Molecular cooking

Observe, Hack, Make Share and Enjoy®
Who are we?

Ralph Moonen

egeltje
"Metabolic constraint imposes trade-off between body size and number of brain neurons in human evolution"

Research by Karina Fonseca-Azevedo and Suzana Herculano-Houzel in 2012
Why are we here?

Oxford English Dictionary on "cooking": "The process of preparing food by heating it."

Heat? A physical process.
Heat? How much?
Heat? For how long?
Heat? Is that all?

NO!
Why are we here?

Traditional cooking
1960 The new nouvelle cuisine
Michel Bras: "Don't copy, be original!"

Gargouillou: A New Meaning to 'Garden Variety'
Why are we here?

Nicolas Kurti (1969):
"I think it is a sad reflection on our civilization that while we can and do measure the temperature in the atmosphere of Venus we do not know what goes on inside our soufflés."
Why are we here?

Jacques Maximin, Cannes, 1987: "To be creative means not copying"
Why are we here?

Harold McGee wrote "On Food and Cooking" in 1984 (heavily revised version in 2004)

"Molecular gastronomy" coined by Nicolas Kurti and Herve This during the first "International workshop on molecular and physical gastronomy" in 1992
Why are we here?

Martin Lersch compiled "Hydrocolloids" at khymos.org

Gweeds presented at HOPE number 6 and the Last HOPE

Jeff Potter presented at the Next HOPE and wrote "Cooking for Geeks" in 2010
Why are we here?
Why are we here?

Nathan Myhrvold wrote "Modernist Cuisine" in 2011.
Why are we here?
Why are we here?

IRRADIATING FOOD TO PERFECTION

Grilling food over an open flame is a practice as old as humanity itself. Indeed, it’s likely that we are human precisely because we learned to grill our food. Perhaps it is this primal connection that makes grilled foods such as hamburgers so mouth-watering; we’ve hard-wired by evolution to find comfort in the heat of the grill, the smell of the smoke, and the taste of the food. Although grilling food has been simple since our ancestors managed to do it tens of thousands of years ago, mastering the heat of the grill is a culinary challenge at the highest order.

Waiting smoke gives rise to the turbulence that makes dry, portal foods undesirable in a brisk, windy environment. The solid cake smoke is denser than air. It travels only when carried aloft by rising hot air from the stack. If you let smoke and its attendant temperatures, it will win. The solid cake smoke scatters light; an example of the so-called ‘light flash’ effect—light is scattered in all directions that enter items such as books. Smoke also distorts vision. See page 84.

A layer of ash should rest on the coals beneath the food on the grill. Ashes also slow down the rate of evaporation. The heat they retain. The ashes also reduce the flames by introducing the coals from the air.

A suitable grade of charcoal is essential to a successful grill. Use charcoal that is 100% pure. A suitable grade of charcoal is essential to a successful grill. Use charcoal that is 100% pure.

Grill is essentially non-combustible. The high temperatures at which charcoal and wood operate make them excellent in a corner. Grilling food on charcoal, but not successful, but not a good way to add smoking to the food with smoke, the best way to add smoking to the food. In a pit with a wood box as you would at an iron stake, wood coal, Inc. "Smoke is an essential"—an example of the so-called ‘light flash’ effect—light is scattered in all directions that enter items such as books. Smoke also distorts vision. See page 84.
Why are we here?
Why are we here?
How to make it practical?
How to make it practical?

Let's start with a menu!

Drinks: Spiked vodka
Starters: Veal broth
Main: Steak
Desert: Banana foam with apple caviar

Kids, DO TRY THIS AT HOME!
Spiked vodka

Vegetable flavoured vodka

As served by Dave Arnold, Booker and Dax, New York, .us
(behind David Chang's Momofuku Ssäm Bar)
Spiked vodka

The technique
• Rapid Infusion

The equipment
• Kidde / ISI whip
Spiked vodka

The physics
• Pressure
• Cavitation

The chemistry
• Not really
Spiked vodka

Rapid drop in pressure will cavitate N\textsubscript{2}O gas that is dissolved in the plant cells under pressure.

Cells will rupture and release their contents into the waiting alcohol.

Much better than boiling.

Similar effect -> caisson disease.
Veal broth

A small cup of homogeneous soup that will make one side of your mouth warm and the other side cold.

A dish served by Heston Blumenthal of "The Fat Duck" in Bray, .uk
Veal broth

The technique
• Gellification / Fluid gels

The equipment
• Blender
• Heater
• Fridge
• µWave

Veal broth
Fluid gels are gels (from shear irreversible hydrocolloids) that behave like a liquid when shear is applied and like a gel when no shear is applied.
Veal broth

Hydrocolloid in this case is Agar at 1%*

- extracted from seaweed (vegetarian)
- readily available in asian stores
- heat-resistant (can be served hot)
- shear-irreversible (it breaks)
- very large temp. hysteresis (easy to use)

* one of my favorites, gellan at .5% works too
Veal broth

The physics
• Shear

The chemistry
• Hydrocolloids are polysaccharides, long chains of sugar molecules
• When hydrated, they form a mesh that will trap other molecules (water, juice, vodka)
Veal broth
Steak

A perfect cooked “medium” steak.
The technique
• Sous vide (french: “under vacuum”)

The equipment
• Heater
• Accurate thermometer
• Some sense of time
Steak

Food is placed in vacuum bags that are placed in a water bath at a specific constant (low) temperature.
Steak

The physics
• Tightly controlled temperature

The chemistry
• Denaturing proteins
Temperature

- 0°C – water thaws
- 40°C – myosin in fish begins to denature
- 50°C – myosin in meat begins to denature
- 55°C – glycogen starts to break down
- 60°C – myoglobin begins to denature
- 56°C - 62°C – collagen denatures (slowly)
- 66°C - 72°C – actin denatures

Steak

< rare   medium   well-done >
Steak

Regular steak
“medium”

Sous vide steak
“medium”

Source: www.cookingforengineers.com
Food safety

Thermal death time = The time needed to kill enough foodborne illnesses by heat to be declared “safe”
Thermal death time

- 0°C – water thaws
- 50°C – myosin in meat begins to denature
- 55°C – glycogen starts to break down
- 60°C – myoglobin begins to denature
- 56°C - 62°C – collagen denatures (slowly)
- 66°C - 72°C – actin denatures
- 50°C highest survival temp foodborne illnesses
Steak?
A cream of banana topped with “caviar” of apple

A dish served by Ferran Adrià of “El Bulli” in Rosas, .es
Banana foam with apple caviar

The technique
- Gellification (foam)
- Spherification (caviar)

Equipment
- Kidde / ISI whip
- Bowls
- Syringe
The physics (foam)
• Not really

The chemistry (foam)
• Similar as with the broth (now with gelatin)
• Hydrocolloids are polysaccharides, long chains of sugar molecules
• When hydrated, they form a mesh that will trap other molecules (water, juice, vodka)
Banana foam with apple caviar

The physics (caviar)
- Surface tension

The chemistry (caviar)
- Alginate
- Calcium salt solution
- Calcium ion from salt to alginate -> calcifies
Don’t forget to rinse, as calcium chloride tastes horrible…
Where do we go from here?*

Next steps are the deconstruction and recreation of food

Eg. deconstructed tiramisu (Michael Laiskonis)
Where do we go from here?*

You can go to our workshop!

Saturday 3 August 18.00 at the Food Hacking Base (field N2)
Vital links

http://www.seas.harvard.edu/cooking

http://www.cookingissues.com
http://blog.khymos.org

http://www.molecularrecipes.com

http://www.duckduckgo.com