Identifying and characterizing the neuronal circuits required for nutrient choice and their effects on aging

ABSTRACT:

Nutrition is a key determinant of health, wellbeing and aging. Recent evidences strongly suggest that nutritional amino acids (AAs) are important mediators of this fitness effect in multiple species, including humans. Accordingly, animals have developed behavioral strategies to ensure a proper balance of AA intake. We have for example shown that upon yeast (main dietary protein source of fruit flies) or AA deprivation Drosophila melanogaster increases the intake of yeast leading to a switch in feeding preference from sucrose to yeast. This change in feeding choice underlies the dietary basis for nutritional AA homeostasis and serves as a powerful paradigm to study nutrient choice and homeostasis.
We have identified a distinct class of Drosophila melanogaster gustatory receptor neurons (GRNs) required for intake of yeast. We show that gustatory receptor neurons of the proboscis act in parallel to mediate yeast feeding. While nutritional and reproductive states act in concert to drive yeast appetite, we find a separation of these state signals at the level of yeast GRNs, with amino acid but not mating state enhancing yeast GRN gain. Importantly, the sensitivity of sweet GRNs to sugar is not increased by protein deprivation, providing a potential basis for this nutrient-specific appetite. The emerging picture is that different internal states act at distinct levels of a specific gustatory processing circuit to elicit nutrient-specific appetites towards a complex, ecologically relevant protein source.
Furthermore, we have made important additional discoveries at the level of the impact of gut bacteria on the selection of nutrients and have developed a new approach using genome information for designing diets optimizing both aging and reproductive output.
We have therefore achieved the main goals of the project which aimed at identifying and characterizing circuits regulating nutrient homeostasis and exploring the impact of nutrients on lifespan with a special focus on amino acids.

Keywords
Nutrition, Diet, Circuits, Drosophila, Brain

Published Work:

Leitão-Gonçalves, R., Francisco, A. P., Carvalho-Santos, Z., Fioreze, G. T., Anjos, M., Baltazar, C., Elias, A. P., Itskov, P. M., Piper, M. D., & Ribeiro, C. (2017). Commensal bacteria control food choice behavior and reproduction by buffering the effect of essential amino acids availability. *PLoS Biology, 15*(4): e2000862. doi: 10.1371/journal.pbio.2000862

Piper, M. D. W., Soultoukis, G. A., Blanc, E., Mesaros, A., Herbert, S. L., He, X., Juricic, P., Salmonowicz, H., Yang, M., Simpson, S. J., Ribeiro, C., & Partridge, L. (2017). Exome matching: a novel in silico approach to optimise dietary amino acid balance for growth and reproduction. *Cell Metabolism, 25*(3), 610-621. doi: 10.1016/j.cmet.2017.02.005

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