A developmental factor in a fly regulates feeding and circadian rhythm

Deimantė Barkauskaitė

The neuroscience field was established more than 100 years ago and has been greatly studied ever since. However, it is still not clear how peripheral signals are integrated centrally to control macronutrient selection. The macronutrient selection is especially important in starvation, during which the selection changes. That is, during chronic starvation the macronutrient selection is increased, and food such as fat and bitter-tasting food are consumed. Therefore, it is important to understand how the food selection is controlled in order to understand the exact pathways that control metabolism.

Mental disorders are known to be closely associated with metabolism and sleep behaviour. However, the regulation of these behaviours in humans and rodents is very complicated. In humans, one of the key factors that increase feeding during starvation is called neuropeptide Y, and it is known to play a conserved role in feeding across many model organisms. However, it is not clear how neuropeptide Y (NPY) is regulated. Moreover, vasopressin, another neuropeptide, is known to be involved in water retention and blood pressure regulation in humans, and its role in feeding has not been clearly defined. In mice and rats, vasopressin was shown to regulate feeding, implicating the possible role in feeding regulation in humans.

To unravel how sleep and metabolism are regulated, and how NPY is controlled, we employed a fruit fly model organism. The fruit fly is a robust model organism which has 10 million times less neurons than humans. Flies have a highly conserved nervous system, with many of their neuronal signalling pathways found in humans. In addition, flies have a similar food preference to humans, preferring carbohydrates and proteins over fats, as well as the avoidance of bitter-tasting food. Furthermore, flies are diurnal, they anticipate morning and evening, and they sleep at night and take a midday siesta.

In this study, we found that a vasopressin homologue in a fly, known as Crustacean cardioactive peptide (CCAP) is involved in the metabolism regulation in flies, and it regulates such a response via a NPY homologue, known as neuropeptide F (NPF). We assessed how the fly behaves during starvation, and CCAP appeared to be essential in increasing the feeding response during starvation. We found that CCAP increases the carbohydrate and protein intake, but surprisingly inhibits fat intake; indicating that CCAP may regulate several pathways under starvation conditions. Additionally, after running a few activity tests, it became clear that CCAP improves fly survival during starvation, and induces fly sleep during the day. Therefore, it may be important for the energy conservation during starvation conditions.

This study showed that a developmental factor, CCAP, increased fly feeding and induced midday sleep. Therefore, it may play a key role in regulating a behavioural response to starvation. Rodent studies should be carried out to assess if vasopressin has a similar role. Understanding how CCAP functions may help improve our understanding of macronutrient selection and how environmental factors, such as starvation, influence food choice.

Degree project in Biology, Master of Science (2 years), 2017
Examensarbete i biologi 45 hp till magisterexamen, Uppsala universitet, 2017
Uppsala University, Department of Neuroscience, Functional Pharmacology
Supervisor: Dr Michael J Williams