Epigenetics in wild guinea pigs

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Wild guinea pigs. Credit: Alexandra Weyrich/IZW

Fathers are able to adjust to increasing temperatures within their own lifetime and do transmit this information to their offspring. This has now been shown for the first time in a wild animal. The findings were the

result of a project within the Joint Initiative for Research and Innovation and have been published in the scientific journal *Molecular Ecology*.

Male wild guinea pigs respond to increasing temperatures with biochemical modifications attached to their genome and pass this "epigenetic" information to the next generation, and most likely even the following one.

In order to study their response to changing environmental conditions, male wild guinea pigs were kept for two months at an ambient temperature raised by ten degrees. It was subsequently examined whether any biochemical changes had occurred in the genome (DNA) of their liver in result of that heat treatment sons sired by the males before and after the rise in temperature were also examined for such possible biochemical changes of the genome of their liver and also in the genomes of their testicles. The joint scientists team from the Leibniz Institute for Zoo and Wildlife Research (IZW), the Berlin Center for Genomics in Biodiversity Research (BeGenDiv) and the Californian company Zymo Research detected significant differences in the methylation of the DNA (a biochemical modification of the genome) of the wild guinea pigs when comparing the genomes prior to and after exposure to increased temperatures. These differences were especially found in genes encoding proteins responsible for protection against heat damage. The magic word which describes this process is "epigenetics" (Greek: epi = upon, over, above; genetics = study of heredity) – a molecular mechanism which regulates the switching-on of genes in response to environmental changes without changing the sequence of the DNA's building blocks.

"We believe that the transfer of epigenetic information from father to sons prepares the latter for changes in environmental conditions such as a rise in temperature. This is particularly important with regards to a possible adaptive response to climate change. Epigenetic mechanisms

could therefore be crucial for the fitness and survival of the offspring," says Alexandra Weyrich, researcher at the IZW.

As the mother-child relationship in mammals during and after pregnancy is particularly intense, previous research focused mainly on the transfer of maternal epigenetic information. "However, in most wild mammal species, including wild guinea pigs, it is the males who leave their ancestral habitats and quickly adjust to varying environmental conditions such as temperatures during the search for females and new territories," explains Weyrich.

The rapid adjustment to environmental changes is, among other things, possible through epigenetic modifications such as the methylation or demethylation of the DNA. Unlike the "genetic code" (the sequence of the DNA's building blocks), epigenetic modifications are flexible and can therefore be used as a "switch" in response to environmental changes. The new findings show that some of these acquired epigenetic modifications can be robust enough to be passed onto offspring. The current study shows that fathers pass on epigenetic changes in their DNA to their sons.

More information: Alexandra Weyrich et al. Paternal intergenerational epigenetic response to heat exposure in male Wild guinea pigs, *Molecular Ecology* (2015). DOI: 10.1111/mec.13494

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