texture manipulation

fluids to solids and the things in between
gel
### “molecular gastronomy”

#### adding structure to liquids

an incomplete list of chemical tools

<table>
<thead>
<tr>
<th>Category</th>
<th>Ingredient</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>thickening</td>
<td>starch</td>
<td>corn starch, arrow root, potato starch, flour</td>
</tr>
<tr>
<td></td>
<td>xanthan gum</td>
<td>bacteria byproduct, thickening and stabilizing agent</td>
</tr>
<tr>
<td></td>
<td>ultra tex</td>
<td>modified tapioca starch, instant stable creamy thickener</td>
</tr>
<tr>
<td>“powdering”</td>
<td>maltodextrin</td>
<td>from cassava root, powders fats</td>
</tr>
<tr>
<td>foaming</td>
<td>soy lecithin</td>
<td>emulsifier, stabilize emulsions, keeps chocolate from separating and crystalizing, keeps oil from spattering</td>
</tr>
<tr>
<td></td>
<td>egg whites</td>
<td></td>
</tr>
<tr>
<td></td>
<td>versa whip</td>
<td>soy based egg substitute for creating stable cold/hot foams</td>
</tr>
<tr>
<td></td>
<td>whipped cream</td>
<td></td>
</tr>
<tr>
<td></td>
<td>aquafaba</td>
<td>chickpea liquid</td>
</tr>
<tr>
<td>emulsions</td>
<td>mustard</td>
<td></td>
</tr>
<tr>
<td>gelification (cooling)</td>
<td>gelatin</td>
<td>collagen from animals, semi-solid gelling agent, stabilizer, thickener, can melt and reform</td>
</tr>
<tr>
<td></td>
<td>pectin</td>
<td>from fruit can thicken or gel to a jelly-like consistency</td>
</tr>
<tr>
<td></td>
<td>agar agar</td>
<td>from red algae “vegetable gelatin”, semi-solid gelling agent, stabilizer, thickener</td>
</tr>
<tr>
<td>gelification (calcium)</td>
<td>sodium alginate</td>
<td>from brown algae, used in spherification with a calcium solution</td>
</tr>
<tr>
<td>gelification (heat)</td>
<td>methyl cellulose</td>
<td>from cellulose, gels/solidifies on heating, liquifies on cooling, reversible.</td>
</tr>
<tr>
<td></td>
<td>egg yolk</td>
<td></td>
</tr>
</tbody>
</table>
thickening/gelling with starches
cornstarch, arrow root, potato, rice, etc.
swelling of starch molecules

roux
4 tbspn butter
6 tbspn flour
1 pint liquid
thickening/gelling with starches
cornstarch, arrow root, potato, rice, etc.

“If the viscous solution is cooled or left at lower temperature for a long enough period, the linear molecules, amylose, and linear parts of amylopectin molecules retrograde and rearrange themselves again to a more crystalline structure.”

Figure 3. Viscosity measurement of starch in an excess amount of water, applying a temperature profile including a heating and cooling step. (1) Gelatinization onset ($T_p$, pasting temperature), (2) hydration of starch granules, (3) max. intensity of gelatinization (PV, peak viscosity), (4) enzymatic and shear destruction of starch granules, (5) minimum viscosity (HPV, hot paste viscosity), (6) viscosity loss (B, breakdown), (7) final viscosity (FV), and (8) paste hardening (S, setback).

© 2014 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
thickening/gelling with starches

cornstarch, arrow root, potato, rice, etc.
thickening/gelling with xanthan gum

polysaccharide obtained by fermentation of bacteria Xanthomonas campestris thickens like flour but with small amounts and with no flavor

Balsamic vinegar syrup
100 g balsamic vinegar
10 g sugar
0.9 g xanthan (0.82%)

Grind sugar and xanthan. Add to vinegar while mixing with immersion blender. Avoid incorporation of air bubbles as these only slowly escape.

Martin Lersch
modified tapioca starch to create instant stable creamy/pudding texture using ultra tex
“powderizing” with **maltodextrin**

*a polysaccharide produced from starch to “dehydrate” fats*
foaming with **whipping cream**

high fat content dairy product

`carrot whip`

1 c carrot juice
1 c cream
2 NO2 cartridges

with compressed air  

mechanical beating
foaming with
egg whites
meringue

soft peak
stiff peak
foaming with egg whites

meringue

French
uncooked, fine sugar beaten into peaks
least stable but lightest

Swiss
heat egg white + sugar in double boil first
firm and slightly denser than French

Italian
hot sugar syrup beaten into egg whites
most stable and smooth

sediment from wine barrels stabilizes egg whites
also increases their tolerance to heat
foaming with chickpeas?

aquafaba
foaming with

**versa whip**
a soy based “egg substitute” for creating hot/cold foams

Honey Foam
125 g Water
4 g Versawhip
2 g Xanthan gum

(works well with xanthan gum as a stabilization)
no fat, oil or alcohol
foaming with soy lecithin tiny amounts: .25-1% by weight

a phospholipid from soy beans used to stabilize immiscible fluid blends
foaming with gluten
breads and cakes

yeast + sugar = carbon dioxide = bubbles
base (baking soda) + acid = carbon dioxide = bubbles
baking powder = base (baking soda) + acid (cream of tarter)
emulsification with mustard/yolk lecithin

mayonnaise = oil + vinegar/acid emulsion with yolk
aioli = mayonnaise + garlic
hollandaise = butter + yolk emulsion

aioli
2 garlic cloves
1 egg yolk
1/2 tspn lemon juice
2 tspn dijon mustard
1/4 c evoo
3 tsbn veg oil
gelification upon cooling

gelatin

collagen from animals, semi-solid gelling agent, stabilizer, thickener, can melt and reform

1 envelope = .25 ounces = 2.5 ts
1 envelope + 2 cups liquid = moldable firmness
needs to chill for 8-24 hours
lasts forever.
gelification upon cooling

gelatin

collagen from animals, semi-solid gelling agent, stabilizer, thickener, can melt and reform

panna cotta
pectin
binds plant cells together

gelification upon cooling

fruit preserves

jelly - juice
jam - pulp
conserve - whole
marmalade - peel included

apples, 1–1.5%
apricots, 1%
cherries, 0.4%
oranges, 0.5–3.5%
carrots approx. 1.4%
citrus peels, 30%
gelification upon cooling

agar agar
from red algae “vegetable gelatin”, semi-solid gelling agent, stabilizer, thickener, brittle

teapears
180 g mint tea
2 g agar
(cold oil)

Balsamic vinegar pearls (cold oil technique)
180 g balsamic vinegar
2 g agar (1.1%)

Cool a tall glass with vegetable oil in the freezer for about 30 min. Combine and heat until agar is completely dissolved (>90 °C). Drip solution into cold vegetable oil. Collect pearls and rinse with water. Flat pearls indicate the oil is too cold or the glass not tall enough.

Parmesan spaghetti

200 g fond/stock (not too salt)
100 g parmesan, grated
5 g agar (1.7%)

Stir parmesan into boiling fond. After one hour filter through chinois and store over night in fridge. Filter again if necessary. Bring filtrate to boil while adding agar and stirring constantly.

For thick spaghetti: close one end of drinking straw (diameter ~ 5 mm) and fill with parmesan mix.

For thin spaghetti: fill a suitable plastic tube (typically 2 m length, 2-3 mm diameter) with the mix using a syringe. Immerse the filled tube into ice water for 2-3 minutes. Fill the syringe with air to blow out the spaghetti.

Adapted from Henrik Schellhoss via http://kochmuster.net
comparing gelled candy
gelification with calcium

sodium alginate

a polysaccharide extruded from brown algae reacts with calcium

spherification

alginate in liquid
dropped in calcium bath

have liquid centers as opposed to agar
gelification with calcium

**sodium alginate**

a polysaccharide extruded from brown algae reacts with calcium
gelification upon heating

methyl cellulose

cellulose based gelling agent that sets on heating and is reversible
eggs

white just set but looks
ghostly and breaks
as soon as you
touch it; useless.

60°
(140)

the perfect egg to put
on toast; white soft
but good. A quick dip
in simmering water will
make it look traditional.

62°
(143.5)
yolk fully set but very
creamy, white firmer.

64°
(147)

the perfect yolk to roll
into sheets; whites
not as nice as 65.

66°
(151)
yolk more granular.

68°
(154.5)

hard boiled.

75°
(167)
yolk fully granular
and starting to turn
green, smells of
sulfur.

57°
(134.5)
still basically raw;
cook for two hours
to pasteurize.

63°
(145.5)
yolk creamy but not
set—it acts like a
sauce; white firmer.

65°
(149)
our favorite white
—firm not rubbery,
doesn’t crack well.
yolk malleable.

67°
(152.5)
yolk developing
granularity but still
soft; will break when
rolled in sheets.
gelification upon heating

eggs

custard - egg yolk thickened dairy

flan/creme caramel
gelatin vs. egg yolk

egg tart

starch vs. egg yolk

quiche
gelification upon heating

**eggs**

curd

custard with fruit juice (lemon)

egg white - protein foam

egg yolk - protein gel
gelification upon heating

**eggs**

bain-marie/water bath/double boiler
swelling gels

chia/basil seeds

mucilaginous gel coating
compression
marinate
macerate
references
Assignment # 2

amuse bouche - single, bite-sized hors d’œuvre
flavor and texture pairing
must feature apple

design an tasty flavor combination (2-4 flavors including apple)
presented on a one-bite spoon (12 judges/12 spoons)
transform at least one ingredient into different texture

blog and spoons due wed Oct 19 in lab

2-4 flavors (not tastes)
texture does not need to be “molecular”
Assignment # 2

should represent almost 36 hours of work × 2 people

<table>
<thead>
<tr>
<th>M</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>flavor</td>
<td>CoCH</td>
</tr>
<tr>
<td>texture</td>
<td>test lab</td>
</tr>
<tr>
<td>outing</td>
<td>critique</td>
</tr>
</tbody>
</table>

test three manipulation and/or presentation ideas using your selected flavors
let us know ASAP what tools or chemicals you may need
deep fryer? ice cream maker? pressure cooker?
do you need the juicer? the chargers? the blender?
black or white spoons?