

HUMAN EVOLUTION

There's More Than One Way to Have Your Milk and Drink It, Too

The adage that milk does a body good may be true for American celebrities wearing milk mustaches in ad campaigns: Many Americans and northern Europeans descend from cattle herders and carry an ancient mutation that allows them to tolerate milk at any age. But milk gives cramps and diarrhea to roughly half the world's adults, especially in Asia and West Africa. That's why lactose tolerance has been held up as a classic example of human evolution, in which some people inherited the trait to digest milk, and some didn't.

Now, an international team reports a revealing twist on this evolutionary story. In this week's issue of *Nature Genetics*, researchers describe three new genetic variants that arose independently in groups of Africans; each variant allows carriers to drink milk and eat dairy products as adults. The study shows that lactose tolerance evolved more than once in response to culture, says team leader Sarah Tishkoff of the University of Maryland, College Park.

It's also an elegant example of how evolution can find several solutions to the same problem, especially in the face of strong selection, says molecular anthropologist Kenneth Weiss of Pennsylvania State University in State College. "There is not just one way to tolerate milk but several ways," he says. "It's very nice work because it shows that evolution isn't just about picking one gene and driving it."

The textbook tale of lactose tolerance runs this way: All humans digest mother's milk as infants. But for most of human history, weaned children didn't drink milk. So they shut down the enzyme lactase, which breaks lactose into sugars. With the domestication of cattle 9000 years ago, it became advantageous to digest milk, and lactose tolerance evolved in people who raised cattle.

In 2002, researchers identified a genetic mutation that regulates the expression of lactase and allows Finns and other northern Europeans to drink milk as adults. But researchers were surprised that the mutation appeared at lower frequency in southern Europe and the Middle East, and it was missing in most African pastoralists.

Tishkoff organized a team to collect blood samples from 470 Tanzanians, Kenyans, and Sudanese from 43 ethnic groups. Her team sequenced the DNA of 110 individuals who also were tested for milk tolerance.



Dairy queen. Some members of the Pokot people of Kenya carry three distinct mutations that allow adults to digest milk.

They found three new mutations in the same stretch of DNA as the European variant. The mutations turned up in varying frequencies in the Maasai and other Nilo-Saharan populations in Tanzania and Kenya, in Afro-Asiatic-speaking Kenyans, and in the Beja from Sudan; some people had all three mutations. People with any of the variants had higher blood sugar levels after drinking milk, a sign that lactose was being digested.

The researchers also found that the most common variant arose as recently as 3000 to 7000 years ago and spread rapidly. "This is extremely significant because it shows the speed with which a genetic mutation can be selected," says zooarchaeologist Diane Gifford-Gonzalez of the University of California, Santa Cruz. Indeed, the data suggest that humans who could digest milk had a huge reproductive advantage. "This is the strongest signature of recent positive selection yet observed," says Tishkoff.

The new data may also help explain why people tolerate milk to varying degrees. The ability to drink milk is "not a qualitative trait that you have or you don't," says Weiss. Tishkoff thinks there are yet more variants, and her team is seeking them.

—ANN GIBBONS

REGULATORY POLICY

EPA Draws Fire Over Air-Review Revisions

In a controversial move, the U.S. Environmental Protection Agency (EPA) has changed the way it reviews its health standards for six of the most widespread and dangerous air pollutants. Agency officials say the decision, announced last week, is designed to speed the notoriously slow process of revising these standards. But

critics charge that the real intent is to give political appointees more control—an allegation that a powerful senator has vowed to investigate.

EPA's National Ambient Air Quality Standards (NAAQS) have enormous consequences, influencing the regulation of vehicles, industry, and agriculture in many ways.

Under the Clean Air Act, the standards must be based on scientific evidence to protect human health and the environment, without regard to cost. The pollutants—including ozone, lead, and soot—must be reviewed every 5 years.

Many observers believe the new review process has its roots in a political contretemps from a year ago, when Administrator Stephen Johnson ignored recommendations from staff scientists and the Clean Air Scientific Advisory Committee (CASAC) that a soot standard be tightened (*Science*, 6 January, p. 27). "It ▶



Fast lane. EPA says it wants to update air-quality standards more quickly, but critics see a political smokescreen.