Meet the Early Stage Researcher - Nikki Cassie

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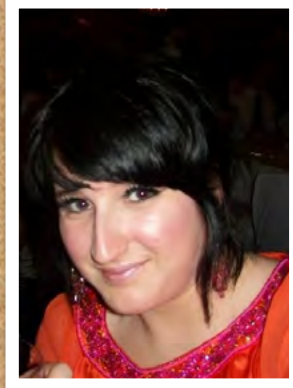

I am a PhD student in the Obesity and Metabolic Health theme at the Rowett Institute of Nutrition and Health, University of Aberdeen, Scotland, under the supervision of Dr Perry Barrett and Professor Julian Mercer. We are researching gut-brain interactions in the regulation of hunger and satiety. Our aim is to investigate the impact of food structure and macronutrient content on the activation of neurones in the primary afferent areas of the brain responsible for receiving signals of GI origin.
More research is needed into how food components promote satiation and satiety. The prospect of discoveries contributing to reduce food intake, thereby alleviating the problems of over-consumption such as obesity, and reducing pressures on food resources, is very exciting.

Gut Feeling

What is the problem this research is addressing?

When we feel hungry we eat, but what makes us stop eating and does it matter if the food we eat is a substantial dinner, or a milkshake, even if the calorie content is the same?

The current obesity epidemic comes with major consequences for health and the economy and is the leading cause of preventable premature death worldwide. In the absence of efficacious drug treatments and with surgical interventions currently being inappropriate for the majority of the overweight population, focus remains on diet and lifestyle strategies. It is widely recognised, however, that attempts at weight management through reducing the amount of calories consumed, while often effective in the short term, are generally not a long term solution as participants return to their previous habitual dietary intake, in terms of both quantity and composition. This has led to more interest in the concept of weight control by reducing appetite and energy intake, through manipulating the satiation and satiety properties of the food we consume. Such dietary manipulation could be viewed not just as treatment for obesity but also potentially as a preventative measure.

What research are you undertaking in Full4Health?

This research is investigating whether different macronutrients, and the form in which they are presented, may affect the satiation and satiety properties of ingested food. Diets high in fat, protein or carbohydrate will be presented as a solid meal, or exactly the same diet will be presented in a liquid form. In order to minimise variability, diets are based on a defined commercial diet but vary in the content of fat or protein at the expense of the carbohydrate component.
Food intake, body weight and body composition of rats fed high protein, high fat or high carbohydrate diets in either solid or liquid formulation are being recorded. The potential of macronutrients and food structure to influence satiety is being assessed using induction of *c-fos* - a marker for neuronal activation. *c-fos* is being assessed in the hindbrain and in the hypothalamus, two key areas of the brain involved in regulating food intake. Furthermore the repertoire of hindbrain genes involved in satiation/satiety processes is not known. To this end we are seeking to use laser capture microdissection coupled with high throughput sequencing to identify gene expression changes in the hindbrain following ingestion of a meal.

What is already known about the topic?

The gut is the first organ that receives food after ingestion and communicates to the brain information on the size and the composition of the meal via two types of signals. First, there is activation of vagal afferent nerve cells which respond to mechanical stimulation. This sensory mechanism provides information about the volume of food consumed. Second, peptide hormones are released from cells which line the gut following the sensing of the nutrients present in the food. These hormones, which include GLP-1, PYY and GIP, are secreted by enteroendocrine cells of the gastrointestinal tract and act either at local vagal afferent nerves connecting the gut to the hindbrain, or via their release into the bloodstream where they influence the activity of hindbrain and other areas of the brain involved in sensing food intake. Satiation and satiety signals gathered during eating are conveyed to the hindbrain and are integrated before further signalling to integrating centres in the hypothalamus and other regions of the brain.

Food composition is important for satiation and satiety; for example we know that diets high in protein tend to reduce the feeling of hunger, but we don't yet understand how the relationship between food composition and structure impacts on satiation and satiety, with respect to body weight and composition. Therefore more research is needed to establish the effectiveness of food in regulating hunger and appetite through gut-brain communication pathways.

What do you hope will be the major outcomes?

We hope to identify and characterise the neural and molecular mechanisms that are integrated in the brain's regulation of hunger and satiety, and the role of dietary macronutrients and food structure. The food-gut-brain axis is still not yet fully understood and by understanding the role of food structure and macronutrient content on neuronal activation and signalling in the caudal brainstem, we may be able suggest ways in which the food industry might manipulate food to increase satiation and satiety properties, identifying routes to preventing excess energy intake and providing the general public with better food choices for a healthier lifestyle.