Research News

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Defining the good, the bad, and the yummy

BY SEAN MOORE
Research Promotion

A pinch of this and a dash of that is a fine approach to home cooking. But for making processed foods it's inefficient and unscientific, and since processed foods are wonderfully complex materials, there can rarely be too many scientists in the kitchen.

Martin Scanlon, food science, is working with numerical techniques for characterizing the material properties of lipid food systems, with the goal of making food healthier and pleasing to the palate. His research, for example, will help the food industry find a replacement for its most recent foe: trans fats.

"It doesn't matter how compelling the nutritional advantages are, if that trans-fat-free food tastes like a hockey puck you're not going to eat it," he said.

Acta Materiala, a leading materials science journal, will soon publish Scanlon's paper on the novel use of indentation – driving a cone-shaped wedge attached to a load cell into a material to back-extract fundamental mechanical properties – on soft food materials like butter and shortening.

Photo by Sean Moore

Martin Scanlon, food science.

Previously, this method was used for analyzing the properties of microelectronic components and thin film coatings.

"We want to understand governing principles, and to achieve this, we take a materials science approach to assessing food properties," Scanlon said.

"If we know what the properties of a food's various components are, then with the right models we can predict what properties a blend of them will have."

Scanlon and Joamin Gonzalez, a food science graduate student, are currently working with University of Guelph researchers to see how computational tools can be used to formulate a range of heart and baker-friendly blends using butter and canola oil.

Developing and modifying recipes is an arduous and expensive process. In food industry circles, Scanlon said, it is rumoured that Kraft Foods spent tens of thousands of man-hours working on more than 100 plant trials before they could reformulate the famed Oreo cookie to its original taste and texture after removing its trans fats.

What's more, as more consumer groups begin filing class-action suits against food giants – like the one filed last June demanding that KFC stop frying chicken in oil that contains trans fats – there will be increasing pressure to change decades-old recipes.

Cooking oils have many readily available substitutes. Baked goods, however, require a more conscientious approach to finding alternative high melting point substitutes that will deliver the same quality and shelf life as the hydrogenated fats they replace.

Currently, when new recipes are developed for things like cookies, a panel of sensory experts gathers to taste them and provide feedback. It is expensive, time-consuming and necessary, Scanlon said.

But by understanding the material properties of ingredients, the properties of potential concoctions can be predicted before they are made, allowing food developers to sidestep poor formulas and consequently become more efficient.

Scanlon is trying to figure out what makes the cookie crumble, so to speak.

"Unraveling the complexity of these dynamically evolving, heterogeneous structures is the key to accurately predicting the quality of novel and conventional foods and to developing successful nutrient loading strategies for the creation of functional foods," he once wrote.

But for now, the healthy cookie remains an enigma.

Researcher honoured with new mineral

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Three years ago, on the eastern edge of a glacier in Tajikistan, mineralogists picked through boulders that had tumbled down the mountain and found a pale yellow mineral.

They sent it to Elena Sokolova, geological sciences, to examine. After three years of work she unraveled its crystal structure, and it turned out to be one of the most complex and exotic arrangements of atoms known to science.

Sokolova is one of a handful of people in North America who can do this type of work and she is well-known around the world for her insight into why atoms organize themselves in the way they do. In recognition of this, mineralogists from the Fersman Mineralogical Museum in Moscow recently named a new mica from Tajikistan in her honour: Sokolovaite, an elegant violet-coloured mineral.

Sokolova uses a diffractometer to shoot X-rays at a crystal, and the diffracted X-rays carry information about the arrangement of its atoms. She then bombards the crystal with a narrow beam of electrons in an electron microprobe and measures the emitted X-rays to learn about its chemical composition.

However, the pale yellow mineral from Tajikistan is odd. For starters, it's packed with 30 chemical elements. A simpler one like quartz, for comparison, consists of two.

"It's the most amazing mineral I've ever worked on, I've never seen anything like it," said Sokolova. "There are many different types of minerals: oxides, borates, silicates, phosphates, et cetera. This yellow mineral from Tajikistan is an oxide-borate-silicate-phosphate. It is unique; there are no other minerals as chemically complicated as this."

Sokolova is continuing to refine her mathematical model of this structure because "it's a very complicated material."

"One has to accept that it's not very well crystallized and has a lot of disorder. Some structures are perfectly ordered and these tend to be simple, some structures are disordered and these tend to be complicated."

Sokolova is interested in understanding the arrangements of atoms in crystals.

"For me, it's interesting not just to work out the structure, but also to establish relations between structures," she said.

"Minerals are the materials of the Earth; if you want to understand Earth processes, you have to understand minerals and the way they react with their environment, be it 1,000 kilometers down in the mantle of the Earth, or at the surface. If you want to know how a mineral interacts with its surroundings, you have to know its structure and understand how it responds to its environment."

Photo by Sean Moore

A recently-discovered mineral has been named in honour of University of Manitoba researcher Elena Sokolova, geological sciences.

Sokolova is an expert on titanium-silicate minerals, borates and phosphates, and has described 38 new minerals.

"The discovery of a new mineral is quite exciting," she said. "One knows that nobody has ever seen this atomic arrangement before, and the thrill of discovery is quite intense."

She has also published over 180 journal papers on minerals and their structures.

"However, there are approximately 4,500 known minerals, and new minerals are discovered every year," she said, "so we are not going to run out of things to do for a long time."

Bringing Research To Life

Research News is Published
by the Office of the Vice-President (Research)
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