

Digging Into Our Fatty-Acid Dilemma

By Donna Berry, Contributing Editor

Today's product designers are seeking trans-fatty-acid-free (per serving) alternatives for all types of food formulations. Often, the answer means a move to fats high in saturated fatty acids. Because both *trans* fatty acids and saturated fatty acids are associated with elevated heart disease risk factors, product designers face a fatty-acid dilemma.

There is general agreement that *trans* fatty acids should be removed from the food supply to address the health concerns, but it is not clear which fats should be used as replacements. Further, emerging research suggests this will not get any clearer in the near future.

Saturates not so bad after all

While it is assumed that reintroduction of saturated fat might be deleterious, recent research suggests that the role of saturated fatty acids needs to be re-examined. "Current dietary intake recommendations of macronutrients have targeted total fat, cholesterol and saturated fat as the principle means to improve human health," says Bruce German, professor, Department of Food Science & Technology, University of California-Davis. "Such recommendations have been translated into a long-term agricultural objective of eliminating these components from human foods. However, many authorities are questioning if it is possible that evolution found benefits to saturated fatty acids that current nutrition recommendations do not consider."

Nutrition research in the 1980s revealed significant differences in how humans metabolized individual fatty acids, and scientists at that time speculated that some saturated fatty acids were "better" than others. Some scientists believe that saturated fatty acids cannot be considered as a single group, because in the human body, each saturated fatty acid has a specific function depending on its chain length. However, because nobody is eating individual fatty acids, but rather a mix of fatty acids as only one component of complex foods, other scientists say saturated fatty acid metabolism and impact on blood cholesterol levels must be considered in terms of daily intake.

"For example, the label of a bar of chocolate may state a high percentage of your recommended intake, or daily value (DV), of saturated fats," says John Radcliffe, professor, Department of Nutrition & Food Science, Texas Woman's University, Houston. "Much of that is provided by stearic acid, which does not raise blood cholesterol levels as do most other saturated fatty acids. However, even though chocolate contains high amounts of stearic acid, it is still important to adhere to the recommended daily intake of saturated fat. This is 10% of a person's energy intake, or approximately 17 to 25 grams per day for most adults, regardless of the source."

Stearic acid is typically found in animal fats such as beef tallow and lard. "Researchers originally speculated that stearic acid was rapidly converted to oleic acid (an 18-carbon monounsaturated fatty acid) in the body, making it 'healthy,'" says Gerald McNeill, director of R&D, Lodders Crokiaan,

Channahon, IL. “However, recent research has not supported that theory, and it has been repeatedly shown that stearic acid is not converted to oleic acid. And, although stearic acid has been shown to not cause an increase in low-density lipoprotein cholesterol (LDL, or “bad” cholesterol) when consumed, it was also shown not to increase high-density lipoprotein cholesterol (HDL, or “good” cholesterol). That is not good.

“It should be noted that the only other fatty acids that do not increase HDL are *trans*,” McNeill continues. “The other saturated fatty acids, such as palmitic acid, increase HDL, but they also increase LDL. So, there is really no net difference among the different kinds of saturated fatty acids. In fact, because all saturated fats do both good and bad things, they are not as ‘harmful’ to humans as was once believed.”

And remember, humans do not consume individual fatty acids. They are complex blends delivered via a food matrix. Other food components such as fiber and plant sterols impact absorption and cholesterol levels.

“Given the lack of difference in the healthfulness of different kinds of saturated fatty acids, it does not make much sense to give a special status to one kind of saturated fat,” says McNeill. “The result could be an undesirable, unforeseen consequence. After all, look what happened the last time a fatty acid got a special label status.” Think *trans*.

“I don’t believe that saturated fatty acids will be ungrouped on food labels down the road,” says Radcliffe. “There is only so much room available on a food label, and it would be very complicated, as different foods contain different amounts of particular fatty acids, but the combination of all fatty acids in a food is what is important when considering daily percentage intake.”

This topic of grouping or singling out saturated fatty acids is one the Dietary Guidelines committee is also reviewing. “This topic received much discussion during the 2005 Dietary Guidelines Advisory Committee meetings, and is again receiving some attention during the current 2010 Dietary Guideline discussions,” says Bob Wainwright, technical director, Cargill oils and shortening team, Minneapolis. “This is a difficult topic, especially with respect to how such a message might be conveyed in language that consumers understand and can make informed choices about.”

Chain length and functionality

The role of saturated fatty acids in our body is strongly linked to their chain length. Each saturated fatty acid has its own merits.

Chain length impacts fat’s functionality in a food system, too. “The fatty acid profile provides a ‘fingerprint’ that gives some useful information regarding what to expect in terms of performance and application utility from a given fat or oil,” says Wainwright. “It is also important to consider the architecture of the fat, or, more appropriately, the triglyceride, in terms of which fatty acids are esterified to specific positions on the glycerol backbone.”

Take the pleasant eating experience associated with chocolate, for example. “Cocoa butter plays a significant role in delivering that sensory delight,” continues Wainwright. “If the fatty acids associated with cocoa butter are reallocated across the glycerol backbone in a random fashion, as opposed to a very directed and symmetrical native association, the resultant fat exhibits a melting point that is well above mouth temperature and hence very undesirable for a chocolate. In fact, the melting point can be expected to increase from the native 97 to 125°F or higher.”

Further, fats and oils for long-shelf-life products should have the lowest polyunsaturated-fatty-acid content possible, as polyunsaturates are several times more unstable when exposed to oxygen than monounsaturated fatty acids.

“Saturated fatty acids, by far, are the most stable, which was one of the main reasons for using hydrogenation,” says McNeill. “It reduced or eliminated polyunsaturated fatty acids in a fat, rendering it more stable. When polyunsaturated fats react with air, the compounds that are formed have an undesirable taste and odor.”

Though the omega-3 fatty acid linolenic acid has many health benefits associated with its consumption, it is highly unstable and prone to rancidity. “It readily oxidizes at very low concentration, producing undesirable off flavors,” says McNeill. “This knowledge stimulated the development of new oils that have low levels of linolenic acid.”

Radcliffe adds: “High levels of unsaturated fatty acids in oils such as soybean oil and canola oil can reduce the shelf life of the oil, reduce fry life and give rise to undesirable flavors in fried products. Oils that have higher levels of saturated fatty acids, such as cottonseed oil, which contains 26% saturated fatty acids, do not need to be hydrogenated and can replace hydrogenated oils in the production of fried foods such as french fries.”

Exploring options

Cottonseed oil has a 2:1 ratio of polyunsaturated to saturated fatty acids. Unlike many other naturally *trans*-free alternatives available to product designers, cottonseed oil is rich in tocopherol (vitamin E), with one tablespoon containing 4.8 mg, making it an excellent source of this fat-soluble vitamin. Further, the vitamin E functions as a natural antioxidant, thus providing extra resistance to oxidative rancidity, according to the National Cottonseed Products Association, Cordova, TN.

A number of partially hydrogenated fat alternatives are made from soybean oil. “The first soybean trait innovation to become commercially available was the low-linolenic variety. Major food companies have made the transition to low-linolenic soybean oils from partially hydrogenated oils for frying and processed food applications,” says Lisa Kelly, a representative with the United Soybean Board (USB), St. Louis, MO. “Decreasing linolenic acid increases flavor stability and supports oxidative stability. Low-linolenic soybean oil can be used as a direct replacement for lightly hydrogenated oil in many applications, including light frying, sauces, rolls and pizza dough.”

One line of soybean oils from ADM, Decatur, IL, is enzymatically interesterified and contains “very low amounts of *trans* fatty acids,” says Gary List, a consultant for USB, “and only a slight increase in

saturated fatty acids, mostly in the form of stearic acid. They are typically blended with liquid oils to achieve the desired melting point and solid fat content, since the interesterified base comprises only 20% to 30% of the final spread or shortening. These products are designed to replace spreads with 10% *trans*-fatty-acid content and baking shortenings with 20% to 25% *trans*-fatty-acid content.

“Frying oils like canola and soy both have significant amounts of linolenic acid and traditionally do not hold up well in heavy-duty frying and foodservice applications,” continues List. “However, low-linolenic soybean oil, with 1% to 3% linolenic acid, performs very well in these applications and has been well-received by the food industry. The increased oleic oils now coming to the marketplace should be even more stable. Several studies have shown them to perform equally well or better than partially hydrogenated products. Of course, low-linolenic, increased-oleic soybean oils have zero grams of *trans* fats and, in some cases, have less saturates, too.”

Another commercial approach is a soy-based, zero-*trans*, reduced-saturated product offered by Bunge Oils, Bradley, IL, prepared with modified hydrogenation technologies. “It will meet the less than 0.5 grams *trans* fatty acids per serving threshold, and claims up to 33.3% less saturates than conventional baking shortenings,” says List.

A variety of solutions offer the opportunity for a zero grams *trans* per standard serving size of finished product. “Among our portfolio are a number of functional systems that do not elevate the total saturates in the finished product when compared against the same product formulated with partially hydrogenated *trans*-fat-containing shortenings. Typical applications include frying and bakery,” says Wainwright. “Trait-enhanced low-linolenic soybean oil and trait-enhanced canola oil offer significant improvements in oxidative stability compared to traditional commodity varieties and, hence, are very good options for many bakery and frying applications where fat structure is not a requirement.”

One new development is the nation’s first naturally processed no-*trans* fatty acid cooking oil produced without blends or chemicals. “We are the first—and, as far as we know, the only—naturally produced zero-*trans* oil in the nation made from nonmodified soybean oil,” says Bob Dawson, COO, Whole Harvest, Warsaw, NC. “You don’t have to genetically alter soybean oil to achieve stability and zero *trans*. We use only natural soybean oil, and have for many years.” The company produces the cooking oils by expeller-pressing nonmodified soybean oil. Without using harsh chemicals or hydrogenation, these oils retain their natural omega-3 fatty acids and vitamin E. The company has been awarded eight U.S. production and product patents for its proprietary production methods.

Shortenings and oils from palm oil serve as alternatives to partially hydrogenated vegetable oils for baked goods, snack foods, donut frying, confections and anywhere a solid fat is required for functionality. The decision to go with palm was made after comparing the functional characteristics of several possible solutions, including liquid vegetable oils, interesterified fats and lightly hydrogenated oils, notes McNeill. “Palm oil is naturally highly stable without the need for any chemical processes. It is naturally free of linolenic acid, and has only 10% of other polyunsaturated fatty acids. The remainder is monounsaturated and saturated fatty acids, making it naturally just as stable as partially hydrogenated oils, just without any *trans* fatty acids.

“Although palm oil is a single natural product that is semisolid at room temperature, it can be tailor-made to be a drop-in solution to replace almost any partially hydrogenated oil,” McNeill adds. “This is achieved through a physical process called fractionation. Melted palm oil is slowly cooled, causing large fat crystals to form. The crystals are filtered off, leaving liquid oil and a hard, waxy solid. These fractions can be blended back in different proportions to generate a range of products with different physical properties. The fractions themselves can be fractionated, creating even more unique components that can also be blended. We have developed more than 30 unique products that are drop-in solutions to almost every partially hydrogenated oil. All of these products are not hydrogenated and contain only a trace of *trans* fatty acids.”

Palm oil has a natural balance of unsaturated and saturated fat, containing about equal amounts of oleic acid and palmitic acid (40% and 45%, respectively). “Partially hydrogenated oils typically have a lower level of saturated fat because the difference is made up with a high level of *trans* fatty acids,” says McNeill. “The sum of the *trans* fatty acids and the saturated fatty acids in hydrogenated oil is usually the same as, or greater than, the saturated-fat content in palm oil. Because *trans* fatty acids are much worse than saturates, a 1:1 substitute with palm oil is a healthier option.”

However, scientists at USDA’s Agricultural Research Service investigated whether palm oil is a good substitute for partially hydrogenated fat. A clinical trial was designed to compare the effect of four different oils, as they are commonly consumed, on heart-disease risk. Fifteen adults, both male and female, volunteered for the study. Their levels of LDL were moderately high at 130 mg per deciliter of blood or above, and all were age 50 years or older. They each consumed each of four 35-day experimental diets. The fats tested were: partially hydrogenated soybean oil (moderately high in *trans* fat), palm oil (high in saturated fat), canola oil (high in monounsaturated fat) and soybean oil (high in polyunsaturated fat).

The findings suggest that, when compared to consuming either of the diets enriched with canola and soybean oils, the diets enriched with palm oil or partially hydrogenated soybean oil resulted in similarly unfavorable levels of LDL cholesterol and apolipoprotein B (a protein, attached to fat particles, that carries bad cholesterol throughout the bloodstream). The results of this study, published in the April 2009 issue of *Agricultural Research* suggest that palm oil might not be the healthiest substitute for *trans* fatty acids.

This is just one study, but it further adds to the fatty-acid dilemma. In the end, it might be best to heed Radcliffe’s advice, notably that “it is still important to adhere to the recommended daily intake of saturated fat,” as well as the recommendation by the American Heart Association to avoid *trans* fat as much as possible.

Donna Berry, president of Chicago-based Dairy & Food Communications, Inc., a network of professionals in business-to-business technical and trade communications, has been writing about product development and marketing for 13 years. Prior to that, she worked for Kraft Foods in the natural-cheese division. She has a B.S. in food science from the University of Illinois in Urbana-Champaign. She can be reached at donnaberry@dairy-food.com.