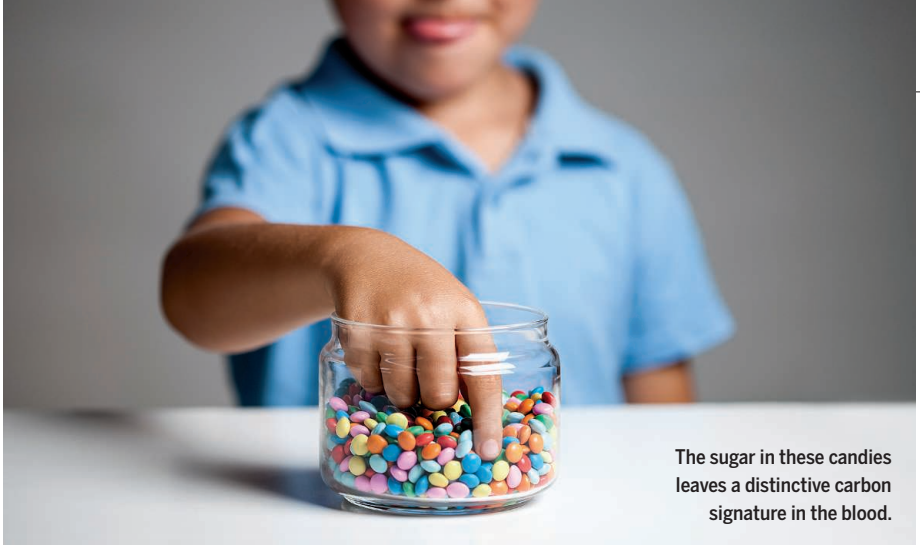

The sugar in these candies leaves a distinctive carbon signature in the blood.

NUTRITION

Have a sweet tooth? New blood test could tell

Isotope ratios could aid research by tracking added sugars

By **Viviane Callier**

Monitoring—and modifying—diet isn't easy, as people struggling with obesity or diabetes are well aware. Keeping track of the added sugars that lurk in foods from soft drinks to cereals is especially hard. Researchers have now come up with a blood test that could help both dieters and nutrition researchers—and they've shown that it is as good at monitoring added sugars as the complex diet reporting usually used in medicine and research.

The test, based on the ratio of common carbon isotopes in blood serum, "could be transformative for combating the ongoing obesity epidemic," declares Hope Jahren, a plant biologist at the University of Hawaii, Manoa, and a co-author of the study, which appeared online last week in *Public Health Nutrition*. Obesity experts see potential, too. The test "provides a simple, objective measure of added sugar in a person's diet that can be used by clinicians and by patients," says Nicholas Christakis, a social scientist and physician at Yale University. "People are often motivated by feedback."

Jahren and collaborators at the Johns Hopkins Bloomberg School of Public Health began developing the test in 2006, exploiting the fact that carbon isotope ratios differ between crops. Carbon-12, by far the commonest isotope, is present in all plants. But a scarcer isotope, carbon-13, is enriched in one group of plants, the so-called C4 plants. Adapted to dry conditions, they have a photosynthetic enzyme that enables them to grab more of the heavier carbons from the air than their cousins, the C3 plants. Corn and sugar cane—the major sources of added sugar in processed food—are both C4 plants.

The result is distinctive carbon signatures in common foods (see table, below), Jahren and her colleagues found. Added cane and corn sugars—major contributors to the obesity and diabetes epidemics—lend a higher carbon-13 ratio to processed foods like candy and soda. Foods from C3 plants—bananas, beets, and wheat, for example—have much lower ratios of carbon-13. Foods containing both C3 and C4 plants—cereal, cookies, and even dark chocolate—fall somewhere in between.

Jahren and her team set out to see whether such isotopes could be measured in people. In 2010, they developed their blood test, which measured the carbon isotopes using mass spectrometry. In a pilot study of 186 men, the test showed that those who consumed more soda had a measurably higher ratio of carbon-13 in their blood. Indeed, just one sugar-sweetened beverage was enough to produce a detectable change.

Telltale carbons

Foods carry distinctive ratios of carbon isotopes depending on whether they come from C3 or C4 plants.

C4 SIGNATURE	C3 SIGNATURE
Cane sugar	Beet sugar
High-fructose corn syrup	Maple sugar
Coca-Cola	Apple juice
SweeTarts	Dark chocolate
Popcorn	Bananas
Cornstarch	Wheat flour

The latest study, led by dietitian Valisa Hedrick of the Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, probed whether the test—since refined—is a good substitute for the standardized diet recalls used to estimate added sugar consumption. The team recruited 216 adults from rural Virginia who consumed at least 200 calories of sugar-sweetened beverages, about 1.25 cans of soda, per day. They then asked subjects to recall every single item they had eaten over three 24-hour periods and compared the inventories with the test results. They discovered that subjects' carbon-13 ratios rose in lockstep with the amount of added sugar they consumed.

Added sugars now account for 15% of the calories Americans take in, three times as many as the American Heart Association recommends. "Most people simply are not aware of how much added sugar they are consuming," says dietitian Jamie Zoellner of Virginia Tech, a co-author of the study; she thinks the test could help. Researchers need such a test as well, says Mark Friedman of the Nutrition Science Initiative in San Diego, California, a private research foundation. "The lack of an objective measure of what people are eating is the single biggest obstacle in nutrition research."

The test has drawbacks, however. It relies on expensive analytical equipment, and it measures all C4 products in the blood, which can come from corn products like tortillas and popcorn or corn-fed livestock as well as from corn syrup sweetener. A follow-up study in the *Journal of Nutrition* showed that the confounding effects of these foods are small. But other added sugars can slip past the test if they come from C3 plants, such as honey, maple syrup, fruit juices, and beet sugar. The trials also relied on self-reported diets, which are notoriously unreliable. Friedman calls for an experiment in which researchers strictly control and monitor subjects' diets before measuring the blood biomarker.

The team is now planning controlled feeding trials. They are also studying how well the test can track changes in sugar intake through time, and adapting it to run on cheaper technology. If all goes well, they hope to commercialize the test and make it widely available in clinics and hospitals, perhaps as part of a standard blood panel. ■

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