What it's about…

*Developing a miniaturized model of the human gut that aims at screening food products for their ability to modulate our metabolic and immune system.*

Context and project goals

The NutriChip project’s goal was to develop an integrated platform to investigate the potential of immunomodulation properties of dairy products. The NutriChip would provide steady-state culture conditions that mimic the in vivo fluid flow and shear stress in controllable manner, thus bringing the gut in vitro model closer to the physiological micro-environment.

How the project differentiates from similar competition in the field

The consortium is not aware of a translational nutritional academic project that covers so widely the research fields of food and nutritional sciences, additionally complementing these fields with work on imaging hardware, software and chip technologies.

Quick summary of the project status and key results

An *in vitro* Gastro Intestinal Tract (GIT) model was established, consisting of a co-culture of an intestinal cell monolayer, which acts as a barrier mediating the active transcellular transport of nutrients, and macrophages, which act as sensors for the presence of immunomodulatory molecules secreted by the epithelial cells. Using this model, it was possible to differentiate between the immunomodulatory properties of meal rich in saturated fat and milk. The same cell lines used in the Transwell model have been successfully cultured on chip. A Complementary Metal Oxide Semiconductor (CMOS) technology-based camera was custom-built and a full CMOS image sensor was designed. The realized image sensor was successfully tested and a second prototype that is now larger in terms of pixels was designed. The team has also implemented on a Field-Programmable Gate Array (FPGA) the algorithm developed for quantitative estimation of biomarkers related to postprandial inflammation in order to move toward the possibility of a real-time acquisition of such kind of data. The researchers performed a postprandial inflammation human study after ingestion of a high fat meal by obese and lean individuals.

Patent

Success stories

In the context of the research program 2014-2017, the project partner Agroscope has created, as of 01.01.2014 a new domain of competence “Functional Nutritional Biology” that will be headed by Guy Vergères and that aims at identifying lactic acid bacteria that ferment milk to products with enhanced nutritional properties. This would not have been possible without the pioneering work conducted in the NutriChip project.

Agroscope has also signed a research agreement with CHUV, which also not have been possible without the results obtained on human nutrition and dairy products in the NutriCip project.

The article by Ramadan et al., published in Lab-on-chip, was recently selected by researchers from the Boston area (Harvard, MIT) in a review highlighting important developments in the microfluidic sciences. It was mentioned as ‘Research Highlight’ in Lab on a Chip 13, issue 15 of August 7th 2013.

Presence in the media:
Guy Vergères was cited in an article in Le Temps “Je m'alimente selon mon génome”

Main publications


J. Ghaye, G. De Micheli, S. Carrara, Quantification of Sub-Resolution Sized Targets in Cell Fluorescent microscopy, IEEE BioCAS proceedings


Güzen Köklü, Julien Ghaye, Ralph Etienne-Cummings, Yusuf Leblebici, Giovanni De Micheli, and Sandro Carrara, Characterization of standard CMOS compatible photodiodes and pixels for Lab-on-Chip devices, IEEE ISCAS 2013 (Beijing), pp. 1075 - 1078

Güzen Köklü, Julien Ghaye, Yusuf Leblebici, Giovanni De Micheli, Sandro Carrara, Empowering Low-Cost CMOS Cameras by Image Processing to Reach Comparable Results with Costly CCDs, BioNanoScience, in press


G. Vergères, Nutrigenomics - linking food to human metabolism, Trends in Food Science & Technology, Volume 31, Issue 1, May 2013, Pages 6–12