

## Trans Fat: A Review

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Received on 29 Dec 2012, Accepted on 17 Feb 2013, Available online from 27 Feb 2013

### Abstract

*Trans* fat is the common name for unsaturated fat with trans-isomer (E-isomer) fatty acid(s). Because the term refers to the configuration of a double carbon-carbon bond, *trans* fats are sometimes monounsaturated or polyunsaturated, but never saturated. While some *trans* fat occurs naturally, most of it is artificial. It is found in partially hydrogenated vegetable oil. Foods that contain artificial *trans* fat include margarines, shortenings, and fry oils, as well as many baked goods, mixes, and packaged foods. Fat should not be completely eliminated from anyone's diet but it is important to understand the difference between good fats and unhealthy fats. Unsaturated fats come from plants, nuts and seeds and are "good" fats, such as olive, canola, peanut and corn oil. The unsaturated fats are classified into monounsaturated and polyunsaturated. Unhealthy fats include the *trans* fatty acids (trans fat) and saturated fats. Artificial *trans* fat results from partial hydrogenation of plant oils. It raises bad cholesterol (LDL cholesterol) as do saturated fats and dietary cholesterol and decreases good cholesterol (HDL). This results in an increased risk of coronary heart disease. *Trans* fat is the most dangerous type of dietary fat. It increases bad (LDL) cholesterol and lowers good (HDL) cholesterol.

**Keywords:** Dietary fat, fatty acids, Trans fat, unsaturated fat, coronary heart disease

### INTRODUCTION

It is important to realize that fat is an important ingredient in our daily diet and is very important for growth, development, energy and good health. It is responsible for taste, consistency, and stability of food in addition to the feeling of fullness after a meal. Fat should not be completely eliminated from anyone's diet but it is important to understand the difference between good fats and unhealthy fats.[1]

Transfat is the common name for unsaturated fat with trans-isomer (E-isomer) fatty acid(s), because the term refers to the configuration of a double carbon-carbon bond. Most trans fats are monounsaturated fatty acids. The shape of trans-fat molecules is more like cholesterol-raising saturated fat than a typical monounsaturated fatty acid. Perhaps for that reason, it increases cholesterol levels in blood and increases the risk of heart disease. It is a type of fat that raises the risk of heart disease [1-2]. While some trans fat occurs naturally, most is artificial. The regulation addresses only artificial trans fat, which is the main dietary source of trans fat. Artificial trans fats are partially hydrogenated fats that are formed through a chemical process used to transform liquid oils into solid fats. This process is used to create products that include many vegetable oils, margarines, shortenings and frying oils. Artificial trans

fats are found in many baked food products, food mixes and prepackaged foods. Unhealthy fats include the trans fat and saturated fats. The process of hydrogenation can increase the shelf life and food flavor of the food item [2-3].

There are three main types of dietary fats:

#### **Unsaturated fatty acids:**

Unsaturated fats come from plants, nuts and seeds and are "good" fats, such as olive, canola, peanut and corn oil. Mostly unsaturated fatty acids are usually liquid at room temperature and are called oils. The unsaturated fats are classified into monounsaturated and polyunsaturated. One common monounsaturated fatty acid is oleic acid, and the most common polyunsaturated fatty acid in food is linoleic acid [3-4].

#### **Saturated fatty acids:**

Unhealthy fats include saturated fats. A majority of saturated fatty acids are solid at room temperature. Some common saturated fatty acids in foods include palmitic, stearic and myristic acids. Saturated fats are found in many animal products such as whole milk, butter, cheese, chicken skin, pork and beef [5].

#### **Trans fat**

Unhealthy fats include the *trans* fat. Although *trans* fat can occur naturally in small quantities in some animal

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products (meat and dairy), the majority of dietary *trans* fat is artificial. Artificial *trans* fat results from partial hydrogenation of plant oils. The process of hydrogenation can increase the shelf life and food flavour of the food item [5]. *Trans* fat is commonly found in vegetable shortenings, some margarines (solid sticks), many crackers and cookies, snack foods, candies, baked and fried goods [4].

**Classification of Trans fat:** *Trans* fats are divided into mainly 2 types: Monounsaturated and Polyunsaturated. *Trans* fat are never saturated. While some *trans* fat occur as Naturally occurring *trans* fat and Artificially available *trans* fat

**Chemistry of trans fatty acid:**

Within an unsaturated fatty acid molecule, one of two configuration forms can occur around one double bond. The *cis* form has the two parts of the carbon chain bent towards each other, and the *trans* form has the two parts almost linear, similar to saturated fatty acids. Linear molecules can pack together closely in a given space, and give the substance a higher melting point, while bent molecules cannot pack together easily, so that fats of these molecules have a lower melting point [6]. Chemical hydrogenation is the process of adding hydrogen atoms to unsaturated sites on the carbon chains of fatty acids, thereby reducing the number of double bonds. The reaction is applied to food industries as partial hydrogenation, by heating vegetable oils (fish oils occasionally) in the presence of metal catalyst and hydrogen. The process of partial hydrogenation accompanied by thermal isomerisation, represents incomplete saturation of the double bonds, in which some double bonds remain but may be moved in their positions on the carbon chain, and produces several geometrical and positional isomers [7-8]. Hydrogenation will convert “*cis*” double bonds to “*trans*” double bonds, producing *trans* fatty acids. Hydrogenated vegetable oil that is solid at room temperature can contain 15–25 percent *trans* fatty acids. Partially hydrogenated oils are lower in *trans* fatty acids. Margarines are often mixtures of both hydrogenated fats and unhydrogenated vegetable oils.

**Content of Trans Fatty Acids in Food**

*Trans* fatty acids contained in food have been analyzed using gas–liquid chromatography with long polar capillary columns, which permits the separation of the *cis* and *trans* isomers. The amount of *trans* fatty acids in

foods which may contain hydrogenated oils ranged from 0 to 34.9%.6) *Trans* fatty acid content varied considerably among foods, reflecting differences in the fat and oils used in the manufacturing or preparation process[7]. Occasionally, gas–liquid chromatography was combined with silver nitrate thin-layer chromatography to characterize the detailed profiles of *trans* fatty acid positional isomers contained in foods or in adipose tissue [8, 9]. Thus, in French foods, the predominant isomer was delta 9-18: 1 (elaidic) acid, with the delta 10 isomer ranked second; and the content of the delta 11 isomer (*trans*-vaccenic acid) was lower than unresolved delta 6 to delta 8 isomers [9]. In adipose tissue of French women, *trans* 18: 1, *trans* 18: 2 and *trans* 16: 1 fatty acids were detected in relation to their dietary sources [10]. With regard to fish oil, it was reported that *trans* fatty acid content in partially hydrogenated oil was 30%, while the content of *trans* fatty acid in highly hydrogenated oil and no hydrogenated oil was 3.6% and 0.5%, respectively [11].

**Consumption of trans fat:** The consumption of *trans* fatty acids from partially hydrogenated oils provides no apparent nutritional benefit and has considerable potential for harm. Although the elimination of partially hydrogenated oils from foods may be challenging for restaurants and food manufacturers that such fats can largely be replaced by *cis* unsaturated fats without increasing the cost or reducing the quality or availability of foods [12]. Health care providers should advise consumers about how to minimize the intake of *trans* fats: Consumers should recognize and avoid products containing *trans* fats and restaurants and food manufacturers should choose to use alternative fats in food production and preparation. These steps should help reduce the consumption of *trans* fatty acids, possibly resulting in substantial health benefits such as averting thousands of CHD events. To control heart disease risk, keep your intake of both saturated and *trans* fat low [13-14].

**TRANS FATS AND HEALTH**

Artificial *trans* fats are partially hydrogenated fats that are formed through a chemical process used to transform liquid oils into solid fats. This process is used to create products that include many vegetable oils, margarines, shortenings and frying oils. Artificial *trans*

fats are found in many baked food products, food mixes and pre-packaged foods. Small amounts of *trans* fats also occur naturally in some foods such as meats and dairy products. Naturally occurring *trans* fats, however, are not suspected of having a negative impact on human health, and are not regulated by this legislation [15-16]. Artificial *trans* fats are of particular concern to health because they affect the human cardiovascular system. Unlike other dietary fats, *trans* fats are neither required nor beneficial for good health. Instead, *trans* fats raise bad cholesterol (LDL) levels and lower good cholesterol (HDL) levels, which can lead to heart disease and stroke.

**Coronary Heart Disease:** Many years of epidemiological research have shown that populations consuming diets high in saturated fatty acids have relatively high levels of serum cholesterol and carry a high prevalence of coronary heart disease [17–19]. Based on the evidence of these studies, it is generally accepted that high levels of serum cholesterol, particularly low density lipoprotein (LDL) cholesterol, promote the development of atherosclerosis and predispose to coronary heart disease. The concept has become widely accepted that lowering LDL cholesterol by virtually any safe means will reduce the risk of coronary heart disease [20]. One study in 1990 demonstrated that *trans* fatty acids raised total and LDL cholesterol while lowering high-density lipoprotein (HDL) cholesterol [21]. As a result, the net effect of *trans* fatty acids on the ratio of LDL to HDL cholesterol was approximately double that of the saturated fatty acid. These adverse effects of *trans* fatty acids have been confirmed by subsequent metabolic studies [22–25]. Strong epidemiological evidence relating dietary factors to the risk of coronary heart disease has been provided by large prospective studies [26–29]. Those studies assessed the intake of *trans* fatty acids using detailed food frequency questionnaires whose results were validated by comparison with the composition of adipose tissue or food diaries. Each of these studies reported high relative risk of coronary heart disease associated with the intake of *trans* fatty acids.

**Other Risks of *Trans* Fatty Acids:** Considerable attention has been focused on the potential adverse effects of *trans* fatty acids, produced by the method of partial hydrogenation of vegetable oils or marine oils, which

may decrease their essential fatty acid content, and raise the saturated fatty acid content. Beyond cardiovascular disease risk, another concern about *trans* fatty acids is theoretical at present. In both animal and human studies, dietary *trans* fatty acids have been determined to be digested, absorbed and incorporated into serum triglycerides, cholesterol esters, phospholipids, lipoproteins and adipose tissue [10,30–32] or platelets [33] in the same way as natural *cis* isomers. Ingested *trans* fatty acids were incorporated in placenta and maternal and fetal tissues, except brain [34]. Furthermore, *trans* fatty acids are readily passed from the mother to the infant via milk [35–37].

#### **Safe acceptable limit of *trans* fat in the diet:**

The daily intake of saturated fats and cholesterol in the diet should be between 5-20% of average daily intake. When reading the food labels, consider the % in the context of your whole day consumption. Artificial *trans* fat should be 0 or less than 0.5%, but if you eat many servings of food with 0.5% *trans* fat, you may be taking in a lot of *trans* fat. The U.S. Food and Drug Administration allows products with less than 0.5 grams of *trans* fats per serving to be labeled 0 grams *trans* fats, even if they contain small amounts of *trans* fats. Any product labeled 0 grams, or less than 0.5 grams of *trans* fats per serving is in compliance with the Code [38-40].

Some examples of food that contains *Trans* Fatty acid: Artificial *trans* fats are found in many baked food products, food mixes and pre-packaged foods. The major food sources of *trans* fatty acids are [40] Fast or frozen foods: French fries, Fried chicken, Breaded fish burger, Breaded chicken nuggets, Pizza, frozen French fries; Packaged snacks: Tortilla (corn) chips, Popcorn, microwave, Breakfast bar; Bakery products: Pie, Danish or sweet roll, Danish pastry, Doughnuts, Cookies, Cake, Brownie.

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**Benefits of trans fat [44]:** Hydrogenated fats prevent rancidity. This gives products like crackers and other snacks a longer shelf life. All fats are suspect because all

Butter**	Margarine, stick	Margarine, tub
<b>Nutrition Facts</b> Serving Size 1 Tbsp (14g) Servings Per Container 32	<b>Nutrition Facts</b> Serving Size 1 Tbsp (14g) Servings Per Container 32	<b>Nutrition Facts</b> Serving Size 1 Tbsp (14g) Servings Per Container 32
Amount Per Serving Calories 100 Calories from Fat 100	Amount Per Serving Calories 100 Calories from Fat 100	Amount Per Serving Calories 60 Calories from Fat 60
% Daily Value*	% Daily Value*	% Daily Value*
Total Fat 11g 17%	Total Fat 11g 17%	Total Fat 7g 11%
Saturated Fat 7g 35%	Saturated Fat 2g 10%	Saturated Fat 1g 5%
Trans Fat 0g 0%	Trans Fat 3g 6%	Trans Fat 0.5g 1%
Cholesterol 30mg 60%	Cholesterol 0mg 0%	Cholesterol 0mg 0%
<b>Saturated Fat: 7g</b>	<b>Saturated Fat: 2g</b>	<b>Saturated Fat: 1g</b>
<b>+ Trans Fat: 0g</b>	<b>+ Trans Fat: 3g</b>	<b>+ Trans Fat: 0.5g</b>
<b>Combined Amt: 7g</b>	<b>Combined Amt: 5g</b>	<b>Combined Amt: 1.5g</b>
<b>Cholesterol: 10% DV</b>	<b>Cholesterol: 0% DV</b>	<b>Cholesterol: 0% DV</b>

are equally high in calories. *Trans* fat intake may also play a role in weight gain and a host of other health conditions. Source of energy (provides more than twice amount of energy compared with carbohydrates and proteins). Supports absorption of fat soluble vitamins (vitamin A, D, E, K and carotenoids). Cholesterol constitutes cell membranes and serves as precursors for hormones and vitamin D.

**Side Effects of trans fat:** It raises bad cholesterol (LDL cholesterol) as do saturated fats and dietary cholesterol and decreases good cholesterol (HDL) and increases the ratio of total cholesterol to HDL cholesterol, a powerful predictor of the risk of CHD. This result in an increased risk of coronary heart disease. *Trans* fats also increase the blood levels of triglycerides as compared with the intake of other fats [45].

**Other Effects of trans fat:** In controlled trials, consumption of *trans* fat reduced the activity of serum paraoxonase an enzyme that is closely associated with HDL cholesterol, and impaired the postprandial activity of tissue plasminogen activator. Trials evaluating the effects of the consumption of *trans* fatty acids on insulin sensitivity have shown variable results. Such variability may be due to differences in the population or the measure of insulin resistance examined and may depend on the duration of intake (short-term trials may not detect an effect). Further investigation is needed to elucidate the possible effects of *trans* fatty acids on these and other physiological pathways [46]. Ingested *trans* fatty acids were incorporated in placenta and maternal and foetal tissues, except brain. Furthermore, *trans* fatty acids are readily passed from the mother to the infant via milk.

## CONCLUSION

It is clear that we all need to include some fat in our diets to remain healthy, but not all fats are equal in terms of their effects on our health. Some are more beneficial and others may prove unhealthy if too much is eaten. The conclusion from these studies- saturated fats are nutritionally undesirable, even though they have highly desirable properties for cooking and food manufacture. *Trans*-isomers of unsaturated fats have many of the desirable physical properties of saturated fats, and manufacturers, started to use partially hydrogenated vegetable oils to provide solid fats with a lower content of saturated fatty acids. However, it is more likely that *trans*-fatty acids will be replaced by saturated fatty acids than polyunsaturated fatty acids, since unsaturated oils simply do not have the properties needed for food manufacture and commercial catering, so the benefits of eliminating *trans*-fatty acids will be less than predicted.

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