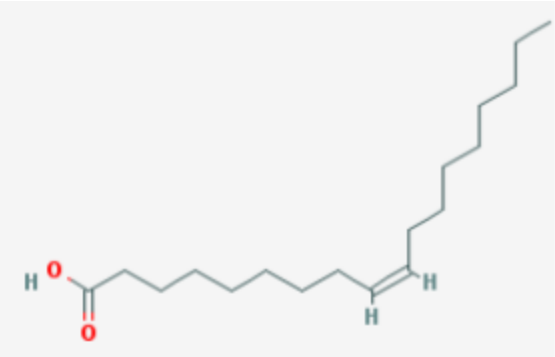
Cooking Oil

Jump to

Peanut Oil: Chemical Composition and Properties

When attending the all-American game of baseball, everyone knows that the main dietary staple besides hot dogs and catsup is everyone's favorite nut- the peanut. However, did you know that some of your other favorite eats are cooked in oil from this delicious legume? Fast food restaurants such as Chick-fil-a and Five Guys use strictly peanut oil for its neutral taste and low saturated fat content in addition to numerous Asian and seafood restaurants that use peanut oil for certain foods as it performs well at high temperatures [2]. However, the students allergic to peanuts should not be alarmed or discouraged from eating at these establishments; like any other cooking oil, peanut oil is refined which removes the allergic proteins from the liquid. This refined peanut oil is the most common kind of peanut oil used in restaurants [8]. There is however a catch- not all refined peanut oils are created equally. Various brands refine peanut oil to different standards (leaving various amounts of potential allergens in the mix). Others mix peanut oil in with various other vegetable oils (such as canola oil) so the allergens, if not greatly refined already, are at a much lower concentration [2]. When in doubt, if the peanut oil could cause an allergic reaction, do not put yourself at risk of consuming the peanut oil.

Peanuts are naturally rich in oil. In fact, 47-50% of the average peanut 'nut' is oil. When extracted from the peanut seed/nut, this pale yellow oil lacks taste or adds a very slight nutty flavor to the foods cooked in it- making it very favorable to a wide variety of restaurants [5]. The composition of peanut oil changes drastically depending on the region that it is from, but consists of mainly palmitic, oleic, and linoleic acids. Oleic acid, $C_{18}H_{34}O_2$, is an unsaturated fatty acid which is the main component of olive oil. Oleic acid is a clear to pale yellow liquid at room temperature, is insoluble with water, and has a boiling point of 360℃ [4]. Palmitic acid, $C_{16}H_{32}O_2$, is a saturated fatty acid and is extremely common in lipids within the human body. Palmitic acid is a solid at room temperature with colorless to white crystals and melts at 61.8℃ [6]. Linoleic acid,



Pictured above is the chemical structure of oleic acid (a chain of carbon atoms very similar to palmitic and linoleic acids)

$C_{18}H_{32}O_2$, is a polyunsaturated fatty acid commonly found in plant oils and helps to synthesize cell membranes (the protective coverings of cells) in various organisms. Linoleic acid is a colorless to pale yellow liquid at room temperature and has a boiling point of 230℃ [3]. Peanut oil also consists of triacylglycerols, diacylglycerols, phospholipids, sterols, tocopherols, tocotrienols, triterpenic, and aliphatic alcohols, and various other fatty acids. This combination of acids leads to a very high oxidative stability perfect for cooking and frying food. Unfortunately, peanut oil does not have a common chemical composition across the globe as climatic conditions greatly affect its composition [1].

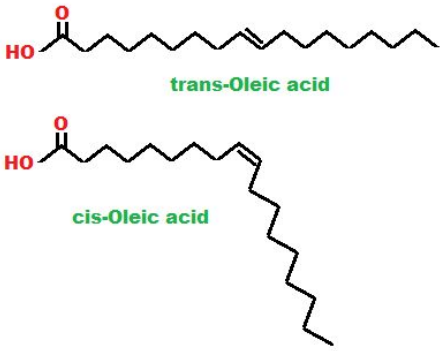
Physical properties of peanut oil include being a clear-yellow viscous liquid at room temperature and being insoluble in water. Even though you would not consider it, the oil used to cook your food is reactive. For example, peanut oil generates large amounts of heat when reacted with acids and caustic solutions. Additionally, when mixed with alkali metals and hydrides, peanut oil produces flammable hydrogen gas. Furthermore, like any other food, peanut oil slowly reacts with oxygen in the air to become rancid (as discussed above with oxidative stability) [7].


Illustration of peanut oil

Peanut oil is classified as a vegetable oil that is cholesterol free, low in saturated fats, and trans fat free. It is also similar to olive oil as it has a high unsaturated fat content. Peanut oil also contains phytosterols (which have shown to improve overall heart health) and vitamin E. In addition, because peanut oil can reach very high temperatures, food cooked in it retains its own flavor (for example, if a filet of fish is deep fried, the fish flavor will not leach into the oil so it can be reused with other foods) and less oil is soaked up by the food item making peanut oil a healthier alternative. In fact, the 2005 US Dietary Guidelines recommend that consumed fats (25-30% of your daily calories) should come from polyunsaturated and monounsaturated fatty acids contained in fish, nuts, and vegetable oils such as peanut oil. Furthermore, the American Heart Association specifically recommends peanut oil as a source of the above listed healthy fats. Studies

have even shown that the use of peanut oil as a substitute for other cooking oils can lead to decreased cholesterol and even some weight loss [8].

A common misconception among the public is that all fats are bad fats- this simply is not the case. The human body needs fats to build cell membranes, create protective sheaths for nerves, reduce inflammation, contribute to muscle movement, and assist with blood clotting. Essentially what makes a fat good or bad for you is its chemical structure. Trans, saturated, or hydrogenated fats (man made) have a chemical structure that packs long chains of atoms together in a way that makes them solid at room temperature. These harmful fats increase cholesterol and the likelihood of diabetes, stroke, and heart disease by clogging your arteries and causing inflammation. Food companies created these lovely forms of fats as a form of preservative so it takes longer for foods to spoil. Cis or unsaturated fats (naturally found in foods such as avocados, nuts, and fish) have a chemical structure that allows them to be liquids at room temperature. Peanut oil is classified as an unsaturated fat [10].

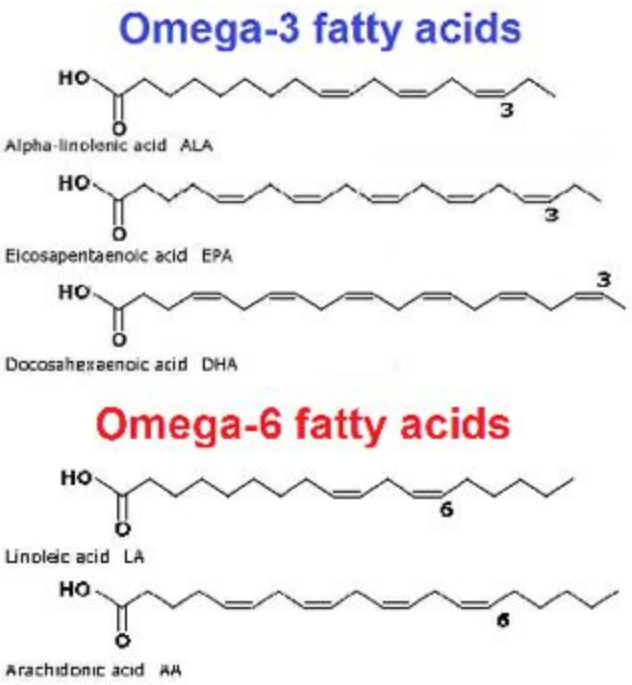


Appendix

Oxidative stability- also known as rancidification; the reaction of a food with oxygen which affects the shelf life of said food; peanut oil has a high oxidative stability so it takes a long time to spoil

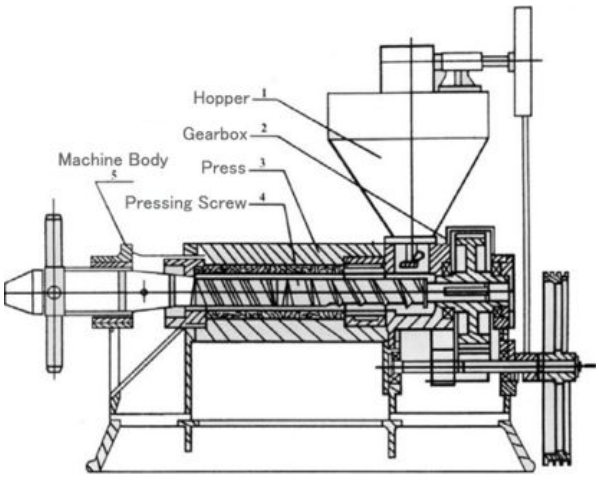
Peanut Oil: Production and Use

Peanut oil has many uses from many different uses in cooking to skin care benefits and uses at home. Most commonly known for its integral part of making those craved fried foods that are so loved at favorite fast food restaurants, peanut oil is used for frying, basting, and the manufacturing of margarines and shortenings [14]. Peanut oil is very ideal for cooking especially because of its high smoke point and it does not absorb flavor. Though mostly flavorless itself, peanut oil sometimes adds at light nutty flavor. Because of its lack of absorbing flavor, many different foods can be fried in the same batch of oil without cross contaminating flavors. Another plus side to using peanut oil to cook with is the high smoke point of the oil. Peanut oil has a smoke point of 450° F, most foods are fried between 365-375° F [13].



The high smoke point of peanut oil can be explained through the explanation of the fats that make up peanut oil. For oils with a high smoke point to be produced, manufacturers must use industrial level refinement to remove the extra compounds, usually fats. The two most important fats used to help determine the smoke point of oils are Omega-6 and Omega-3. Typically, oils with the highest smoke points have a large Omega-6 to Omega-3 ratio, though there are some exceptions. Peanut oil, specifically, has a ratio of 32:1, making it great for high temperature cooking [15].

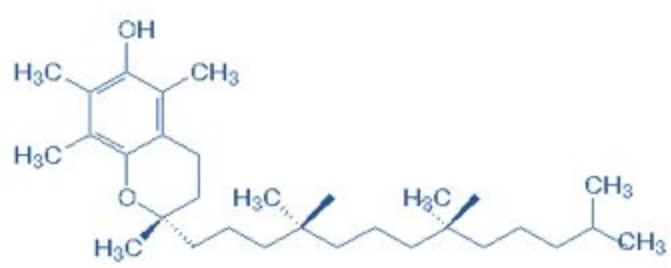
When peanut oil is produced for use, it is said to be pressed. Typically, this pressing of peanut oil takes place in four steps. The first step is the cleaning and drying of the peanut itself. Before the peanut can be processed, the impurities of the legume must be reduced. Without cleaning, there is often mud or stems and leaves on the peanuts. The impurities cause the finished oil to be of a lower quality and also absorb some fats and reduce the rate at which the oil is produced [12]. There are several methods that can be used to clean the peanuts. Among these methods are using an air stream to blow the impurities, like stems and leaves, off the peanuts. If the impurities are small in size but heavier than leaves, these can be selected and removed through a screening process. If the materials are metal, electromagnet can be used to remove them. In the second step, the peanuts are shelled. Shelling done used to reduce the absorption of fats and to increase oil rate in production. Also, shelling increases the processing capacity and lowers the wear out of the machines pressing the oil. The third step of this process, is the cooking of the peanut kernels. This step is the most important in the entire process. Approximately 8-10% of water is added to the peanut kernels before cooking to increase the



fluidity and oil rate. After a peanut is cooked, it is then referred to as a ripe bullet. The cooking process directly influences the pressing of the peanuts and the oil rate and quality. When the moisture content is decreased to 1-2% and the temperature is in a rage between 120-130° C, the peanuts are finished cooking and are ready for the final stage of pressing. The last step of peanut oil production is the direct pressing of the peanuts. The screw oil press is used most commonly. The peanuts are put into this machine and are pressed to create the oil used in restaurants and at home. These machines are ideal for the process because they are simple to operate and the high pressure of the machines ensures continuous pressing [1].

Not all peanut oil is made equally, though, there are three main types of the oil. The first is refined peanut oil. Refined peanut oil is processed like all other vegetable oils and has been bleached and deodorized. This type has had all allergen properties removed, making it safe for consumption for those with a peanut allergy. This is the main type used to fast food restaurants. The second type is gourmet peanut oil, which is not refined. This is typically used to add a peanut flavor or aroma to different foods. Gourmet peanut oil has the highest levels of vitamin E and can be purchased at retail outlets. The last type of peanut oil is 100% peanut oil. This is usually solely used for frying meats. These three types of peanut oils are the most commonly used although other types do exist [8].

Peanut oil is very high in energy, approximately 100 grams of oil is about 884 calories. This high calorie count comes from the fatty acids it contains, as mentioned earlier. It is composed of a lipid profile, it has healthy proportions of monounsaturated, polyunsaturated, and saturated fats. Though it contains all o f these fats, it is low in saturated fat and contains no cholesterol making one of the healthiest cooking oils. Since it is rich in monounsaturated fats, it helps to lower bad cholesterol in blood and increase the good cholesterol [6]. Similar to the richness of fats, peanut oil is also rich in vitamins. Specifically, peanut oil is high in vitamin E. Vitamin E plays important roles in balancing cholesterol, preventing diseases, repairing damaged skin, balancing hormones, and many other things in the human body [7].



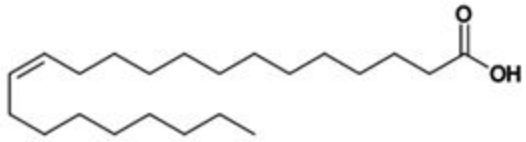
Vitamin E (α-tocopherol)

Peanut oil is a commonly used oil for many different purposes. The most common use being cooking and frying but also can be used for many health benefits. Though fried foods may not be the healthiest choice, the food fried in peanut oil is among the healthiest available. The oil contains many fats and vitamins that aid the human body in growth and development. Next time someone says fried food is all bad, remind them places like Chick-fil-a and Five Guys use peanut oil to fry their food.

Canola Oil: Chemical Composition and Properties

Did you know that canola oil wasn't the original oil that came from the rapeseed plant? As intuitive as it may sound, rapeseed oil was the original oil, but the major problem with rapeseed oil is that fact that it could kill you! But the reason why canola oil won't kill you in moderate amounts and why it's a relatively healthy oil is because of its chemical composition and properties.

Rapeseed oil could kill you because it contains about 40% erucic acid [19]. Erucic acid is a monounsaturated omega-9 fatty acid. In other words, it's an unsaturated fat from a plant. While it is typical to associate unsaturated fats, especially from plants, to be healthy, erucic acid has been shown to be toxic to animals causing heart lesions and many other problems in high doses. Even though there are no studies that have been conducted to find whether the same effects happen to humans, it was best to lean on the side of safety and a modified rapeseed plant was created [20]. Consequently, canola oil comes from genetically modified rapeseed plant that has significantly less erucic acid: less than 2% (If you want to know more about Erucic acid, here is a link to a video that explains more about it) [21].



Erucic Acid

Figure 1 [22]

But as far as what broadly makes up canola oil, it can be broken down into three different elements: carbon, oxygen, and hydrogen. Any oil that is used in cooking today isn't generally made up of one type of molecule, it's made up of multiple molecules that have different ratios of carbon, oxygen, and hydrogen: fats. Canola oil is made up of a variety of fats, but the reason canola oil is a particularly healthy choice of oil is because it contains mostly unsaturated fats [23].

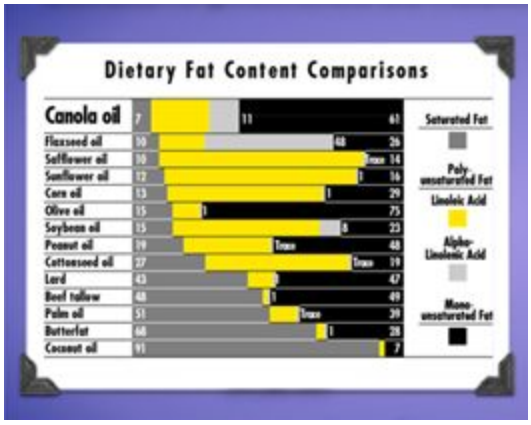


Figure 2 [24]

All fats are just chains of carbons with hydrogens and a carboxyl group, but the reason why unsaturated fats are considered healthier than trans and saturated fats is because of two reasons: the shape of the fat molecule and the appearance or absence of a carbon-carbon double bond. Saturated fats have a linear like structure and don't have a carbon-carbon double bond.

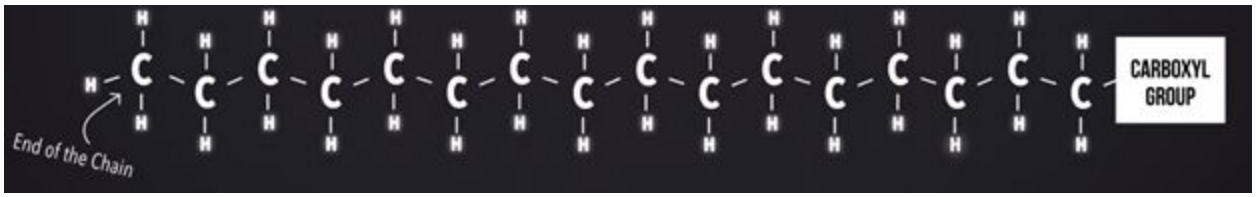


Figure 3 [25]

Unsaturated fats are a cis isomer. They have a bent like structure and a carbon-carbon double bond. Trans fats are a trans isomer, hence the name trans fats. They have a linear like structure and a carbon-carbon double bond [7].

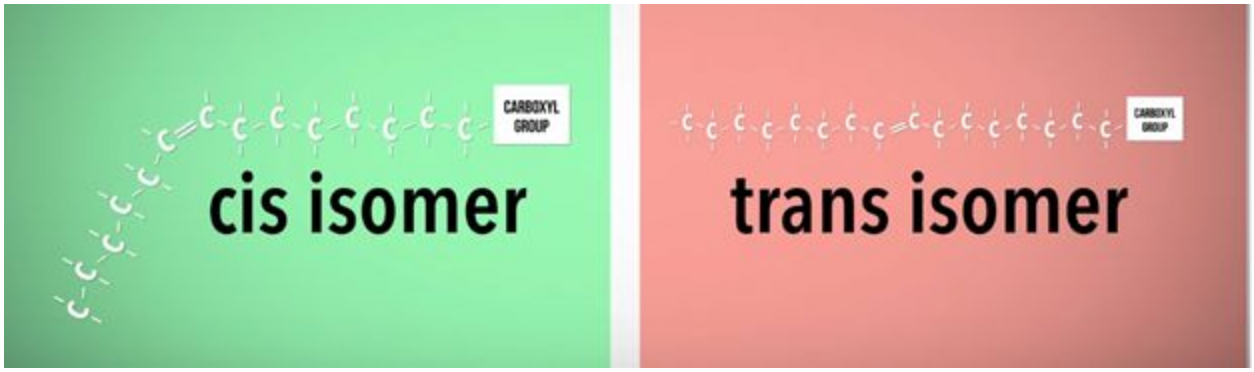


Figure 4 [25]

Unsaturated fats are the healthiest out of the three because of its shape. The bent like shape makes it hard for the long carbon chains to group up and form solid structures like plaque in your arteries. This is also the reason why canola oil is a liquid at room temperature [26]. Both saturated and trans fats, though, can easily condense into a solid because of the linear the shape of the molecules. But trans fat is particularly better at becoming a solid than saturated fats, making both fats unhealthy but trans fats worse. One study showed that just a 2% increase in trans fats has been shown with a 23% percent increase in heart disease (If you want to know more about the differences in unsaturated fats, trans fats and saturated fats, here is a link to a video that explains more about it) [25].

Canola oil's unsaturated fats are mostly made up of three moderately healthy unsaturated fatty acids: oleic acid ($C_{18}H_{34}O_2$) making up about 56% of canola oil's composition, linoleic acid ($C_{18}H_{32}O_2$) making up about 26% of canola oil's composition, and alpha-linolenic acid ($C_{18}H_{30}O_2$) making up about 10% of canola oil's composition [23]. Each of these fatty acids have been shown to be healthy in moderate amounts. Oleic acid is abundantly found in nature and is has been shown to lower blood pressure [27]. Linoleic acid has been shown to support heart health when used to replace saturated fats and carbohydrates [28]. Alpha-Linolenic acid an omega-3 fatty acid which has been shown in many studies to prevent heart disease and support brain health [29,30].

Canola oil's saturated fats, though, are mostly comprised of two kinds of saturated fatty acids: palmitic acid ($C_{16}H_{32}O_2$) making up about 4% of canola oil's composition and stearic acid ($C_{18}H_{36}O_2$) making up about 2% of canola oil's composition [23]. While both palmitic acid and stearic acid have been shown to be harmful towards one's health, the harmful effect of these fats only appear when eaten in excess [31,32]. Since canola oil has such a small amount of these fats in the total composition, it is highly unlikely that one could reach the point of having too much of these saturated fats by only consuming canola oil.

Canola oil though, is a popularly used oil for frying food. Of course, not all oils can be used for frying like canola oil. A good way of determining whether an oil is good to use for frying is by determining its smoke point. An oil's smoke point is the temperature at which the oil produces a continuous amount of smoke at said temperature. While there are many specifications for defining a frying oil, the Canadian Government specifications are having a smoke point of about 200°C and above [26]. While smoke point varies drastically depending on the method of heating, canola oil smoke point is 225-475°C [26,33]. This high smoking point makes canola oil a popular choice when frying foods because it can fry at high temperatures and it doesn't turn into a solid at room temperature when cooled back down. If you try use a fat that is solid at room temperature, like butter, to fry some food, there won't be a

drastic difference between the two fats, but after the food cools back down to room temperature, the food will have a waxy coating as the fat begins to solidify [34].

Smoke Points of Fats and Oils	
Fat/Oil	**Degrees Fahrenheit**
Flax Oil	225
Canola Oil, unrefined	*225*
Safflower and Sunflower Oil, unrefined	225
Corn Oil, unrefined	320
Peanut Oil, unrefined	320
Olive Oil, extra virgin	320
Butter	325-375
Coconut Oil, unrefined	350
Vegetable Shortening (e.g., Crisco)	360-370
Lard	360-400
Safflower and Sunflower Oil, refined	450
Corn Oil, refined	450
Peanut Oil, refined	450
Canola Oil, refined	*425-475*
Clarified Butter (Ghee)	400-500

Figure 5 [33]

If you want to read up more on some basic chemical properties of canola oil, here is a link.

Appendix

Isomer. An isomer is when two molecules have the same empirical formula but different connectivity. Trans and cis is a way of differentiating the shape of the molecule.

Carboxyl group. A carboxyl group consists of a carbon atom double bonded to oxygen and single bonded to a hydroxyl group.

Fatty acid. A fatty acid is another word for fat. Fat is a long carbon chain with a carboxyl group.

Canola Oil: Production and Uses

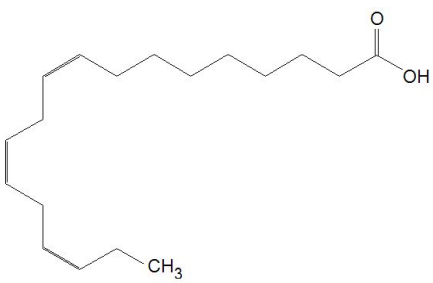
Canola Oil is used in many food products, from Chick-Fil-A to stir fry. The main use of canola oil is as a “healthy” substitute to other oils such as olive oil or peanut oil. Canola oil is made from the rapeseed plant, and its harvesting is done in a process to ensure only the correct parts of the plan are processed into oil, causing canola oil to be a much more refined oil as compared to other cooking oils. The rapeseed plant is cleaned, to remove bacteria, and

specifically, the seeds are checked for correct moisture, damage, and levels of chlorophyll [36] The seeds are then heated to “cake” them, which is when the outside of the seed flakes off, and can be harvested for oil. The rapeseed flakes are then pressed to extract the oil from them, and the product is pure canola oil. The canola oil is refined by adding compounds such as organic acids and removing organic compounds deemed unhealthy or unproductive to the oil process, in order to make the oil last longer and be healthier. This refining includes processing the oil through a clay, to give the oil the correct color, and processing the oil through a steam distillation to remove any unnecessary odors. Considering only about fifty percent of the canola plant is actually oil, there are many leftover flakes, seeds, and waxes that cannot be transformed into oil. However, in production, these leftovers are used for various purposes. The seeds and leftover flakes that cannot be crushed are turned into what are called “cakes” and are used to create animal feed. The waxes that cannot heat off of the oil are cooled and used to create soap and vegetable shortening. Most of this processing happens in large factories, with a majority of the factories in Canada, and these factories ship canola oil to the rest of the world [35].

Figure 1-Canola Oil

Figure 2-Rapeseed Plant

Canola oil is used in many types of foods, primarily as a cooking agent. Foods commonly cooked with canola oil are meats, such as chicken or beef, and vegetables as an oil. Canola oil is primarily composed of unsaturated fats, which is what causes it to be a liquid at room temperature, as the oil has kinks in it, meaning it cannot compact. This allows canola to be used to fry foods. When frying foods, the canola oil interacts with the molecules of food at a very high temperature, giving it the “crispy” texture we are familiar with. This occurs when canola, which has a very high boiling point, superheats the foods, and a combination of the acids within the oil, as well as the high levels of hydrogen in the oil cause the browned, hard exterior to the food [36]. Because canola is primarily an unsaturated fat, which means it has less hydrogen than other fats, it does not “weigh down” the food it cooks or make it greasy, as there is less oil that attaches to the food [37]. One important quality of canola oil is that because of its high boiling and smoke point, paired with its unsaturated fat content, it is often used to cook foods as an alternative to oils such as olive oil or peanut oil.



One of the primary uses of canola oil is as a healthy substitute for other types of oils. Canola is viewed as healthy for a few reasons. The first is because of its high levels of unsaturated fats. Unsaturated fats are considered to be more healthy than saturated ones, as they don’t build up in the body, and do not contribute to high levels of cholesterol or diabetes [38]. Another reason canola is

Figure 3-Alpha Linolenic Acid (ALA)

healthier is because of its high levels of Omega-3 fatty acids. These are acids that interact with the body to decrease inflammation of the heart and reduce the risk of artery disease [39]. One Omega-3 fatty acid specifically that is high in canola oil is known as Alpha-Linoleic Acid (ALA). This acid is known to help cure heart disease, lower cholesterol, and decrease blood pressure [40]. When canola oil is used to cook foods, these fats and acids are transferred into the food, giving them high quantities of the "healthy fats." While the components of canola oil are healthier than other oils, many people do not believe that canola is a healthier option than other oils, however. Due to the artificial compounds added in the production of canola oil, and its genetic modification when growing and producing the plants, people view it as not natural [41]. Additionally, Canola oil is often partially hydrogenated, which means that hydrogen atoms are added to maintain the oils stability, however this can lead to negative health effects, due to the increase in hydrogen "weighing down" the oil [42]. However, this genetic modification and partial hydrogenation is not enough of a change to the canola oil to cause it to be considered unhealthy, or for it to not be used as a substitute for other oils.

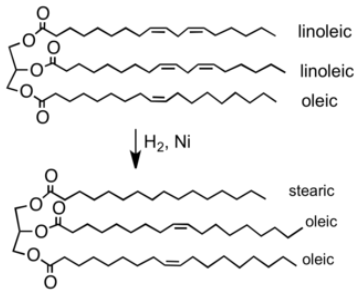


Figure 4-Partial Hydrogenation

Canola oil is used in cooking, and is a much healthier option than oils such as olive oil or peanut oil. Due to its high levels of unsaturated fats, Omega-3 fatty acids, and unsaturated fats, canola oil is becoming more and more common to fry foods, or just cook foods in general. Even though there are elements to the oil that are unhealthy, specifically partial hydrogenation, it is still a healthier option than most other oils. So, the next time you are cooking and need to use oil, consider canola oil, a healthier option than the other choices you have.

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