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WEIZMANN INSTITUTE OF SCIENCE

Science Tips

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Bread and Health: A Personal Matter

Bread occupies a unique place in our diet: it accounts for about one-tenth of the calories many people in the West consume and up to 40% of the caloric consumption in some non-Western countries – more than any other food product. In the past few decades, since white bread has acquired a bad name, bakeries have been going out of their way to produce high-quality whole grain breads. But a new study conducted at the Weizmann Institute of Science and published recently in *Cell Metabolism* reveals that these "wholesome" choices are not necessarily the healthiest for everyone.

The Weizmann Institute scientists compared two kinds of bread viewed as being on opposite ends of the health spectrum. One was industrial white bread made from refined wheat and considered less healthy. The other was sourdough-leavened bread made in an artisanal bakery from freshly stone-milled whole grain wheat flour and baked in a stone hearth oven: It was prepared specially for the study and was assumed to possess superior properties.

Twenty study participants were divided into two groups and asked to consume large quantities of bread (supplying about a quarter of their caloric intake) for a week. One group ate the white bread, and the other, the "healthy" sourdough bread. After a two-week break, they switched, and for a week the group that had previously eaten white bread ate the sourdough bread, and vice versa.

Tests revealed that eating bread of any kind affected the blood levels of sugar, minerals, liver enzymes and other substances. But when the scientists compared the effects of the two types of bread, they were surprised. "We were sure that the sourdough bread would come out a healthier choice, but much to our surprise, we found no difference between the health effects of the two types of bread," says Prof. Eran Segal of Weizmann Institute's Computer Science and Applied Mathematics Department.

"That's probably because the body's response to bread is a highly personal matter, so the differences between people in the study averaged themselves out," says Dr. Eran Elinav of the Immunology Department, who headed the study with Prof. Segal and Prof. Avraham Levy of the Plant and Environmental Sciences Department. Levy adds: "We planned the experiment so that everyone would consume the same amount of available carbohydrates from both bread types. Because whole wheat bread contains relatively fewer carbohydrates, this meant that people ate more of it compared to the white bread. This difference in carbohydrate levels should also be taken into consideration when planning a diet."

The study showed, for example, that about half of the participants had higher blood sugar levels after eating white bread, whereas the other half had higher blood sugar after eating sourdough bread. It is possible that these different responses were due, in part, to the differences in the individuals' intestinal microbes – the microbiome. The composition of the microbiome in the people whose response to white bread produced high blood sugar levels differed from that of the people who responded to sourdough bread with high blood sugar.

The scientists developed an algorithm connecting the microbiome's composition with the person's response to the type of bread. "Using this algorithm, we managed to predict who will have high blood sugar after eating white bread, and who will have high blood sugar after eating the sourdough," says research student Tal Korem, who conducted the study with research student Dr. David Zeevi and other team members: Dr. Omer Weissbrod, Noam Bar, Maya Lotan-Pompan,

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Dr. Tali Avnit-Sagi, Noa Kosower, Gal Malka, Michal Rein and Dr. Adina Weinberger of the Computer Science and Applied Mathematics Department; and Dr. Niv Zmora and Jotham Suez of the Immunology Department.

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How to Reduce Shockwaves in Quantum Beam Experiments

Aeronautic engineering provided the answer

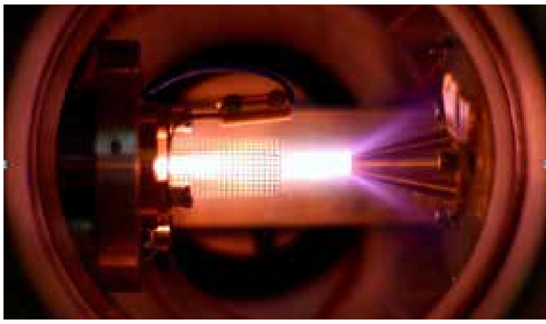
The tiny cone-shaped "skimmers" used in experiments looking for exotic chemical-quantum phenomena resemble the intake mechanisms of aircraft engines, and they perform similar functions: Each directs the flow of gas – the engine intake controls the supply of air for burning fuel, and the "skimmer" creates beams of cold flying atoms or molecules. While skimmers have been a necessary component in atomic and molecular-beam experiments for decades, they were also known to impose a fundamental limit on the number of particles one could pack into the beam. However, Prof. Edvardas Narevicius and his team in the Weizmann Institute of Science's Chemical Physics Department have now revealed a simple way to overcome this limit.

Cold-beam experiments are conducted in labs around the world to observe atoms and molecules behaving in a quantum manner – as, for example, waves that interfere with one another. Adding beams together, as Narevicius and his group do in their lab, creates new and interesting chemical reactions.

Narevicius explains that the extreme cooling needed for such experiments – close to absolute zero – is accomplished by spraying a gas of atoms or molecules through a small nozzle into a vacuum chamber, from high pressure to nearly none. The atoms in the experiment spread out, forming a very cold cloud of atoms that are moving very fast. Skimmers are used to direct some of these atoms into a beam. "One would think," says Narevicius, "that if the gas in the canister is at a higher pressure, and thus releases more atoms at once into the vacuum chamber, the resulting beam would have a higher density. But that is not the case. Above a certain pressure the density levels off. Researchers have not known how to overcome this limit, placing many interesting experiments beyond reach."

"This was a perfect problem for my student, Yair Segev," adds Narevicius. Segev came to the Weizmann Institute with expertise in aerospace technology and physics. Beginning with an algorithm used by aerospace engineers to model flows high in the atmosphere, he created simulations of the particle flow in the skimmers. These simulations revealed the existence of shockwaves within the skimmer cones, which blocked the subsequent flow of particles in the beam. This phenomenon emerges from interactions between the beam's particles and the cone: particles bounce off the skimmer at high velocities, colliding and disrupting the beam's flow. The high reflected velocities result from the "hot" (that is, room temperature) surface of the skimmer, so Segev tried the simulation with cooled skimmers. The results showed a significant reduction in the shockwaves, as well as much denser beams behind them.

Next the team undertook experiments with various molecular beams, chilling their skimmers to progressively lower temperatures. Performing the tests with neon and other types of fluorescing plasma enabled them to clearly observe the colorful results. The researchers found that the shape of the shockwaves was significantly changed and the density of the beams indeed rose with skimmer cooling,



Cold beam experiment reveals shockwaves from the skimmer lip interfering with the beam

peaking when the temperature was below some tens of degrees above absolute zero – cold enough to freeze atoms to the tip of the cone and thus allow the rest to flow through "without feeling any disturbance from the skimmer," says Narevicius.

"The shockwaves in and around the skimmers turn out to be similar to those that a spacecraft experiences when it crosses the boundary between the vacuum of space and the upper atmosphere," says Segev. "In both cases, suppressing the heat transferred between the surface and the gas can drastically change the shape of the flow. In the spacecraft we want to keep the atmosphere from heating the shell, while in our experiments we want to prevent the skimmer from heating up our cold beams."

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