

## Reduced-Fat Formulating

By Cindy Hazen, Contributing Editor

At the height of the low-fat craze, comedian Dave Barry observed, "American consumers have no problems with carcinogens, but they will not purchase any product, including floor wax, that has fat in it."

It's an exaggeration, but it speaks to the incongruities of consumer purchase behavior.

Today's food buyers are just as discerning about selecting products based on ingredient statements. And one of their concerns is fat, although they are not always well-informed.

### Dietary guidelines

The USDA Report on the 2010 Dietary Guidelines for Americans specifically targets "solid fat (fats that are solid at room temperature, such as animal fats or fats made from vegetable oils by hydrogenations) and added sugars" with the acronym SoFAS. These contribute approximately 35% of calories to the American diet. "Reducing the intake of SoFAS can lead to a badly needed reduction in energy intake and inclusion of more healthful food into the total diet," the report says. The reasoning is that sugars and solid fats contribute excess calories "and few, if any, nutrients."

Fats contribute 9 calories per gram, which may contribute to obesity. Moreover, because intakes of dietary fatty acids and cholesterol are major determinants of cardiovascular disease, the dietary guidelines recommend limiting saturated-fatty-acid intake to less than 7% of total calories and opting for food sources of mono- and/or polyunsaturated fatty acids. Recognizing that this might not be immediately achievable, the report suggests aiming for less than 10% and gradually reducing intake over time.

Cholesterol-raising fats are described as saturated fats exclusive of stearic acid and trans fatty acids. Because trans fatty acids are believed to increase the risk of cardiovascular disease, the Guidelines recommend avoiding trans fatty acids from industrial hydrogenation as a beneficial change, "leaving small amounts (less than 0.5% of calories) from natural (ruminant) sources."

### Multifunctional fat

Calling for changes in dietary intake of certain fats is easy enough, but cutting the percentage of fat or dropping in a substitute is not a simple task in most products. Fat is multifunctional. Formulators must account for the many ways that it contributes to the final product.

As a flavor, fat may be neutral or it may have notes derived from its source, e.g., beef tallow. The degree of processing also can determine flavor. Equally important, fat may mask off flavors from other ingredients in a product or round-out the overall flavor perception. The choice of fat is also connected to potential development of off flavors due to oxidation and rancidity. There is a correlation between stability and the degree of saturation in a fat. Polyunsaturated fats react rapidly with oxygen, so storage conditions, processing stress, packaging protection and shelf-life expectations must be considered.

Further, mouth-coating, adhesiveness and melt impression are generally associated with solid or semisolid fats. Slipperiness is a sensory descriptor related to liquid oils. In baked goods, fat provides texture, helps with aeration and reduces moisture loss. In soups, sauces, dressings and dairy products, fat can add viscosity, creaminess and opacity. In all of these foods, it adds lubricity.

### Hydrocolloids help

When formulating a reduced-fat product, the first step is to determine what functionality the fat is performing in the particular application, then using a gum or combination of gums to mimic the functionality. Because each gum has its own characteristics and may or may not work synergistically with other ingredients, seeking the advice of a supplier can save time and money.

For example, a reduced-fat cake application requires "something that will favor the air entrapment and help to bind just the right amount of moisture without making the product too moist," explains Janae Kuc, laboratory technician, Gum Technology Corporation, Tucson, AZ. "It should also be able to create a very nice crumb and help with suspension of any particulates in the formula. Some gums usually used in combination for this type of application are xanthan, carboxymethyl cellulose (CMC), microcrystalline cellulose, gum arabic, konjac and guar gum. Typically, a 50% fat reduction is easily achievable."

Fat in muffins coats the flour proteins and reduces the proteins' interaction with water. "Higher-fat recipes tend to produce a much-moister product. When the fat is reduced, a muffin or cake will tend to become dry and crumbly," Kuc says. "By adding in a gum or gum system, the gums bind the water and work like the fat to protect the proteins from direct interaction with the water. This reduction of interaction between the protein and the water reduces the formation of gluten, creating a tender muffin or cake."

When reducing fat in cookies, Kuc says, "a blend of cellulose gum, konjac and xanthan aids in stabilization. A reduced-fat cookie without a gum system in place will tend to have a wide spread and produce a floppy finished product with a lack of crunchiness." Implementing the correct gum system will stabilize the ingredients "by a more-viscous batter that produces a crunchy, delicious cookie comparable to a full-fat version," she says.

In a creamy dressing application, Kuc advises that fat can be reduced by 50% when using the correct gum system. "We have found great success using a blend of xanthan, fenugreek and bulking agents such as fibers," she says. "The combination of gums helps build back viscosity and creates a creamy texture that is usually lost with the reduction of oil. The gum system also aids in emulsification of the remaining oil or fat and suspends particles."

National Starch Food Innovation, part of Corn Products International, Bridgewater, NJ, offers unique systems designed specifically for transforming or building back the texture of soups, sauces and dressings. Processing conditions—from high-heat to cold-process—determine the choice of a particular texturizing system.

Pourable salad dressings can be reformulated with a system developed for cold-process, high-shear manufacturing. "We can reduce oil by 20% to 40% and build back the eating experience, even when the original product is already reduced-fat," says Yadunandan Dar, senior manager, technology, National Starch Innovation. Using the same system in a spoonable dressing can "achieve an 80% to 100% reduction in oil and still make a comparable product," he says.

In salad dressings, these texturizing systems provide oil-like lubricity, yet also increase cling and aids suspension of particulates, such as fine herbs.

Thick, creamy set dairy products, such as sour cream, Greek yogurt and dips, require a system to deliver thickness and set characteristics along with the melt and mouth-coating qualities of a full-fat product. Low-calorie, fat-free products, such as nonfat yogurt, should be thick and satisfying but not watery.

"Milkfat, cream, other dairy ingredients and powdered shortening are relatively expensive ingredients, can be highly volatile (in pricing), have a finite shelf life and are perishable, whereas our starch-based texture systems offer greater process stability and refrigerated shelf-life stability over time," says Dar. "Commodity prices have been rising steadily for a number of the oilseed and dairy-product ingredients. Our starch-based solutions are relatively stable by comparison."

### **Fiber replaces fat**

Fiber is a nutrition-label-friendly fat-replacement solution, because many consumers are trying to increase daily fiber intake. A product designer can also benefit from fibers' functional contributions. In addition, insoluble fiber does not contribute calories, so it is ideal for low-calorie formulations.

"Insoluble fibers, such as powdered cellulose, sugar-cane fiber, bamboo fiber and wheat fiber, can function well in baked goods, certain dairy-based products, frozen desserts and extruded products," says Ramakanth Jonalla, project leader, R&D, cereal science, International Fiber Corporation (IFC), North Tonawanda, NY.

In breads, Jonalla recommends adding 4% to 5% fiber. Benefits include shelf-life extension, textural enhancement and good crumb-grain structure. In cakes and muffins, 1% to 2% is suggested to improve volume and aeration; 2% to 3% fiber can be added to cookies and doughnuts. Tortillas will benefit from improved rollability at 4% to 5%.

However, note that in many baked products, higher than recommended use levels of added fiber may interact adversely with the gluten network formation and result in structural issues.

Long insoluble fibers can exhibit synergistic effects with other ingredients, such as gums, to improve thickening and viscosity properties. For example, in pancakes, Jonalla says powdered cellulose, "when used at 0.5%, has demonstrated synergistic effect with xanthan gum in the formulation to improve the thickening properties of the batter. Insoluble fibers can improve emulsification properties in synergy with other emulsifiers in the formulation. This is especially useful in a low-fat pound-cake application."

Using insoluble fibers in the batter or coating of a product for a frying application will also reduce fat pickup during the frying process, thus helping to reduce fat content.

Several types of fiber can be used in meat products, depending on the desired function and the meat-processing technology being used, such as tumbling, injection or rubbing. "Insoluble fibers are widely used in emulsified meat and ground-meat products, while partially soluble and/or insoluble fibers such as inner-pea and sugar-beet fibers are used in whole-muscle-meat products," says Vareemon Tuntavanich, project leader R&D, meat science, IFC.

Fat contributes to meat juiciness and palatability. "Fiber plays a major role in these aspects, since it has high water-absorption capacity. Moisture entrapped in fiber is stabilized during the cooking process, providing juiciness in finished products while controlling the shrinkage," Tuntavanich explains. "In addition, consumers also perceive fiber-added meat product as tender, which is comparable to full-fat-formula products. Since most fiber is odorless, flavorless and neutral in color, fiber is suitable in a variety of meat-product categories. In

comminuted meat products, fiber mimics the texture of meat ingredients, therefore providing organoleptic properties. In addition to palatability, fiber's main functionality in meat products is cooked-yield enhancement. By replacing fat with fiber and water, reduction in cooked loss is always observed."

## Shortening solutions

For many baked goods, such as pie crusts, frostings and cream-filled cookies, replacing trans-fat shortenings has been especially challenging. Customers expect the unique mouthfeel, taste and creaminess these shortenings give to products. Manufacturers and bakers, faced with government mandates to remove trans fats, have struggled to match products and maintain customer satisfaction.

Technology continues to evolve. Loders Croklaan, Channahon, IL, offers new shortenings based on the concept that less is more. Shortenings based on extreme fat-reduction principals often create products with dramatic—and often unsatisfying—differences from their full-fat counterparts. Approaching fat reduction moderately yields more acceptable results. According to Gerald McNeill, Ph.D., vice president of research and development, Loders Croklaan, these new products are effective wherever an all-purpose shortening would be used. "It is particularly effective in many types of cookies and muffins," he says.

The modest fat reduction provided by these shortenings does not adversely affect the taste and texture of finished products. This means that minimal reformulation is required, saving time and reducing the need for additional product-development resources.

One product is designed for maximum saturated fat reduction, and another is optimized for maximum cost reduction and a modest reduction in saturated fat.

One 25-gram cookie formulated with the company's all-purpose shortening has 120 calories, 6 grams total fat and 3 grams saturated fat. A cookie formulated with the new, saturated-fat-reducing product has 110 calories, 5 grams total fat and 2 grams saturated fat. It is trans-free, nonhydrogenated and can reduce saturated-fat content up to 30% in baked goods.

McNeill reminds us that, in the 1980s, when the U.S. food industry attempted to address the obesity issue by producing reduced-fat and fat-free food products, fat was reduced by 50% to 100% in these types of products. "However, fats and oils are essential to maintain the desirable texture and flavor of many kinds of foods, including snacks and baked goods. Because of the poor eating quality of most reduced-fat products, consumers soon abandoned them and the low-fat craze was over," he says.

In another thirty years, will we look back to today and see that we've succeeded at meeting the USDA's Dietary Guidelines goals for fats? Or, will it appear as another comedic fad? That's the industry's challenge.

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