequences and, on a larger scale, cause society-level issues. The levels of glucose in blood plasma provide a good readout of metabolic changes and are predictive of the later health status of individuals. Consequently, we are interested in understanding how diet regulates blood plasma glucose levels through metabolic pathways and how metabolic pathways can be altered to provide "healthier" levels of glucose in the body. To do this we will use a computational modelling approach.

This project will comprise of three key tasks: First, by using and simplifying a published model of blood plasma glucose levels, we wish to know which reactions in the metabolic pathway have the largest impact on glucose dynamics (parameter sensitivity analysis). Second, given data from individuals, can the simplified model be fit to the data, finding metabolic rates/fluxes for an individual and providing a means of comparing different individuals metabolic systems. Third, given the metabolic profile of an unhealthy individual, could experiments (either by targeting metabolic pathways or changing the model inputs/individuals diet) be designed that may yield healthier levels of glucose in the individual. The results of this project will help inform future studies and experiments in this area.

References

Pratt AC, Wattis JAD, & Salter AM (2015) Mathematical modelling of hepatic lipid metabolism. *Mathematical Biosciences* **262:** 167-181.

Sips FLP, et al. (2015) Model-based quantification of the systemic interplay between glucose and fatty acids in the postprandial state. *PLoS ONE* **10:** e0135665.

O'Donovan SD, et al. (2019) A computational model of postprandial adipose tissue lipid metabolism derived using human arteriovenous stable isotope tracer data. *PLoS Computational Biology* **15:** e1007400.