TABLE 1. An application and fat-reduction comparison

	Shortening		
Application	Coasun	Trancendim	Olestra
Baking	Yes	Yes	Yes
Frying	No	Yes	Yes
Sat. fat reduction	Up to 85%	Up to 60%	60% or more
Total fat reduction	Up to 40%	Not achievable	Up to 90%

Challenges for the food industry in the post-*trans* era

In the post-trans era, the big hurdle for the food industry is to make lower-calorie, lower-fat, lower-saturated-fat foods that still taste good and meet consumer demands. The following article looks at three technologies that may help with this challenge.

Peter Lin and Don Appleby

Health and wellness concerns are sweeping the globe. According to the World Health Organization's *World Health Statistics 2012* report, one in six adults is obese, one in 10 has diabetes, and one in three has elevated blood pressure, Obesity and its resulting health consequences impose an increasing economic burden on national health care systems worldwide. The global health expenditure on diabetes alone is expected to total at least $490 billion by 2030 (Zhang, P., *et al.*, Global healthcare expenditure on diabetes for 2010 and 2030, *Diabetes Res. Clin. Pract. 87*:293–301, 2010). As governments bear a greater percentage of these costs, politicians will be forced to require food companies to reformulate their products to have significantly lower caloric density, to limit serving sizes, or, at the extreme, to cease sales of certain foods.

Some national and local governments are already taking action. New York City was first to ban the sale of foods containing *trans* fats and has recently announced it will ban the sale of large-sized sugar-sweetened soda in 2013. San Francisco has banned toys in McDonald's "Happy Meals." Mexico has banned "unhealthy" products such as chips and cookies from their school system lunches. Even some corporations are getting into the act. The Disney Channel is refusing to advertise unhealthful foods on their network.

Consumers are also becoming more aware of the nutritional content of foods they buy. Recent studies show that two-thirds of consumers in the United States say they look at calories and total fat on the nutrition label when deciding what new foods to buy (International Food Information Council—*2011 Food & Health Survey*). Such nutritional awareness on the part of consumers is being accelerated by dietary fat recommendations and nutrition labeling initiatives in the United States, Canada, United Kingdom, European Union, Japan, Korea, Philippines, Australia, and other countries.

With so much market pressure, the newest hurdle for the food industry is to make lower-calorie, lower-fat, lower-saturated-fat foods that still taste good and meet consumer demands.

Consumers desire indulgent flavors in baked goods and confections. Low-calorie and low-fat products are often relegated to niche products owing to taste and texture compromises. Beverage manufacturers have successfully navigated these waters by developing great-tasting diet sodas, such as Diet Coke and Diet Pepsi. A solution in the bakery industry has been more elusive. However, there are technologies that may help address these challenges, including Coasun ™ SA, Trancendim™, and Olestra.

Coasun SA structured shortening delivers reduced fat and sat fat

Coasun SA (Guelph, Ontario, Canada) structured monoacylglyceride (MAG) gel behaves as a solid at room temperature, like conventional shortening. Coasun shortenings are reported to be substitutes for vegetable shortening, butter, lard, and bakers' margarine and are suitable for making muffins, cookies, cakes, brownies, biscuits, breads, pie crusts, and biscotti without any quality compromises.

It uses MAG to form an oil-in-water emulsion that is 1–5 micrometers (μm) in diameter. The water-swollen multilamellar globules are reported to be interconnected via hydrogen bonding where the surface charges (aided by stearic acid) are adjusted to deliver a solid

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TABLE 2. Nutritional values for chocolate chip cookies made with three shortening substitutes

Chocolate chip cookie	Control	Coasun	Trancendim	Olestra
Calories	250	230	250	185
Fat (g)	11	9	11	5
Sat. fat (g)	3.5	2	2	2
trans fat (g)	2	0	0g	0

shortening-like rheology (Marangoni *et al.,* 2007a,b). MAG gel is composed of vegetable oil (55%), water (40%), MAG (4.5%), and stearic acid (0.25%).

Structured MAG gel is similar to mayonnaise in that both are oil-in-water emulsions. Mayonnaise is emulsified by egg yolk lecithin and stabilized by mustard powder. Mayonnaise globules are typically 10–40 μm in diameter, substantially larger than the MAG gel particles. Unlike MAG gel, mayonnaise is not a good shortening substitute because it does not have the structural integrity needed to withstand the dough-making processes in baking owing to its large, easily collapsible globules. The MAG gel's inherently smaller particle size and interconnection significantly increase its rheology to withstand dough-making shear stresses to provide its shortening functionality.

Trancendim structured shortening delivers reduced sat fat

Caravan Ingredients (Dolton, Illinois, USA) developed Trancendim to deliver a zero-*trans*, reduced-saturates alternative for structuring fats and oils. Trancendim shortenings can be used to prepare cookies, donuts, icing, pastries, frying, and laminated products. These shortenings provide significant saturated fat reduction (up to 60%) while eliminating hydrogenated and palm-based fats (palm and palm kernel) from the ingredient declarations. The structured shortening can be used in both baking and frying applications.

Trancendim is composed mainly of diglyceride with minor amounts of monoglyceride and triglyceride. It replaces the hydrogenated hardstocks in shortenings and margarines and improves the crystallization properties by promoting the β′ polymorph formation. It is reported to increase shortening production efficiency and reduce production cost by increasing the rate of shortening crystallization and reducing production time.

Trancendim shortening is produced by combining Trancendim with vegetable oil and votating the blend into shortening. A range of Trancendim from 5–30% can be used, but the preferred range is 15–20% (US Patent number 7691428 B2).

Olestra: a zero-calorie, zero-saturated and zero-*trans*-fat substitute derived from sugar and oil

Procter & Gamble scientists serendipitously discovered this noncaloric fat substitute in the late 1960s while looking for a more digestible fat. After thorough review of numerous clinical study data, the US Food and Drug Administration approved the use of olestra for salted snack applications in 1996. Olestra is currently approved in the United States for all ready-to-eat and ready-to-heat baked goods and mixes (cookies, cakes, puff pastries, breads, etc.); confections (including chocolates); cheeses (pizza, cheese sauces); ice cream and whipped toppings; sauces; salted snacks and popcorn. It is approved in more than 20 countries including Mexico, China, South Korea, and others.

Olestra is a fat substitute made from sucrose and fatty acids from vegetable oils. It consists primarily of the sucrose octa-esters of fatty acids with lower amounts of hepta- and hexa-esters. Olestra contributes zero calories and zero saturated or *trans* fats to the diet because it is not absorbed by the human body. Normal fat absorption via lipase is not applicable to olestra. Lipase does not hydrolyze the esterified fatty acids of olestra because of the steric hindrance due to the large number of fatty acids surrounding the sucrose core. Olestra may be formulated to provide the full shortening functionalities to deliver baked good with full-fat texture and taste utilizing a variety of fatty acids without being absorbed by the body and producing the subsequent deleterious health effects of consuming these fats. Nor do these fatty acid constituents appear on the nutritional label (US Code of Federal Regulations 21CFR§172.867).

By combining the zero-calorie, fat-free aspects of olestra with the lipid-structuring ability of Trancendim diglycerides, it is possible to create shortenings containing significantly fewer calories, zero *trans* fat and very low saturated fatty acid content.

Olestra formulations are being evaluated in a number of applications including baked goods, confections, frozen desserts, fried foods, and cooking oils in several countries. In all cases, the olestra prototypes are indistinguishable from their full-fat controls. In some cases, the olestra prototypes are more preferred than full-fat controls in blind tests.

Benefit and cost comparisons

These distinct shortening technologies deliver unique benefits and costs. All three technologies deliver shortening alternatives with significant saturated fat reduction of at least 60%, with options to achieve higher reductions. All options are reported to produce high-quality baked goods with no compromises (Table 1, page 527).

Table 2 shows nutritional benefits that can be achieved in chocolate chip cookie cookies by using these technologies. All three technologies significantly reduce the saturated and *trans*-fats contents. Each formulation provides differing levels of fat and caloric reduction.

Olestra delivers a much more consumer meaningful caloric and total fat reduction, in addition to the saturated and *trans* fat reductions.

The future is industry's to shape

Food industry managers may ask if they can afford these technologies. The real question ought to be, "Can the food industry afford not to use these technologies?" While these technologies are no substitute for a healthful lifestyle including exercise and a diet containing more fruits and vegetables, providing consumers with a choice of foods that satisfy the occasional emotional need for the indulgent taste they desire with no more calories or fat than is necessary just makes good business sense. It behooves industry to use all available tools to offer consumers great-tasting, satisfying foods with improved nutritional properties before regulators force their hand. It would be irresponsible to their consumers and shareholders to do otherwise.

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Busken "Skinny" Cookie: a small shining light

One regional bakery has successfully crossed the barrier by delivering a cookie with improved nutritional properties that also tastes good. For the past two years, Busken Bakery in Cincinnati, Ohio, USA, has seen a 37% increase in cookie sales resulting from introduction of the "Skinny" Cookie version of their signature "Really Happy Cookie" that contains less than half the fat and one-third fewer calories while delivering all the taste and satisfaction of the regular cookie. Busken has improved their profit margins by achieving premium pricing.

*inform*ation

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