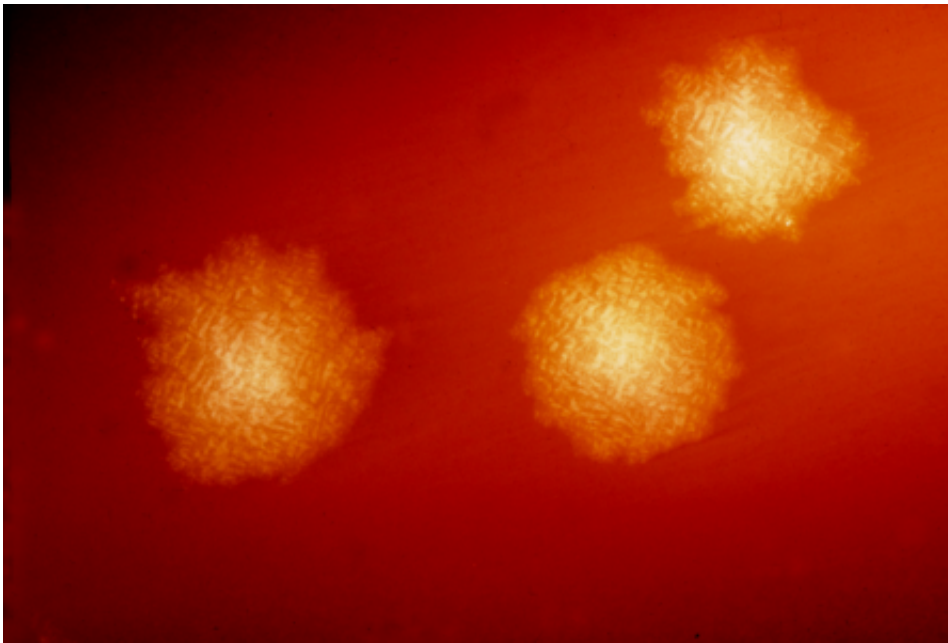


Clostridioides difficile infection flourishes with a high-protein, high-fat diet

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This photograph depicts *Clostridium difficile* colonies after 48hrs growth on a blood agar plate; Magnified 4.8X. *C. difficile*, an anaerobic gram-positive rod, is the most frequently identified cause of antibiotic-associated diarrhea (AAD). It accounts for approximately 15–25% of all episodes of AAD. Credit: CDC

Diets like the Keto, Paleo and Atkins focus on high-fat, high-protein meals that are often low in carbohydrates. This mix may appeal to *Clostridioides difficile* bacteria, too.

In a new study published this week in *mSystems*, an open-access journal

of the American Society for Microbiology, researchers report that [mice](#) fed a high-protein, [high-fat diet](#) were more likely to acquire a deadly *C. difficile* [infection](#) than mice eating a [standard diet](#). Their findings also suggest that a [diet](#) high in carbohydrates protects against infection.

Every year in the United States, hundreds of thousands of people are diagnosed with *C. difficile* infections and more than 10,000 die, according to the Centers for Disease Control and Prevention. Taking [antibiotics](#) increases a person's risk of infection.

The researchers behind the new work caution that their study was done on mice and additional research is needed to establish a connection between these diets and infections in people. At the same time, they argue, it's an avenue of research that's important to explore.

"We have to look at humans to see if it correlates," said chemist Ernesto Abel-Santos, Ph.D., at the University of Nevada, Las Vegas (UNLV).

"We know that people have been following these different extreme diets and we really don't have a good handle on what these changes are doing to our systems."

"We know very well that diet affects the gut microbiome," added microbiologist Brian Hedlund, Ph.D., also at UNLV. Hedlund and Abel-Santos co-led the new study.

The group studied 4 groups of mice with 5 animals each. Each group received antibiotics and was fed a different diet: one was high-fat, high-protein; another was high-fat, low-protein; a third was high-carbohydrate; and the fourth was a standard laboratory diet for experimental mice.

The results were startling. In the high-protein, high-fat group, all the animals developed severe infections and died within 4 days. In the high-

fat, low-protein group, only 2 animals died. In the high-carbohydrate group, 2 mice showed mild symptoms and recovered and in the standard diet group, all of the animals showed signs of infection but also recovered.

Recent studies suggest that because antibiotics kill bacteria species indiscriminately, the medications decimate populations of organisms that compete for amino acids, leaving *C. difficile* free to propagate. But Hedlund said the story is even more complex. "It's clear that it's not just a numbers game," he said. The new work suggests that diet may promote microbial groups that can be protective, even after antibiotics. For an infection to flourish, he said, "you might need this combination of wiping out *C. difficile* competitors with antibiotics and then a diet that promotes overgrowth and disease."

The new study raised questions that the researchers will pursue in future studies. For example: The high-carb diet, which seemed protective against *C. difficile* infection, gave rise to the least diverse community of microbes. "Lots of papers say that a lower microbial diversity is always a bad thing, but in this case, it had the best disease outcome," said Abel-Santos. However, he cautions that a high-carb diet could lead to animals becoming asymptomatic carriers that can disseminate the infection to susceptible subjects.

The group will also begin looking at ways to understand the connection between diet and *C. difficile* infection in people. "Whether this will translate to humans or not, I'm not totally sure," said Abel-Santos. "But the next time I take antibiotics, I'm not going to be eating a high-protein or Atkins diet."

More information: Chrisabelle C. Mefferd et al, A High-Fat/High-Protein, Atkins-Type Diet Exacerbates *Clostridioides* (*Clostridium*) *difficile* Infection in Mice, whereas a High-Carbohydrate Diet Protects,

mSystems (2020). [dx.doi.org/10.1128/mSystems.00765-19](https://doi.org/10.1128/mSystems.00765-19)

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