

Institute of Environmental Sciences

Topic: Experimental evolution of the thrifty and spendthrift genotypes, and its consequence for susceptibility to adverse effects of “Western diet”: insights from a selection experiment on bank voles

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Background information:

Obesity and co-occurring disorders have become major medical issues in a large and rapidly increasing part of the World. The immediate reasons seem obvious: a practically unlimited access to calorie-rich food, although often nutritionally deficient (so called “Western diet”), combined with reduced physical activity. However, despite great progress of knowledge, the question why humans are so vulnerable to these conditions, remains subject of debate and intensive research. The question is important not only from biomedical, but also from the evolutionary biology perspective, and, remarkably, the evolutionary perspective contributed to the progress in medicine. According to the “thrifty genotype” hypothesis, the ultimate cause is a history of past selection for the ability to cope with the food scarcity combined with energy-costly locomotory demands. This hypothesis, and related hypotheses concerning phenotypic mechanisms (epigenetic and developmental), have been supported by results of many studies. However, its logical counterpart, the “spendthrift genotype” hypothesis, which predicts ability to avoid the detrimental effects of calorie excess in animals adapted to perform best under no energy limitation, received much less attention and the results are inconsistent.

The main question to be addressed in the project:

How does the selection for high performance under the conditions of unlimited vs restricted energy sources affects vulnerability of animals to adverse effects of the *Western diet*?

Information on the methods/description of work:

The “thrifty” and the “spendthrift” genotype hypotheses will be tested within the framework of a unique experimental evolution model system: lines of a rodent, the bank vole, selected for three distinct performance traits. The student will perform a series of experiments to investigate the effect of the Western diet on the voles. Several characteristics will be analyzed, such as body composition, food consumption and digestion, the aerobic exercise capacity, locomotor performance, blood biochemical characteristics, and reproductive performance. Samples of tissues will be preserved for follow-up project focused on metabolomics, transcriptomics and pathological changes in cardiovascular system (depending on success in acquiring additional financing).

The enrollment to this project is based on special rules. The deadline for application is August 16. Details of the application procedure is described [here](#).

Additional information (e.g. Special requirements from the student):

Requirements:

- evidence of good quantitative/computational skills;
- strong English language, communication, organizational and collaboration skills.

- Previous experience with small mammals, animal physiology, biochemistry, and/or evolutionary biology are considered advantageous.

A 5000 PLN/month stipend is warranted for 4 years.

Place/name of potential foreign collaborator:

University of California, Riverside (Prof. Theodore Garland), University of Aberdeen (Prof. John Speakman)

References:

Sadowska, E. T., *et al.* 2015. Evolution of basal metabolic rate in bank voles from a multidirectional selection experiment. *Proc. R. Soc. B*: 282, 20150025.

Reddon, H., *et al.* 2018. Revisiting the evolutionary origins of obesity: lazy versus peppy-thrifty genotype hypothesis. *Obes. Rev.* 19, 1525–1543.

Müller, M. J. 2019. About 'spendthrift' and 'thrifty' phenotypes: resistance and susceptibility to overeating revisited. *Am. J. Clin. Nutr.* 110, 542–543.