

FOOD AND GUT HEALTH (FGH)

1. OBJECTIVES

- Diet has a major impact on human health and well-being, and is increasingly recognized as important in prevention of chronic diseases, especially in ageing populations.
- Modern food ingredient and product development, based on scientific substantiation of physiological effects, plays a key role in supporting a healthful society.
- Documentation of the functionality of foods and development of food product in relation to gut health is difficult, as diet influences, *via* different mechanisms, at many levels of physiology and metabolism.

This long-term collaborative initiative will develop new approaches and tools to investigate the effects of foods on our well-being, utilizing food product modification and novel ingredient development, mechanistic studies, predictive assays and biomarkers for toxic and health effects, and clinical trials as the final proof of the effect in human.

Specifically, we aim to explore the influence of food factors on gut-host symbiosis synergy in health and disease. This work combines the scientific background of all members of the Food for Health group, each having complementary expertise.

2. EXPECTED ACHIEVEMENTS

1. The immediate outcome of this collaborative effort will be submission of an ITF and CRF application within 12 months from allocation of the fund.
2. By focusing our work on this topic, utilizing the seed money, and then by gaining and utilizing external funding such as ITF, and by the addition of further expertise through future hiring, we will strengthen our group towards later application for more highly competitive grants at local (e.g., theme-based research together with the staff members from the faculty of medicine, AOE) and international level (EU Horizon 2020).
3. The FGH will synergistically combine the expertise of members of the SRA on Food for Health working on the interface of food and health research, around the common theme of the gut microbiome in health and disease. The combined efforts will produce new skills for designing and bioprocessing foods with tailored behavior and metabolism in the gastrointestinal tract.
4. New understanding of the importance of food components and structure to the nutritional and health value of foods and new biomarkers for identifying the physiological and health effects of foods will be established.
5. This collaborative effort will catalyze our efforts towards a long-term effort in interdisciplinary research in food and nutritional sciences at international level. This enhanced quality research environment will attract new postdoctoral researchers and graduate students who will further strengthen our program in SBS.

3. PLAN

The overall research for the FGH theme will be carried out in two parts. There is significant synergism and overlap among these groups at all levels, e.g. new ingredients with modified structures will be used as samples for the *in vitro* and *in vivo* mechanistic studies and flow into the microbiome studies. It is important to note that this work sets the stage for the long term planning of the whole program and is not restricted to the current funding cycle. With the funding received we will be able to address and focus on several aspects extracted from the listed work that will provide sufficient preliminary data for the joint ITF application.

Phase 1. Transformed phytochemicals through fermentation: feeding into microbiome studies (HC, NPS, MW, Jimmy).

In addition to macronutrient components, food also contains other valuable ingredients such as probiotics, prebiotics and phytochemicals. It is necessary to evaluate the health benefits of these non-traditional nutrients in foods and evaluate their impact on the reduction of toxicant formation. Identification of genetic variations in composition of e.g. resistant starches or polyphenolic antioxidants is followed by processing steps (such as *Lactobacillus* fermentation) that can transform them into more biologically active forms. Detailed mechanistic studies of processing and the chemistry of the transformations is essential in order to optimize development of bioactive materials. This will provide a flow of novel materials into the microbiome studies in Part 2, initiated through this funding and hopefully continued through ITF support.

Phase 2. Interactions between the host and intestinal microbiome in health and disease in response to the transformed phytochemicals (JL, JW, Jimmy, ELN, ETS, HC, NPS, MW)

The gut microbiota is the microbial population that resides in the gastrointestinal tract. It is now widely accepted that the whole community composition, in addition to some particular bacteria, influences the differentiation of the T cell subpopulation in the intestine and expansion in the lamina propria. In relation to cancer it is known that some infectious agents, including *Helicobacter pylori* as well as hepatitis B and C viruses, contribute to carcinogenesis. Overgrowth of certain bacteria that may induce cancer-promoting inflammation is often controlled by regulatory T cells (Tregs) that produce the anti-inflammatory cytokines IL-10, which could be induced in peripheral tissues, such as the gut. In this study, we will evaluate the efficacy of natural and modified food components on selected diseases of importance to Hong Kong population (e.g., Hepatocellular carcinoma, colon cancer, and type-2 diabetes). We will apply whole genome shotgun metagenome sequencing to develop a molecular roadmap of the interactions between the diet-modulated gut microbiota and their metabolic products with the T-cell differentiation, secretion of anti-inflammatory cytokines and HCC/colon tumorigenesis and atherosclerosis/diabetes progression. Members of the food for health are actively working on different parts of this challenging topic and hence the tools to achieve the targets of this work package are readily available.

At this stage, further collaboration will be developed with other researchers in microbial population ecology (e.g., Fred and Gianni) and with clinical researchers in the Faculty of Medicine who are developing an interest in food and nutrition.

3. PROPOSED BUDGET

Manpower (RA)	150,000
A research assistant, Mr. Gan Renyou (Ph.D. thesis submitted, Nov. 2015; if appointed, will be appointed as a RA, not as a postdoc), who has already collaborated with several members of the group [HC, NPS, MW) or other suitably qualified RA will work immediately on methods development, data collection and information collection in support of forthcoming ITF application. This will enable targeted submission of one of the key outputs of this work on time in June, 2016.	
Consumables	
(for genosequencing, cell assays, omics, bioinformatics)	110,000
(for bioassays, end points, sensory evaluation)	40,000
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Total	300,000
Contribution from the group (10K each),	80,000
Grand total for the project	380,000