# Natural Oils Can Be Hydrogenated Without Making Unhealthy Trans Fats

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(PhysOrg.com) -- To prolong the shelf life of foods, manufacturers often add hydrogen to natural oils, a process called hydrogenation. But hydrogenation also results in the production of trans fats, which have adverse health effects such as raising bad cholesterol and increasing the risk for coronary heart disorders.

Trans fats are found in vegetable shortenings, some margarines, crackers, cookies and snacks. Health authorities worldwide recommend that people reduce their consumption of trans fats.

Now UC Riverside chemists have designed a catalyst - a substance that accelerates a chemical reaction - that allows hydrogenated oils to be made while minimizing the production of trans fats.

In their experiments, the researchers, led by Francisco Zaera, a professor of chemistry, used platinum, a common catalyst for these processes. By controlling the shape of the platinum particles, the Zaera group was able to make the catalyst more selective.

Catalytic selectivity refers to the ability of a catalyst to select a specific pathway from among many possible chemical reactions. In the case of the researchers' experiments, selectivity refers to the production of partially hydrogenated fats without the making of trans fats.

Zaera's lab found that the platinum catalyst performed most selectively when its particles assumed tetrahedral shapes, with the atoms arranged in a hexagonal honeycomb lattice. Particles with these shapes allow for the preservation of the harmless cis configuration in the hydrogenated fats. Other lattices, the researchers found, favor the production of trans fats.

Platinum catalysts such as those used by the Zaera group are considered heterogeneous because they exist in a different phase (solid) than the reactants (liquid or gas). Compared with homogeneous catalysts, where the catalyst is in the same phase (liquid) as the reactants, heterogeneous catalysts have the advantages of easy preparation, handling, separation from the reaction mixture, reuse, high stability, and low cost.

But their main disadvantage is that, unlike homogeneous catalysts, which tend to be molecular, heterogeneous catalysts must be dispersed as small particles in a high surface-area support in order to optimize their use. This typically results in catalysts with surfaces of ill-defined structures.

The research by Zaera and his colleagues is a breakthrough also because it shows for the first time that it is possible to achieve selectivity with heterogeneous catalysts like platinum by controlling the structure of their surfaces.

"The more control we can exert on how we prepare catalysts, the more we can control the catalytic selectivity of a particular chemical process," Zaera said. "Our work shows that it is possible to make heterogeneous catalysts that afford us more control on selectivity. This opens the door, we hope, for chemists to think about achieving selectivity for other reactions via the design of specific heterogeneous catalysts with specific shapes."

Zaera explained that heterogeneous catalysts tend to be more practical in terms of manipulation, but are harder to control.

"Our paper shows that, thanks to new advances in nanoscience, sophisticated and highly selective heterogeneous catalysts can be made by controlling their structures," he added. "In this sense, our paper changes the paradigm of heterogeneous catalysis. These catalysts can now compete more closely with homogeneous catalysts, which industry traditionally uses for reactions that require high selectivity such as those involved in the manufacture of medicines or other fine chemicals."

Study results appeared online earlier this week in *Nature Materials*.

Next in their research, Zaera's lab plans to find other reactions where selectivity is needed. The researchers also plan to improve on the synthetic techniques used to make selective catalysts.

Nearly 80 percent of all chemical industrial processes use catalysts. With annual global sales of about $1500 billion, catalysts contribute approximately 35 percent of the world's gross domestic product. They are used in the manufacture of commodity, petro- and agro-chemicals, pharmaceuticals, cosmetics, foods, and polymers.

Journal link: [www.nature.com/nmat/index.html](www.nature.com/nmat/index.html)

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