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Plant Oil Based Soap

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Name: _____
Biology 401: Applied Plant Science

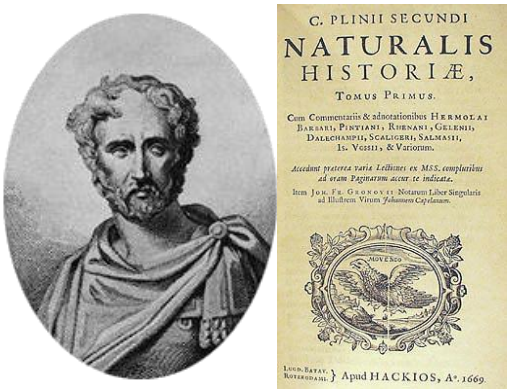
☙Vegetable Oil Soap❧

History of Soap:

The earliest evidence of soap-like materials dates to around 2800 BC in Babylon. A soap formula consisting of water, alkali, and cassia oil was written on Babylonian clay tablets around 2200 BC. In Egypt the Ebers Papyrus, although authorless, is a 110 page document that date back to 1534 BC, mentions bathing with a soap-like substance made from a combination of animal and vegetable oils with alkaline salts.

The Ebers Papyrus
en.wikipedia.org/wiki/History_of_science#mediaviewer/File:P._Oxy._I_29.jpg

Pliny the Elder's *Historia Naturalis*, 77-79 AD, uses the word sapo (Latin for soap) to describe a pomade for hair used by the Gauls and Germans which was made from tallow and ashes. In the first century AD Aretaeus of Cappadocia recorded that the "Celts, which are men called Gauls, those alkaline substances that are made into balls [...] called soap". By ~300 AD Zosimos of Panopolis described soap and soapmaking. Galen of Pergamon, (129-200/216 AD) a prominent Greek physician, described soap-making using lye and prescribed washing to carry away impurities from the body and clothes. According to Galen, the best soaps were Germanic, and soaps from Gaul were second best.



Pliny the Elder: an imaginative 19th-century portrait. No contemporary depiction of Pliny is known to survive.
http://en.wikipedia.org/wiki/Pliny_the_Elder

The abundance of olive trees in the Mediterranean area led to the development of soaps based on olive oil and lye from the ashes of the Barilla (*Salsola soda)*, a common plant. Barilla is a small (to 0.7 m tall), annual, succulent shrub that is native to the Mediterranean Basin. It is a halophyte (a salt-tolerant plant) that typically grows in coastal regions and can be irrigated with salt water.

Salsola soda (Barilla) is historically importance as a source of soda ash, which was extracted from ashes. Soda ash is one of the alkali substances that is used in glass and soap making.
en.wikipedia.org/wiki/Salsola_soda#mediaviewer/File:Salsola_soda_Rignanese.jpg

Aleppo soap, made from Olive Oil
en.wikipedia.org/wiki/Aleppo_soap#mediaviewer/File:Aleppo_soap_01.jpg

Aretaeus of Cappadocia
it.wikipedia.org/wiki/Areteo_di_Cappadocia

The European Dark Ages

There was little soap making or use after the fall of the Roman Empire in Western Europe during the European Dark Ages. Italy and Spain saw a revival of soap making during the 8th century. France became a producer of soap for the European market by the 13th century. Olive oil based soaps of higher quality were produced in southern Europe, Italy, Spain, and the southern ports of France (Marseilles and Castle soaps). These soaps were mainly used for bathing. Soaps produced with animal fats (tallow) in England and northern France were poorer quality were used for laundry and textile usage. Northern European soap makers even used fish oils for making soap.

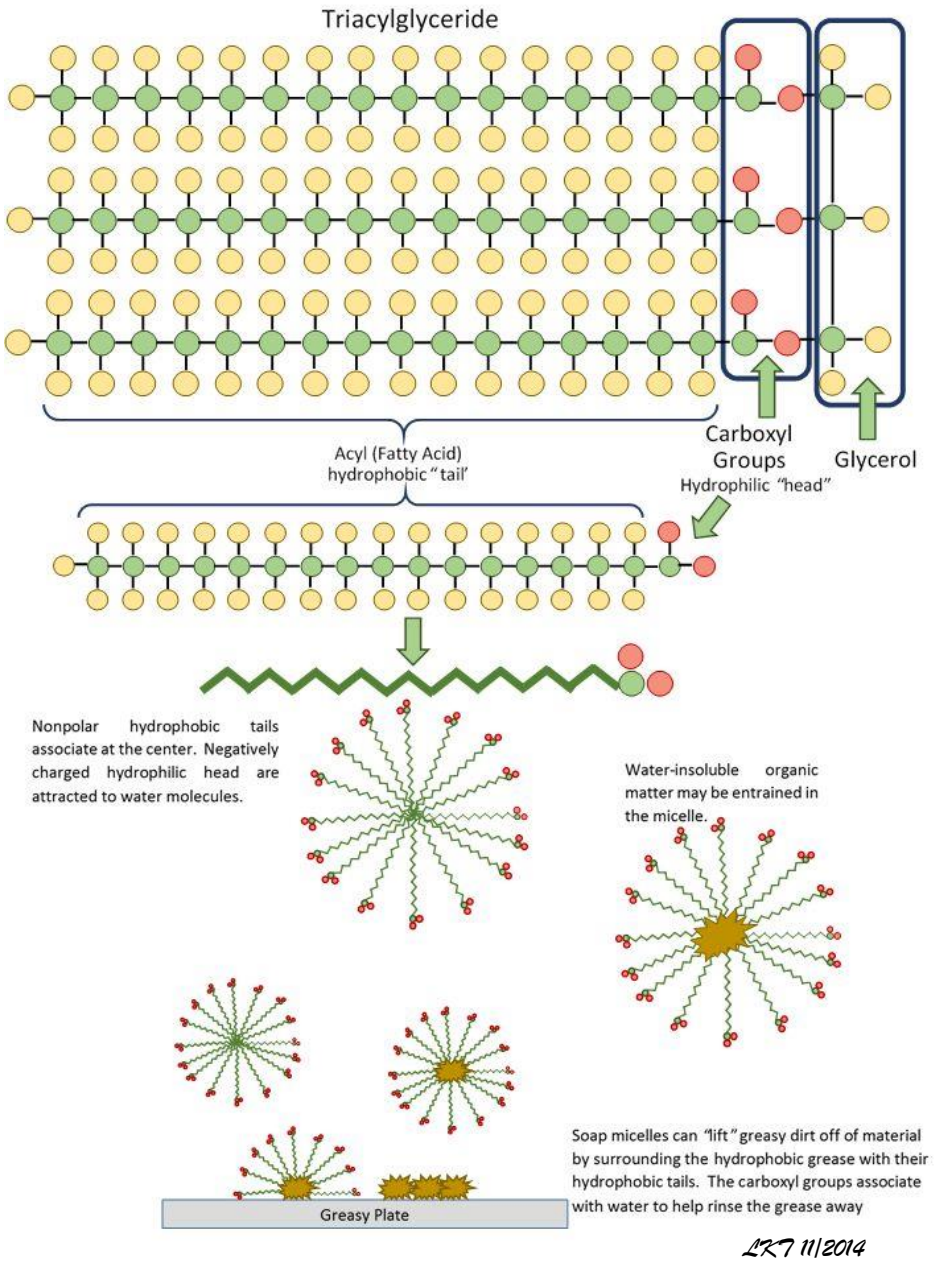
Settlers in America used wood ash and animal fat from butchering as the ingredients for soap making. Soap making became a yearly or semiannual event on the homesteads of the early settlers. As the butchering of animals took place in the fall the large amount of tallow and lard that resulted was used to make soap. On the homes or farms where butchering was not done, soap was generally made in the spring using the ashes from the winter fires and the waste cooking grease, that had accumulated throughout the year.

Liquid soap was invented in 1865 by William Shepphard who holds a patent on the process. In 1898, B.J. Johnson developed a soap made from palm and olive oils. This new soap's popularity rose rapidly to such a degree that the B.J. Johnson Soap Company changed its name to Palmolive in the same year. By the beginning of the Twentieth century, Palmolive was the world's best-selling soap.

In the early 1900s, other companies began to develop their own liquid soaps. Products such as Pine-Sol and Tide appeared on the market, making the process of cleaning much easier. Liquid soap detergents tend to be more effective than solid soaps. Liquid soaps leave less residue on skin, clothes, and surfaces (e.g., wash basins). Liquid soap also works better for more traditional/non-machine washing methods, such as using a washboard.

Vegetable Oil Soap

Plant seed oils are composed of acylglycerides: a three carbon glycerol molecule to which one, two, or three fatty acid (acyl) groups are attached. Soap is made by hydrolyzing the fatty acids from glycerol with potash (NaOH commonly known as Lye – the liquid form of NaOH). Potash can be formed by percolating water through wood ash. As the water passes through the ash it dissolves NaOH, thus creating Lye. When Lye is mixed with fats it causes the separation of the fatty acid tails from the glycerol at the carboxyl group. This process is called saponification from the Latin Sapon which means soap. As the fatty acids are hydrolyzed from the glycerol the mixture of the heavier water soluble fraction ($NaOH + H_2O$) and the lighter lipid fraction form a uniform mixture which will solidify into soap. Soap's cleaning properties come from an interaction of the fatty acid carboxyl group (COO^-) with water, and the fatty acid hydrocarbon tails attraction to grease or dirt.



Classification of Fatty Acids:

Reactive atoms such as hydrogen, iodine, and chlorine can break the double bonds of unsaturated fatty acids. The **Iodine Value** indicates the degree of unsaturation in a fatty acid. This is accomplished by reacting a known amount of iodine with a known amount of oil. Iodine ions are incorporated into oil's fatty acid chains at positions where there were double bonds. Iodine values of edible oils range from about 7 to over 200. Oils with values below 70 are fats because they are solid at room temperature.

Another way to group oils reflects the degree of saturation. Oils can be **drying, semidrying,** or **nondrying**. Drying oils have many double bonds that tend to link together, forming polymers. If these oils are spread as a thin film over a substance, they dry into impervious coating. Nondrying and most semidrying oils have fewer double bonds. They will not cross link to form coatings. Typically drying oils have iodine values greater than 150, semidrying oils between 100-150, and nondrying oils between 70-100.

Oil melting points & Iodine Values		
Oil	**Approx. melting point °C**	**Iodine Value**
Coconut oil	25	10
Palm kernel oil	24	37
Mutton tallow	42	40
Beef tallow	-	50
Palm oil	35	54
Olive oil	-6	81
Castor oil	-18	85
Peanut oil	3	93
Rapeseed oil	-10	98
Cotton seed oil	-1	105
Sunflower oil	-17	125
Soybean oil	-16	130
Tung oil	-2.5	168
Linseed oil	-24	178
Sardine oil	-	185

Omega Fatty Acids:

Omega fatty acids are unsaturated with high carbon chain lengths (C_{20}-C_{22}). Omega fatty acids are abundant in fish oils, but can be obtained from seeds of evening primroses, borages, and black currants. These fatty acids aid in reduction of triaclyglyceride levels in the blood, reduce blood pressure, and may have anticarcinogen properties.

Fatty Acid Oxidation:

Fatty acid double bonds can absorb oxygen. Oxidation of fatty acid leads to cleavage of the fatty acid into smaller units such as aldehydes and other fowl smelling volatile compounds that cause a rancid odor. Rancidity can be prevented by adding antioxidants such as BHT, BHA, and polysorbate 80 to oils or processed oil containing foods such as crackers, cookies, cereals, and margarine.

The "Mardi Gras" soap made on the last day of the soap workshop at John C. Campbell Folk School.

Tracey Adams, Vidalia, GA.
Soap Making Workshop Instructor

We will be making soap from a recipe by Tracey Adams of Nanty's Naturals as taught during the August 2009 course at the John C. Campbell Folk School, Brasstown, NC. (http://www.nantysnaturals.com)

Materials: "Class Basic" Recipe -Total Weight: 48.2 oz

Oils:		
Olive	16 oz	453.6 g
Coconut	8 oz	226.8 g
Palm	10 oz.	283.5 g
Lye (NaOH)	4.72 oz	133.8 g
Distilled Water	9.46 oz	268.2 ml

Procedure:

1) Line your soap mold with freezer paper. Be as neat as possible since folds and lines will appear in your soap.
2) **Make a Lye (NaOH) Solution:** Follow safety procedures as lye is a dangerous chemical (wear gloves, aprons, goggles)
   - Measure **133.8 grams** (4.72 oz) of sodium hydroxide (NaOH) on a weigh boat
   - Measure out **268.2 mls** (9.46 oz) of distilled water into a large beaker or plastic pitcher
   - ***SLOWLY*** add the NaOH to the water. Always add the NaOH to the water, not the other way around. Be careful and avoid splashes. Notice that this is an exothermic reaction!
   - Gently stir until NaOH is completely dissolved
   - Using the digital thermometer, monitor the temperature of the NaOH solution. It will need to cool to 80-90 ^{o}F or 27-32 ^{o}C.
3) **Measure out the oils into a stainless steel pot. Place into a pot on the stove at medium heat**
   - Melt the coconut oil and gently stir as it melts
   - Once all coconut oil is melted, add liquid olive oil and palm oil.
   - Set aside until the oil mixture is cooled to between 80-90 ^{o}F or 27-32 ^{o}C.
4) **Determine the Essential Fragrance Oil you will use and the herbal additive.**
   - Select one of the Fragrance Oils. Measure out 2 ounces into a beaker and set aside.
   - Other additives can include green tea, vanilla bean, and sesame seed.
   - Pick a colorant that will match your fragrance selection. You will need ¼ teaspoon of colorant.
5) **Have the hand blender ready for adding lye mixture. BE READY TO WORK QUICKLY!!!!**
   - When the temperature of the oils and NaOH ranges between 80-90 ^{o}F, begin to slowly add the NaOH mixture to the oils in the stainless steel pot. The oils will turn cloudy
   - Once the NaOH is added the reaction will speed up and you will have to be ready to blend quickly
     - Turn on the stick blender and continue stirring with the blender
     - The soap mixture will start to come together
     - Keep blending in until the oils and lye/water are completely mixed
     - You should reach ***'trace'*** in a few minutes… when soap is completely blended
6) **Once the mixture is completely blended together, add the fragrance, additives, and pigments.**
   - Make sure the fragrance, additives, and colorant is added before the soap is too thick

7) **Pour it all into a mold and make it as even as possible**
    - Tap the mold on the counter top to make sure air bubbles are dislodged
8) **Put the mixture in a warm place, covered with freezer paper and then a towel to retain heat**
9) **After 24 hours the soap will be hard enough to remove it from the mold and cut it into slices.**
10) **Set it aside to cure for around four weeks. This will make the soap harder, last longer, and have a better lather.**

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Lab Questions:

- What makes soap lather?

- What is the purpose of lye in the soap?

- What is ‘trace’?

- Why is making soap so much easier now than it was fifty years ago?

- How is plant oil soap better than soap made from lard?

- What peoples of the world were the first to use/make soap and when?

- What is an Iodine Value?

- Why are BHT, BHA, and polysorbate 80 used in processed foods?