Essentials of Cooking: FAT

FATS are one of four fundamental food molecules

WATER
FATS
PROTEINS
CARBOHYDRATES

The chemical composition of fats and how it differs from its cohort molecules allows it to affect the other three molecules and interplay with them to create many culinary combinations.

We will briefly explore the composition of fats, thereby exploring the variation among lipid molecules, which has bearing on health as well as application in the kitchen.

What are fats? SOLID at room temperature

What are oils? LIQUID at room temperature

Difference arises from the combination of triglycerides that make up the fat—how much sat fat, how much unsat fat (incl. mono and poly, trans, etc)

Saturated fats- straight, paralellel, consistent carbon chains coming off of a glycerol frame. This means they bond to each other easily (zip together) and are more stable. They have a higher smoke point, are more structured, and less susceptible to rancidity

Unsaturated fats- have a double carbon bond somewhere in one (mono) or more (poly) of their carbon chains. This creates a kink in the chain, and the fats there fore are less uniform and cannot bond together as strongly. The weaker network means they will be more liquidy/less solid, have a lower smoke point (which varies by makeup), are less stable, and have a higher chance of rancidity, oxidation and off flavors (due to the availability along their chains of open bonding spaces).

Hydrogenation- straightens the kinks in unsat fats by flooding the carbon chains with hydrogen atoms, filling all the bonds and therefore straightening the carbon chains. The fat becomes artificially saturated.

Trans fats develop during hydrogenation when carbon chains straighten as a result of a twisting of the double bond. This means they remain unsaturated, but form the shape of unsaturated fats, and therefore behave in the body as sat fats when really they are unsaturated. This has implications in cell membrane function including composition and cell exchange (production and/or absorption of required enzymes.

fatty acid compounds, and other nutrients). They also affect the structure and strength of artery walls, and more.

Read up: https://www.nytimes.com/2016/09/13/well/eat/how-the-sugar-industry-shifted-blame-to-fat.html

When cooking whole, natural foods, focus on pure, fresh fats such as

- Animal fats like lard, tallow, duck fat, or schmaltz
- Vegetable fats that are high in saturated fat or healthy unsaturated fat like olive oil, sunflower oil, sesame oil, and coconut oil
- Whole fat dairy products like yogurts, cheeses, butter, ghee, and cream

Smoke Point- is the change of a fat from a liquid to a gas as fat bonds are decomposed by heat. Free fatty acids in various fats affect the smoke point. The lower the number of free fatty acids, the higher the smoke point, and stability of the fat.

Unsaturated fats < saturated fats
Vegetable fats < animal fats
Refined oils < unrefined oils
Old oils < fresh oils
Fats with additives < pure fats

Inducing smoke point in cooking not only ruins the fat's inherent flavor, it ceases the fat's ability to work the way it normally does (because it has decomposed bonds) and it leaves the molecules exposed to new bonds (with molecules in the atmosphere, or in your body). This can be a health hazard, in addition to a cooking faux pas.

Choosing fat wisely, as well as reducing the fat's exposure to the atmosphere while heating, will delay or avoid smoke point. Think pan size, here.

The role of Fat in Cooking-

FLAVOR
1. Fat has inherent flavor. One should pair fats with food according to the desired taste. For example, don't make a sweet cake with pork fat. Don't cook an Asian stir fry with olive oil

2. Fat carries flavor, and subsequently amplifies it by prolonging and circulating it. Fat molecules bond to flavor and aroma molecules (usually proteins), suspending them and circulating them through food, and allowing them to persist longer, as the flavor studded fat coats foods, and your tastebuds.

3. Fat allows for browning reactions such as caramelization and the maillard reaction, which lend their own individual flavors (usually desireable ones) to the flavors already in the food. Browning reactions only occur at high temperatures (230F or higher) and thus occur in fat-based cooking mediums. Water vaporizes before it reaches temperatures where browning is induced. Browning also occurs in dry conditions, so the exclusion of water from the cooking surface (often aided by fat) allows this to occur.

TEXTURE

Because of fat's chemical composition, the way it interacts with water and protein has immense implications for cooking.

1. Crispness- fat has long carbon chains which form MORE (however weaker) chemical bonds than water, and this means it can absorb way more energy (HEAT) BEFORE it decomposes. This allows higher heat cooking in the presence of fat, which contributes to dry surfaces and browning reactions, as well as the evaporation of water from food surface cells, creating delicious crisply textured food.

Creating crispy goodness requires food to be DRY, and fats to be fresher and purer so they burn or denature less readily. Any practice which encourages water in the cooking process will counteract crispness (putting a lid on the food, crowding the food). Adding the food to the fat too early causes the food to absorb the fat, creating sogginess.

2. FLAKINESS- fat will increase space between proteins and starches if it can displace water (nonpolar lipids and polar water do not mix) thereby creating layers of flaky goodness in foods. Fats must be COLD to do this, so that the water in the fat will instantly evaporate when it is heated.

The perfect example of this is in a pie crust or puff pastry, where butter is kept as cold as possible, and remains in chunks within the dough. As the dough bakes, water is evaporated from the butter immediately, and the fat remains in between dough layers to lift them apart. The warmer the butter is, the more water is released, which has the opposite effect.

3. MOISTNESS- Fat inhibits bonds with water. This means that fat inhibits the formation of gluten, for example, because gluten is protein molecule formed when water and proteins in flour bind. Gluten molecules that do exist will be coated with fat and won't bond together as easily, "shortening" gluten chains. This leads to soft and melty foods, like shortbread. Fat is used, but used warm, so that water can release into the dough and build some gluten, but the fat still present will shorten the gluten network.

This is why cakes made with oil will be moister than cakes made with butter. Oil coats flour more quickly, and contains less water, so it will inhibit gluten networks and leaven better than butter. Butter creates a denser cake or bread with more flavor.

4. TENDERIZATION- Fat contains water as well as its own moistness from lipid viscosity. This creates a tenderizing affect (overlapping with softness in the above example of shortbread) by infusing foods. A non-pastry example of this is the basting of meat (protein) with fats to make it more succulent and tender. Using low heat with fat allows for rendering or gentle cooking which has a basting effect.

5. CREAMINESS- fats are inherently creamy because of their weak but numerous bonds, and some dairy fats are the epitome of creaminess with their combination of proteins and lipids. Other fats, called mono and di-glycerides also contribute to creaminess because they have both polar and nonpolar characteristics, meaning they can form bonds with both water and other lipids. These hybrid fats are emulsifiers, allowing us to make the creamiest sauces, because they will allow us to combine ingredients that don't normally combine, as long as we introduce them to eachother slowly (i.e. water-based vinegar and oil = vinaigrette, or egg and oil = mayonnaise)

6. LIGHTNESS- fat can act as a leavener because it can be manipulated to trap air and proteins inside of its own network of chemical bonds. This is what happens when you whip cream, and when you cream together fat and sugar. Temperature and timing become the most important factor, here. COLD cream whips up better because water is not releasing into the matrix and inhibiting the deposition of air. Warm (but not melted) butter creamed slowly and for at least 4-7 minutes with sugar will add a network of air pockets to baked goods like cookies. If you've ever wondered why recipes ask you to add ingredients slowly, one at a time, or at room temperature to baked goods while mixing it is so as not to interrupt the time and temperature-sensitive leavening that is happening.

RECIPES from demos

1. Za'atar spice (added to 3 different olive oils for tasing)

equal parts dried thyme, sesame seed, and ground sumac
salt to taste

2. Pie crust

2 cups flour
8 T. very cold, unsalted butter
generous pinch of salt

3-5 T. very cold water or vodka

Combine flour and salt, then using a box grater, grate in the cold butter. Working quickly, combine the grated butter throughout the flour mixture. Add ice cold water or vodka until the mixture barely forms a ball. Gather, wrap in waxed paper and chill at least 30 minutes before rolling out. Dough will freeze well in an airtight bag.

3. Shortbread

1 C. flour
¼ C cane sugar
generous pinch of salt
8 T. softened butter, as spreadable as mayonnaise
¼ C chopped almonds

Combine the flour, sugar, and salt, then mix in the butter with your hands and let it moisten the dry ingredients thoroughly. Work the dough well with your hands, and add a smidge of water if you need it to help the dough hold together more. It should not be sticky, but it should be most enough to press into a 8 x 8 rectangle on an ungreased sheet pan. Sprinkle the almonds on top and press them in gently with your palm. Bake at 375*F until lightly browned around the edges. Cool slightly before cutting and serving.

4. Mayonnaise

per egg yolk (for best results, yolk should be at room temperature)
¾ C. neutral vegetable oil, my favorite is sunflower oil
salt to taste
lemon juice to taste

Grab a deep mixing bowl with a wide bottom. roll up a dish towel and make a nest out of it for your mixing bowl. Place the bowl in the nest and grab a wire whisk. Whisk up the egg yolk in the bottom of the bowl, and then, whisking continuously, add the oil drop by drop by drop. S.L.O.W.L.Y, whisking the whole time. As the mixture thickens, continue whisking, adding lemon juice or water if it gets too thick. Once you have used all the oil, add salt and lemon juice to taste.