

Does eating bamboo make it harder for pandas to reproduce?

June 24 2016, by Garret Suen And Kimberly Dill-Mcfarland



Will this make my tummy hurt? Credit: Chi King, CC BY-SA

Most people get upset stomachs from time to time. Usually, a few trips to the bathroom or antibiotics solve the problem. For pandas, it's an entirely different story. [Our research into panda digestion](#) shows that pandas get upset stomachs so frequently it may help explain why it's so hard for them to reproduce. Our work may, as a result, highlight a new way to boost pandas' breeding success in captivity.

Generally, in both pandas and humans, upset stomachs result from some sort of imbalance in the stomach or intestines. Often this is caused by foodborne bacteria, whose invasion prompts an inflammatory response that rapidly expels whatever is inside the gut. The human digestive system usually resets fairly quickly, and we go back to eating the wide variety of meats, plants and carbohydrates that make up our diet. This is why food poisoning doesn't have long-term effects on an otherwise healthy individual.

This, however, is not the case for the giant panda. Giant pandas are biologically bears, members of the [Ursidae family](#), along with grizzly bears, black bears and even polar bears. However, unlike other bears, pandas are not carnivorous or omnivorous. Rather, they have evolved a unique lifestyle in which they almost [exclusively eat bamboo](#).

Their switch to a plant-based diet happened [more than two million years ago](#). Pandas' bodies have adapted to their herbivorous diet by evolving stronger [jaw structures](#) to crush and chew bamboo and a [thumb-like paw structure](#) for grasping and ripping apart bamboo. But the panda digestive system has not yet adapted. Their resulting stomach problems have possible repercussions for their reproductive success and their status as [an endangered species](#).

Unlikely herbivores

Even millions of years after giving up meat, pandas' digestive tracts remain similar to carnivorous bears, passing food through the gut in [less than 10 hours](#). But other herbivores, like cattle, hold food in their stomachs for [24 hours](#), or even longer, to allow time for optimal digestion of plant components. The panda's speedy digestive process doesn't allow enough time to extract much energy from its food. This likely explains why pandas spend so much of their time eating – as much as [16 hours a day](#).



Le Le and Ya Ya are two giant pandas at the Memphis Zoo that suffer from. Credit: chronic mucoids. Dr. Candace Williams

The panda's need for such large quantities of bamboo also contributes to its endangered plight. There are about 1,800 pandas in the wild, and although recent conservation efforts have resulted in moderate increases in the last 10 years, [numbers remain at roughly 70 percent](#) of the earliest estimates from the 1970s. Much of their decline is thought to be caused by severe [habitat loss](#). Today's roughly 11,000 square miles (28,000 square kilometers) is just half or even one-third of their [former range](#).

Pandas' shift from omnivory to herbivory makes them particularly sensitive to this habitat loss. Switching food sources way back when was likely a good move at the time: bamboo was abundant and required no hunting. Since then, however, access to high-quality bamboo throughout

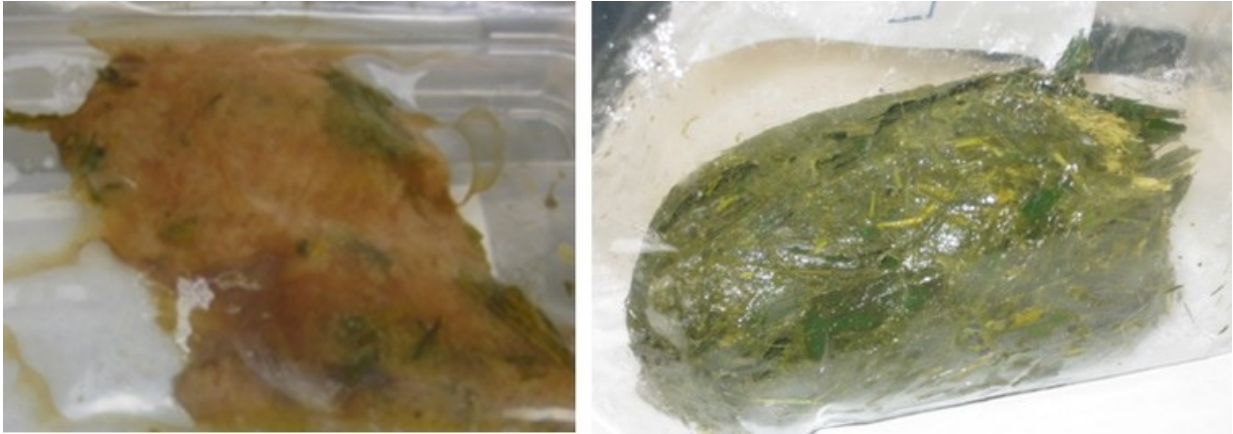
the year has [drastically declined](#). Poor-quality bamboo has many effects, one of which may be upsetting pandas' stomachs. This is a particular problem for pandas in captivity, where only one species of bamboo may be available at a time and biscuits, vegetables and fruits must be used to supplement the [panda diet](#).

Irritated digestive systems

Pandas in captivity [chronically suffer from upset stomachs](#). As a result, they excrete mucus-like stools (termed "mucoids") and lose their appetites. In many cases, these symptoms result in more severe digestive system diseases like colitis, an [inflammatory bowel disease \(IBD\)](#) with chronic inflammation of the digestive tract.

Mucoids are gelatinous and membranous, reminiscent of the protective mucus layer produced in mammals' digestive tracts. Normally, this layer [protects the animal](#) from invading pathogens and from physical damage caused by hard or sharp food particles. This led us to hypothesize that panda mucoids might be the product of a panda's gastrointestinal (GI) tract expelling its own mucus layer. With our colleagues [Candace Williams](#) and [Ashli Brown](#) at Mississippi State University, we studied the breeding pair of pandas (LeLe and YaYa) at the Memphis Zoo. Both suffer from chronic bouts of mucoids.

Because we could not invasively sample the pandas' GI tracts, we took a completely different approach. [Recent work](#) has revealed the importance of microbial communities (the "microbiome") to many biological processes in the GI tract, such as conversion of food into nutrients and protection from pathogens. We reasoned that if mucoids contain part of the GI tract mucosal layer, they would have a very different microbial community than healthy panda stools.



Mucoids (left) are different from regular stools (right) and characterized as mucus-like excretions. Mucoids are typically accompanied by a loss of appetite and can lead to severe disorders like colitis. Credit: Dr. Candace Williams

We collected stool samples from the Memphis Zoo pandas before, during, and after mucoid episodes. Our [genetic analysis of the microbes](#) in the various stool samples found that, as expected, the mucoids had a radically different microbial community than healthy panda stool. While microbes in pandas' digestive mucus have not been analyzed, we found that panda mucoids had many microorganisms in common with those found in the mucus layer of the GI tracts of other mammals.

Affecting reproduction

These results led us to hypothesize that pandas periodically shed their GI tract lining because their gut has not fully adapted to digesting only plants. We think that the hard, fibrous nature of bamboo may physically abrade the GI tract, possibly leading to an inflammatory response resulting in this expulsion of the mucus layer. This, and the cessation of eating, then allows the panda time to reestablish its [mucus layer](#) and a healthy microbiome.

Where this starts to affect pandas as a species, rather than just as individuals, is in the timing of these mucoid discharges. Most often, it happens just after the breeding season. Physical discomfort, loss of appetite, and upset digestive systems may impair a female panda's ability to carry a fetus to term. This may help explain why pandas in captivity have a particularly hard time reproducing, and suggests that efforts to mitigate mucoidal episodes might help this process.

Based on these findings, we suggest that captive pandas be continually provided with the freshest variety of bamboo. This is challenging, as several zoos with pandas are in climates where bamboo doesn't grow well. Therefore, future research should investigate other dietary supplements to determine the best diet for preventing mucoids in captive pandas.

So, the next time you visit a zoo that has [pandas](#) (including the [Atlanta Zoo](#), [Memphis Zoo](#), [Smithsonian National Zoo](#), [San Diego Zoo](#) and [Toronto Zoo](#)) and they are looking a little disgruntled, remember that it might be because of an upset stomach. While this would be no big deal for you and your stomach, it may have dramatic consequences for the enigmatic but endangered giant panda.

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