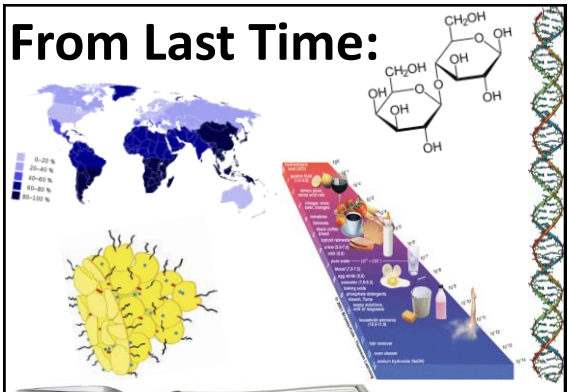
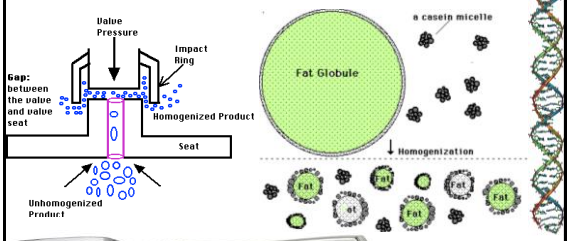
From Last Time:



Homogenization

Increase surface area

Casein proteins coat – Negative



Sphere Math

Volume = $^4/_3\ \pi\ r^3$

Surface area = $4\ \pi\ r^2$

1 sphere, 2cm radius

Volume = $^4/_3\ \pi\ (2cm)^3 = 34cm^3$

Surface = $4\ \pi\ (2cm)^2 = 50.cm^2$

Break into 2 spheres:

Volume of each = $17cm^3 = {}^4/_3\ \pi\ (x)^3$ → x = 1.6cm

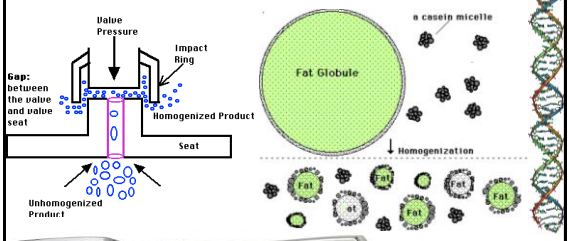
Surface of each = $4\ \pi\ (1.6cm)^2 = 32cm^2$

Total surface = $64cm^2$ → too much!

Homogenization

Increase surface area

Casein proteins coat – Negative



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Pasteurization

Hot enough to sterilize, not cook

Batch = 145°F, 30 minutes

HTST = 162°F, 15 seconds

UHT = 265°F, 1-3 seconds

Cooked flavor due to sulfur cmpds

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Foams

Heterogeneous Mixtures

Air in solid or liquid

Milk foams

Protein and/or fat and/or sugar

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Milk Foams

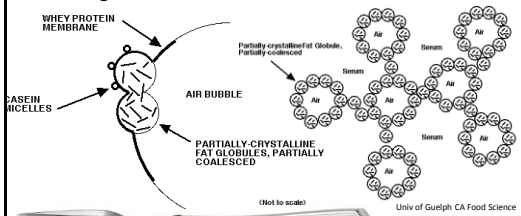
Frothed Milk or "Espresso Foam"

- Protein-based foam
- Heat from steam denatures milk protein (whey)
- Denatured proteins tangle, form net around air
- Not stable – as water drains, bubbles collapse

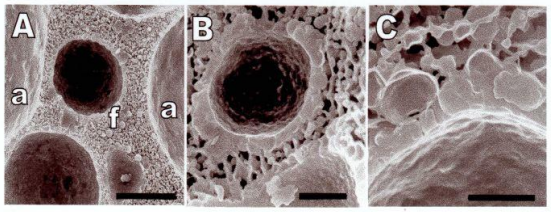
Milk Foams

Whipped Cream

- Fat-based foam
- Mechanically shearing fat globules
- Homogenization without the extra casein



Whipped Cream



The structure of whipped cream as determined by scanning electron microscopy. A. Overview showing the relative size and prevalence of air bubbles (a) and fat globules (f); bar = 30 um. B. Internal structure of the air bubble, showing the layer of partially coalesced fat which has stabilized the bubble; bar = 5 um. C. Details of the partially coalesced fat layer, showing the interaction of the individual fat globules. Bar = 3 um.

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Whipped Cream

Cold, cold, cold – Keep fat solid
Don't over-whip

Let's whip!

Over-whipped!

Fat globules combine = butter

Water and whey = buttermilk
"modern" buttermilk
Add protein and acid

Butter

80% milkfat
21 pounds milk = 1 pound butter

"Churning" = mechanical shearing of fat globules

Finishing

Butter

Salted Butter

- Reduces spoilage
- Add salt or soak in brine

Sweet Cream Butter

- No salt

Color?

Image: http://funandmania-creatives.blogspot.com/2010/02/butter-sculptures.html

Butter

Cultured Butter

- Bacteria added
- Acidified

Diacetyl – "butter flavor"

- Used in butter substitutes
- Inhibits enzymes that protect against oxidative damage
- Exposure risk for workers and heavy "fake butter" eaters (popcorn)

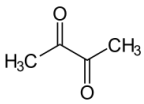

Image: http://en.wikipedia.org/wiki/Diacetyl

Cooking with Butter

Lemon Butter

- Add lemon and sugar

Restaurant trick

- On steaks, and just about anything else

Clarified Butter

- Melt heat to evaporate water (gently!)
- Milk solids (proteins) separate
- Used to flavor, fry or garnish – almost pure fat
- Popcorn!
- Ghee – south Asia

Imitating Butter

Fake Butter

- Emulsified vegetable oils
- Added sugars and proteins – scorch easily
- Not good for cooking

Margarines

- "Partially hydrogenated" vegetable fat
- Tallow from beef fat mixed with milk {traditional "oleo margarine"}
- Saturated fats