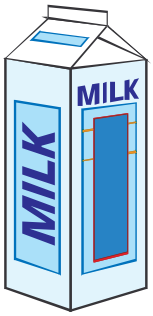
Got Milk? How About Iron?



In research that may one day affect food crops, ARS and Cornell University researchers in Ithaca, New York, are studying the mechanisms by which humans absorb iron from milk.

"Although human milk is not high in iron content, there appear to be some compounds in it that promote iron uptake," says animal physiologist Ray Glahn, of ARS's U.S. Plant, Soil, and Nutrition Research Laboratory. "By identifying these compounds and understanding how they work, we may be able to make other foods, such as staple food crops, more nutritious."

In collaboration with Paz Etcheverry, a Cornell graduate conducting postdoctoral studies, and Dennis D. Miller, a professor in the Ithaca-based university's Department of Food Science, Glahn used a combination of human cell culture and separation techniques to reveal clues about how iron's bioavailability is affected by fat, whey, and casein—three major components of both human milk and cow's milk.

"Using ultracentrifugation, we divided the milk into fractions and then identified the iron uptake characteristics of each fraction with cultures of human intestinal epithelial cells," says Glahn.

To no one's surprise, the study found that there seems to be a factor in the whey of human milk that enhances iron uptake. Noteworthy, however, was that this factor wasn't lactoferrin. For years, scientists have debated whether that protein's ability to bind and transport iron—and release it at specific receptor cells in the human intestine—actually enhances iron absorption.

Instead, the study found that it's the low-molecular-weight fractions of whey that promote uptake. "Low molecular weight corresponds directly to the size of molecules," says Glahn. "In this study, we used filters to separate compounds in whey by their molecular size. When these substances were exposed to our human intestinal cell cultures in the presence of iron, iron uptake was higher with the low-molecular-weight fractions. The high-molecular-weight fractions of whey, including lactoferrin, did not enhance iron uptake."

Overall, the study showed that removal of whey from human milk resulted in less iron uptake. Removal of the fat fraction increased iron uptake, indicating that this component hinders iron bioavailability. Removal of the casein component had no effect.

In cow's milk, the story is different: Removal of whey and fat had no effect on iron uptake, whereas removal of the casein fraction increased uptake, indicating that casein is an iron-uptake inhibitor.

The simulated digestion and cell culture techniques have been an integral part of Glahn's research since the late 1990s. These methods mimic human food digestion and uptake to the point where nutrients are actually absorbed by a line of human intestinal cells. (See "A Gut Issue—Measuring Iron Bioavailability," *Agricultural Research*, August 1999, p. 4.)—By **Luis Pons,** ARS.

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Nutritional Implications of Rheumatoid Arthritis

For some people, the benefits of eating a healthy diet are hard to detect on a daily basis. But for others—such as those with rheumatoid arthritis—the effects are often much more palpable.

Rheumatoid arthritis, or RA, is a chronic inflammatory disease with three diet-associated aspects. One is elevated resting energy expenditure. Another is elevated whole-body protein catabolism—a destructive form of muscle metabolism that translates to muscle wasting. And yet another is low body cell mass, which leads to increased fat mass.

Nutritionist Susan B. Roberts, rheumatologist Ronenn Roubenoff, and colleagues have conducted a study that solves the puzzle as to whether folks with RA should increase their caloric intake to make up for their increased resting energy expenditure. Roberts is director of the Energy Metabolism Laboratory at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University in Boston, Massachusetts. Roubenoff has a visiting appointment with the center.

People with RA tend to be less active than people without—the stiffness and swelling caused by inflammation naturally prompt them to pursue less physical, more sedentary lifestyles. Such habits lead in turn to overall gains in fat mass. The combination of high fat mass and low muscle mass contributes to an increased risk of disability.

Researchers at the center had previously shown that those who develop RA also develop an increased metabolic rate; they simply burn more calories while at rest. But they did not know what effect the elevated resting energy expenditure has on daily total energy expenditure and thus on dietary energy requirements.

Twenty healthy women and 20 women with RA, all of similar weight and size, were studied. Their total energy expenditure and their energy expended during rest and during exercise were measured or estimated. These three measures make up the major components of the energy balance equation.

The researchers found that in the women with RA, low energy expenditure from physical activity was directly linked to lower total energy expenditure. "Even though their basal metabolism is revved up, people with rheumatoid arthritis tend to be less active than people without—which reduces their caloric needs," says Roberts. This finding helped solve the puzzle of whether women with RA need to eat more to make up for the fact that they burn more calories while at rest. They don't.

The researchers concluded that those with RA should consume nutrient-rich diets and incorporate physical activity throughout the day to boost their total energy expenditure. "Such a regimen will help them improve their physical function and quality of life and maintain a healthy weight," says Roubenoff.

The study was published in the *American Journal of Clinical Nutrition*.—By **Rosalie Marion Bliss,** ARS.

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