Molecular cooking

Observe, Hack, Make
Share and Enjoy®

Who are we?

Ralph Moonen

egeltje

Why are we here?

"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?

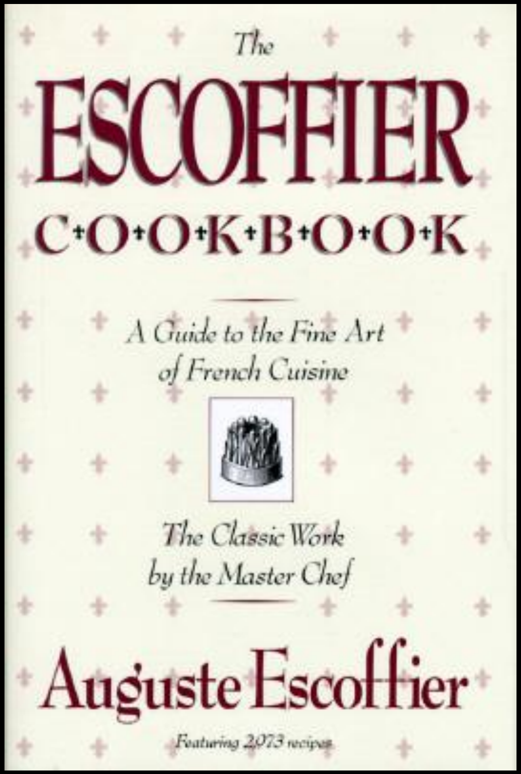
Heat? For how long?

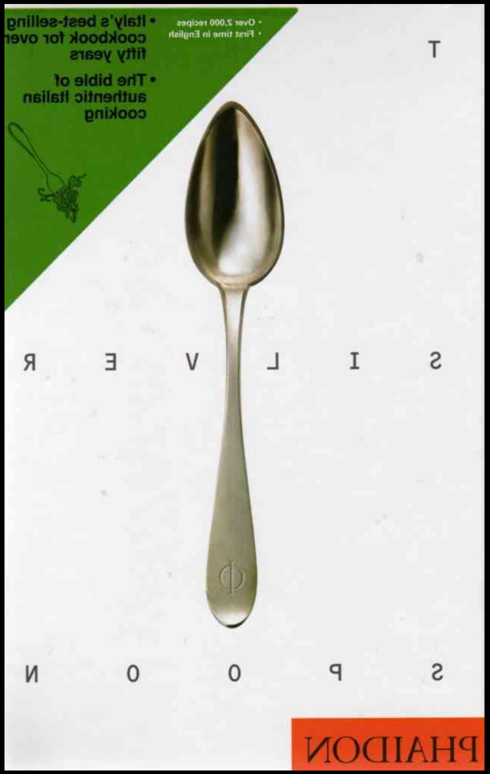
Heat? Is that all?

NO!

Why are we here?

Traditional cooking





Why are we here?

1960 The new nouvelle cuisine

Michel Bras: "Don't copy, be original!"

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?

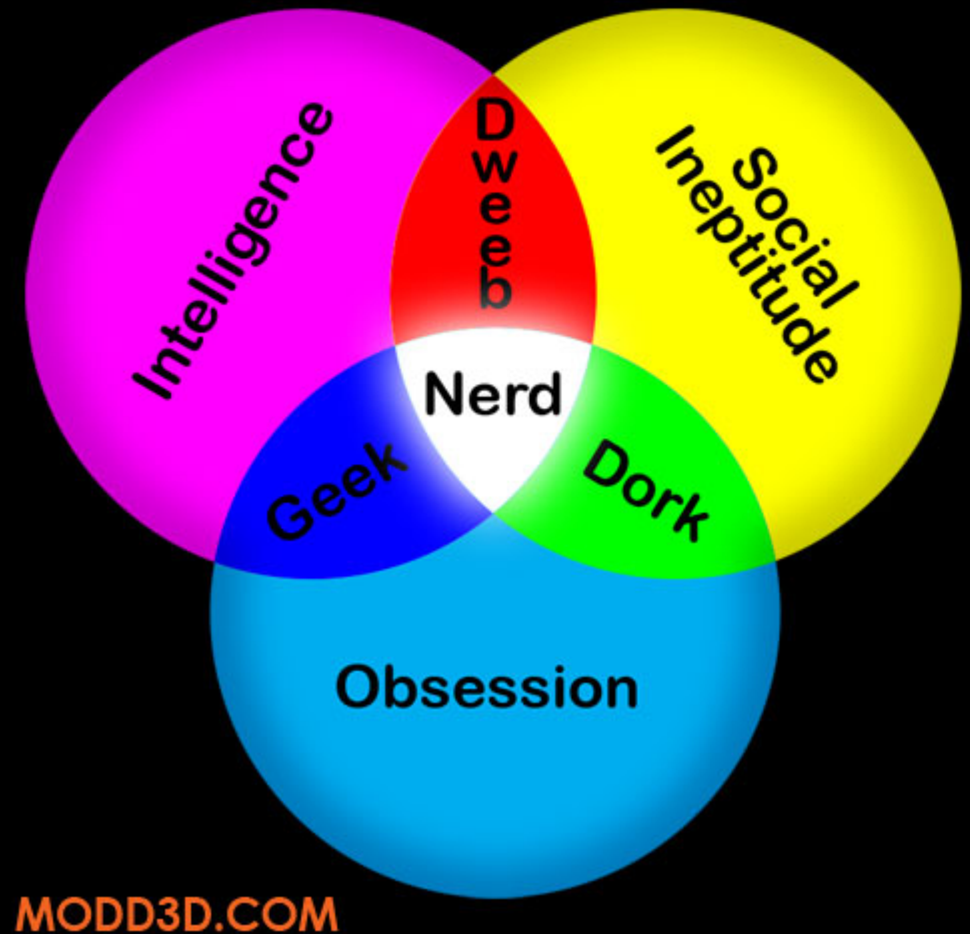
Why are we here?

- 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

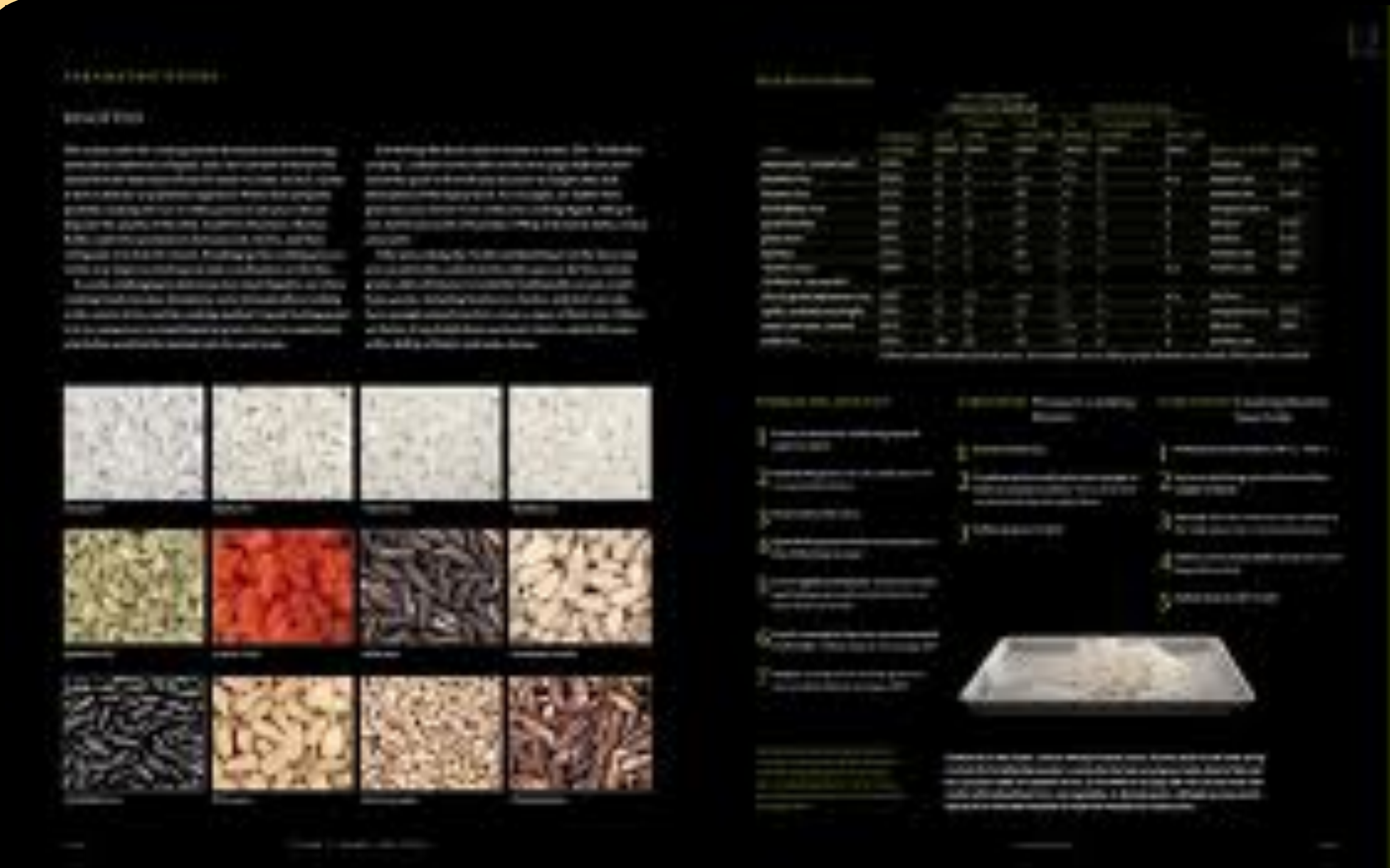
Why are we here?



Why are we here?

Nathan Myhrvold wrote "Modernist Cuisine“ in 2011

Why are we here?



Why are we here?

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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 primeval connection that makes grilled foods such as hamburgers so mouth-watering: we're 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 is so simple that our ancestors managed to do it eons ago, mastering the heat of the grill is a culinary challenge of the highest order.

Most of the heat a grill produces is wasted. It bypasses the food and literally goes up in smoke or is radiated away into the sky. But without the intense heat, grilled food would not taste as good.

Wafting smoke gives form to the turbulent air that rushes skyward past the patties, much like what happens in a chimney. Heat from the burning fuel causes adjacent air to expand, making it more buoyant. As the hot air rises, it cooks the food and creates a draft that sucks more air in to fuel the fire.

Smoke is an aerosol—a mixture of minuscule solid particles and liquid droplets dispersed within a blend of invisible gases. The solids make smoke heavier than air; it floats only when carried aloft by rising hot air from the draft. If you let smoke cool to ambient temperature, it will sink. The solids also scatter light—an example of the so-called Tyndall effect—and blue rays get scattered more than red, casting smoke's blue haze (see page 124).

Food must be relatively thin to cook properly in the intense radiant heat and scorching air rising from the coals. Food that is too thick will burn on the outside before heat can penetrate to its core.

Grills are definitely *not* nonstick surfaces. The high temperatures at which charcoal grills operate would make most nonstick coatings unstable. Coating food in oil works, but can cause flare-ups that coat the food with soot. The best way to avoid sticking is to preseason the grill with a patina much as you would an iron skillet or steel wok (see How to Season a Wok, page 53).

A layer of ash should coat the coals before food goes on the grill. The ash dims the coals' glow, moderating the heat they radiate. The ash also reduces the chimney effect by insulating the coals from the air.

Drippings are the real secret to the unique flavor of grilled food. As these complex chemical solutions combust, they coat the food with a panoply of aromatic and delicious compounds.

Flames may seem to flicker above charcoal, but these fiery tongues are actually little plumes of incandescent carbon soot. The superheated air is turbulent; it lifts soot particles off the coals and allows them to react with carbon dioxide in the air to produce carbon monoxide. The flammable monoxide burns with a hot but faint blue flame at 1,600 °C / 2,900 °F or higher, which heats the soot particles so much that they glow with an intense white light that masks the dim fire from the monoxide.

A variable air vent allows the griller to control the flow of air into the fire. Starve the coals of fresh air to cool them and slow the chimney effect; open the vents to turn up the heat.

Glowing coals generate temperatures well above the 700 °C / 1,300 °F required to emit light in the visible part of the spectrum. The bright orange light emitted by the center of the embers indicates a temperature above 1,100 °C / 2,000 °F. Pockets between the coals are hotter still: there, burning carbon monoxide heats soot to at least 1,400 °C / 2,550 °F!

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_2O 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 hydrocollids) 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.

Steak

The technique

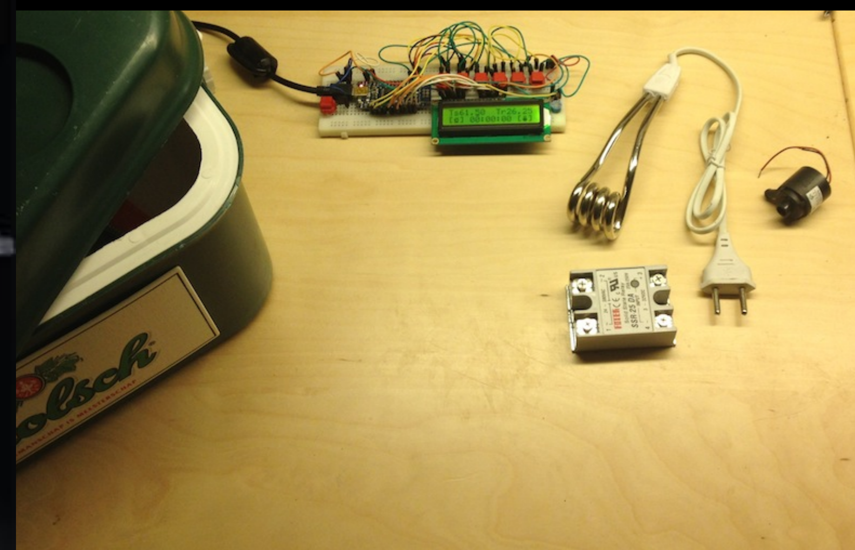
- Sous vide (french: “under vacuum”)

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

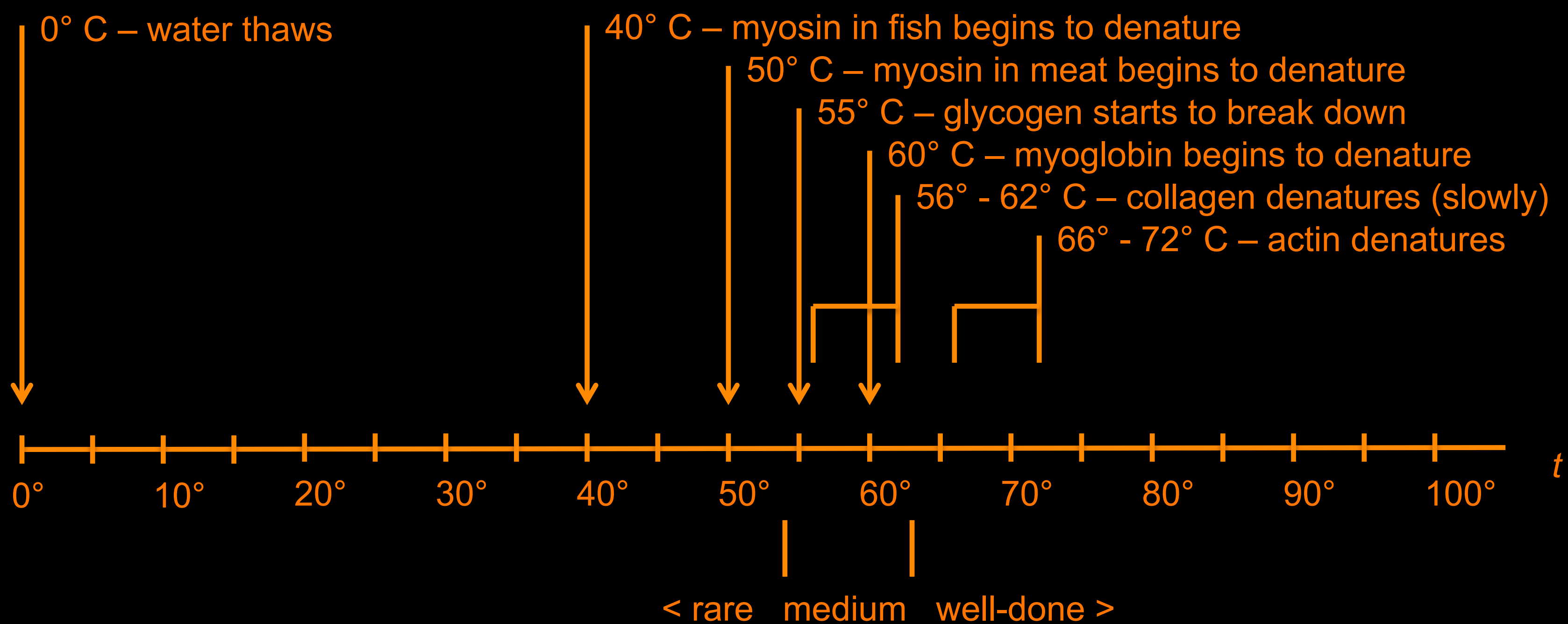
- Tightly controlled temperature

The chemistry

- Denaturing proteins

Steak

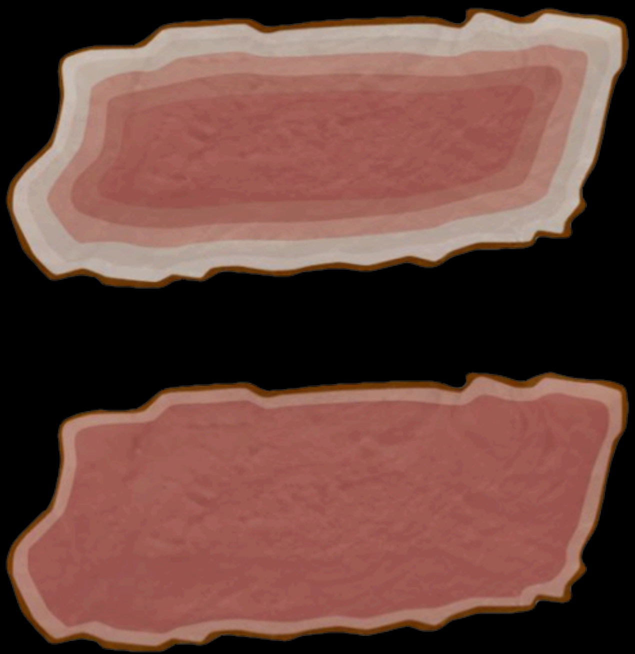
Temperature



Steak

Regular steak
"medium"

Sous vide steak
"medium"

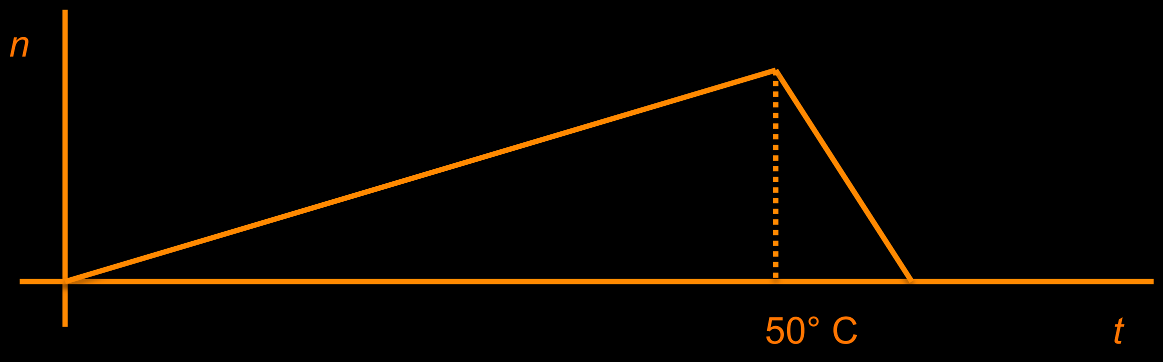


Source: www.cookingforengineers.com

Steak

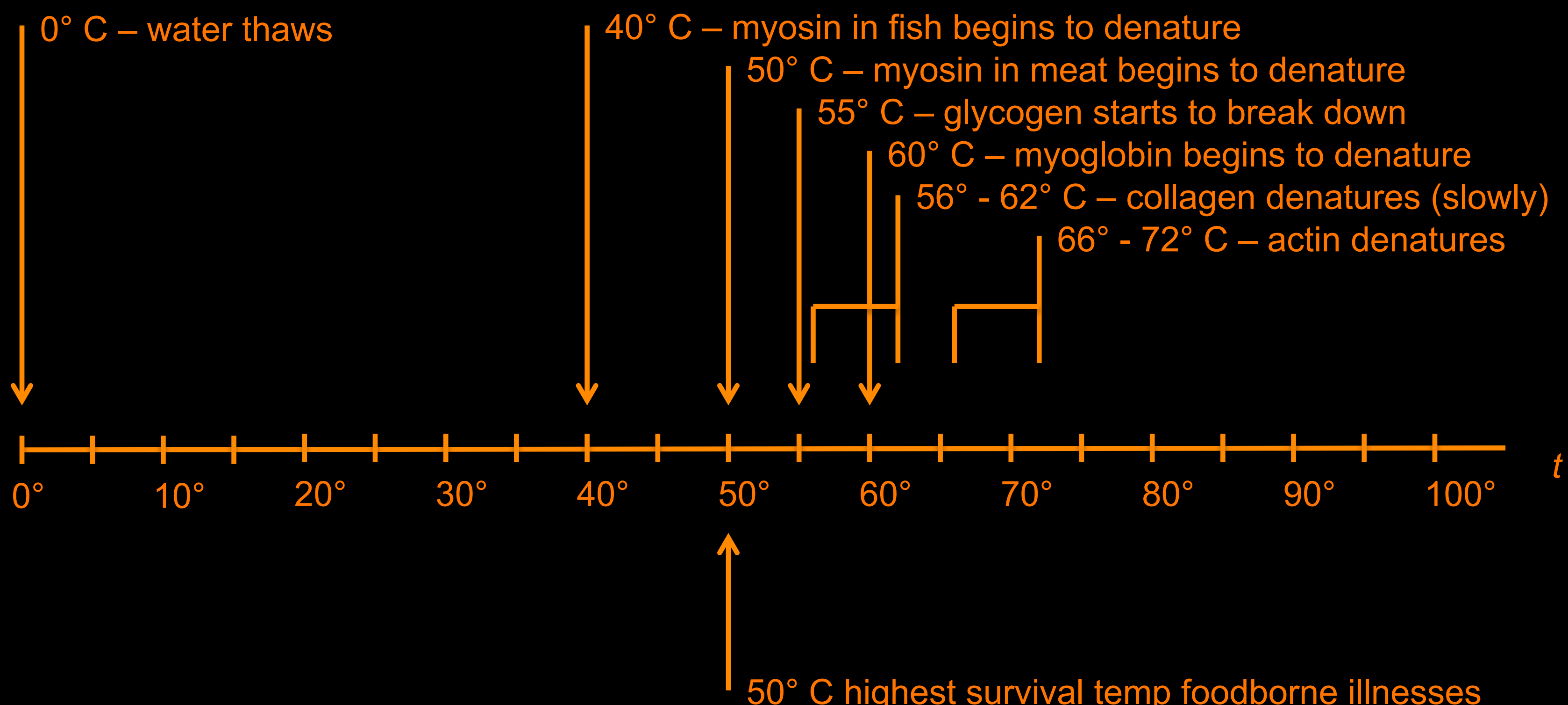
Food safety

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

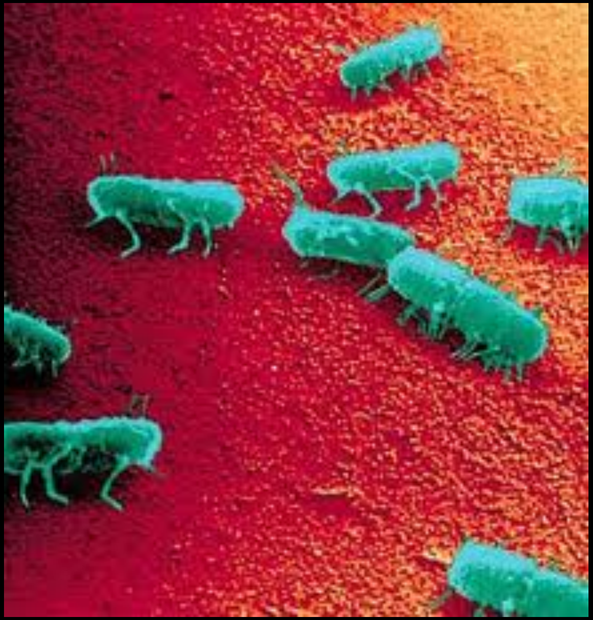


Steak

Thermal death time



Steak?



Banana foam with apple caviar

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

Banana foam with apple caviar

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

Banana foam with apple caviar

Don’t forget to rinse, as calciumchloride tasts horrible…

Where do we go from here?*

Next steps are the deconstruction and recreation of food

Eg. deconstructed tiramisu (Michael Laiskonis)

Marillion

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