Did We Get Calories Wrong?

5 MIN READ

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A new calorie-counting tool could change how we think about the energy in our food.

Our calorie-counting system may have just gotten an upgrade. Researchers from Arizona State University created a new mathematical model called DAMM, which stands for digestion, absorption, and microbial metabolism, that takes the gut microbiome into account.

Currently, we use the Atwater system, a century-old tool that assumes everyone receives the same amount of energy from the same foods. According to Atwater:

- Carbohydrates provide 4 calories per gram
- Fats provide 9 calories per gram
- Protein provides 4 calories per gram

This isn't necessarily wrong, but it doesn't tell the whole story, the new model suggests. The **paper** — a 17-person crossover trial which has not yet been validated in people with metabolic conditions — argues that a more accurate interpretation would highlight the influence of our gut bacteria on energy metabolism.

"[The Atwater system] cannot account for individual differences in gut microbiome composition and may provide estimates that are accurate on average but inaccurate for specific individuals," **Taylor Davis**, PhD, first author of the DAMM research, tells Super Age.

The scientists themselves say the applicability remains to be confirmed, but it

certainly begs the question: have we been getting calories wrong all along?

What, Exactly, Is a Calorie?

Before we dive in, a note on calories themselves. Collectively, we've taken this scientific concept and turned it into a moral one, but it's important to remember what a calorie actually *is*: a unit of energy that measures how much fuel your body can get from food. Scientifically, it's neutral. Not good, not bad, just a measurement, like an inch or a pound.

And in fact, there are two types: small and large. A small calorie, written as the lowercase "cal" represents how much heat it takes to warm 1 kilogram of water by 1°C. A large calorie or kilocalorie, written as the uppercase "Cal" or "kcal" equals 1,000 small calories and heats 1 kilogram of water by 1°C. When we talk about "calories" in food, we're talking about the latter: kilocalories (kcal), the stored energy in what we eat that powers everything from cellular function to physical movement.

The Atwater System Provides a Solid Foundation

To understand why DAMM is so significant, we'll need to go back to the beginning with a quick lesson in food science history.

In the late-1800s, Wilbur O. Atwater, an American nutrition researcher and chemist, developed a system for calculating the average amount of available energy in macronutrients (the 4-9-4 method we discussed earlier).

He built a massive device known as the respiration calorimeter to measure a person's oxygen intake, carbon dioxide output, and the heat produced. This system helped

Atwater calculate the average number of calories in carbohydrates, fat, and protein. His landmark equation:

Total Calories = (4 x grams of carbohydrate) + (9 x grams of fat) + (4 x grams of protein)

The Atwater system is valued for its simplicity, but it may incorrectly estimate calorie counts since it treats the gut microbiome's contribution as a constant, Davis says.

"The DAMM model tracks the movement and metabolism of macronutrients throughout digestion, explicitly accounting for nutrient absorption, colonic microbial metabolism, and the energy provided by microbially produced organic acids. By incorporating these processes and variations in microbial activity, the DAMM model provides more accurate predictions of metabolizable energy than the traditional Atwater system," he adds.

Gut Microbiome Contributes to More Than You Think

The Atwater model suggests that we all absorb the same number of calories from our food, but modern nutrition scientists believe something else happens in the body. When we eat, most of our food is broken down and absorbed, but some nutrients pass through undigested.

"We can divide our nutrients into two categories: those we can digest and absorb, which we call human nutrition, and nutrients which are non-digestible to humans that become gross substrates available to gut bacteria, which we call microbiome nutrition," **Liping Zhao, PhD**, the director of the Center for Nutrition, Microbiome and Health at Rutgers School of Environmental and Biological Sciences, tells Super Age.

Fiber is the gut microbiome's main source of nutrition. Our bodies **can't digest fiber**, but bacteria in our gut can *ferment* that fiber. **Short-chain fatty acids (SCFAs)** are produced during the fermentation process. These fatty acids, including acetate, propionate, and butyrate, are absorbed for energy or help regulate hormones that control hunger and satiety cues. These hormones include glucagon-like peptide 1 (GLP-1) and peptide YY (PYY). When these are secreted, gastric emptying slows and appetite decreases, helping to prevent overeating.

DAMM captures more of this nuance than the Atwater model, in part because it accounts for methane-producing gut microbes, often missed in standard microbiome tests. According to **Rosa Krajmalnik-Brown, PhD**, co-author of the study and director of the Biodesign Center for Health Through Microbiomes at Arizona State University, these microbes support fermentation in the gut and, if they are underestimated, can throw off a calculation of calories recaptured from the colon.

Here's how it works: Fermentation also produces hydrogen, and hydrogen is a problem if it accumulates. A small group of gut microbes called methanogens solve that by consuming it and converting it to methane, which you exhale or pass as gas. The methane itself is energy leaving the body. What matters is what the methanogens make possible: by clearing hydrogen out of the way, they keep fermentation moving, which means more short-chain fatty acids for you to absorb.

These microbes are easy to miss. The DAMM researchers found that stool tests dramatically undercounted them, because methanogens appear to live in biofilms along the gut wall rather than passing through in waste. Underestimate that population and the whole calculation of what your colon returns to you shifts.

"The microbiome actually acts as a metabolic 'gatekeeper' that determines where calories end up. When more dietary fiber reaches the colon, gut bacteria consume carbohydrates and proteins that escape digestion," Krajmalnik-Brown says.

DAMM Could Support Personalized Nutrition Guidance

The Atwater system doesn't capture the complexity of human *and* microbiome nutrition. But that's where the DAMM model shines. With that additional information captured, the new emphasis on gut microbiome could lead to personalized nutrition recommendations in the future.

Everyone's microbiome is different and has a unique capacity for fermenting dietary fiber and producing short-chain fatty acids, Zhao explains. (**Recent research** published in *Cell* found that gut bacteria contribute between 2 and 5% of a person's energy when they follow a Western diet. This goes up to 10% on a non-Western diet since this includes more fiber.)

We are still in the early stages of applying the DAMM model to nutrition and food science. The scientists themselves say that applicability remains to be confirmed. In the future, nutrition professionals could reference this when providing targeted, individualized advice to their patients.

"Instead of being a fixed set of equations, the model provides a flexible framework that can be refined over time to better represent digestion, absorption, and microbial metabolism," Davis said.

Eat More Fiber

While personalized approaches will probably become more standard, there's one change most should plan on making now.

"Many people actually do not eat enough fiber, so the proportion of calories we take from dietary fiber may be much less than 10%. The DAMM model has developed a calorie counting system to include calories coming from microbiome fermentation,

which is a big step forward," Zhao says.

The Atwater system probably won't go away anytime soon. It's much easier to calculate, even if the estimates are off. For now, rather than trying to calculate your energy intake based on the DAMM model, your best bet is to fill your diet with more gut-healthy, fiber-rich foods.

More studies with diverse populations are needed before this is ready for widespread use. But since most Americans don't eat enough fiber, that's a good place to start. And as you eat more fiber, you'll produce more short-chain fatty acids, increase your satiety signalling, and lower the overall number calories your body absorbs by leaving more energy in your stool.

"Our findings strengthen the biological plausibility that microbiome-targeted ingredients can influence energy balance and metabolism. The work demonstrates that microbiome-mediated processes can meaningfully affect the amount of energy extracted from food and the metabolic signals generated in the gut," says Krajmalnik-Brown.

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