

Scientists make squirrels hibernate

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A squirrel sits on a snowy tree branch in a Moscow park. Scientists in Alaska said Tuesday they have figured out how to make squirrels hibernate, a process that could be used to preserve brain function in humans who suffer strokes or heart attacks.

Hibernation is an essential survival strategy for some animals and scientists have long thought it could also hold promise for human survival. But how hibernation works is largely unknown. Scientists at the University of Alaska Fairbanks have successfully induced hibernation at will, showing how the process is initiated. Their research is published in the July 26 issue of *The Journal of Neuroscience*.

A hibernating animal has a reduced heart rate and blood flow similar to a person in cardiac arrest, yet the hibernator doesn't suffer the brain damage that can occur in people. "Understanding the neuroprotective qualities of hibernating animals may lead to development of a drug or

therapy to save people's lives after a stroke or heart attack," said Kelly Drew, senior author and UAF professor of chemistry and biochemistry in the Institute of Arctic Biology.

Hibernating animals survive by severely reducing their metabolism, a condition called torpor, in which oxygen consumption can fall to as low as one percent of resting metabolic rate and core body temperature to near or below freezing temperatures.

Arctic ground squirrels, like all animals and people, produce a molecule called adenosine that slows nerve cell activity. "When a squirrel begins to hibernate and when you feel drowsy it's because adenosine molecules have attached themselves to receptors in your brain," said Tulasi Jinka, lead author and IAB post-doctoral fellow in Drew's lab.

The receptors can be regulated by a simple cup of coffee. A caffeine molecule is similar enough in structure to adenosine that it binds to the receptors and effectively stops or reverses the onset of drowsiness. Jinka and Drew wanted to know what substances trip the squirrels' switch to start to hibernate.

"We devised an experiment in which non-hibernating arctic ground squirrels were given a substance that stimulated adenosine receptors in their brains. We expected the substance to induce hibernation," Drew said. "We also gave a substance similar to caffeine to arouse hibernating ground squirrels."

The non-hibernating squirrels were tested three times during one year. They were tested during the summer when they were not hibernating, again early in their hibernation season and a third time mid-way through the hibernation season. If animals were hibernating before the test Jinka woke them up to see if the substance would cause them to go back into hibernation. To ensure that his expectations did not influence the results

he delivered a placebo in the same manner as the drug and did not know which solution contained the active substance when he conducted the experiments.

Torpor was induced in all six of the squirrels awoken during mid-hibernation season, but in only two of the six from the early hibernation season group and in none during the summer season. The caffeine-like substance reversed torpor in all of the hibernating squirrels.

"We show for the first time that activation of the adenosine receptors is sufficient to induce torpor in arctic ground squirrels during their hibernation season," Jinka said, who conducted this experiment while he was a graduate student.

What Jinka and Drew don't yet know is how season causes the receptors to become increasingly sensitive to adenosine as the time of hibernation progresses.

Jinka and Drew are expanding their adenosine research to rats, which more closely resemble the physiology of humans. "Rats allow us to move toward being able to apply this research to humans," Jinka said.

Provided by University of Alaska Fairbanks

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