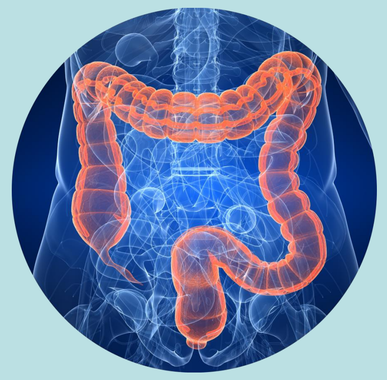
eGUT: a Predictive Tool to Understand Gut Microbiota and Host Interactions



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There has been an explosion of research into the gut microbiota with many fascinating findings.

Animal models are often used in this research, but there are a number of disadvantages of animal experiments. **We aim to reduce or replace animal experiments with computer simulation**.

Advantages of *in silico* experimentation over animal experiments:
- fully controlled conditions, complete information
- consequences of assumptions/hypotheses can be examined
- scaling/translation of results from one animal to another
- everything is feasible – no ethical, technical or resource constraints

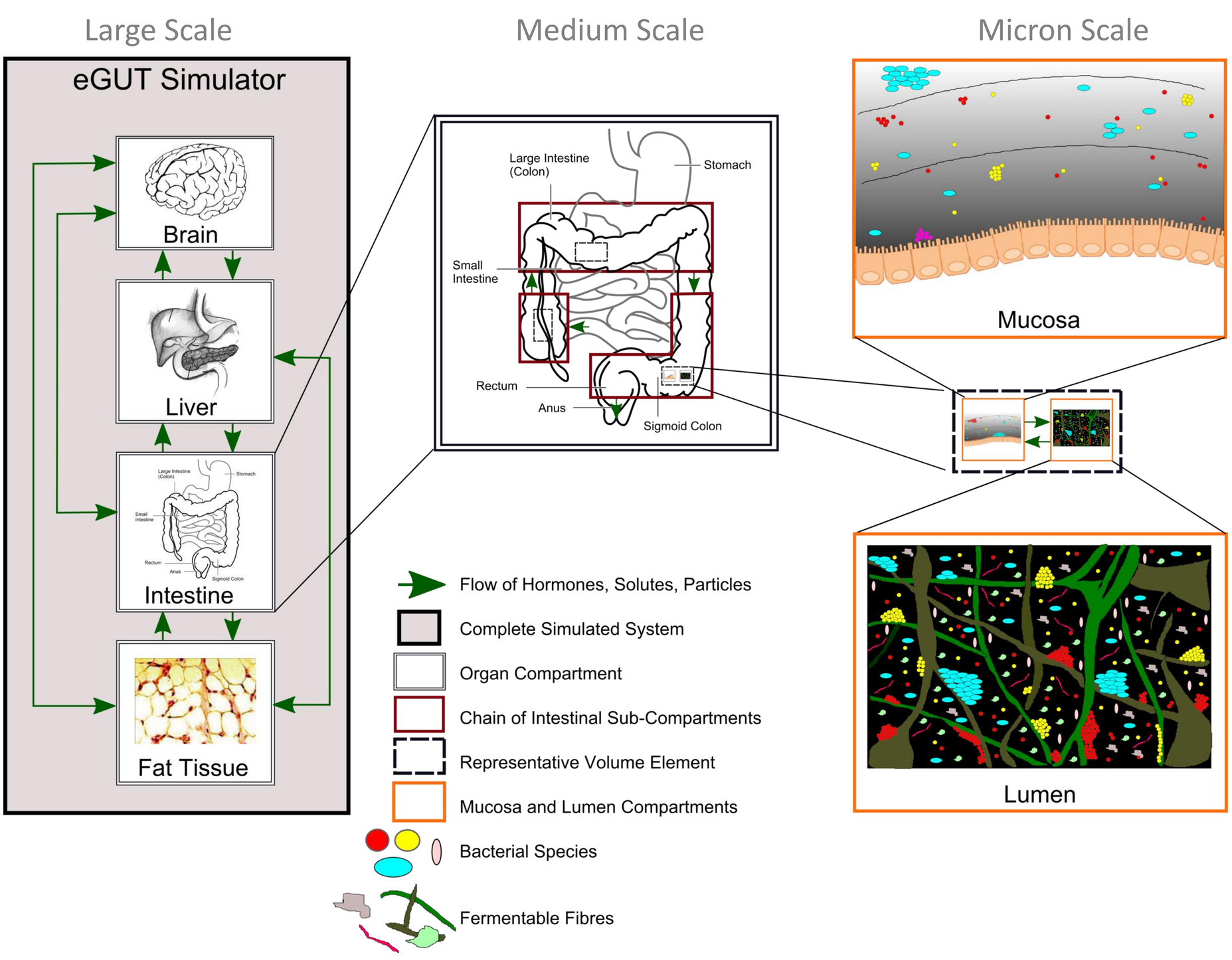
We are in the process of constructing ***eGUT***, **a predictive computer simulation tool** for gut microbiota and host interactions. This generic simulation platform is being developed using an **agent-based** modelling technique that allows us to capture the activities of individual microbes of various species, to determine how population dynamics, gut metabolism, and so on emerge from interactions between the individuals and the environment.

We aim to first validate specific applications of the simulator against laboratory models, and are seeking collaborators for such validation or for validation against animal models or human volunteer studies.

eGUT will be open to the scientific community and enable non-mathematicians to run virtual, *in silico*, experiments. We will also teach the use of ***eGUT*** in workshops.

eGUT is meant to reduce and replace animal experiments in studies similar to previously validated applications.

The Developing Structure of *eGUT* - the electronic GUT (initially metabolism focussed)



- ***eGUT*** will build upon our previously published tool iDynoMiCS [1], an individual-based model of biofilm formation.
- We consider the hierarchical structure of compartments linked by exchange of metabolites, signals and microbes.
- Non-gut compartments (e.g. Brain) will be treated simplistically - as a mixed compartment with metabolism and signalling and exchange with other compartments.
- Such compartmentalisation will enable us to simulate the relevant organs of the whole system – the body – for example the Gut-Brain axis.
- A gut compartment will be scaled up from representative volume elements.
- Simulated mucosal activities will include nutrient uptake (e.g. SCFA), as well as digestive enzyme and mucin secretion.
- Through a chain of sub-compartments, it will be possible to simulate all gut regions of interest.

eGUT: a Call for Collaboration

We are offering early collaborators their say in the development of the *eGUT* tool. In return we will offer training on applying ***eGUT*** in future microbiota research.

For More Information:
- Web: www.egut.org.uk
- Email: j.kreft@bham.ac.uk
- Kreftlab: www.tinyurl.com/kreftlab

References

[1] Lardon LA, Merkey BV, Martins S, Dötsch A, Picioreanu C, Kreft JU, Smets BF (2011). iDynoMiCS: next-generation individual-based modelling of biofilms. Environmental Microbiology 13: 2416-2434

iDynoMiCS - individual-based Dynamics of Microbial Communities Simulator

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