

Vultures evolved an extreme gut to cope with disgusting dietary habits

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Vultures have special digestive systems adapted to deal with putrid carcasses that would be toxic to many other animals

How is it that vultures can live on a diet of carrion that would at least lead to severe food-poisoning, and more likely kill most other animals? This is the key question behind a recent collaboration between a team of international researchers from Denmark's Centre for GeoGenetics and Biological Institute at the University of Copenhagen, Aarhus University,

the Technical University of Denmark, Copenhagen Zoo and the Smithsonian Institution in the USA. An "acidic" answer to this question is now published in the scientific journal *Nature Communications*.

When vultures eat lunch they happily strip the rotting carcasses they find back to the bone. And if, however, the animal's hide is too tough to easily pierce with their beak, they don't hesitate to enter it using other routes, among them the back entrance - so to speak: via the anus. Although their diet of meat that is both rotting and liberally contaminated with feces would likely kill most other animals, they are apparently immune to the cocktail of deadly microbes within their dinner such as Clostridia, Fuso- and Anthrax-bacteria.

"To investigate vultures' ability to survive eating this putrid cocktail, we generated DNA profiles from the community of bacteria living on the face and gut of 50 vultures from the USA. Our findings enable us to reconstruct both the similarities, and differences, between the bacteria found in turkey vultures and black vultures, distributed widely in the Western Hemisphere. Apparently something radical happens to the bacteria ingested during passage through their digestive system," says Lars Hestbjerg Hansen, a professor at Aarhus University who together with PhD-student Michael Roggenbuck lead the study while he was at the University of Copenhagen.

From head to gut

On average, the facial skin of vultures contained DNA from 528 different types of micro-organisms, whereas DNA from only 76 types of micro-organisms were found in the gut. Michael Roggenbuck explains:

"Our results show there has been strong adaptation in vultures when it comes to dealing with the toxic bacteria they digest. On one hand vultures have developed an extremely tough digestive system, which

simply acts to destroy the majority of the [dangerous bacteria](#) they ingest. On the other hand, vultures also appear to have developed a tolerance towards some of the [deadly bacteria](#) - species that would kill other animals actively seem to flourish in the vulture lower intestine."

These observations raise the question as to whether the Clostridia and Fusobacteria in the gut simply out-compete the other bacteria but don't confer any benefit to the vulture, or in contrast, if their presence actually confers dietary advantages for the vultures. The team's results suggest that it's probably a bit of both - while other microorganisms are likely out-competed by the surviving bacteria, the [vultures](#) also receive a steady stream of important nutrients when the [bacteria](#) break down the carrion. Of broader significance, Gary Graves of the Smithsonian Institution's National Museum of Natural History observed:

"The avian microbiome is terra incognita but it is not unreasonable to suppose that the relationship between birds and their microbes has been as important in avian evolution as the development of powered flight and song."

Provided by University of Copenhagen

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