5.7: Lipids and the Food Industry

Learning Objectives

- Discuss reasons oils are hydrogenated and describe this process.
- Describe the health effects of trans fats.

What is the first thing that comes to mind when you read ingredients such as “partially hydrogenated oil” and “hydrogenated oil” on a food label? Do you think of heart disease, heart health, or atherosclerosis? Most people probably do not. As we uncover what hydrogenation is and why manufacturers use it, you will be better equipped to adhere to healthier dietary choices and promote your heart health.

Hydrogenation: The Good Gone Bad?

Food manufacturers are aware that fatty acids are susceptible to attack by oxygen molecules because their points of unsaturation render them vulnerable in this regard. When oxygen molecules attack these points of unsaturation the modified fatty acid becomes oxidized. The oxidation of fatty acids makes the oil rancid and gives the food prepared with it an unappetizing taste. Because oils can undergo oxidation when stored in open containers, they must be stored in airtight containers and possibly be refrigerated to minimize damage from oxidation. Hydrogenation poses a solution that food manufacturers prefer.

When lipids are subjected to hydrogenation, the molecular structure of the fat is altered (Figure \(\PageIndex{1}\)). Hydrogenation is the process of adding hydrogen to unsaturated fatty-acid chains, so that the hydrogen atoms are connected to the points of saturation and results in a more saturated fatty acid. Liquid oils that once contained more unsaturated fatty acids become semisolid or solid (upon complete hydrogenation) and behave like saturated fats. Oils initially contain polyunsaturated fatty acids. When the process of hydrogenation is not complete, for example, not all
carbon double bonds have been saturated the end result is a partially hydrogenated oil. The resulting oil is not fully solid. Total hydrogenation makes the oil very hard and virtually unusable. Some newer products are now using fully hydrogenated oil combined with nonhydrogenated vegetable oils to create a usable fat.

![Figure 1: Partial hydrogenation of a typical plant oil to a typical component of margarine. Most of the C=C double bonds are removed in this process, which elevates the melting point of the product. Image used with permission (CC BY-SA 2.0; Smokefoot).](https://med.libretexts.org/Courses/Sacramento_City_College/SCC%3A_Nutri_300_(Sheldon)/Text/05%3A_Lipids/5.07%3A_Lipids/)

Manufacturers favor hydrogenation as a way to prevent oxidation of oils and ensure longer shelf life. Partially hydrogenated vegetable oils are used in the fast food and processed food industries because they impart the desired texture and crispness to baked and fried foods. Partially hydrogenated vegetable oils are more resistant to breakdown from extremely hot cooking temperatures. Because hydrogenated oils have a high smoking point they are very well suited for frying. In addition, processed vegetable oils are cheaper than fats obtained from animal sources, making them a popular choice for the food industry.

Trans fatty acids occur in small amounts in nature, mostly in dairy products. However, the trans fats that are used by the food industry are produced from the hydrogenation process. Trans fats are a result of the partial hydrogenation of unsaturated fatty acids, which cause them to have a trans configuration, rather than the naturally occurring cis configuration.

### Health Implications of Trans Fats

No trans fats! Zero trans fats! We see these advertisements on a regular basis. So widespread is the concern over the issue that restaurants, food manufacturers, and even fast-food establishments proudly tout either the absence or the reduction of these fats within their products. Amid the growing awareness that trans fats may not be good for you, let’s get right to the heart of the matter. Why are trans fats so bad?

Processing naturally occurring fats to modify their texture from liquid to semisolid and solid forms results in the development of trans fats, which have been linked to an increased risk for heart disease. Trans fats are used in many processed foods such as cookies, cakes, chips, doughnuts, and snack foods to give them their crispy texture and increased shelf life. However, because trans fats can behave like saturated fats, the body processes them as if they
were saturated fats. Consuming large amounts of trans fats has been associated with tissue inflammation throughout the body, insulin resistance in some people, weight gain, and digestive troubles. In addition, the hydrogenation process robs the person of the benefits of consuming the original oil because hydrogenation destroys omega-3 and omega-6 fatty acids. The AHA states that, like saturated fats, trans fats raise LDL “bad cholesterol,” but unlike saturated fats, trans fats lower HDL “good cholesterol.” The AHA advises limiting trans-fat consumption to less than 1 percent.

How can you benefit from this information? When selecting your foods, steer clear of anything that says “hydrogenated,” “fractionally hydrogenated,” or “partially hydrogenated,” and read food labels in the following categories carefully:

- cookies, crackers, cakes, muffins, pie crusts, pizza dough, and breads
- stick margarines and vegetable shortening
- premixed cake mixes, pancake mixes, and drink mixes
- fried foods and hard taco shells
- snack foods (such as chips), candy, and frozen dinners

Choose brands that don’t use trans fats and that are low in saturated fats.

**Dietary-Fat Substitutes**

In response to the rising awareness and concern over the consumption of trans fat, various fat replacers have been developed. Fat substitutes aim to mimic the richness, taste, and smooth feel of fat without the same caloric content as fat. The carbohydrate-based replacers tend to bind water and thus dilute calories. Fat substitutes can also be made from proteins (for example, egg whites and milk whey). However, these are not very stable and are affected by changes in temperature, hence their usefulness is somewhat limited.

**Tools for Change**

One classic cinnamon roll can have 5 grams of trans fat, which is quite high for a single snack. Foods such as pastries, frozen bakery goods, cookies, chips, popcorn, and crackers contain trans fat and often have their nutrient contents listed for a very small serving size—much smaller than what people normally consume—which can easily lead you to eat many “servings.” Labeling laws allow foods containing trans fat to be labeled “trans-fat free” if there are fewer than 0.5 grams per serving. This makes it possible to eat too much trans fat when you think you’re not eating any at all because it is labeled trans-fat free.

Always review the label for trans fat per serving. Check the ingredient list, especially the first three to four ingredients, for telltale signs of hydrogenated fat such as partially or fractionated hydrogenated oil. The higher up the words “partially hydrogenated oil” are on the list of ingredients, the more trans fat the product contains.

Measure out one serving and eat one serving only. An even better choice would be to eat a fruit or vegetable. There are no trans fats and the serving size is more reasonable for similar calories. Fruits and vegetables are packed with water, fiber, and many vitamins, minerals, phytonutrients, and antioxidants. At restaurants be aware that phrases such as “cooked in vegetable oil” might mean hydrogenated vegetable oil, and therefore trans fat.
Key Takeaways

- Hydrogenation is the process of adding hydrogen to the points of unsaturation in unsaturated fatty acid chains. The resulting oil is very hard and unusable. Partial hydrogenation is the process of adding hydrogen to some of the points of unsaturation in unsaturated fatty acid chains. This produces oils that are more spreadable and usable in food products.
- Food manufacturers favor the use of hydrogenated oils because they do not succumb to oxidative damage, they increase the shelf life of food products, and they have a high smoking point.
- Fat replacers mimic fat but do not have the same chemical configuration as fat. Therefore the body does not process these the same way it would a naturally occurring fat. Fat substitutes such as Olestra have produced symptoms of fat malabsorption in some people.

Discussion Starters

1. Describe how trans fatty acids are created. Explain the drawbacks of consuming this type of fat and its impact on human health.
2. Make a list of the foods in your kitchen. Read each food label. List all of the food items that contain trans fat. Recall the recommendation that trans fat be less that 1 percent of your fat intake. About what percentage of your diet is currently trans fat? Do you see a need to adjust your trans fat intake?