Woodrats' genes help them to win the arms race against their food

August 15 2014

A handful of genes arm the woodrat against the toxic chemicals in its foodstuff, the creosote plant, according to research published in the open access journal *BMC Ecology*.

It's long been a mystery exactly how the woodrat developed the ability to handle the chemicals in the creosote plant, which are toxic to other rodents. Previous research has suggested that they are protected by factors such as gut bacteria. But the new study identifies the genes switched on in two species of woodrat with resistance to the plant poisons, showing that the genes that they are born with play a central role in whether they feel the effects of its toxic chemicals.

Creosote bushes and the woodrat have been in an evolutionary arms race, ever since the bush started colonizing the deserts of the western USA, where the rat lives. To save itself from being eaten, the plant's leaves are covered with a toxic resin containing the chemical nordihydroguaiaretic acid (NDGA). Most rodents' livers and kidneys are ravaged by the substance, but woodrats detoxify the substance so they can eat creosote plants as a normal part of their diet. Being able to withstand the creosote bush's resin gives them exclusive access to the valuable food source in an area with little plant life.

Two closely related species of woodrat have switched over from juniper and cactus to creosote at different times - the Neotoma bryanti woodrat was first in contact with creosote bush 7,000 years before the Neotoma lepida woodrat.

Scientists from University of Utah and Weber State University have investigated the gene expression in N. bryanti and N. lepida to see what enzymes the species produced in reaction to the plant resin. They looked at three groups – 'experienced' N.bryanti and N.lepida that had been exposed to creosote in the wild, and 'naive' N.bryanti, a population of woodrats for whom creosote was a new addition to their diet.

They found that when woodrats had been exposed to the creosote bush in the wild, a small number of similar genes were switched on by both species to detoxify the plant, despite having evolved the mechanisms at completely different times.

Jael Malenke from the University of Utah says: "We were surprised by how few genes were induced by woodrats of both species when they were consuming a toxin-laced diet. We expected a huge list of genes - instead we found very few."

When the creosote was a new addition to the diet of individual N.bryanti woodrats, they had different reactions. They exhibited signs of severe stress, showing that because they hadn't been exposed to the diet, the genes to detoxify it hadn't been switched on.

Dr Malenke says: "For N. bryanti but not for N. lepida, there appears to be a hidden strategy of maintaining expression of exactly the right combination of enzymes to suit the animal's 'normal' diet and not altering that expression, even with a change in diet. Although very efficient, this strategy might be a disadvantage, say, in the face of a climate change event".

More information: Evidence for functional convergence in genes upregulated by herbivores ingesting plant secondary compounds Jael R Malenke, Michele M Skopec and M Denise Dearing *BMC Ecology* 2014, 14:23. www.biomedcentral.com/1472-6785/14/23

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