Proposition de stage

Titre: “Investigating the role of energy and metabolism in size determination”

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Ce stage peut être poursuivi en thèse : Oui
Si oui, la thèse est-elle financée : à discuter

Sujet du stage:

The size and shape of organs are characteristic for each species. During development, organs (and therefore organisms) continuously synthetize new dry mass, mostly in the form of proteins, and grow in mass and volume. This process requires oxygen and nutrients that are metabolized by cells to produce ATP. Even when organisms develop to different sizes due to varying environmental conditions, organ size follows species-specific rules of proportionality to the rest of the body, a phenomenon referred to as **allometry**. Therefore, organs stop growth at a predictable size set by the species’ genotype. **How do organs stop growth? How can related species give rise to organs of strikingly different size?** No definitive answer has been given to date.

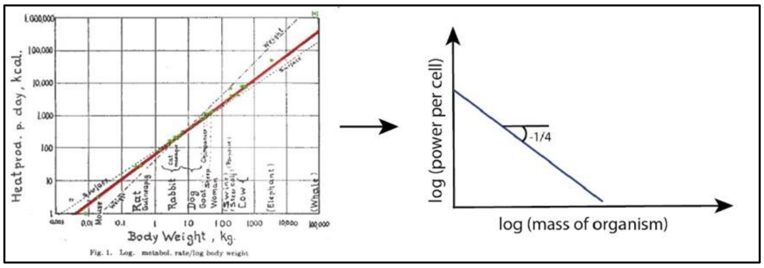

Figure 1. On the left, graph representing metabolic rate as a function of body mass in log scale. Kleiber’s law predicts that metabolic rate grows sublinearly with respect to body mass following the power law $B=B_0m^{3/4}$, where B is the metabolic rate, m the mass and B_0 a constant. This implies that cellular metabolic rate is minimized with increased organism size (right)

Allometry is the study of biological scaling relative to organismal size with a key interest in the relationship between organismal metabolic rate and body mass. Kleiber’s law was established through measurements of released heat/oxygen and body mass of adult animals (Glazier, 2005; Kleiber, 1932). It indicates that the metabolic power of an animal scales to the 3⁄4 power of animal mass (Kleiber, 1932) (Fig. 1). As a consequence, the metabolic power per unit volume (or cell) decreases with increasing organism mass. Thus, larger organisms have less oxidative metabolism per unit volume. To date, the physiological relevance of Kleiber’s law during development, in particular at the scale of growing organs, lacks evidence mainly due to the lack of tools allowing dynamic and parallel quantitative analysis of growth and metabolic rates. To what extent developing larvae follow Kleiber’s law and whether individual organs also follow the same rule remain unanswered questions.

The goal of this project is to establish an allometric scaling law between organs and organism using the developing *Drosophila* larvae as a model system. Using 3D image analysis and metabolic rate measurements, the aim is to obtain volume and metabolic profiles of developing organs and organism and correlate their growth and metabolic rates to reveal a potential scaling law governing growth.

Keywords: Growth; Energy; Metabolism

Skills: Imaging, image analysis, microcalorimetry

References

Glazier, D.S., 2005. Beyond the : variation in the intra- and interspecific scaling of metabolic rate in animals. Biol. Rev. 80, 611. https://doi.org/10.1017/S1464793105006834

Kleiber, M., 1932. Body size and metabolism. Hilgardia 6, 315–353. https://doi.org/10.3733/hilg.v06n11p315