Unsaturated fatty acids play a role in winter hibernation

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Credit: AI-generated image (disclaimer)

The duration of the periods for which animals hibernate in winter is affected by the quantity of unsaturated fatty acids that they absorb from their food. How animals react to an excess – or a lack – of unsaturated fatty acids is now being studied in an Austrian Science Fund FWF project.

Hibernating animals don't always have it easy. Instead of spending the whole winter in energy-saving mode, they need to start up their body functions at irregular intervals and rewarm, all of which accounts for 80 percent of the total energy they expend over the winter season. Why they do this is a mystery, but scientists do know that the quantity of unsaturated fats in their diet is a contributory factor. A team working with Sylvain Giroud at the Research Institute of Wildlife Ecology in the University of Veterinary Medicine, Vienna is now investigating how the animals deal with too much or too few unsaturated fats. By doing so, they hope to be able to solve the mystery of their winter rewarming.

A matter close to the heart

The studies planned for the garden dormice – rodents from the dormouse family – are based on a working hypothesis, as Giroud explains: "Unsaturated fatty acids are important building blocks for cell membranes. We assume that they influence the effects of low temperatures on the functioning of a membrane-bound protein in the heart muscle." This protein – called SERCA2A – regulates the calcium balance in the heart muscle cells, which is vitally important in maintaining cardiac function. As Giroud continues to explain: "At low temperatures, less of this protein is produced – but it continues to be degraded. This leads to a situation where, over time, increasingly less SERCA2A is available and the heart's ability to function could be curtailed."

Waking up with heart palpitations

According to Giroud, therefore, the rewarming phases could serve to create conditions in the body that allow new SERCA2A to be produced and thereby safeguard cardiac function again. If the team's hypothesis is correct, and unsaturated fatty acids effectively stabilise SERCA2A and

prevent its degradation, then a higher fatty acid content in the animals' diet would have to enable longer periods of hibernation. This is exactly what the team will investigate in the coming months.

Fatty research

To accomplish this, Giroud's team will provide several groups of garden dormice with various dietary situations, which will differ with regard to the quantity of unsaturated fatty acids (specifically linoleic acid). According to their working hypothesis, this should lead to hibernation periods of varying lengths. Giroud adds: "Initially, we expect of course that an optimum level of linoleic acid will lead to considerably fewer rewarming phases than in the group that is not allowed to absorb enough of this unsaturated fatty acid. If our hypothesis is correct, these animals that have the optimum diet will be able to stabilise SERCA2A in the cell membrane and maintain cardiac function at an optimum level, even at low body temperatures."

Too much of a good thing

However, scientists already know that an excess of linoleic acid can also lead to more frequent interruptions of winter hibernation. Another aspect of Giroud's work therefore deals with analysing these effects in greater detail. "We surmise that oxidative stress is caused here by the breaking down of an excess of unsaturated fatty acids. This can have a negative effect on SERCA2A activity and thus force the animals – just as in the case of a deficiency of unsaturated fatty acids – to experience more frequent rewarming phases during which new SERCA2A needs to be produced." Yet it is precisely during these rewarming phases that the harmful by-products of oxidative stress would increase and thereby accelerate cell damage and ageing processes in the animals. The results of the project will show whether this is actually the case.

The various analyses conducted within the framework of the FWF project will make an important contribution to resolving one of the biggest mysteries in physiology: although the winter hibernation cycles of many animals are very well documented, little is known about the physiological processes that lead to hibernation.

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