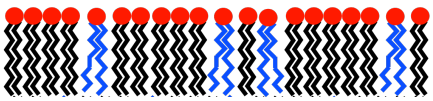
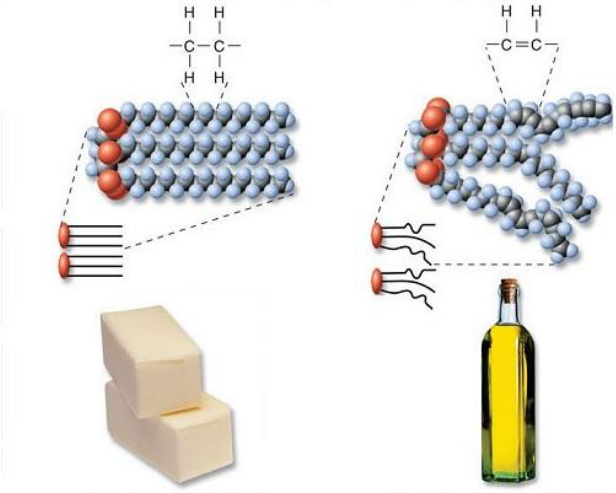
COOKING WITH FATS

The Effect of Unsaturation on Consistency





(b) Hard fat (saturated): Fatty acids with single bonds between all carbon pairs

(c) Oil (unsaturated): Fatty acids that contain double bonds between one or more pairs of carbon atoms

Cooking with fats and oils

A pure substance has a clearly defined melting point, but a mixture (a.k.a. an *impure* substance) melts over a broad range of temperature.

So what can we conclude about the *purity* of butter?

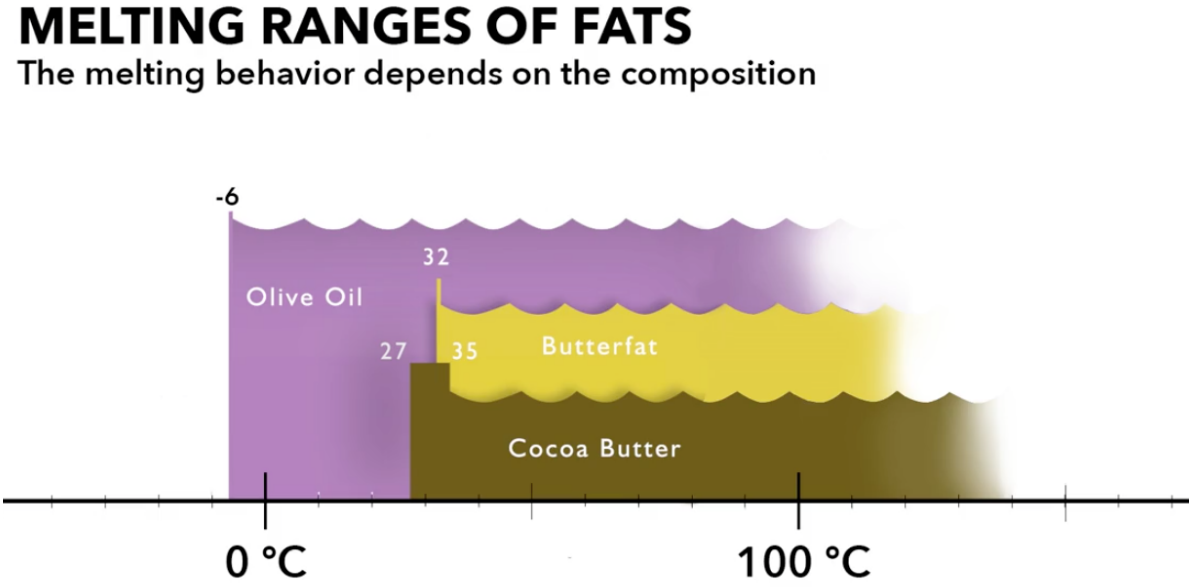
Any *pure substances* will have a clearly defined point at which it *changes physical state* (i.e. boiling, melting etc.). Impure substances do not.

Table: Melting Characteristics of Butterfat

Temperature (°C)	Solid Content (%)	Temperature (°C)	Solid Content (%)
5	43-47	30	6-8
10	40-43	35	1-2
20	21-22	40	0

[1]Belitz, Hans-Dieter and Grosch, Werner. *Food Chemistry*. New York: Springer, 1999: 485.

Structure vs melting point



Melting – a change in physical state

What is happening chemically as fats *melt*?

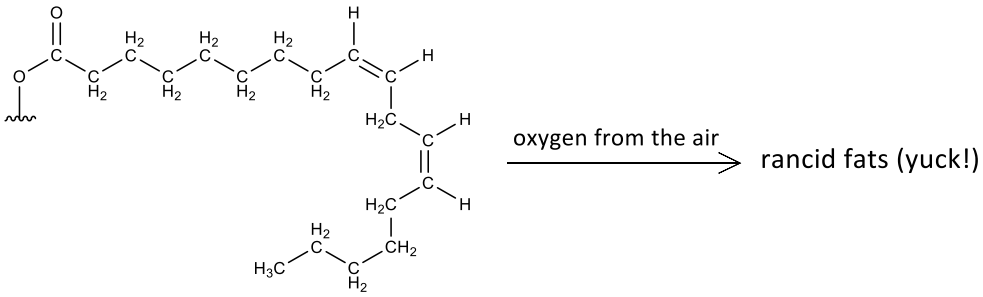
Butter is comprised of triglycerides with 62% saturated, 29% monounsaturated and 4% polyunsaturated fatty acids. Butter melts over a wider temperature range: 82.4 - 96.8 °F (28-36 °C). Most fats (like butter) do not have a sharply defined melting point, instead they soften gradually over a broad temperature range. As the temperature rises, the different kinds of fat molecules melt at different points and slowly weaken the whole structure.

Do liquid cooking oils *boil*?

Fats will melt into oils when warmed, but if the heat is raised, most do not boil. Before the fat can reach a boil it *smokes* and breaks down instead (eventually, it can actually light on fire!). The **breakdown of fat at high temperatures** is due to several factors…

- **Oxygen from the air**

  Oxygen in the air can *oxidize* the *cis* double bonds in unsaturated fats – creating **smelly and off-tasting by products and turning the fat rancid**. Some of these oxidation products of fats can be toxic and others are hazardous to cardiovascular health. This *oxidation* is accelerated at high temperatures – like when you are heating the oil in a pan.



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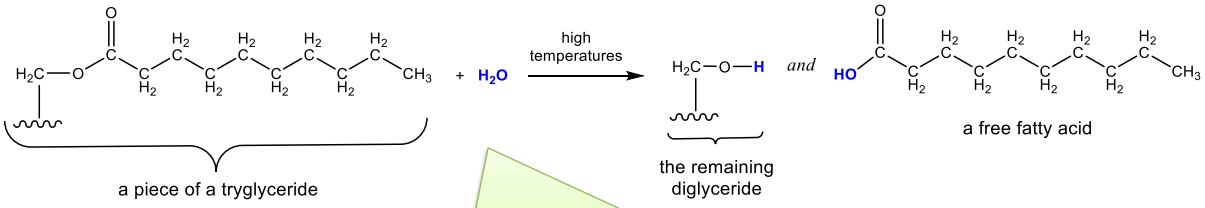
- **Water in the air or in the fat**

For example, butter is ~15% water

At high temperatures, water from the air (or contaminating the fat) reacts with the triglyceride to **break off a free fatty acid from the glycerol backbone.** This creates a *free fatty acid (FFA). Free fatty acids* taste bad and are less hydrophobic – which compromises the quality of the oil.



Why is this process called ***hydrolytic rancidity***?

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For example, butter contains proteins and sugars that burn if the butter is over heated

- **Purity of the fat**

Contaminants like *free fatty acids*, proteins, sugars **will burn in the oil at high temperatures** producing dark colors and off-tasting molecules. Free fatty acids are naturally present in fats and oils in very small amounts, but the amount of *free fatty acids* increases as fats/oils are heated.

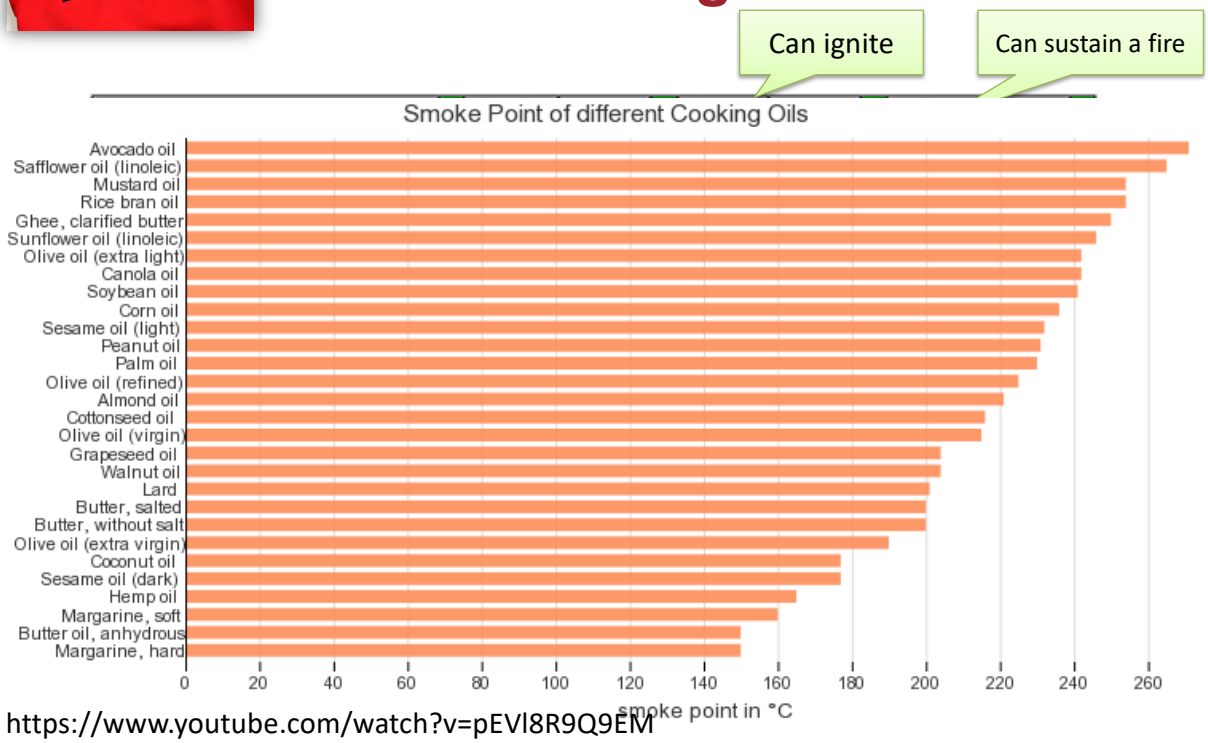
For example, animal fats contain some FFAs naturally

Cooking safely with fats and oils

The *smoke point* of an oil is a temperature at which the oil begins to break down into visual gaseous products. **It is known that the smoke point is dependent upon that small concentration of *free fatty acids* in the fat/oil**. *So what affects free fatty acid content*?

- **The type of oil.** Animal fats/oils have higher free fatty acid content than plant oils.
- **Oil refining** (a method of purification). Refined oils have lower free fatty acid content than unrefined oils.
- **Age**. The longer a fat/oil sits exposed to oxygen and water (along with heat, in the case of cooking) the more *free fatty acids* will form. One use of an oil at high temperature can lower the *flash point* (or burst-in-to-flames point) by as much as 100˚F due to the increase in free fatty acid content.

Smoke points of common cooking fats/oils

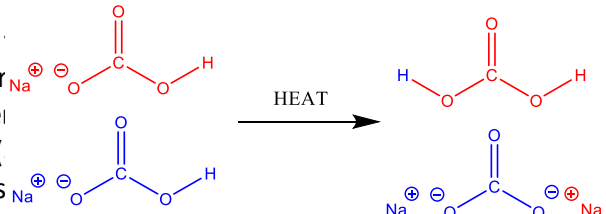


https://www.youtube.com/watch?v=pEVl8R9Q9EM

What should you do if an oil/fat lights on fire while cooking?

• **Turn** yourself or your

• **Cove** With the lid on (ut itself out. Us



• **Pour on Baking Soda** - Baking soda will extinguish grease fires, but only if they're small. It takes *a lot* of baking soda to do the job.

• **Spray the Pot with a Class B Dry Chemical Fire Extinguisher** - This is your last resort, as fire extinguishers will contaminate your kitchen. Still, it's better than the alternative if the fire is getting out of control.

• **Get Out and Call 911** - If the fire does break out of control, don't try to be a hero. Get out and find a phone to call 911.

http://www.thekitchn.com/kitchen-safety-how-to-put-out-138233

https://www.youtube.com/watch?v=pEVl8R9Q9EM