

Protein in Handcrafted Soap

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Acknowledgements

- Mike Lawson/Columbus Foods
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 - Lee Ayescue
 - Alan Fish
 - Ben Jenkins
 - Josh Isaacs
 - Hakeem Mohammed
 - Taylor Redmond

Things People Add to Soap

- Colorants
- Essential Oils, Fragrance Oils
- Exfolients (Pumice, Oatmeal)
- Sugar, Honey
- Lavender Buds, Rosebuds
- Jojoba, Cetyl Alcohol

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- Sugar, Honey
- Lavender Buds, Rosebuds
- Jojoba, Cetyl Alcohol
- Milk (Particularly Goat's Milk)
- Silk (Various Grades)

What is Milk?

What is Milk?

- Water (218.4 g per 8 fluid ounces)
- Sugars (10.8 g per 8 fluid ounces)
- Protein (8.5 g per 8 fluid ounces)
- Fats (7.2 g per 8 fluid ounces)

Meyenberg Whole Goat Milk

What is Milk?

- Water (89%)
- Sugars (4%)
- Protein (3%)
- Fats (3%)

Meyenberg Whole Goat Milk

What is Milk?

- Water
- Sugars (Mostly Lactose)
- Protein (Mostly Casein)
- Fats (Mostly Small Saturated Fats)

Meyenberg Whole Goat Milk

What is Silk?

What is Silk?

- Protein (Mostly Fibroin)
- “Silk Protein,” “Silk Peptides,” “Silk Amino Acids”

wikipedia.org/wiki/Silk

Silk products were purchased from New Directions Aromatics.

Questions I Am Not Qualified to Address

- Do silk/milk soaps moisturize dry skin?
- Do they treat excema?
- Do they treat psoriasis?
- Do they treat acne?
- Do they remove dead skin cells?

Questions I Am Not Qualified to Address

- Do silk/milk soaps reduce wrinkles?
- Do they repair damaged skin?
- Do they nourish the skin with vitamins?
- Do they prevent skin cancer?
- Are they “better” than other soaps?

Questions I Am Qualified to Address

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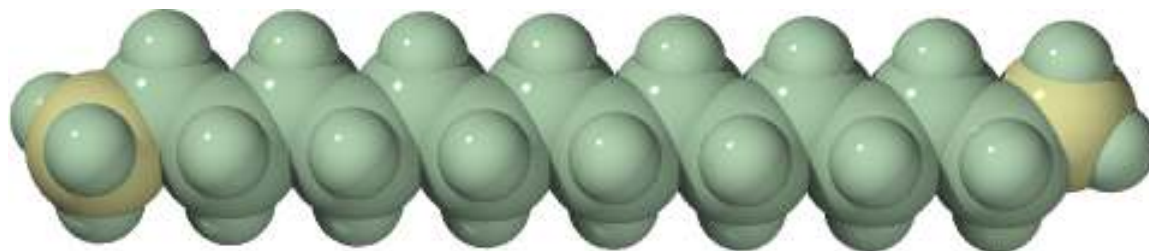
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- What is the saponification value of goat's milk?

Background Chemistry

Oil and water don't mix.

Oil and Water



Nerds and Cheerleaders

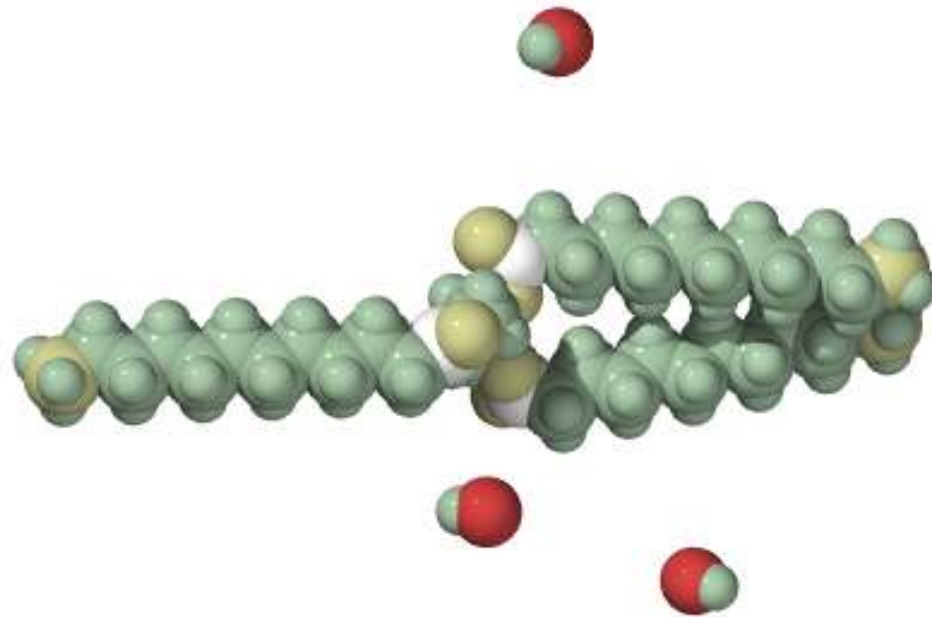


Lipophilic

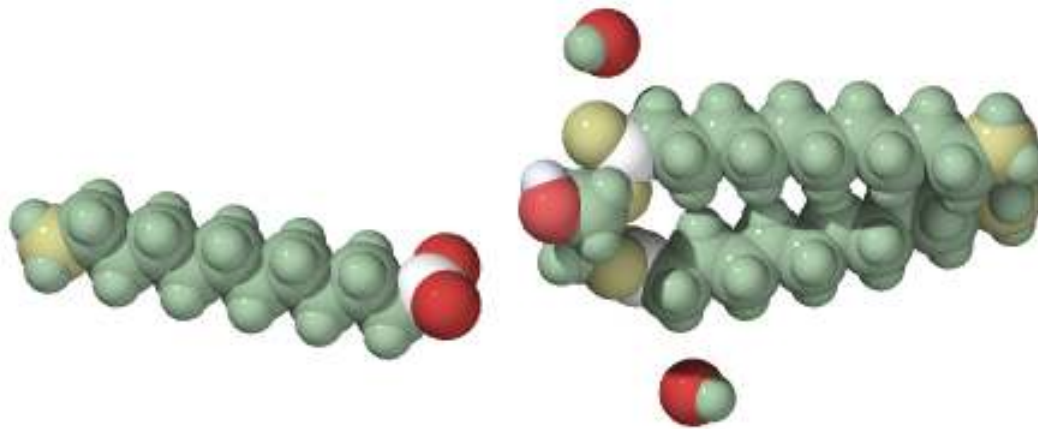


Hydrophilic

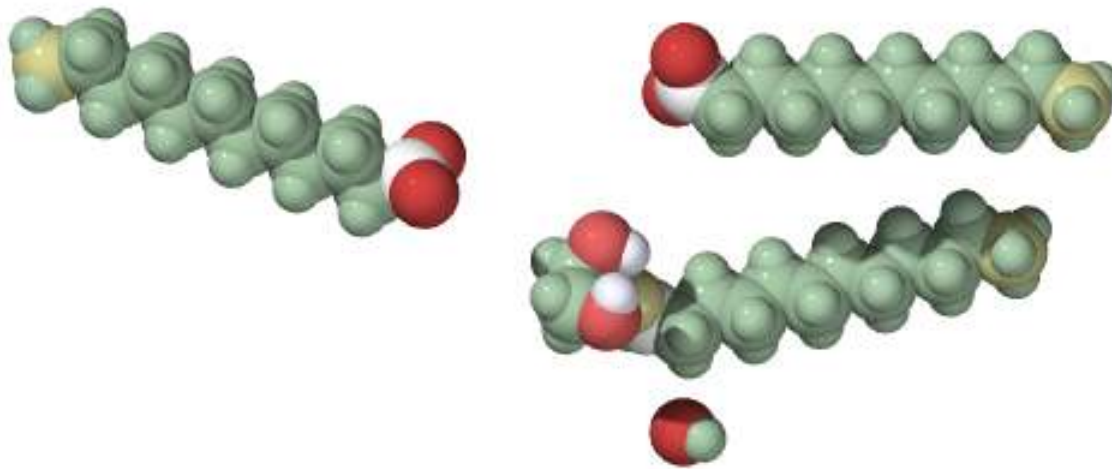
Oil and Lye



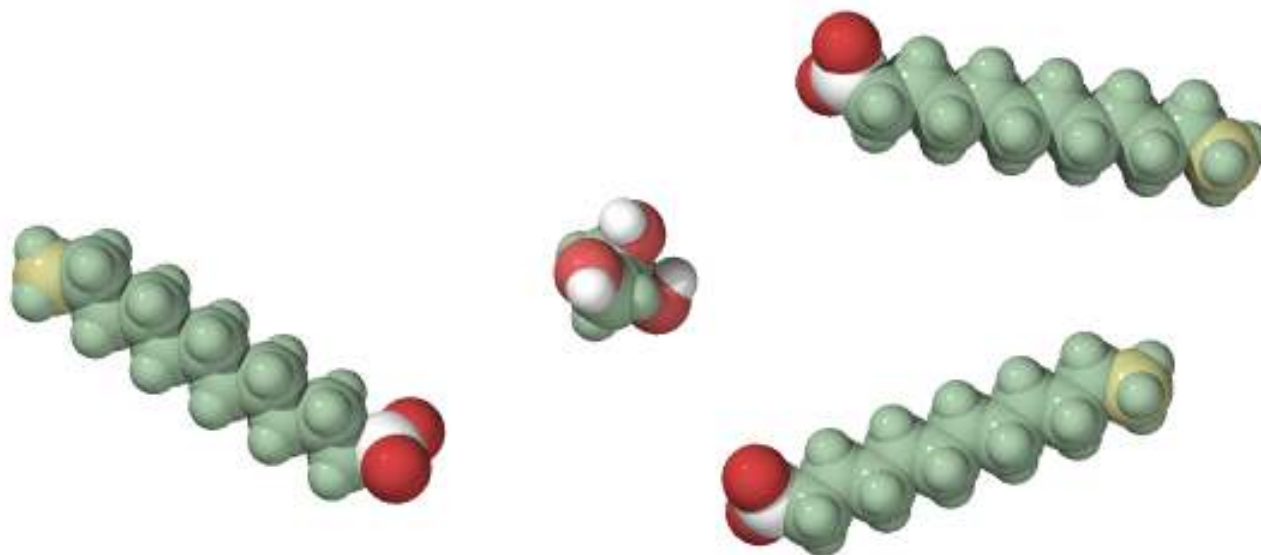
One Soap



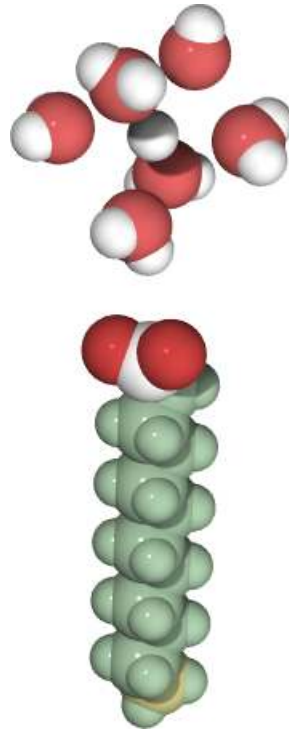
Two Soaps



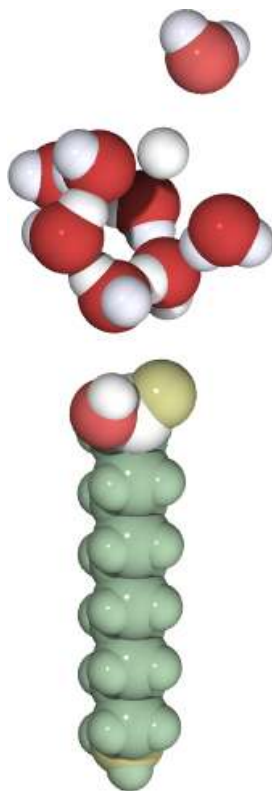
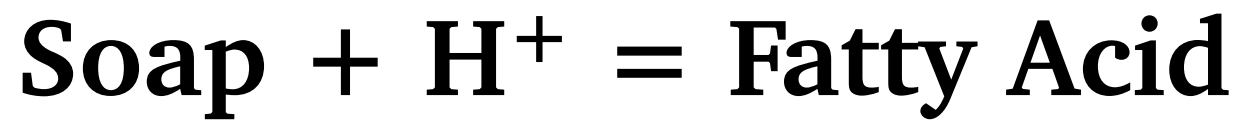
Three Soaps and a Glycerin



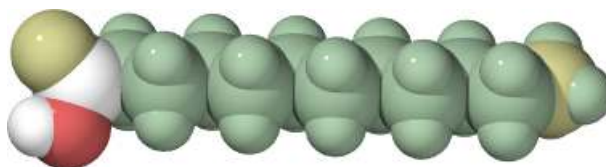
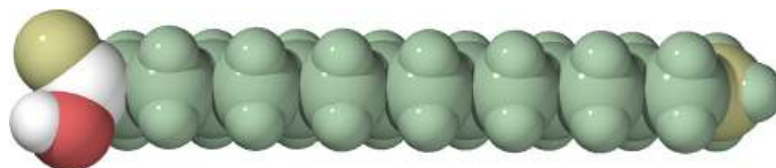
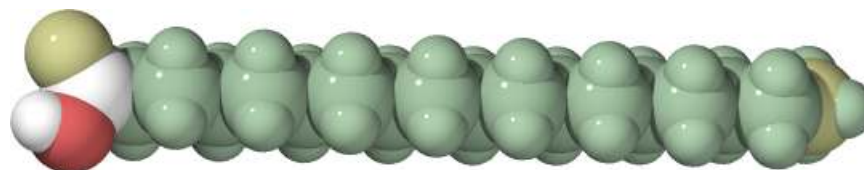
Soap: A Nerdy Cheerleader



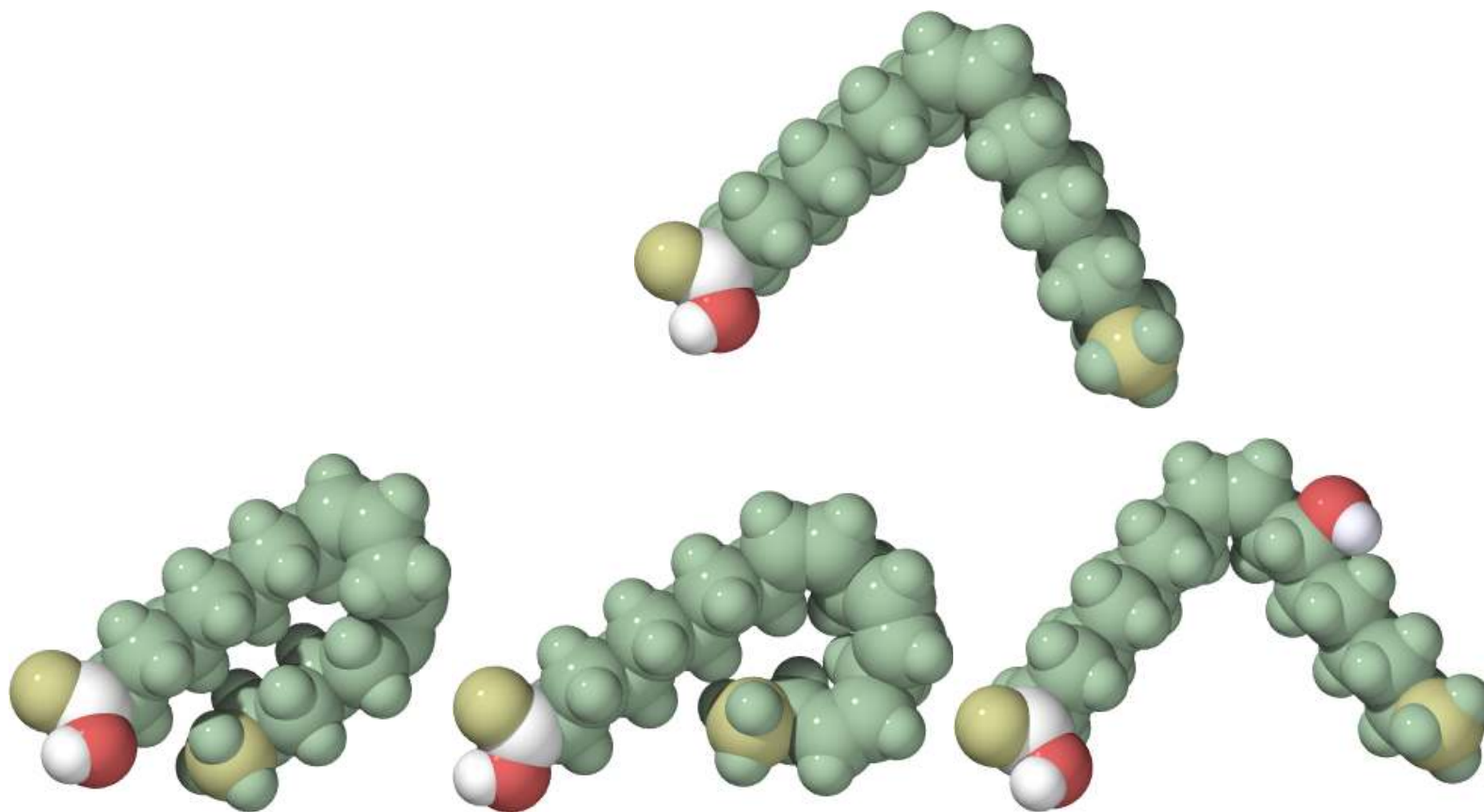
Amphiphilic



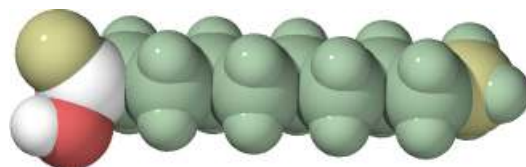
Saturated Fatty Acids



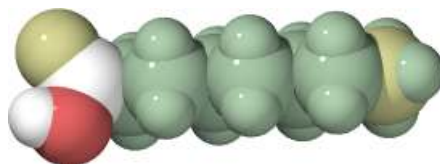
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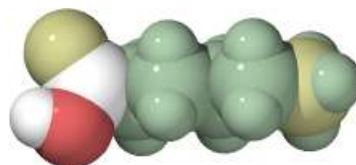
Fatty Acids from Goat's Milk



Capric Acid

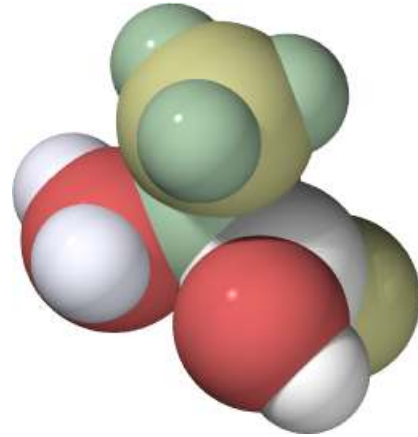


Caprylic Acid



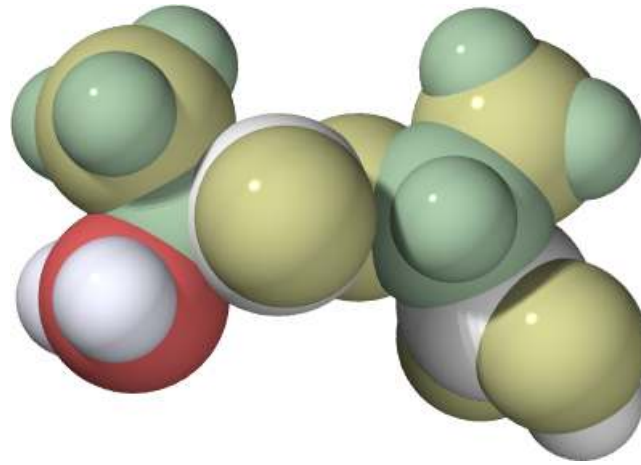
Caproic Acid

Amino Acid



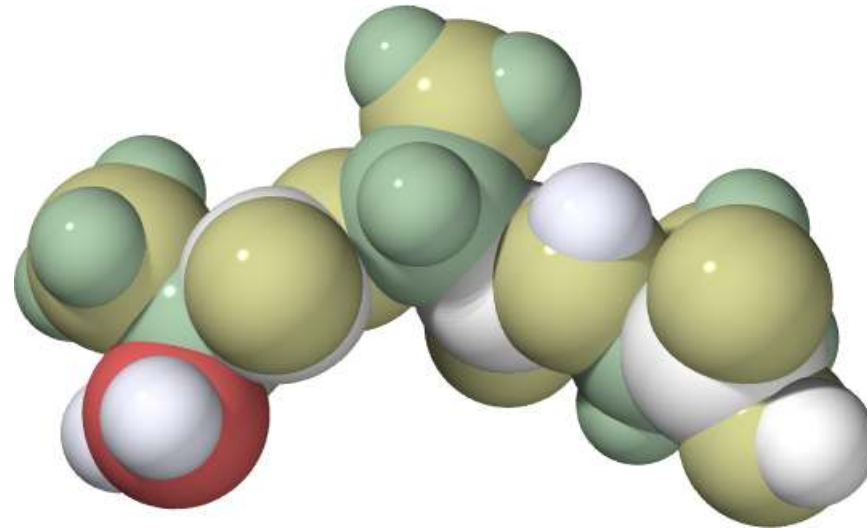
Alanine, one of twenty-three amino acids

Dipeptide



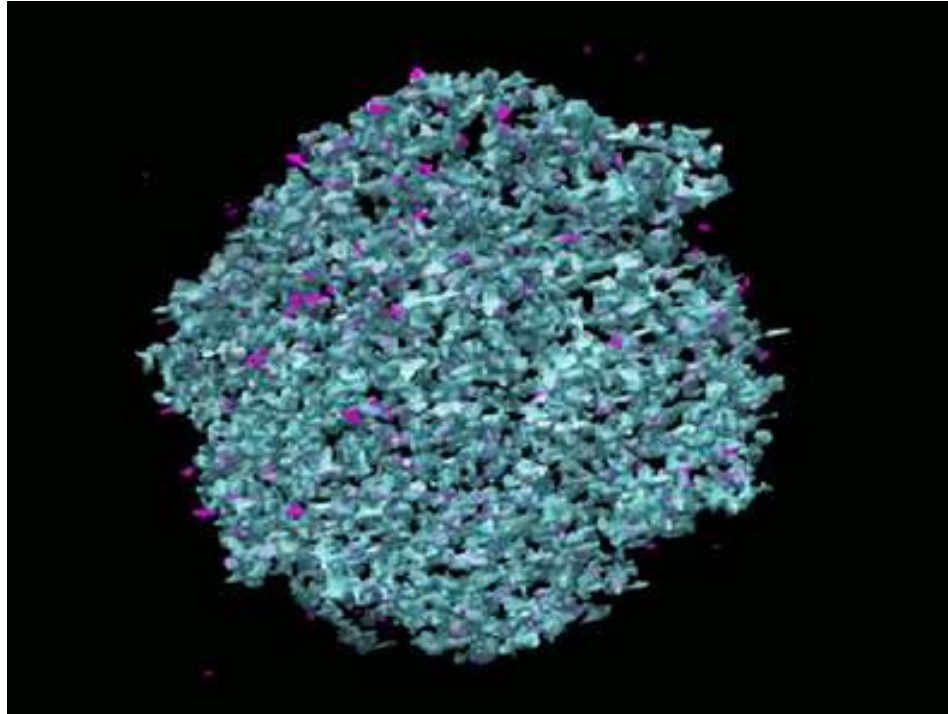
Two alanine molecules hooked together

Tripeptide



Three alanine molecules hooked together

Casein Micelle

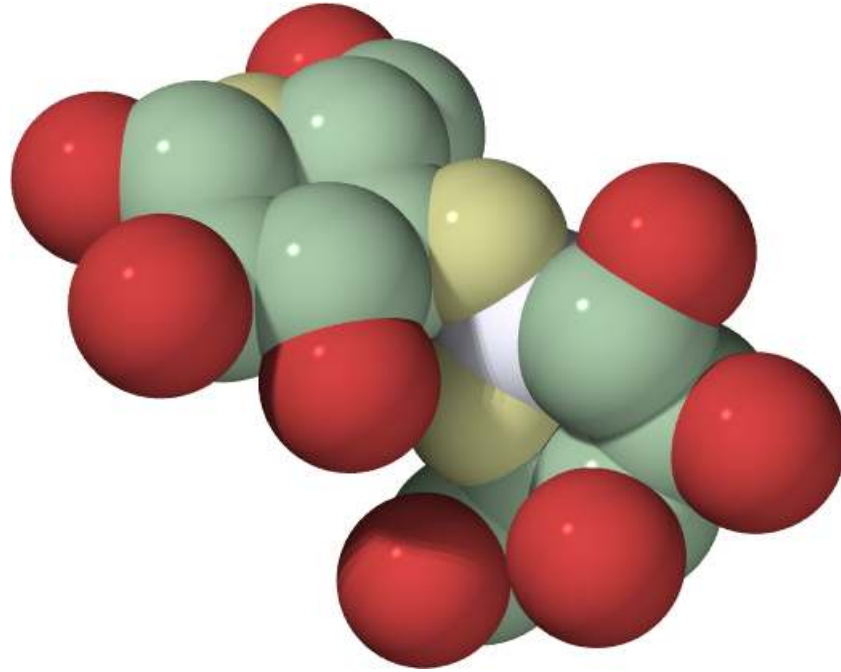


Proteins such as casein (milk) and fibroin (silk) consist of thousands of amino acid "residues."

Image source: ag.tennessee.edu/news/Pages/3T-08harte-13.aspx

Sugar

Lactose



Condensation vs Hydrolysis

- Condensation: small molecules join to make large ones
- Hydrolysis: large molecules are split into small ones

Condensation vs Hydrolysis

- Condensation: amino acids become proteins; fatty acids become fats
- Hydrolysis: proteins become amino acids; fats become fatty acids

Solution vs Suspension

- Solution: transparent (wine, apple juice, honey)
- Suspension: milky or cloudy (milk, blood, dishwater)

Solution vs Suspension

- Solution: small, hydrophylic molecules (sugars, amino acids)
- Suspension: large, hydrophobic molecules (fats, proteins)

Terms to Keep Straight

- Fat vs Fatty Acid vs Soap
- Protein vs Amino Acid
- Lactose
- Condensation vs Hydrolysis
- Solution vs Suspension

Questions I Am Qualified to Address

- *Does lactose react with lye?*
- Do casein and fibroin react with lye?
- Do the capric milk fats react with lye?
- What is the saponification value of goat's milk?

Does Lactose React with Lye?

- Centrifugation of Milk

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- Top Layer Mostly Fat

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- Top Layer Mostly Fat
- Bottom Layer Mostly Protein

Does Lactose React with Lye?

- Centrifugation of Milk
- Top Layer Mostly Fat
- Bottom Layer Mostly Protein
- Middle Layer Sugar/Water

Does Lactose React with Lye?

- Middle Layer is Colorless and Transparent

Does Lactose React with Lye?

- Middle Layer is Colorless and Transparent
- Turns Transparent Orange/Brown When Lye is Added

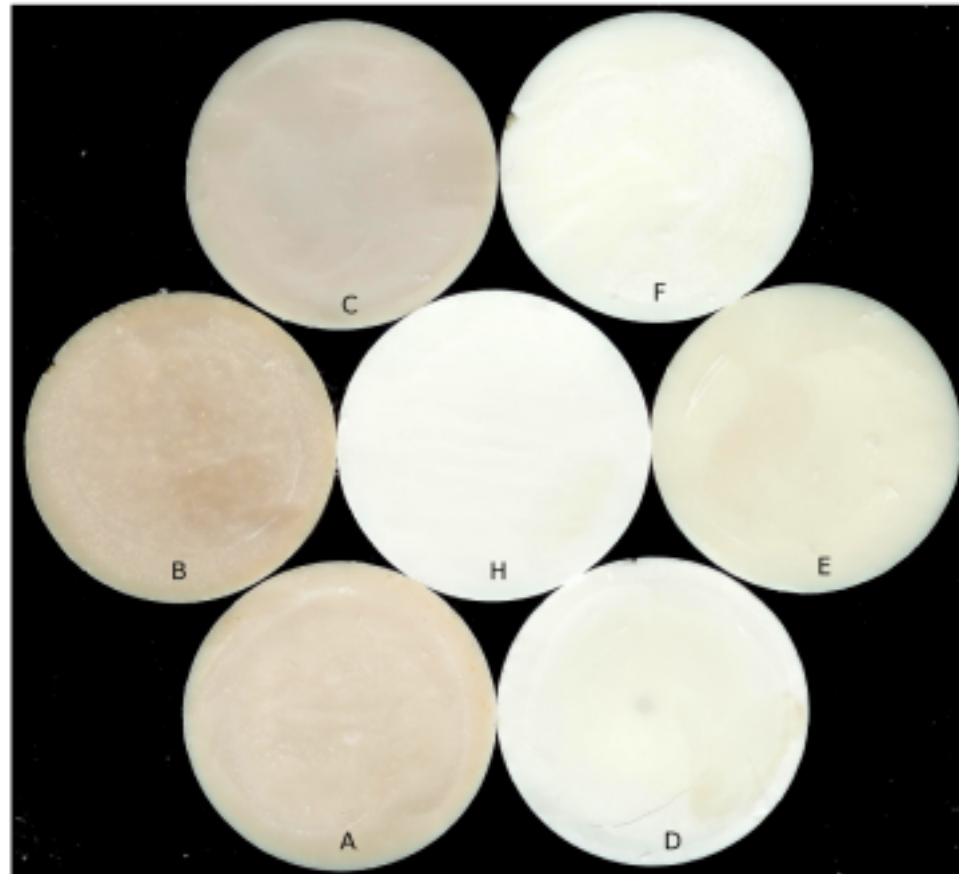
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- Lactose from Aldrich Chemical Forms Colorless Transparent Solution

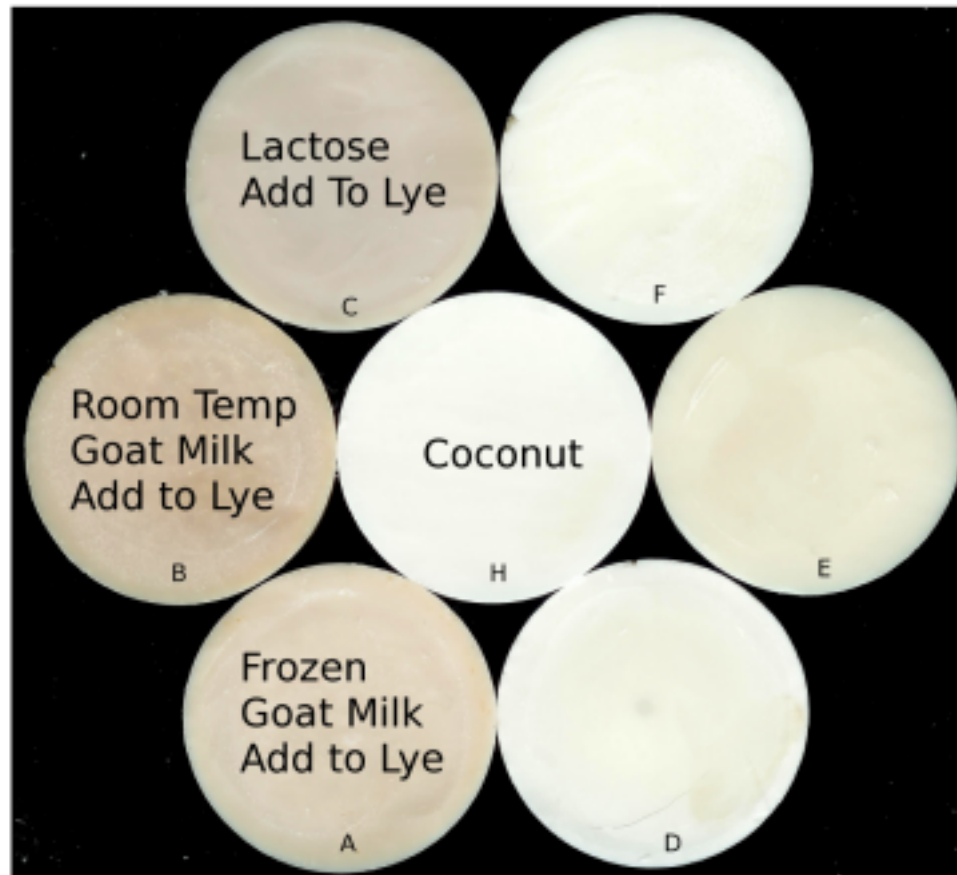
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Which Soaps Contain Lactose?



Which Soaps Contain Lactose?



Does Lactose React with Lye?

- Yes
- Lactose browns in minutes when it reacts with lye, the result either of caramelization or the Maillard reaction. This is likely responsibility for the color of goat milk soap.

Questions I Am Qualified to Address

- Does lactose react with lye? Yes
- *Do casein and fibroin react with lye?*
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Does Casein React with Lye?

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- Bottom layer is mostly protein.

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Does Casein React with Lye?

- Centrifugation of Milk
- Bottom layer is mostly protein.
- Bottom layer curdles when lye is added.
- Bottom layer does not dissolve in lye.

Does Fibroin React with Lye?

- Silk amino acid forms transparent solution in water.
- Silk amino acid remains transparent when lye is added.

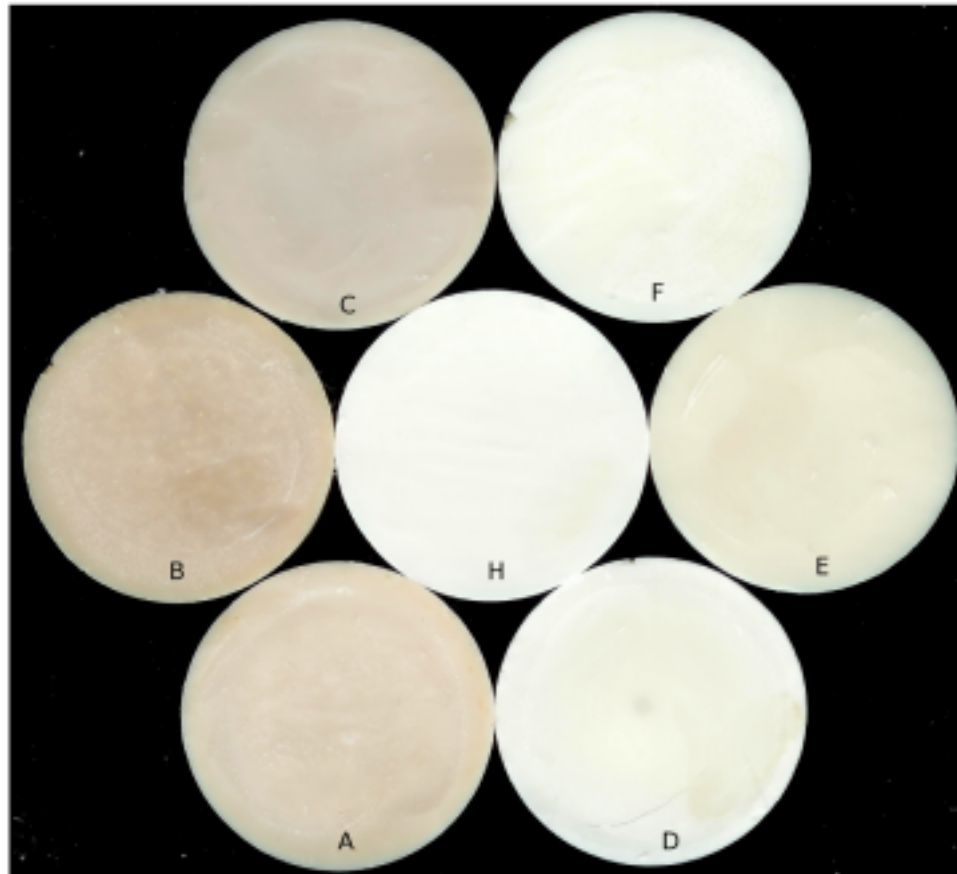
Does Fibroin React with Lye?

- Silk amino acid forms transparent solution in water.
- Silk amino acid remains transparent when lye is added.
- Silk peptide forms translucent suspension in water.
- Silk peptide remains translucent when lye is added.

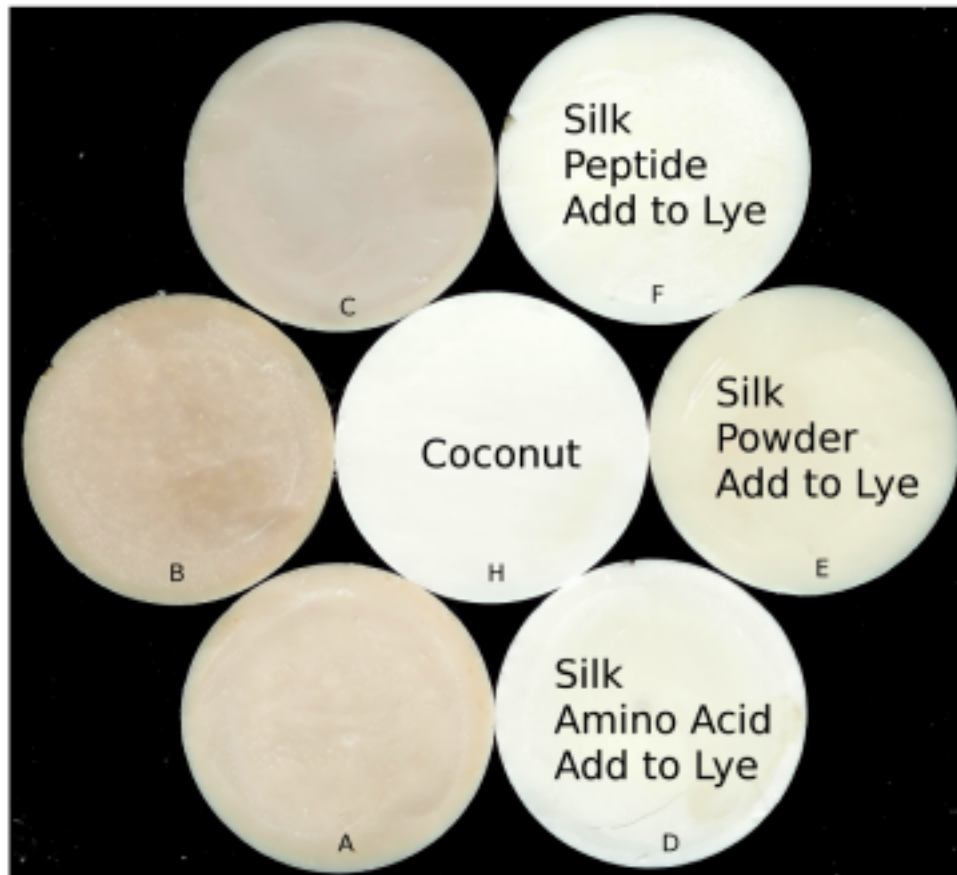
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- Silk amino acid forms transparent solution in water.
- Silk amino acid remains transparent when lye is added.
- Silk peptide forms translucent suspension in water.
- Silk peptide remains translucent when lye is added.
- Silk powder forms milky suspension in water.
- Silk powder remains milky when lye is added, even after months.

Which Soaps Contain Silk?



Which Soaps Contain Lactose?



Do casein and fibroin react with lye?

- Not much.

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- Milk protein curdles, indicating that there is some change in its molecular structure, but it does not hydrolyse into amino acids.

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- Not much.
- Milk protein curdles, indicating that there is some change in its molecular structure, but it does not hydrolyse into amino acids.
- Silk powder does not visibly react with lye, even over a period of months.

Questions I Am Qualified to Address

- Does lactose react with lye? Yes.
- Do casein and fibroin react with lye? Not much.
- *Do the capric milk fats react with lye?*
- What is the saponification value of goat's milk?

Do the Capric Milk Fats React with Lye?

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- Top layer reacts with lye.

Do the Capric Milk Fats React with Lye?

- Centrifugation of Milk
- Top layer is mostly fat.
- Top layer reacts with lye.
- The product produces suds when shaken with water.

Do the Capric Milk Fats React with Lye?

- Yes.
- Capric fats react with lye as expected, and become soap.

Questions I Am Qualified to Address

- Does lactose react with lye? Yes, it turns brown.
- Do casein and fibroin react with lye? If they do, they do not hydrolyse to amino acids.
- Do the capric milk fats react with lye? Yes, they turn to soap.
- *What is the saponification value of goat's milk?*

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- Boil a weighed amount of oil in 6% KOH in ethanol for an hour.

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- Add 4-5 drops 1% phenolphthalein. The solution turns pink.

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What is the Saponification Value of Goat's Milk?

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- Add 4-5 drops 1% phenolphthalein. The solution turns pink.
- Add 500 ppt citric acid solution until pink color disappears.
- From the weight of the oil and the weight of the citric acid, the saponification value may be calculated.

What is the Saponification Value of Goat's Milk?

	mg NaOH/g	mg KOH/g
Coconut Oil	182	255

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Reconstituted Evaporated Goat's Milk	23	33

So What?

- 100 g coconut oil requires 18.2 g NaOH for complete saponification.

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- 36.4 g reconstituted goat's milk would make a 33% lye solution.
- That milk will consume 0.8 g NaOH.
- This constitutes a 4% lye discount.
- For an oil blend, the discount would be about 6%.

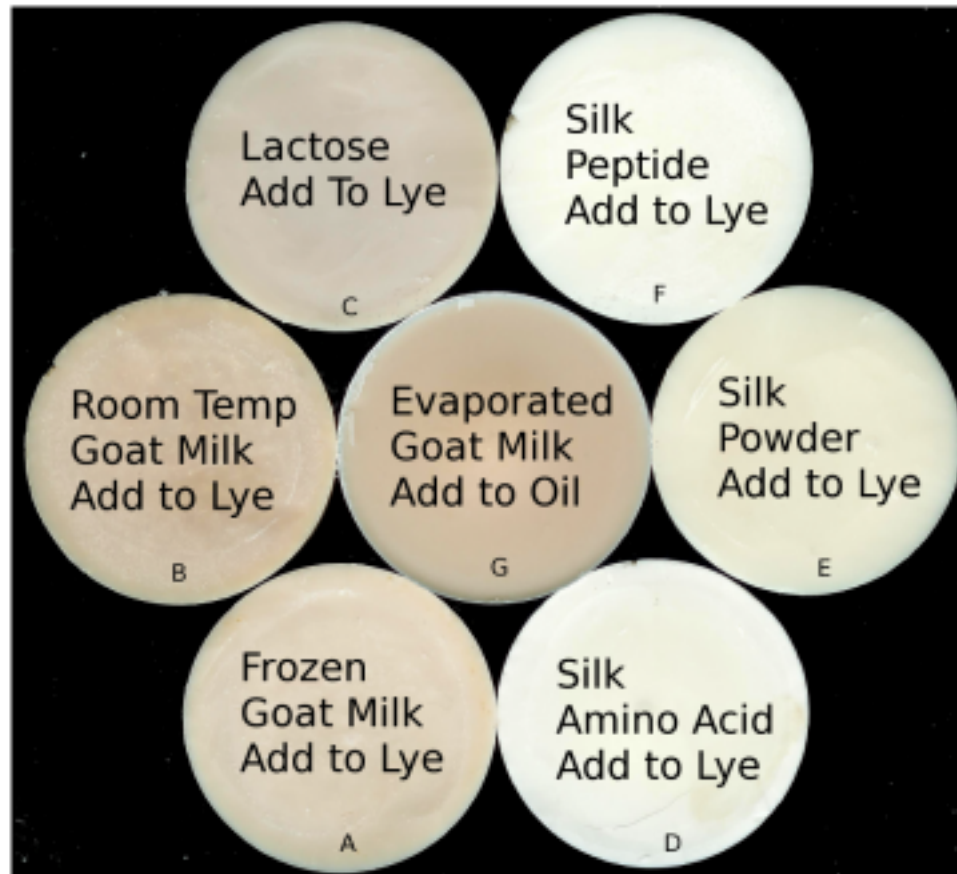
So What?

- For test soaps, I used 100 g coconut oil, 19.1 g NaOH, 18.3 g evaporated goat's milk (EGM), and 19.1 g water.

So What?

- For test soaps, I used 100 g coconut oil, 19.1 g NaOH, 18.3 g evaporated goat's milk (EGM), and 19.1 g water.
- This constitutes a 0% lye discount, including the milk.
 - A) NaOH added to frozen reconstituted milk
 - B) NaOH added to reconstituted milk at room temperature
 - G) EGM mixed with oil; NaOH mixed with water; both combined at room temperature

So What?



All soaps tested tongue-neutral.

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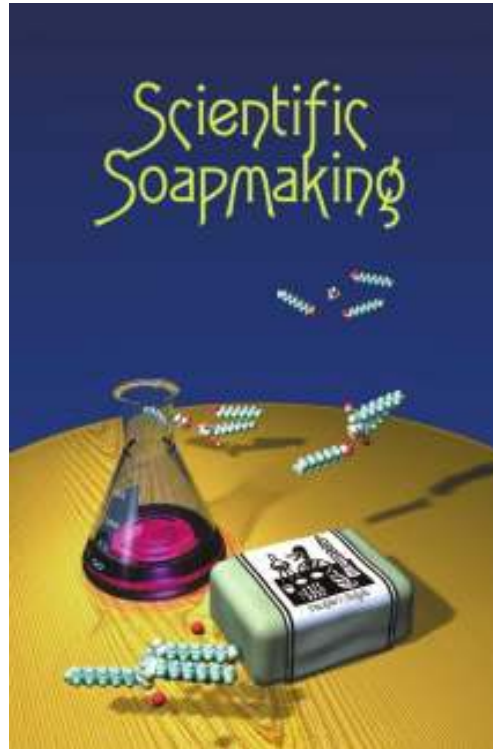
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- Do the capric milk fats react with lye? Yes, they turn to soap.
- What is the saponification value of goat's milk? It consumes 4% to 6% of the lye in a typical soap.
- If you use goat's milk instead of water, you don't need to discount your lye further.

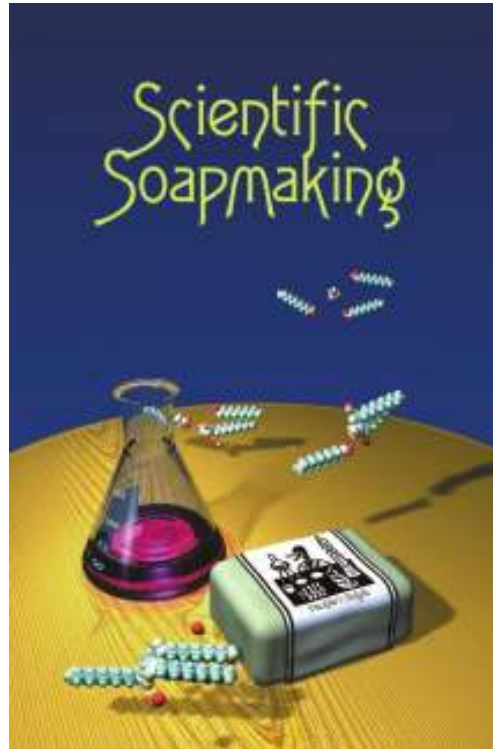
Questions

Scientific Soapmaking



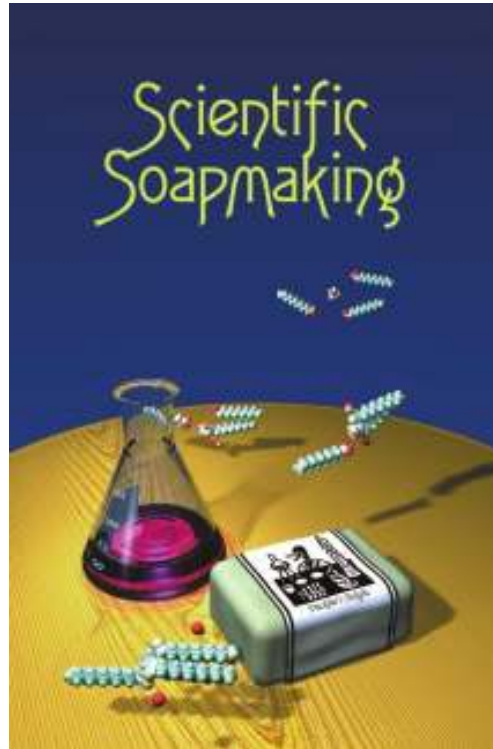
These lecture slides are available at ScientificSoapmaking.com.

Scientific Soapmaking



Thanks to the HSCG for all the questions I could not have answered 9 years ago.

Scientific Soapmaking



Thanks to the HSCG for all the questions I may be able to answer in the coming years.