The "Handedness" of a Molecule Influences the Crystal Structure and Properties of Some Solid Fats

What is this research about?

In many foods, the main type of fat is triacylglycerols (TAG), more commonly known as triglycerides. These fats take different shapes, depending on how the TAG molecules come together to form a solid, crystal-like structure. Researchers usually classify TAG molecules based on the length and type of the fat molecule, and by the way these molecules are packed together. However, these factors alone cannot predict the taste and texture of foods produced from these fats. This research argues that the "handedness" (chirality) of the molecule is also important.

Just as your right hand is a mirror image of your left hand, some molecules also have a mirror-image version of themselves. These forms are chemically identical, but some are more stable than others, and they melt at slightly different temperatures. How high-fat foods taste and feel in the mouth also depends a lot on the handedness of the form of fat used. Because of these differences, it is useful to be able to identify and tell apart the different forms.

What did the researchers do?

The researchers looked only at one particular TAG. The "mixed" sample (both right and left-handed versions) had an equal amount of both the left and right-handed versions of the molecule. The "pure" sample had only one version of the molecule that is either all left-handed or all right handed. The temperature was increased slowly in both the pure and the mixed sample in order to learn if their melting points were different. Next, the crystal structure of each sample was determined by seeing how X-rays bounced off each sample under a microscope.

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What did the researchers find?

The mixed sample produced two different forms of fat crystals, one of which was more stable than the other. In the stable form, called β, the crystal had individual units made up entirely of either the left-handed or the right-handed version of the molecule, but never both. In the less stable form, called β', each unit of the crystal contained both left and right-handed versions in equal amounts. Although both the β and β' forms are initially created in the mixed sample, all of the less stable form (β') is eventually converted to the more stable form (β). For the pure sample, the β' form was stable, and was the only form possible, since it didn't have the opposite version needed to create the more stable β form. Reporting on the handedness (chirality) of TAG molecules will allow researchers to better predict the taste and texture of high-fat foods.

What you need to know:

Triacylglycerols (TAG), a common type of fat in foods, often exist in different forms when solid, which may taste or behave slightly differently. The 3D arrangement, or "handedness" of atoms in a molecule, can influence which solid form a TAG will take. TAG molecules should be described in terms of their handedness (chirality) in addition to their length and composition to improve predictions of the taste and texture of resulting food products.

How can you use this research?

Food chemists and food scientists can use this research to classify different fats for use in food products and to create foods with improved taste and texture.

About the University of Guelph researchers:

Dr. Robert Lencki is an Associate Professor in the Department of Food Science, at the University of Guelph. Email: rlencki@uoguelph.ca.

John Craven is a Research Associate in the Department of Food Science, at the University of Guelph.

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