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Study finds cooking increases energy from meat, may have driven human evolution

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Next time you're out to dinner, you may want to think twice before ordering your steak rare.

In a first-of-its kind study, Harvard researchers have shown that cooked meat provides more energy than raw meat, a finding that suggests humans are biologically adapted to take advantage of the benefits of cooking, and that cooking played a key role in driving the evolution of man from an ape-like creature into one more closely resembling modern humans.

Conducted by Rachel Carmody, a student in Department of Human Evolutionary Biology at Harvard's Graduate School of Arts and Sciences and described in the Proceedings of the National Academy of Sciences (*PNAS*), the research also raises important questions about the way modern humans eat.

"The results of this paper are equally relevant to human evolution and to the way we think about food today," Carmody said. "It is astonishing that we don't understand the fundamental properties of the food we eat. All the effort we put into cooking food and presenting it – mashing it up, or cutting it, or slicing or pounding it – we don't understand what effect that has on the energy we extract from food, and energy is the primary reason we eat in the first place."

Though earlier studies had examined specific aspects of what happens during the cooking process, surprisingly Carmody said, none had ever fully examined whether cooking affected the in vivo energy value of food.

"There had been no research that looked at the net effects – we had pieces that we could not integrate together, so we didn't know what the overall answer was," Carmody said. "We knew some of the mechanisms that might be at play, but we didn't know how they combined."

To examine those effects, Carmody designed a unique experimental model. Over forty days, she fed two groups of mice a series of diets that consisted of either meat or sweet potatoes prepared in four ways – raw and whole, raw and pounded, cooked and whole, and cooked and pounded.

Over the course of each diet, researchers tracked changes in each mouse's body mass, as well as how much they used an exercise wheel. The results, Carmody said, clearly showed that cooked meat delivered more energy to the mice that raw.

It's a finding, she said, that holds exciting implications for our understanding of how humans evolved.

Though early humans were eating meat as early as 2.5 million years ago, without the ability to control fire, any meat in their diet was raw, and probably pounded using primitive stone tools. Approximately 1.9 million years ago, however, a sudden change occurred. The bodies of early humans grew larger. Their brains increased in size and complexity. Adaptations for long-distance running appeared.

Though earlier theories suggested the changes were the product of increased meat in their diet, Carmody's research points to another possible hypothesis – that cooking provided early humans with more energy, allowing for such energetically-costly evolutionary changes.

Although that theory that had been advanced years earlier by Richard Wrangham, the Ruth Moore Professor of Biological Anthropology and Master of Currier House, it wasn't until Carmody's work that scientists had hard evidence to either support or refute it.

"I'm a biologist by training," Wrangham said. "If you want to understand the anatomical, physiological and behavioral features of a species, its diet is the first thing you ask about. If you want to know what makes a giraffe tick, it's the fact that it eats leaves from the tops of trees. If you want to understand the shape of a flea, it's because it eats blood. But with humans everyone had said what's key about humans is the fact that we are variable, that we are good at solving problems, so human adaptation in general is the result of our brains. But this, right away, strays from the fundamental biological concept of diet.

"That's why Rachel's work is so important," he continued. "For the first time, we have a clear answer to the why cooking is so important cross culturally and biologically – because it gives us increased energy, and life is all about energy."

The impacts of Carmody's work, however, aren't limited to the early days of human evolution. The findings also lay bare the shortcomings in the Atwater system, the calorie-measurement tool used to produce modern food labels.

"That system is based on principles that don't reflect the in vivo energy availability," Carmody said. "Although it measure what has been digested, the human gastrointestinal system includes a whole host of bacteria, and those bacteria metabolize some of our food for their own benefit.

"Atwater doesn't discriminate between food that is digested by the human or the bacteria, and increasing evidence suggests that the bacteria take a pretty good portion of the food we eat," she continued. "In fact, research has shown that one of the ways to increase the value humans get, relative to the bacteria, is by processing food, and cooking is one way to do that."

Carmody's research could also inform how food scientists tackle one of the thorniest of dietary challenges – the prevalence of obesity in Western nations, and malnutrition in developing parts of the world.

"As human evolutionary biologists, we think about energetic gain as being something positive, because it allows for growth and reproduction, and it's a critical component of a species' evolutionary fitness," Carmody said. "But the question in the modern world is: If we now have the problem of excess as opposed to deficit, is that still a positive?

"This research illuminates that that way we've been thinking about food energy value historically, and the way we derive recommendations whether for areas that are experiencing famine or areas where people suffer from energetic excess have been based on assumptions that are not biologically relevant. Instead, they've been based on the treatment of the human body as an efficient digestion machine, when, in fact, it's not, and the degree to which it's not is affected by food processing, including cooking."

Provided by Harvard University

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