

## **KEY BBSRC RESEARCH CHALLENGES IN FOOD, NUTRITION AND HEALTH**

### **1. To establish how food and nutrition can optimise health and reduce disease risk**

- by defining 'healthy' (metabolic homeostasis) and identifying early indices of unhealthy (metabolic dysregulation) states that are modifiable by diet
  - *Understanding the molecular and cellular signatures of metabolism and their dynamics, and responses to stress in a healthy state*
  - *Using the healthy state as a comparator to identify and characterise early-stage homeostatic disturbance*
  - *Determining how nutrition and nutritional status contributes to resilience at cellular, tissue and whole body levels*
- by defining and understanding how dietary needs and responses to dietary intake change across the life-course
  - *Understanding and quantifying nutritional needs at critical times in the life-course and for specific population groups*
  - *Understanding how nutritional modulation of early life events and other critical developmental stages influence later life health outcomes*
  - *Conducting mechanistic analysis to test hypotheses generated by epidemiological and prospective cohort studies*

### **2. To understand how diet interacts with external and internal factors to modulate phenotypic responses that influence health**

- by understanding how nutrients regulate key cell functions, including proliferation, apoptosis, DNA repair and cell-to-cell signalling
  - *Understanding nutrient sensing at the cellular level, and its consequences for cellular, organ and behavioural decision-making*
  - *Understanding the mechanisms through which energy balance, nutrients and bioactive compounds modulate gene expression*
- by understanding the contribution of genotype to individual responses and diet and health outcomes
  - *Understanding the interactions of phenotype, genotype, microbiome and diet*
- by characterisation and mechanistic analysis of the gut microbiome
  - *Understanding nutritional modulation of the gut microbiome*
- by understanding the role of biological rhythms in determining responses to diet and subsequent health outcomes
  - *Understanding mechanisms of metabolism "fine-tuning"*
  - *Understanding nutritional physiology*
- by understanding the impact of lifestyle on dietary choices and health responses
  - *Impacts of modern lifestyle characteristics - including shift-work, artificial light exposure, sedentary behaviour and meal patterning*

### **3. To understand the contribution of dietary patterns, individual nutrients, whole and processed foods and food structures to promoting and maintaining health**

- by using systems biology and imaging approaches to study responses to foods and diets
  - *Emphasis on systems-based approach; appreciation of complex interactions rather than reductionist analysis*
  - *Understanding food behaviour in the gut*
  - *Understanding the relationship between biofortification and bioavailability*
- by providing robust evidence of the mechanisms of action for bioactive components within foods, which can be translated to human models
- by understanding functional characteristics of gut receptors, including interaction with micro and macro nutrients and effects on satiety
- by understanding the role of the gut microbiome in the metabolism and biological activities of food, and on endocytic-immune interactions
- by manipulating the physical and chemical structures of foods and evaluating metabolic and neurological responses

### **4. To understand the behavioural responses and attitudes toward food, nutrition and health**

- by understanding the determinants of palatability and flavour preference
  - *Understanding the process by which flavour preferences are learned and modified over time*
  - *Establishing sensory/textural determinants of food choice with a focus on understanding the acceptability of low-sodium/fat foods*
- by understanding the formation of unhealthy dietary habits and behaviours
  - *Evaluating determinants of food reward and understanding its underlying neurobiology*
  - *Understanding how early-life experience influences behavioural responses to unhealthy and healthy foods in adulthood*
- by understanding controls of meal size and overconsumption
  - *Understanding how environmental cues promote overconsumption*
  - *Understanding determinants of portion size and dietary decision making, and effects on meal size and satiety*
- by understanding “top-down” and/or cognitive controls of dietary behaviour
  - *understanding barriers to sustained behaviour modification through evaluation of successful and unsuccessful dietary restrictions*
  - *Understanding the role of memory and attentional processes in appetite control*

## **Key research technologies & opportunities**

- Biomarkers
- Epigenetics
- Metabolomics
- Transcriptomics
- Proteomics
- Genomics
- Cell biology
- Imaging; particularly gut and brain
- Cellular mechanisms of epigenetic effects
- Personalised nutrition
- Diet-gene interaction analysis
- Systems biology approaches; recognition that mechanistic analysis can go beyond the molecular
- Co-ordination of high-throughput technologies for effective mechanistic studies
- Making use of existing knowledge around dietary choice in animals
- Integration and iteration of model systems with human intervention studies
- Link to socio-economic influences
- NIHR Clinical research Infrastructure