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THE DANGERS OF TRANS FATTY ACIDS

Though *trans* fatty acids occur abundantly in industrially processed fats, they also exist naturally. The mono-unsaturated 16 carbon fatty acid *trans*-3-hexadecenoic acid is found in some plant leaves such as the broad bean (*Vicia faba*) [1] and in the chloroplasts of all green plants and eukaryotic algae. Besides, two mono-unsaturated 18 carbon fatty acids are produced by anaerobic bacteria in the rumen of cow, goat, sheep and other ruminants: *trans*-9-octadecenoic acid (also called **elaidic acid**) and *trans*-11-octadecenoic acid (also called **trans-vaccenic acid**). Finally, one more *trans* poly-unsaturated 18 carbon acid (called **eleostearic acid**) is found in some seed oils such as tung oil extracted from seeds of the tung tree (*Aleurites fordii*) [2] and bitter melon seed oil (*Momordica charantia*) [3].

Two of these, elaidic acid and *trans*-vaccenic acid, can be routinely assessed through usual fatty acids profiles in order to evaluate their abundance in the patient's phospholipids. If so, it would not only reflect their intake as natural forms produced by **biohydrogenation** in rumen microorganisms, even though dairy products and beef fat contain small amounts of *trans* fatty acids. Indeed, biohydrogenation is mimicked by catalytic hydrogenation in industrial food processing [4].

The goal of **industrial hydrogenation** is to reduce the degree of unsaturation in fatty acids from vegetable origin, this being done purportedly for two main reasons. One reason is improving stability, as less unsaturated fats show a lower susceptibility to oxidation. The second consists in modifying their physical properties. Highly unsaturated oils have low melting points and, as such, do not suit most food uses when a solid texture is desired, which happens often. Let's imagine what would occur when you open the plastic bag containing your favorite chocolate bar! Hydrogenation of vegetable oils produce "harder" fats, as "**hardening**" raises the melting point, thereby giving better textural properties to many food fats.

Industrial hydrogenation is carried out in enclosed tanks by adding a small quantity of a finely powdered catalyst, usually nickel (to be removed after by filtration), at temperatures of 180° C. Chemically, this process: 1) tends to reduce the total number of double bonds in the fatty acid; 2) isomerizes some of the *cis* double bonds present in the original oil into the *trans* form; 3) may shift some double bonds along the hydrocarbon chain from their original position [5]. These physical modifications of the fatty acid render it much more rigid, in fact close to the molecular configuration of saturated fatty acids. Not surprisingly, more rigid membranes explain why dietary *trans* fatty acids **decrease** adipocyte **insulin sensitivity** [6]. Another mechanism by which *trans* fats may harm human health lies in the disruption that they might cause to all desaturases and elongases, the enzymes designed to naturally process our fatty acids.

The structural changes resulting from industrial hydrogenation have sound nutritional significance [7]. The highly negative impact on plasma lipoproteins, worse than the one due to saturated fats, is known for ten years [5]. We now understand that "from a public health point of view, the type of fat is more important than the amount of fat" [8]. More links with cardiovascular disease have been published: increased risk of **primary cardiac arrest** [9, 10], **systemic inflammation** [11], **endothelial dysfunction** [12], increased risk of **gallstone disease** [13]. "The contribution of dietary *trans* fatty acids [to] the risk of **ischemic heart disease** (IHD) has recently gained further support due to the results from large, prospective, population-based studies. Compared to saturated fats, [they] are, gram to gram, associated with a considerably (2.5- to 10-fold) higher risk for IHD" [14]. Further studies are needed about negative effects on fetus and newborns, colon cancer risk, allergic disease in children and **type-2 diabetes** risk in adults [14].

Among the processed foods providing *trans* fatty acids, **margarines** have been criticized, even if major improvements took place in recent years to reduce their content in *trans* fatty acids. We also must warn against **crisps, dressings, shortenings, doughnuts, fried foods** (including **French fries**), **mayonnaise, popcorn, biscuits, cakes, fast food, processed snacks** and **bars**. Even human milk is contaminated [15].

Beyond these exclusions, we emphasize the need to avoid any food which label mentions the presence of "**partially hydrogenated vegetable oils or fats**". Even if Denmark has taken strict measures to reduce *trans* fatty acids consumption (2004), European laws do not make a label compulsory [14]. It has recently been made a legal obligation in Canada (2003) and by the FDA in United States of America (01/01/2006).

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