Edible Oil Information Highlights

Cooking oil is plant, animal, or synthetic fat used in frying, baking, and other types of cooking. It is also used in food preparation and flavoring not involving heat, such as salad dressings and bread dips, and in this sense might be more accurately termed edible oil.

Lighter, more refined oils tend to have a higher smoke point. Experience using an oil is generally a sufficiently reliable guide. Although outcomes of empirical tests are sensitive to the qualities of particular samples (brand, composition, refinement, process), the data below should be helpful in comparing the properties of different oils.

Smoking oil indicates a risk of combustion, and left unchecked can also set off a fire alarm. When using any cooking oil, should it begin to smoke, *reduce the heat immediately*. The cook should be fully prepared to extinguish a burning oil fire *before* beginning to heat the oil, by having on hand the lid to place on the pan, or (for the worst case) having on hand the proper fire extinguisher.

Comparison to other types of food

Saturated fat is a fat in which the fatty acids all have single bonds.
A fat is made of two kinds of smaller molecules: monoglyceride and fatty acids. Fats are made of long chains of carbon (C) atoms. Some carbon atoms are linked by single bonds (-C-C-) and others are linked by double bonds (-C=C-). Double bonds can react with hydrogen to form single bonds. They are called saturated, because the second bond is broken up and each half of the bond is attached to (saturated with) a hydrogen atom. Most animal fats are saturated. The fats of plants and fish are generally unsaturated.

Various fats contain different proportions of saturated and unsaturated fat. Examples of foods containing a high proportion of saturated fat include animal fat products such as cream, cheese, butter, other whole milk dairy products and fatty meats which also contain dietary cholesterol. Certain vegetable products have high saturated fat content, such as coconut oil and palm kernel oil. Many prepared foods are high in saturated fat content, such as pizza, dairy desserts, and sausage. The effect of saturated fat on risk of disease is controversial. Many reviews recommend a diet low in saturated fat and argue it will lower risks of cardiovascular diseases, diabetes, or death. However, other reviews have rejected those arguments.

Monounsaturated fatty acids (abbreviated **MUFAs**, or more plainly **monounsaturated fats**) are fatty acids that have one double bond in the fatty acid chain with all of the remainder carbon atoms being single-bonded. By contrast, polyunsaturated fatty acids (PUFAs) have more than one double bond. Fatty acids are long-chained molecules having an alkyl group at one end and a carboxylic acid group at the other end. Fatty acid viscosity (thickness) and melting temperature increases with decreasing number of double bonds; therefore, monounsaturated fatty acids have a higher melting point than polyunsaturated fatty acids (more double bonds)

and a lower melting point than saturated fatty acids (no double bonds). Monounsaturated fatty acids are liquids at room temperature and semisolid or solid when refrigerated.

Polyunsaturated fats are lipids in which the constituent hydrocarbon chain possesses two or more carbon–carbon double bonds. Polyunsaturated fat can be found mostly in nuts, seeds, fish, algae, leafy greens, and krill. "Unsaturated" refers to the fact that the molecules contain less than the maximum amount of hydrogen. These materials exist as *cis* or *trans* isomers depending on the geometry of the double bond.

Omega-3 fatty acids — The human body can make most of the types of fats it needs from other fats or raw materials. That isn't the case for omega-3 fatty acids (also called omega-3 fats and n-3 fats). These are *essential* fats—the body can't make them from scratch but must get them from food. Foods high in Omega-3 include fish, vegetable oils, nuts (especially walnuts), flax seeds, flaxseed oil, and leafy vegetables.

What makes omega-3 fats special? They are an integral part of cell membranes throughout the body and affect the function of the cell receptors in these membranes. They provide the starting point for making hormones that regulate blood clotting, contraction and relaxation of artery walls, and inflammation. They also bind to receptors in cells that regulate genetic function. Likely due to these effects, omega-3 fats have been shown to help prevent heart disease and stroke, may help control lupus, eczema, and rheumatoid arthritis, and may play protective roles in cancer and other conditions.

Omega-3 fats are a key family of polyunsaturated fats. There are three main omega-3s:

- Eicosapentaenoic acid (EPA) come mainly from fish, so they are sometimes called marine omega-3s.
- Docosahexaenoic acid (DHA) Also come mainly from fish, so they are sometimes called marine omega-3s.
- Alpha-linoleic acid (ALA), the most common omega-3 fatty acid in most Western diets, is found in vegetable oils and nuts (especially walnuts), flax seeds and flaxseed oil, leafy vegetables, and some animal fat, especially in grass-fed animals. The human body generally uses ALA for energy, and conversion into EPA and DHA is very limited.

Omega-6 fatty acids - Omega-6 fatty acids are essential fatty acids. They are necessary for human health, but the body cannot make them. You have to get them through food. Along with omega-3 fatty acids, omega-6 fatty acids play a crucial role in brain function, and normal growth and development. As a type of polyunsaturated fatty acid (PUFA), omega-6s help stimulate skin and hair growth, maintain bone health, regulate metabolism, and maintain the reproductive system.

A healthy diet contains a balance of omega-3 and omega-6 fatty acids. Omega-3 fatty acids help reduce inflammation, and some omega-6 fatty acids tend to promote inflammation. In fact, some studies suggest that elevated intakes of omega-6 fatty acids may play a role in complex

regional pain syndrome. The typical American diet tends to contain 14 to 25 times more omega-6 fatty acids than omega-3 fatty acids.

The Mediterranean diet, on the other hand, has a healthier balance between omega-3 and omega-6 fatty acids. Studies show that people who follow a Mediterranean-style diet are less likely to develop heart disease. The Mediterranean diet does not include much meat (which is high in omega-6 fatty acids, though grass fed beef has a more favorable omega-3 to omega-6 fatty acid ratio), and emphasizes foods rich in omega-3 fatty acids, including whole grains, fresh fruits and vegetables, fish, olive oil, garlic, as well as moderate wine consumption.

Iodine value (or "iodine adsorption value" or "iodine number" or "iodine index") The iodine value is a measure of the degree of the unsaturation of an oil. Technically it is the value of the amount of iodine, measured in grams, absorbed by 100 ml of a given oil. Although the iodine value may sound uninteresting, it has some very important health implications.

All fats and oils are composed of fat molecules known as fatty acids. The molecules can be classified into three categories depending on their degree of saturation. You have saturated fatty acids, monounsaturated fatty acids, and polyunsaturated fatty acids.

No oil in nature is composed entirely of any one of these three. All dietary oils contain a mixture. Soybean oil, for example, is referred to as a polyunsaturated oil because that is the predominant fatty acid. It also contains 24 percent monounsaturated fatty acids and 15 percent saturated fatty acids. Coconut oil is also a mixture. It contains 92 percent-saturated fatty acids, 6 percent monounsaturated fatty acids, and 2 percent polyunsaturated fatty acids.

The terms saturated, monounsaturated, and polyunsaturated refer the degree of hydrogen saturation. A saturated fatty acid contains all the hydrogen atoms it possibly can. In other words, it is fully saturated with hydrogen. A monounsaturated fatty acid contains all but one pair of hydrogen atoms it can hold. A polyunsaturated fatty acids is lacking two or more pairs of hydrogen atoms.

The iodine value is a measure of the amount of unsaturated fatty acids in the oil. A fatty acid that is missing any hydrogen atoms is classified as being unsaturated. This includes all monounsaturated and polyunsaturated fatty acids.

Although the iodine value is used primarily in industry, it is of value to us because it gives an indication of the oil's stability and health properties. Coconut oil has an iodine value of 10. This indicates that it contains a high amount of saturated fatty acids and a very small amount of unsaturated fatty acids. The higher the iodine value, the greater amount of unsaturation. As noted above, coconut oil is 92 percent saturated and 8 percent unsaturated. Soybean oil, in contrast, has an iodine value of 130. It contains only 15 percent saturated fatty acids with 85 percent-unsaturated fatty acids, thus the reason for its high iodine value.

The higher the iodine value, the less stable the oil and the more vulnerable it is to oxidation and free radical production. High iodine value oils are prone to oxidation and polymerization. During heating, such as when used in cooking, oils with a high iodine value readily oxidize and polymerize. Polymerization is an irreversible process, which causes the fatty acids to become hard, insoluble, plastic-like solids.

Because of their tendency to harden when oxidized, polyunsaturated vegetables have been used extensively as bases for paints and varnishes. You can see this effect in the kitchen. When you use polyunsaturated vegetable oils in cooking sometimes the oil spills onto the outside of the pan. If the outside of the pan is not thoroughly cleaned, over time you will notice a buildup of a very hard, amber colored, varnish-like substance on the bottom of your fry pans. This is polymerized vegetable oil. The oil you used in cooking has literally turned into varnish. It takes a scouring pad and a lot of elbow grease to scrub it off the pan. When high iodine value oils are heated, you are creating polymerized fatty acids in your food. The higher the temperature or the longer the exposure to heat, the greater the degree of polymerization.

Trans Fats

Trans fatty acids, more commonly called trans fats, are made by heating liquid vegetable oils in the presence of hydrogen gas and a catalyst, a process called hydrogenation.

- Partially hydrogenating vegetable oils makes them more stable and less likely to become rancid. This process also converts the oil into a solid, which makes them function as margarine or shortening.
- Partially hydrogenated oils can withstand repeated heating without breaking down, making them ideal for frying fast foods.
- For these reasons, partially hydrogenated oils became a mainstay in restaurants and the food industry – for frying, baked goods, and processed snack foods and margarine.

Partially hydrogenated oil is not the only source of trans fats in our diets. Trans fats are also naturally found in beef fat and dairy fat in small amounts.

- Eliminating industrial-produced trans fats from the U.S. food supply could prevent between 6 and 19 percent of heart attacks and related deaths, or as much as 200,000 each year.

Trans fats are worse for cholesterol levels than saturated fats because they:

- Raise bad LDL and lower good HDL
- Create inflammation, – a reaction related to immunity – which has been implicated in heart disease, stroke, diabetes, and other chronic conditions
- Contribute to insulin resistance
- Can have harmful health effects even in small amounts – for each additional 2 percent of calories from trans fat consumed daily, the risk of coronary heart disease increases by 23 percent.
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Eliminating trans fats from food – policy efforts

- In the 1990s, the average American was eating about 6 grams of trans fats a day; ideally that should be less than 1 gram a day, and zero from partially hydrogenated oils is best.

A 2006 labeling law required food companies to list trans fats on food labels. This caused many food makers to switch to using trans-fat-free oils and fats in their products, resulting in a reduction of trans fat levels in the U.S. food supply.

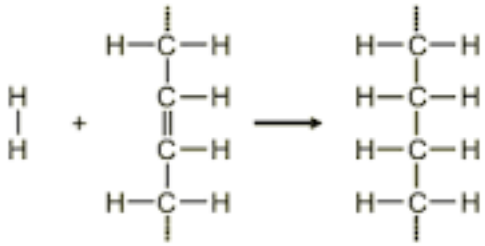
- A study from the Centers for Disease Control and Prevention found that Americans' blood-levels of trans fats dropped 58 percent from 2000 to 2009—evidence that the labeling law has had its desired effect.
- A survey of 83 major-brand grocery store products and restaurant dishes offers encouraging news: When most of these food makers reformulated their products, they cut back on trans fat without increasing saturated fat. [21]
- If a product contains less than half a gram of trans fat and a half-gram of saturated fat per serving, it can still be labeled as "trans fat-free." So while many products in the United States are labeled "trans fat-free," those products may still contain a small amount of trans fat.

In June 2015 the FDA announced its decision to ban artificial trans fat in the food supply. Food manufacturers in the U.S. will have three years to remove partially hydrogenated oils — the primary source of artificial trans fat — from products.

While we're making progress in the United States, trans-fat intake is widely used in some developing nations. Inexpensive partially hydrogenated soybean oil and palm oil have become staples not only for the food industry but also for home use. This shift away from traditional cooking oils and toward trans-rich partially hydrogenated oils is contributing to the growing epidemic of cardiovascular disease in developing nations around the world.

Hydrogenation

During hydrogenation, vegetable oils are reacted with hydrogen gas at about 60ºC. A nickel catalyst is used to speed up the reaction. The double bonds are converted to single bonds in the reaction. In this way unsaturated fats can be made into saturated fats – they are hardened.



Fractionation

In edible oil processing, a fractionation process consists of a controlled cooling of the oil, thereby inducing a partial, or 'fractional', crystallization. The remaining liquid (olein) is then separated from the solid fraction (stearin) by means of a filtration or centrifugation.
The chain length of a triglyceride defines its melting point. Fractionation entails controlled crystallization. Solids are removed by means of solvents or winterization or pressing. Pressing happens with hydraulic pressure or vacuum filtration. Fractionation is used to produce specialty fats from palm and palm kernel oil.

Levels of Oil available in the market

Low grade oil: Iodine Value (IV) 125-145
Examples- Creamies such as 96.5% Soy (soybean salad oil) and 3.5% hydrogenated soy
Dirty burning oils
Rancid in 1 month
Weak and will breaks down faster
Low margins (Around 15 cents)

Mid grade oil: Iodine Value (IV) 115-125
Examples: Soy- Canola blend
Cheaper blends marketed as a healthier option
Competes with mid level and even some high level oils
Slightly higher margin (30-35 cents)

High grade oil: Iodine Value (IV) 95- 110
Examples: Rice Bran, High Oleic Canola
High Oleic Soy (IV- 85)
Cleaner burning oils
Most stable and burns longer
Highly refined
Margin (30-50 cents)

Ultra strong grade and food type oils: Iodine Value (IV) 80 and below
Examples: Coconut, Lard
The most stable and burns the longest

Type of oil or fat	Saturated	Monoun-saturated	Polyun-saturated	Omega-3	Omega-6	Iodine	Smoke point [note 1]	Uses
Soybean oil	15%	24%	61%	6.7%	50%	125-145	241 °C (466 °F)	Cooking, salad dressings, vegetable oil, margarine, shortening
Sunflower oil	11%	20%	69%	0%	56%	120-145	246 °C (475 °F)	Cooking, salad dressings, margarine, shortening
Safflower oil	10%	13%	77%	0	74%	120-135	265 °C (509 °F)	Cooking, salad dressings, margarine
Corn oil	13%	25%	62%	1.1%	53%	109-133	236 °C (457 °F)	Frying, baking, salad dressings, margarine, shortening
Cottonseed oil	24%	26%	50%	0.2%	50%	105-115	216 °C (421 °F)	Margarine, shortening, salad dressings, commercially fried products
Canola oil	6%	62%	32%	9.1%	18%	105-120	204 °C (399 °F)	Frying, baking, salad dressings
Sesame oil (Unrefined)	14%	43%	43%	0.3	41%	103-116	177 °C (351 °F)	Cooking
Rice bran oil	20%	47%	33%	1.6%	33%	95-108	254 °C (489 °F)	Cooking, frying, deep-frying, salads, dressings. Very clean flavored & palatable.
Peanut oil / groundnut oil	18%	49%	33%	0	31%	84-105	231 °C (448 °F)	Frying, cooking, salad oils, margarine
Olive oil (virgin)	14%	73%	11%	0.7%	9.8%	80-88	215 °C (419 °F)	Cooking, salad oils, margarine
Palm oil	52%	38%	10%	0.2%	9.1%	44-51	230 °C (446 °F)	Cooking, flavoring, vegetable oil, shortening

Type of oil or fat	Saturated	Monoun-saturated	Polyun-saturated	Omega-3	Omega-6	Iodine	Smoke point [note 1]	Uses
Lard	41%	47%	2%	1%	10%	43	138–201 °C (280–394 °F)	Baking, frying
Coconut oil, (virgin)	92%	6%	2%	0	1.8%	7.5-10.5	177 °C (351 °F)	Cooking, tropical cuisine, beauty products