Researchers believe giant pandas can survive on bamboo because of gut bacteria

October 18 2011, by Bob Yirka

(PhysOrg.com) -- Because of its cuteness factor, people tend to overlook the fact that giant panda's are in fact bears, though very few likely forget that most other bears do eat meat. A lot of it. It's hard to overlook those really big teeth designed to tear and eat flesh. Thus, it seems rather odd that a big bear living in the wild would forgo meat, even though it is still technically a carnivore, and subsist instead almost entirely on bamboo.

Yet that's just what the giant panda does, eating some 12 kilograms of the stuff each day, a feat that would lead to starvation in most other species of bear. So, the question of how they do it has come up, and researchers in China believe they have found the answer. It's because they have bacteria in their guts that break down some of the cellulose in

bamboo for them.

Fuwen Wei, and colleagues at the Institute of Zoology at the Chinese Academy of Sciences in Beijing, describe in their paper published in the *Proceedings of the National Academy of Sciences*, how they found, using DNA analysis, previously unknown types of bacteria in stool samples taken from both wild and captive giant pandas, that they believe allows the animals to get the nutrients they need from simple bamboo.

The problem with bamboo is that its cell walls are made of difficult to digest cellulose fibers, which makes it rather useless for most carnivores because most can't break it down to get at the sugars, fats and proteins that it contains. Other animals (herbivores), such as cows, are able to do it only because they have multiple processing stomachs with all sorts of special microbes to do the job. But carnivores for the most part, simply don't have the tools necessary to get the job done. One exception, of course, is the giant panda.

Wei and his team believe that some of the bacteria they've found in the panda stools help the bears break down that cellulose, if only a little bit. A very little bit. In a study conducted at the Washington National zoo several years ago, it was found that pandas only process something like eight percent of the cellulose in the bamboo they eat. Thus, they have to eat not just a lot, but constantly to get enough nutrition from the bamboo to survive.

Also helpful for the pandas are strong jaw muscles, sharp teeth and paws that help them to grip stalks. And while all these things contribute to the ability of giant pandas to survive on such a limited diet, they clearly aren't enough to help them overcome they problem of finding places that have enough bamboo to live on as humans continue to convert land to farm use; thus, their status as an endangered species.

More information: Evidence of cellulose metabolism by the giant panda gut microbiome, *PNAS*, Published online before print October 17, 2011, doi: 10.1073/pnas.1017956108

Abstract

The giant panda genome codes for all necessary enzymes associated with a carnivorous digestive system but lacks genes for enzymes needed to digest cellulose, the principal component of their bamboo diet. It has been posited that this iconic species must therefore possess microbial symbionts capable of metabolizing cellulose, but these symbionts have remained undetected. Here we examined 5,522 prokaryotic ribosomal RNA gene sequences in wild and captive giant panda fecal samples. We found lower species richness of the panda microbiome than of mammalian microbiomes for herbivores and nonherbivorous carnivores. We detected 13 operational taxonomic units closely related to Clostridium groups I and XIVa, both of which contain taxa known to digest cellulose. Seven of these 13 operational taxonomic units were unique to pandas compared with other mammals. Metagenomic analysis using ~37-Mbp contig sequences from gut microbes recovered putative genes coding two cellulose-digesting enzymes and one hemicellulose-digesting enzyme, cellulase, β-glucosidase, and xylan 1,4-β-xylosidase, in Clostridium group I. Comparing glycoside hydrolase profiles of pandas with those of herbivores and omnivores, we found a moderate abundance of oligosaccharide-degrading enzymes for pandas (36%), close to that for humans (37%), and the lowest abundance of cellulases and endohemicellulases (2%), which may reflect low digestibility of cellulose and hemicellulose in the panda's unique bamboo diet. The presence of putative cellulose-digesting microbes, in combination with adaptations related to feeding, physiology, and morphology, show that giant pandas have evolved a number of traits to overcome the anatomical and physiological challenge of digesting a diet high in fibrous matter.