Robert M. Kerr Food & Agricultural Products Center

FOOD TECHNOLOGY FACT SHEET

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Formulating Food Products with Low Trans Fats

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Edible oils and fats mainly consist of triacylglycerides (TAG), which are compounds with three fatty acids esterified onto a glycerol backbone. Fats and oils of animal origin, such as butter and lard, are rich in saturated fatty acids (SFA). Plant derived oils and fats mostly contain monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA), which include one or more double bonds in their chemical structure, respectively. In the presence of oxygen, MUFA and PUFA can deteriorate and go rancid. Manufacturers can reduce deterioration and improve food texture by partially hydrogenating the unsaturated fat. Most naturally occurring unsaturated fatty acids have *cis* structures at their double bonds. Hydrogenation eliminates some double bonds and rearranges others, converting them to the *trans* configuration. The extent of hydrogenation determines how much a fat's melting point is raised. Thus, liquid vegetable oils are converted into products ranging from soft margarines to solid shortenings. In a previous fact sheet (FAPC-133 Trans Fats, Health and Nutritional Labeling of Foods), detailed information on the health effects of *trans* fatty acids (TFA) and the Food and Drug Administration's rule regarding listing of TF on nutrition labels was reported. This fact sheet focuses on the alternatives to TF for food applications.

Edible oil quality is defined by its oxidative stability, functionality and nutritional value. Various fat modification techniques: hydrogenation, interesterification, fractionation and combinations thereof are used to improve oil functionality and stability. Plant breeding and biotechnology also have been used extensively to develop oilseeds with required agronomic properties and oil functionality. Over the past several decades, a number of oilseeds have been introduced with modified fatty acid compositions. Some of these oilseeds are canola and soybean with low linolenic acid content; corn, soybean, sunflower and peanut with high oleic acid content; and soybean with high and low saturated fatty acid contents. Many of these oils have potential in TF reduction. A number of laboratory frying studies with high oleic and low linolenic oils demonstrated superiority of modified oils versus traditional oils. Although most of these modified oils are commercially available today, cost and production problems may hinder their use in commodity food product.

Palm oil can be fractionated into olein and stearine fractions, which can be further fractionated into harder and softer products. Some manufacturers replace hydrogenated oils in their product with palm oil stearine (saturated fat fraction). Both types of fats, TF and saturated fat, increase Low Density Lipoprotein (LDL) or bad cholesterol, which contribute to atherosclerosis and high cholesterol in the blood. Hence, the reformulated TF-free product is not healthier than the food containing TF. Palm oil crystallizes slower than the other fats and oils. This leads to a phenomenon known as post hardening in which the product becomes harder during storage. Hence, the products reformulated with palm oil could have different flavor profile and shelf life than the original product. Trans-free margarines prepared with sunflower and cottonseed oils interesterified with palm oil, palm kernel oil, palm stearine, and palm kernel olein minimize post hardening. There are studies indicating that preparation of skim milk-containing emulsifiers prior to crystallization retards post hardening in blends containing high palm oil and palm kernel oil. Random interesterification of soybean, corn, peanut, cottonseed, canola and palm with completely hydrogenated soybean also yields products that are suitable for formulation of zero-*trans* margarines and shortenings.

Fluid shortenings are stable suspensions of 2-20 percent hard fat in liquid vegetable oils, which may or may not be hydrogenated. These products have been used in baked goods where high solid contents are not required, such as fillings, cakes and breads. Fluid shortenings improve tenderness, lubricity and serve as carriers for emulsifiers needed for aerating cake batter or giving crumb strength to bread. The other advantages of liquid shortenings are they are pumpable and can be easily metered into the process. Some reduction in TF can be achieved by substituting fluid shortenings in food formulations.

In the U.S., medium-chain-triacylglycerides (MCT) oils have traditionally been used in special dietary formulations and supplements. MCTs are not fully metabolized, therefore, deliver fewer calories. These oils are not hydrogenated; hence, they are TF-free products. There have been reports indicating a MCT-based product may be used as a replacement for partially hydrogenated vegetable oils in bakery applications.

The current emphasis on TF reduction in foods without compromising their quality and taste has accelerated development of new ingredients that can be used as TF replacers in a variety of applications such as pastries, breads, fried foods, soups and sauces. Several companies including Cargill, Minneapolis, Minn.; Stepan Co., Maywood, N.J.; Archer Daniels Midland Co., Decatur, Ill.; Bunge Foods, Bradley, Ill.; and Loders Croklaan, Channahon, Ill., produce various *trans*-free fat alternatives.

It is recommended food manufacturers consider the following steps before they start reformulating their products as reduced and/or no TF products:

1) Talk with fat/oil suppliers about the types of alternative ingredients they offer and how much they will cost.
2) Determine how reliable the chosen oil/fat supply is and in what range its price fluctuates. Some suppliers may have not scaled up their process for TF-free oil production from pilot-plant level to full-scale production. If the demand for *trans*-free foods increases, there might be a temporary deficit in supply.
3) Compare processes and ingredients by testing your product in the lab or pilot plant. Remember specific taste and texture profiles, and the feasibility of obtaining the same results with the new oil are the key for the success of your business.