CPP: Caviar, Physics, Pleasure

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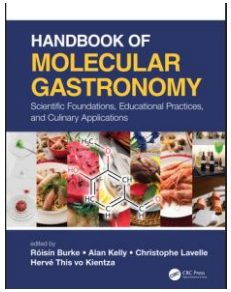

Thomas A. Vilgis
soft matter food physics
MPI-für Polymerforschung
Mainz

Pleasure

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Texture, mouthfeel, surface
Bursting under force
Flavour release

Physics
Chemistry
Oral processing
Physiology
…

What is caviar / fisheggs?

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Difference in size

Flavour of caviar

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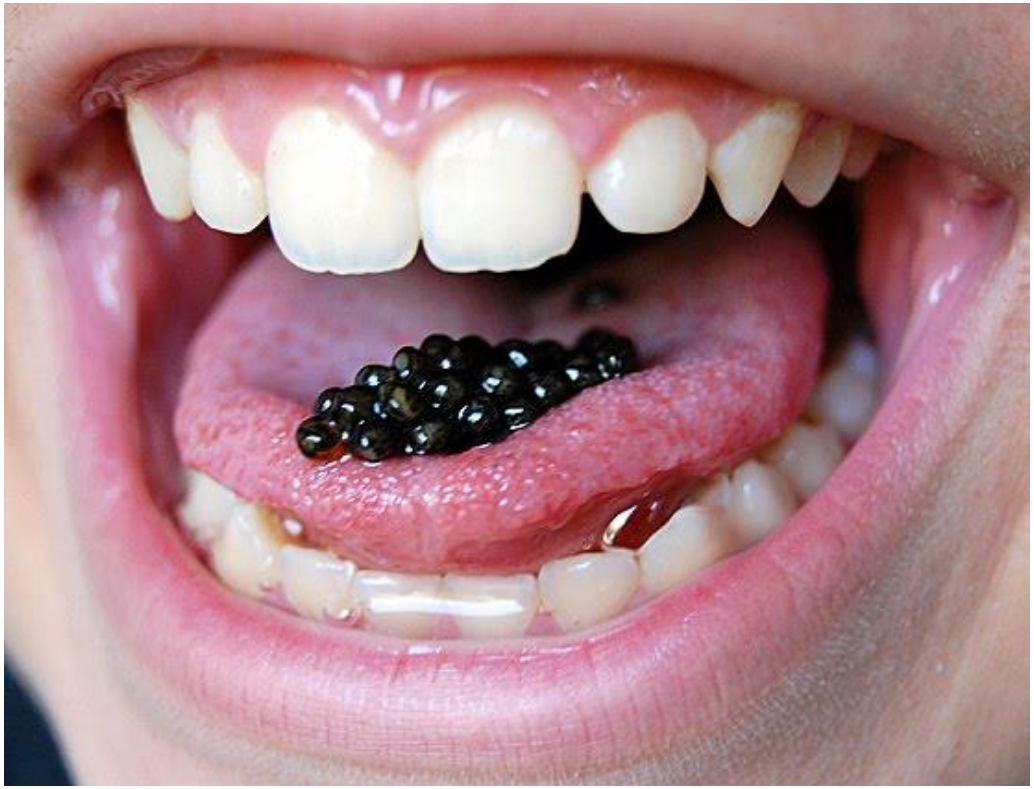

flavour ≈ taste + olfactory sensation + texture + mouthfeel + …

Flavour of caviar

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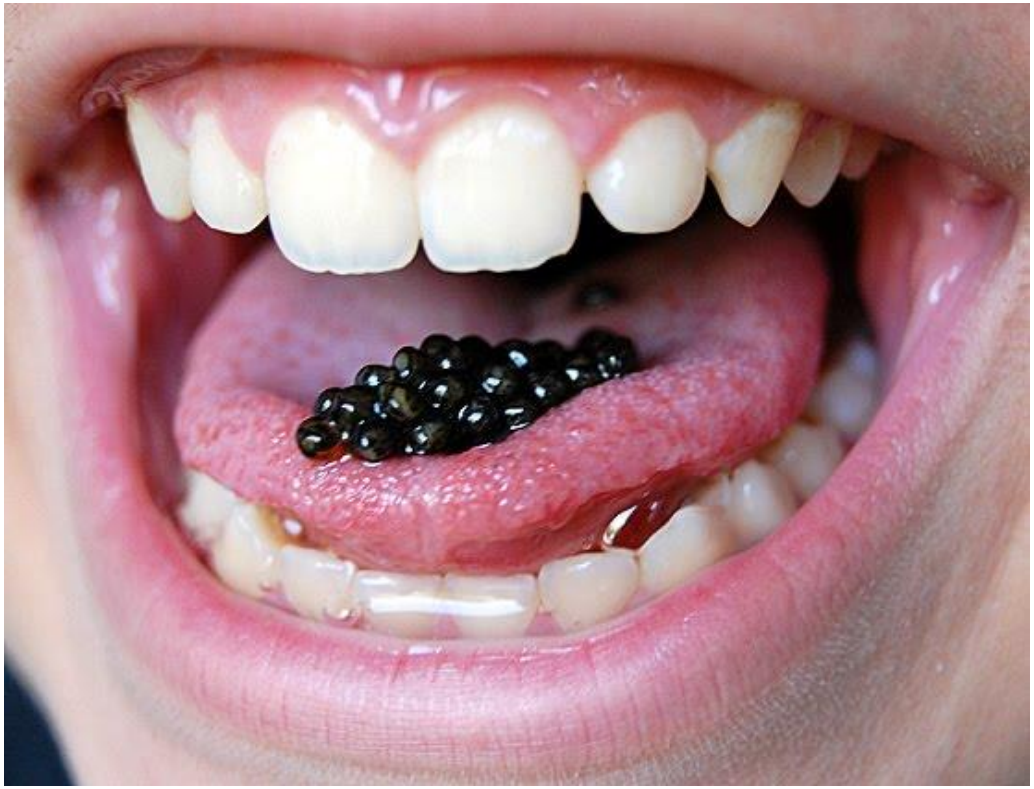

flavour ≈ taste + olfactory sensation + **texture** + **mouthfeel** + …

Closer look

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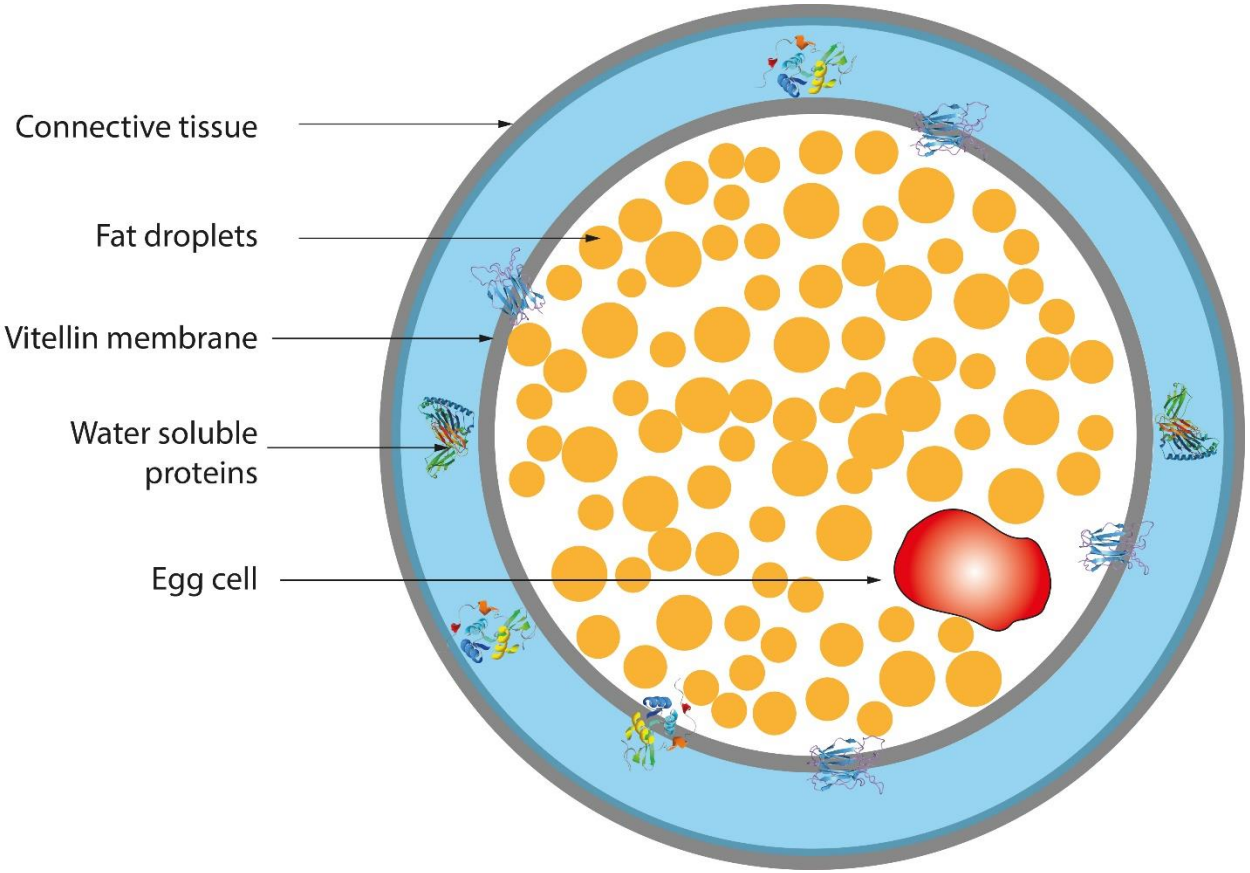

What happens?

View our Chemistry Journals eml

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hard, brittle

soft, elastic

How to do gastrophysics with fish eggs?

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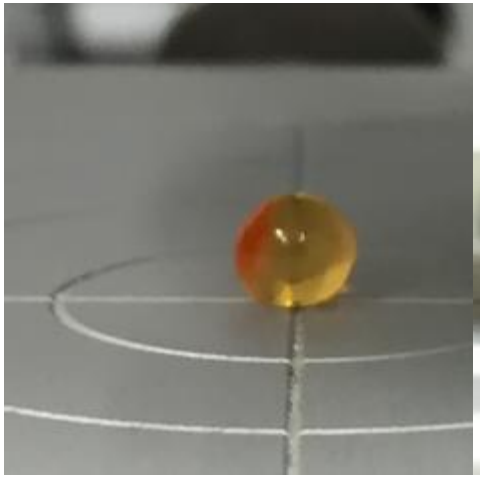
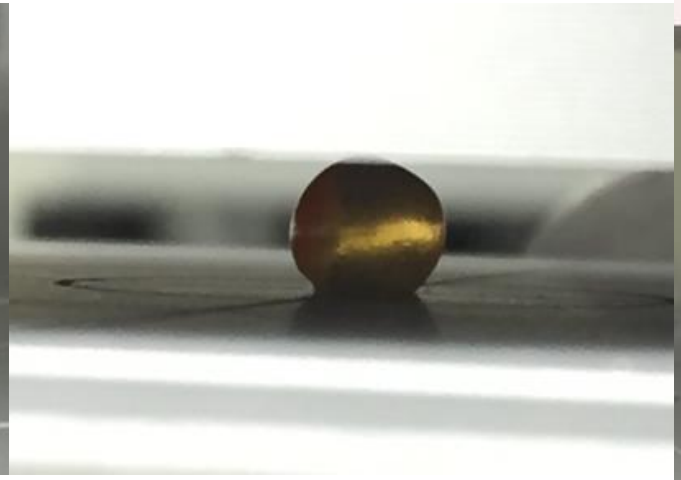
Measure force - extension





How to do physics with fish eggs?

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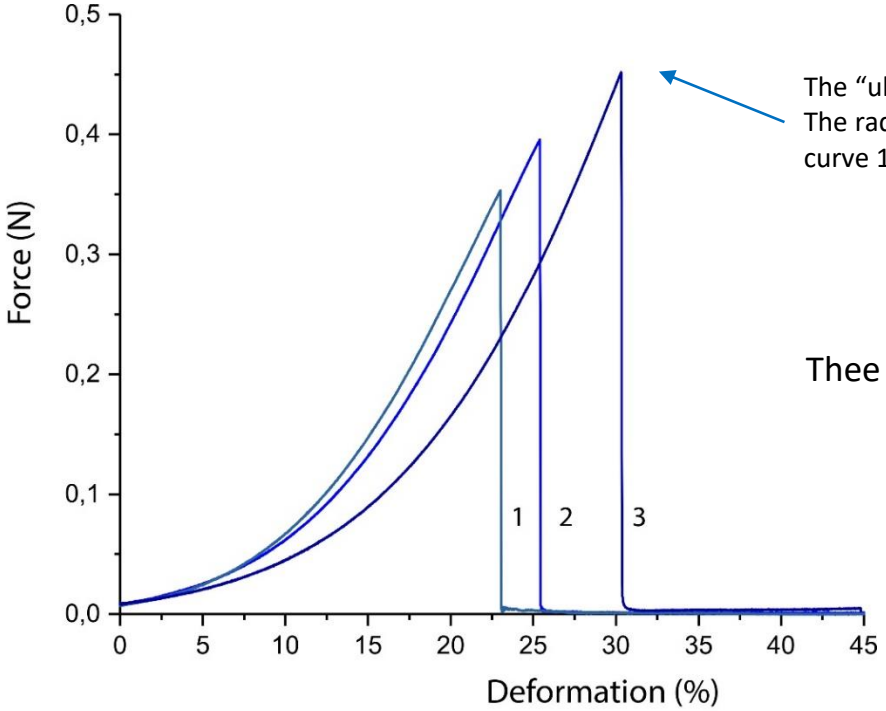

The “ultimate force”: bursting.
The radii:
curve 1: 4.0 mm, curve 2: 5.2 mm, curve 3: 8.1 mm.

Thee different eggs / diameters

What happens?

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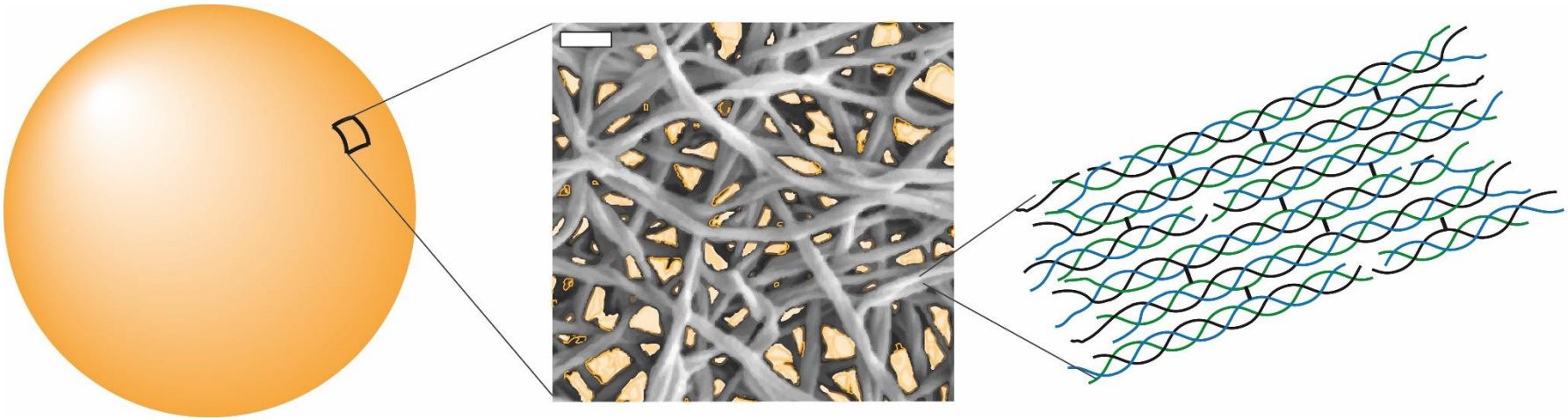

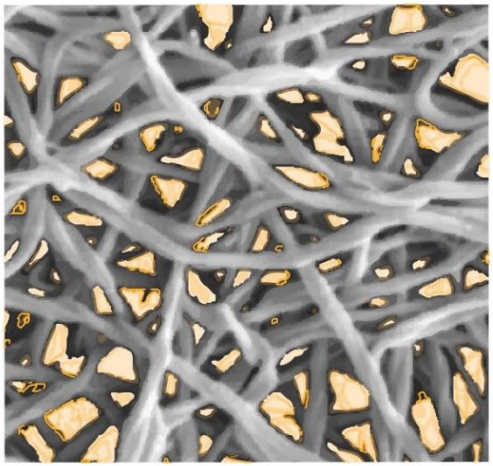

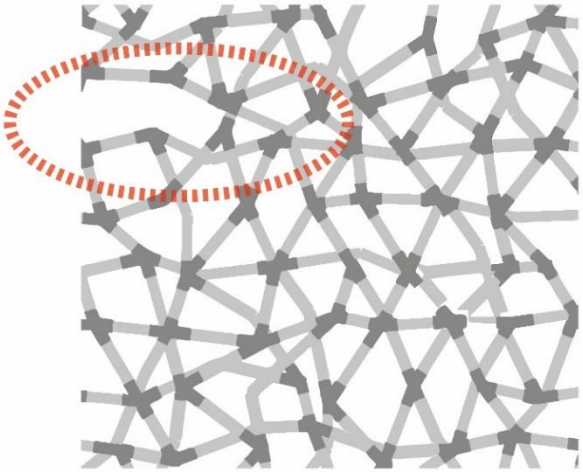

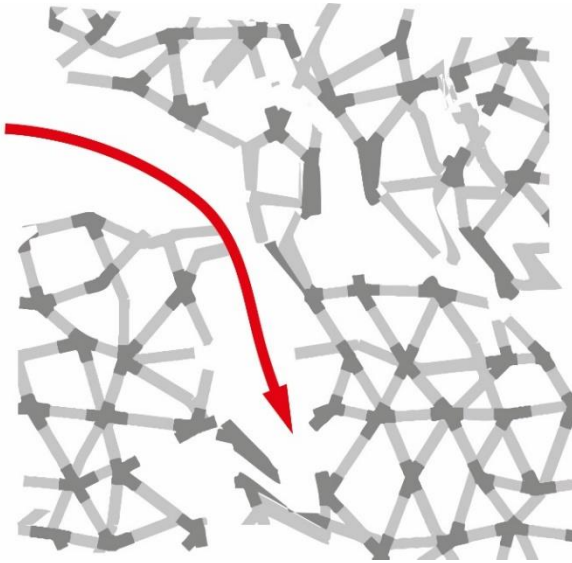

What happens?

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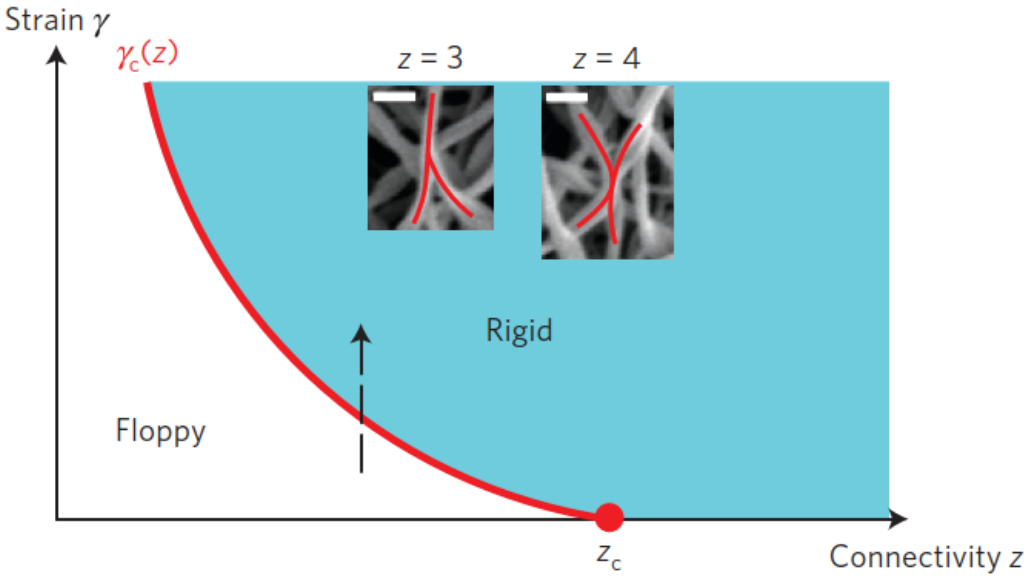

Figure 1 | At zero strain, networks undergo a continuous transition from floppy to rigid at the isostatic threshold $z = z_c$. This connectivity threshold shifts to lower values for networks subject to shear strain γ. This threshold defines a line $\gamma_c(z)$ of continuous transitions. We study here strain-induced transitions indicated by the vertical dashed line for z well below z_c. The insets show SEM (scanning electron microscope) images of reconstituted collagen networks indicating points of 3-fold and 4-fold connectivities. The scale bars are 200 nm.

Sharma, A., et al. "Strain-controlled criticality governs the nonlinear mechanics of fibre networks." *Nature Physics* 12.6 (2016): 584-587.

Estimate of crack force

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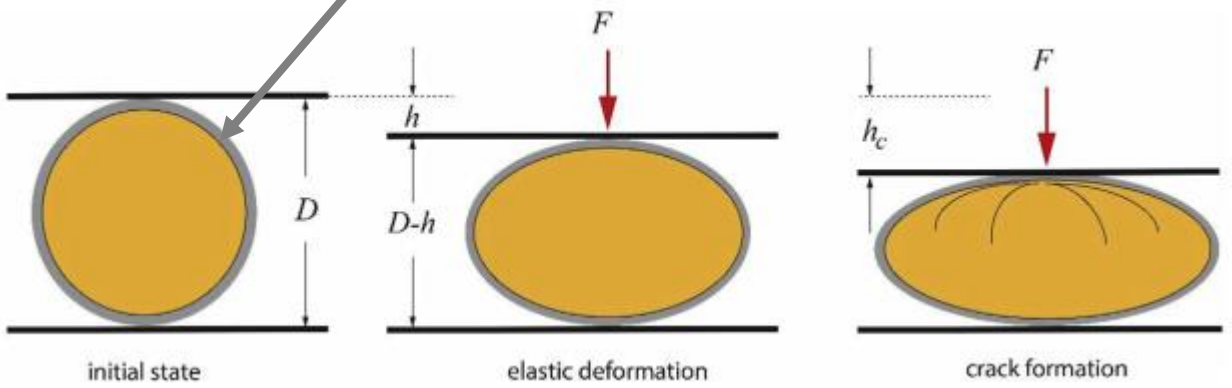
surface tension / collagen network modulus

$$f \sim -(\gamma/d)\frac{\ln(1 - h/R_0)}{1 - h/R_0} \qquad R_0 = D/2$$



Miao, B., Vilgis, T. A., Poggendorf, S., & Sadowski, G. (2010). Effect of finite extensibility on the equilibrium chain size. *Macromolecular theory and simulations*, *19*(7), 414-420.

Zidek, J., Milchev, A., Jancar, J., & Vilgis, T. A. (2016). Deformation-induced damage and recovery in model hydrogels–a molecular dynamics simulation. *Journal of the Mechanics and Physics of Solids*, *94*, 372-387.

Many eggs

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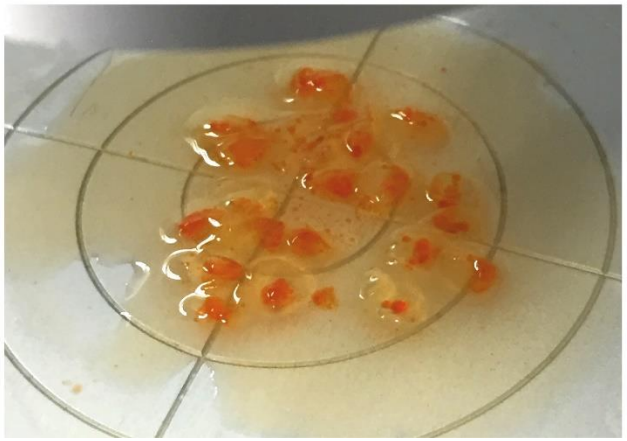

Many eggs: bursting sensation in the mouth

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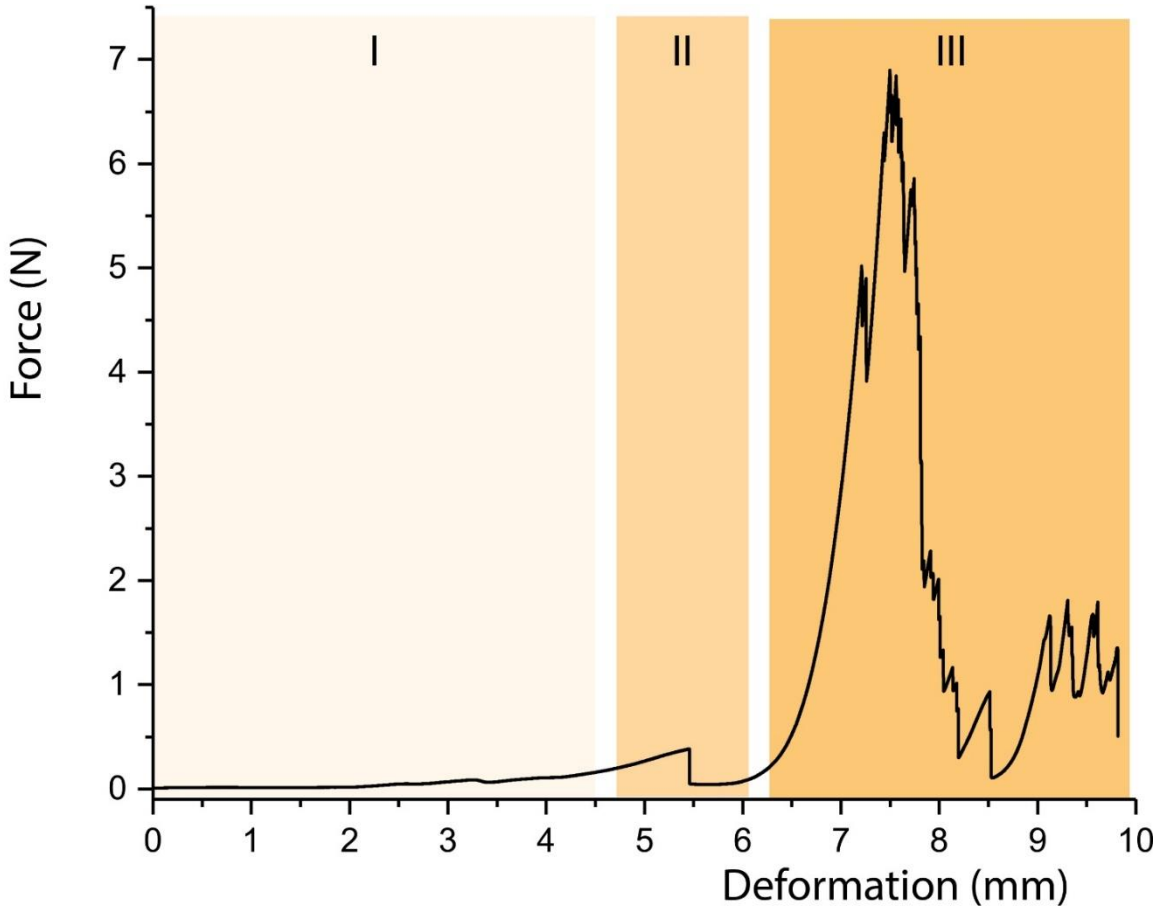

The maximum force defines the “ultimate force” of rupturing or bursting.
The radii of the eggs have been: curve 1: 4.0 mm, curve 2: 5.2 mm, curve 3: 8.1 mm.

Caviar: smaller eggs, different perception

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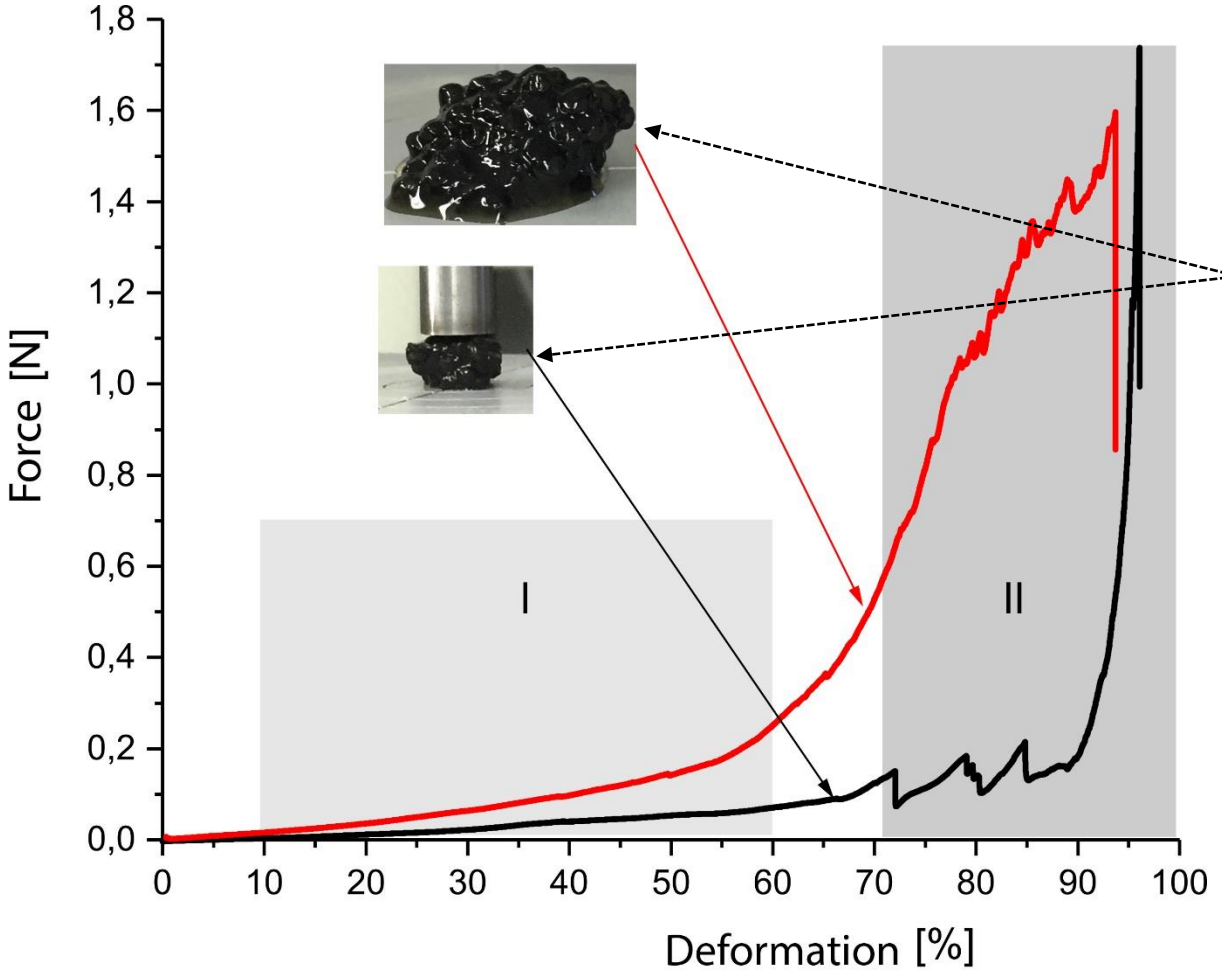

depends on
portion, shape
&
„indvidual
mouth geometry ,
tongue motion,
muscle tone,
…“

What about dishes?

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What about „flavours“?

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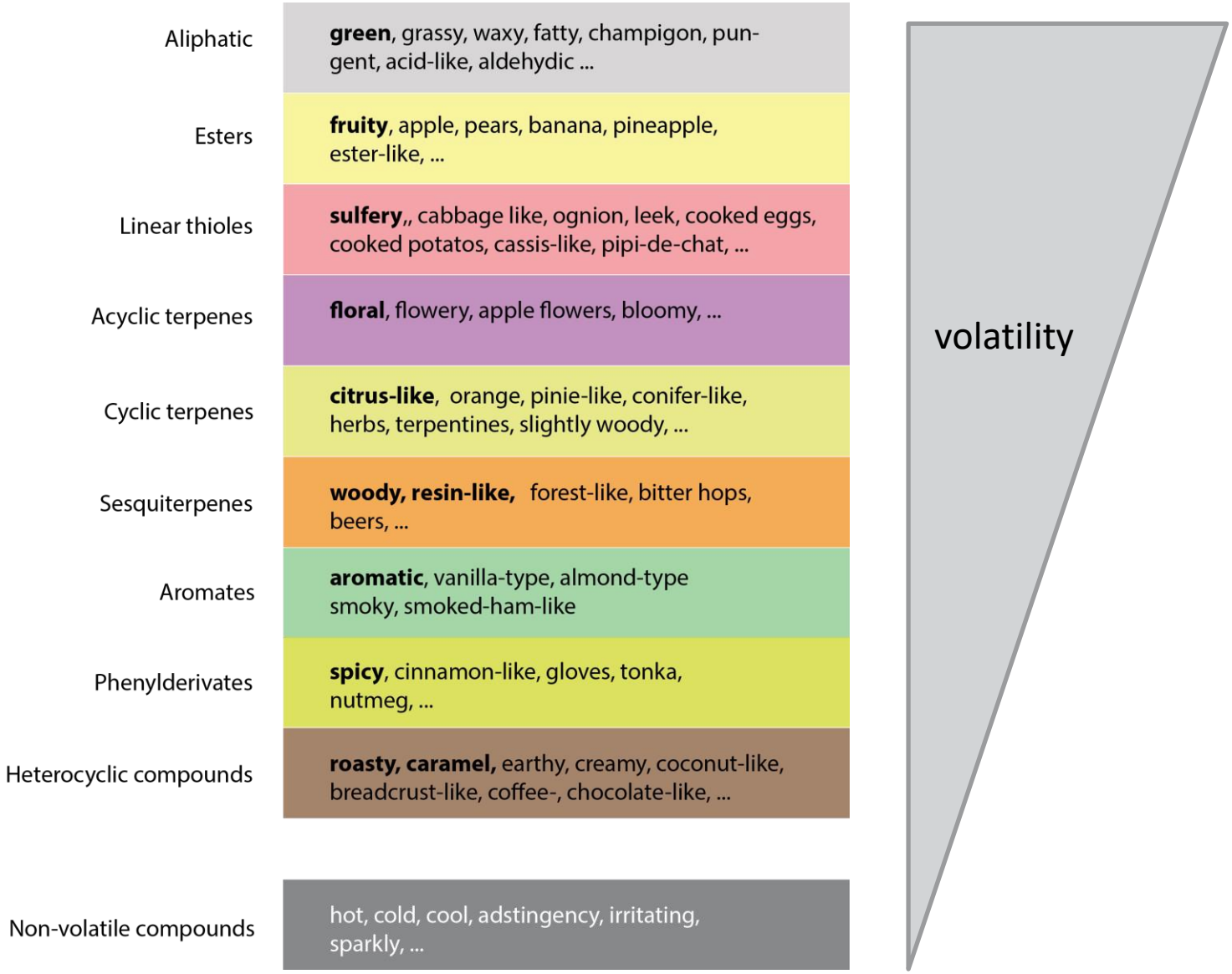

Simple example: Caviar + Vodka

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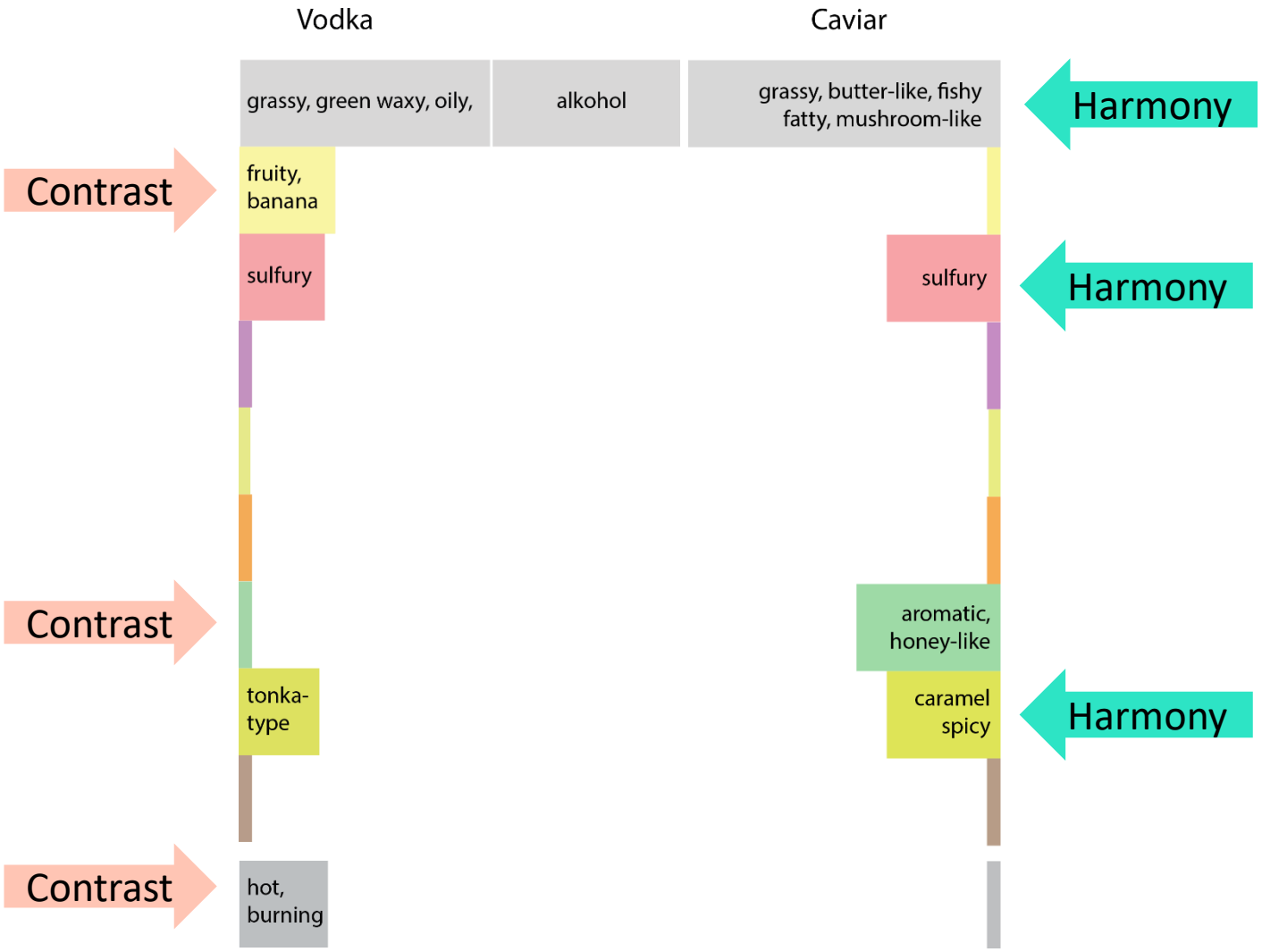

Simple example: Caviar + Vodka

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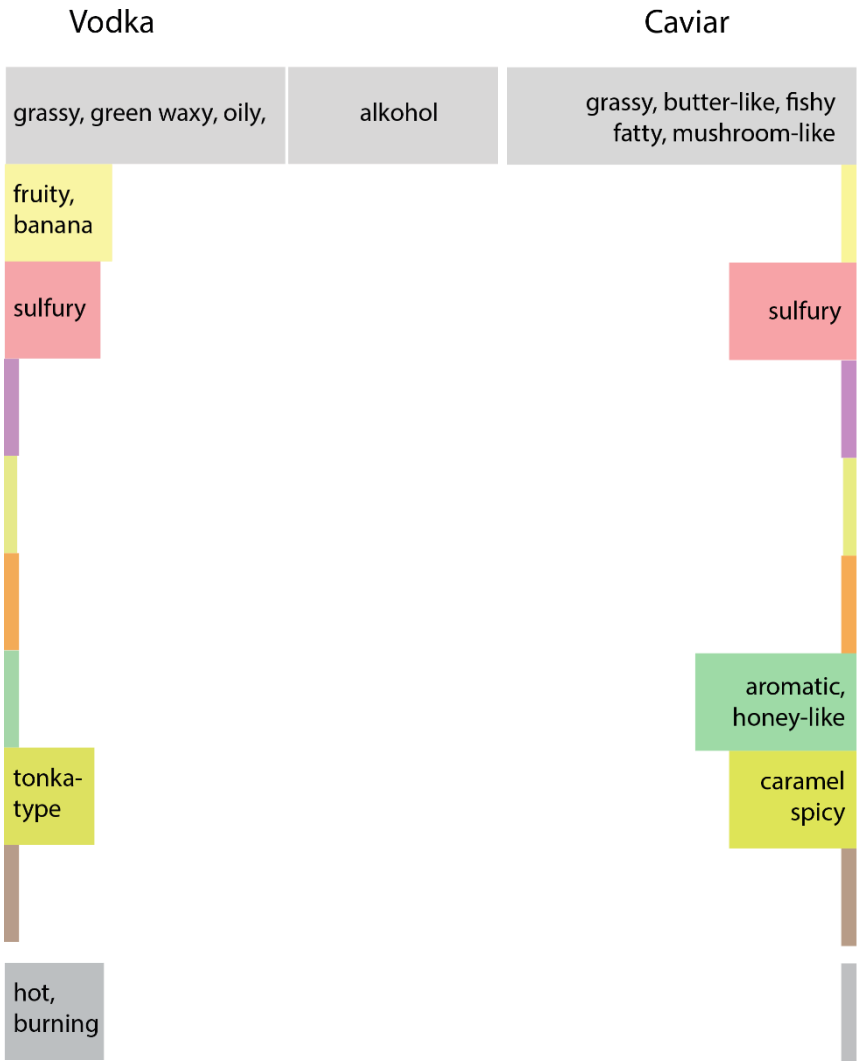

Simple example: Caviar + Vodka + Blini

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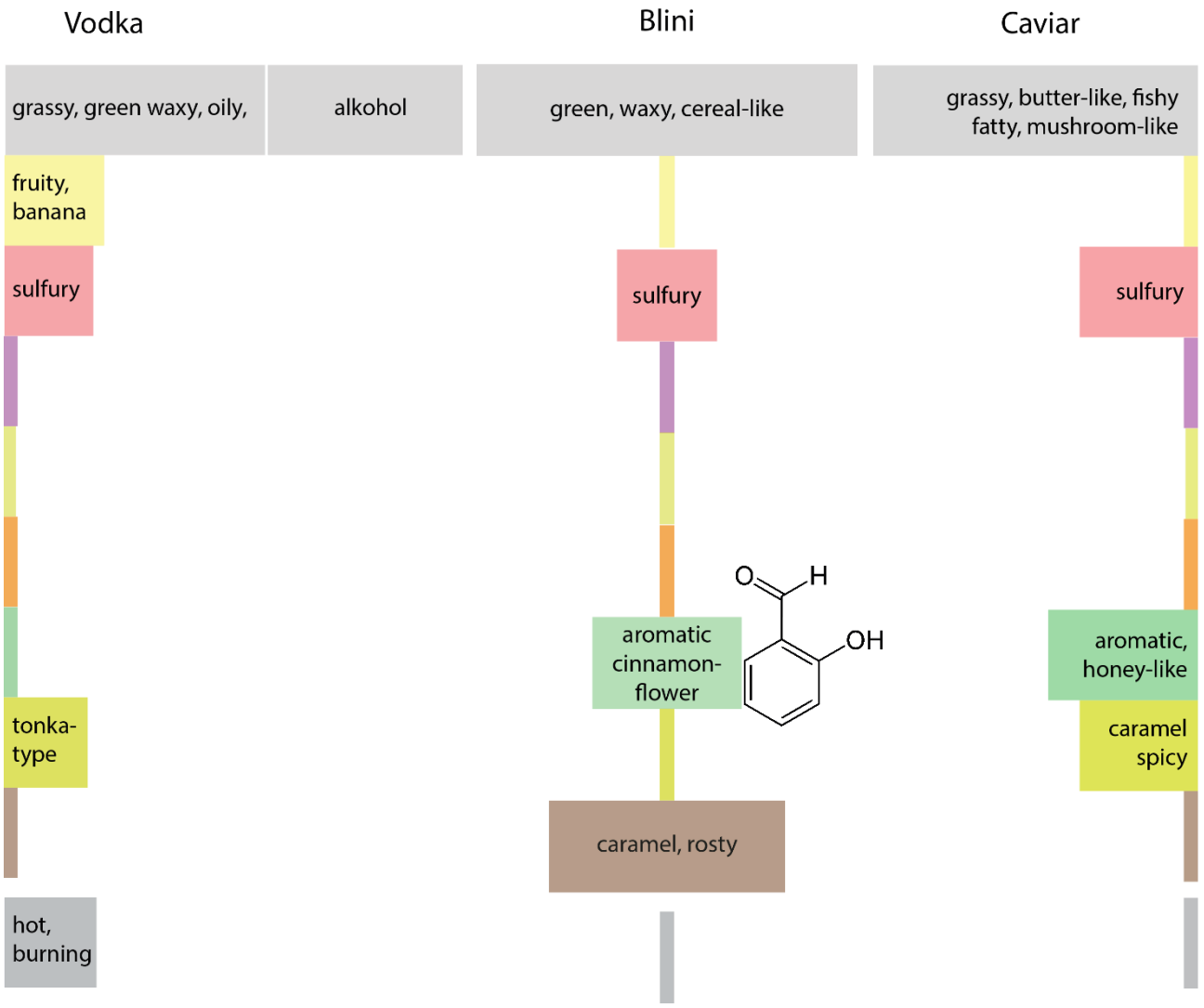

Simple example: Caviar + Vodka

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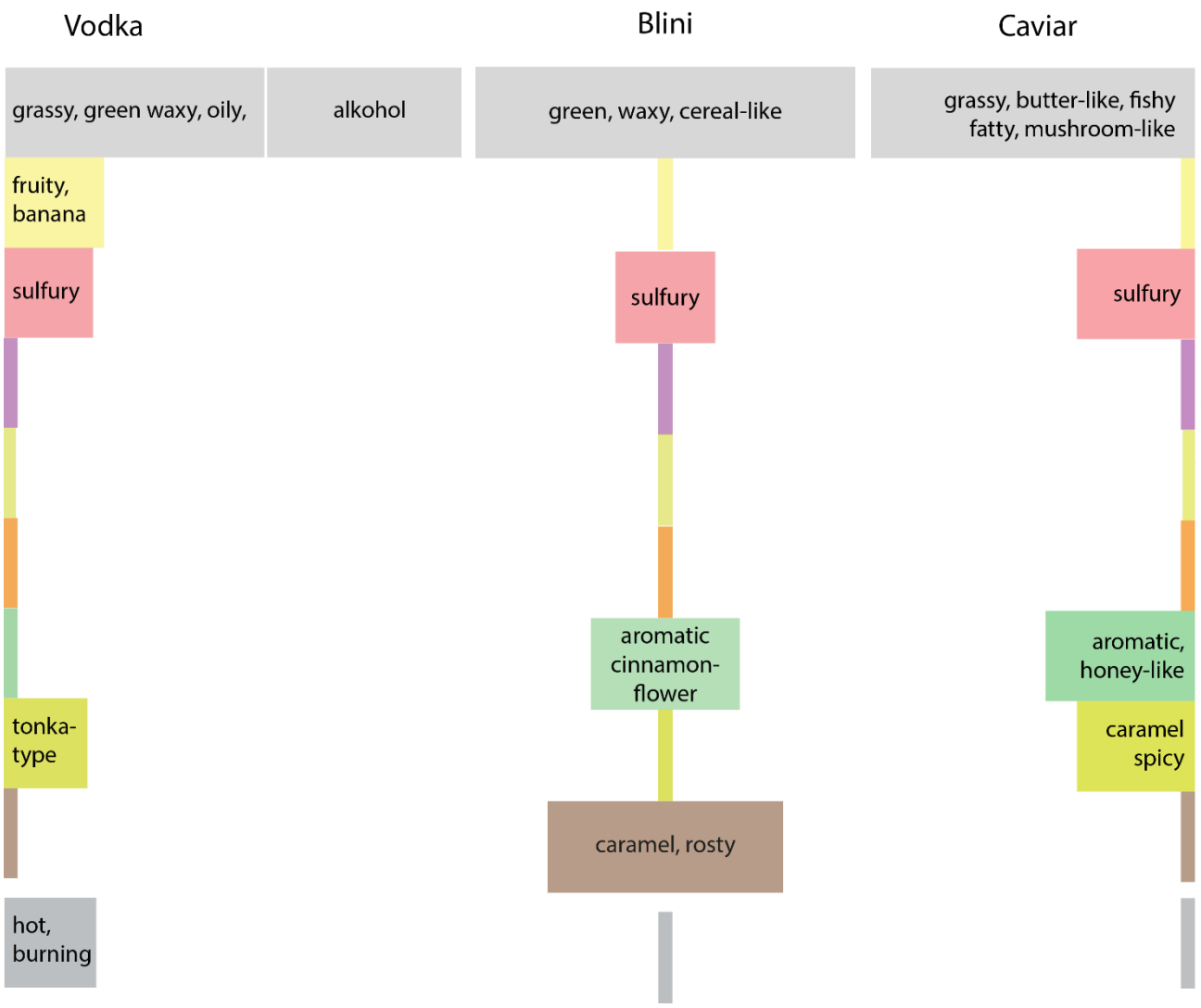

Make it more exciting?

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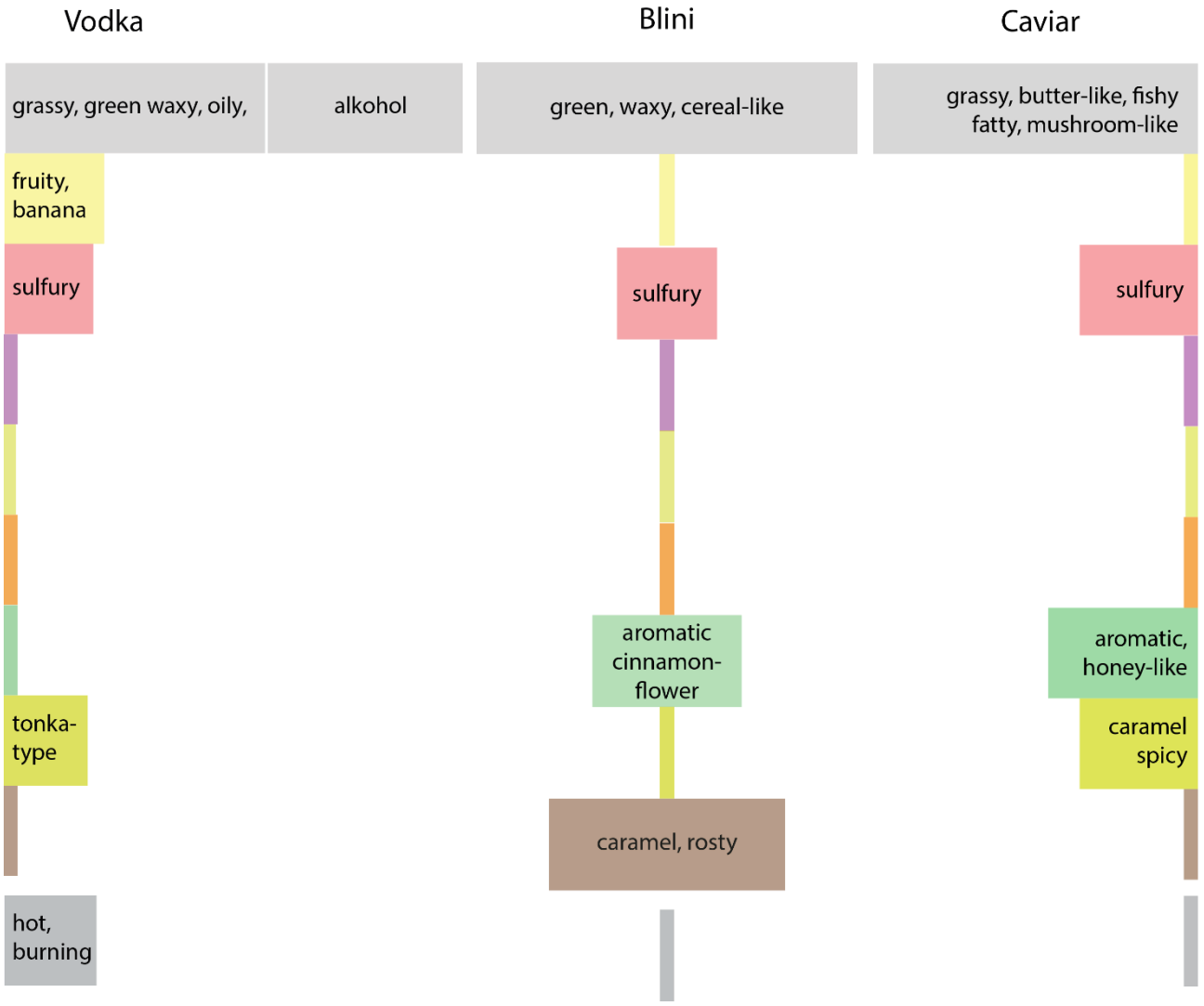

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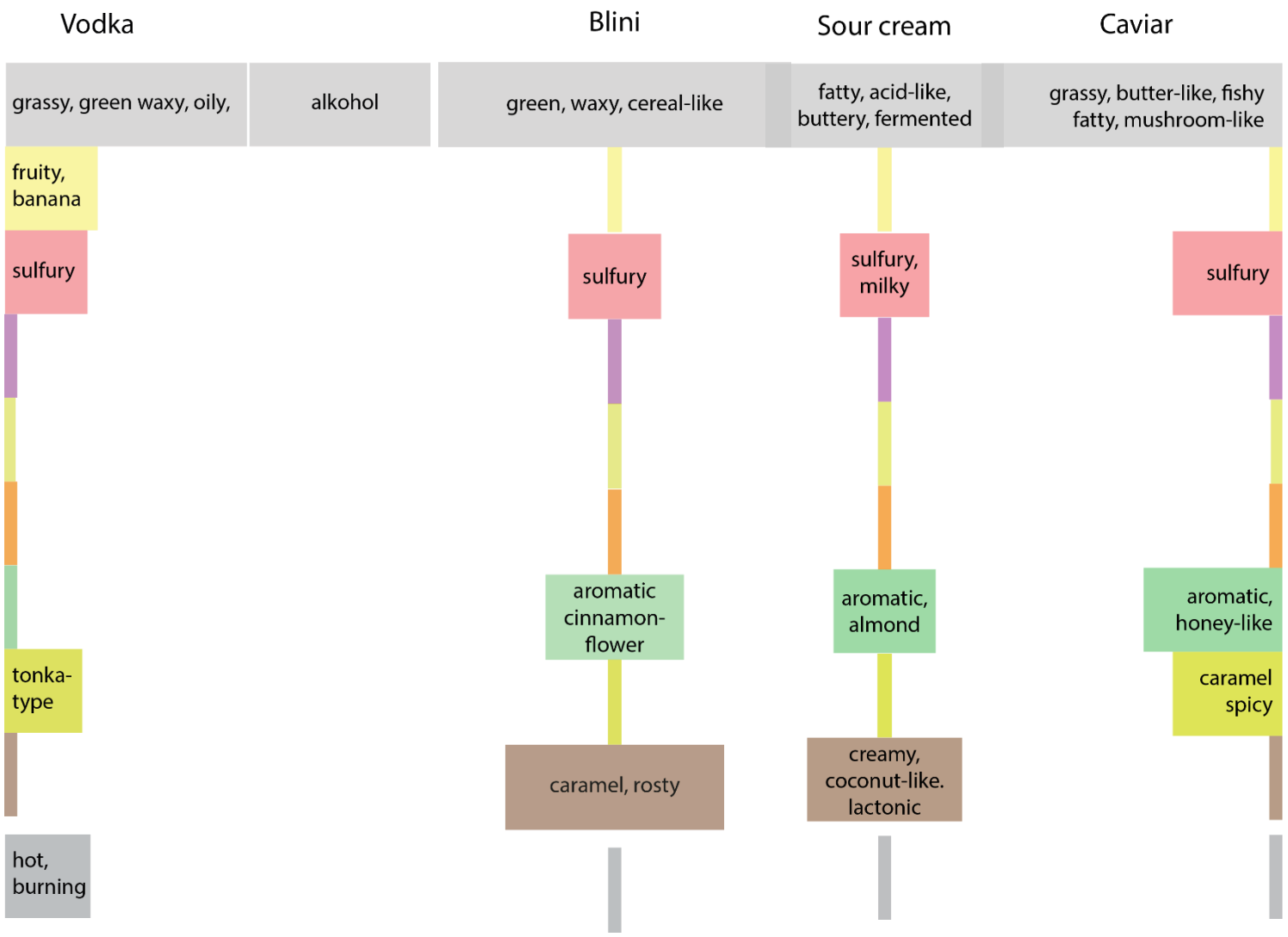

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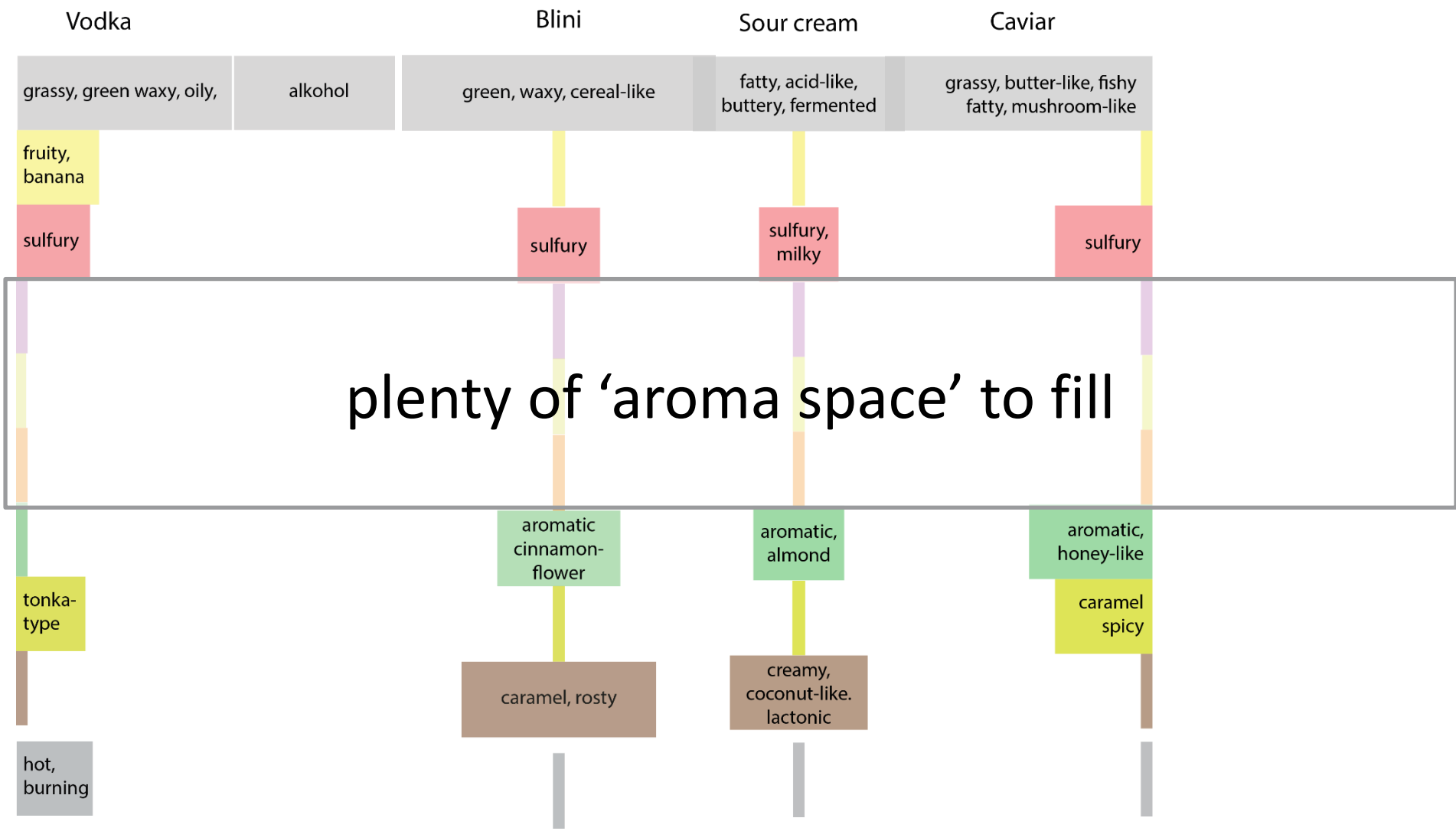

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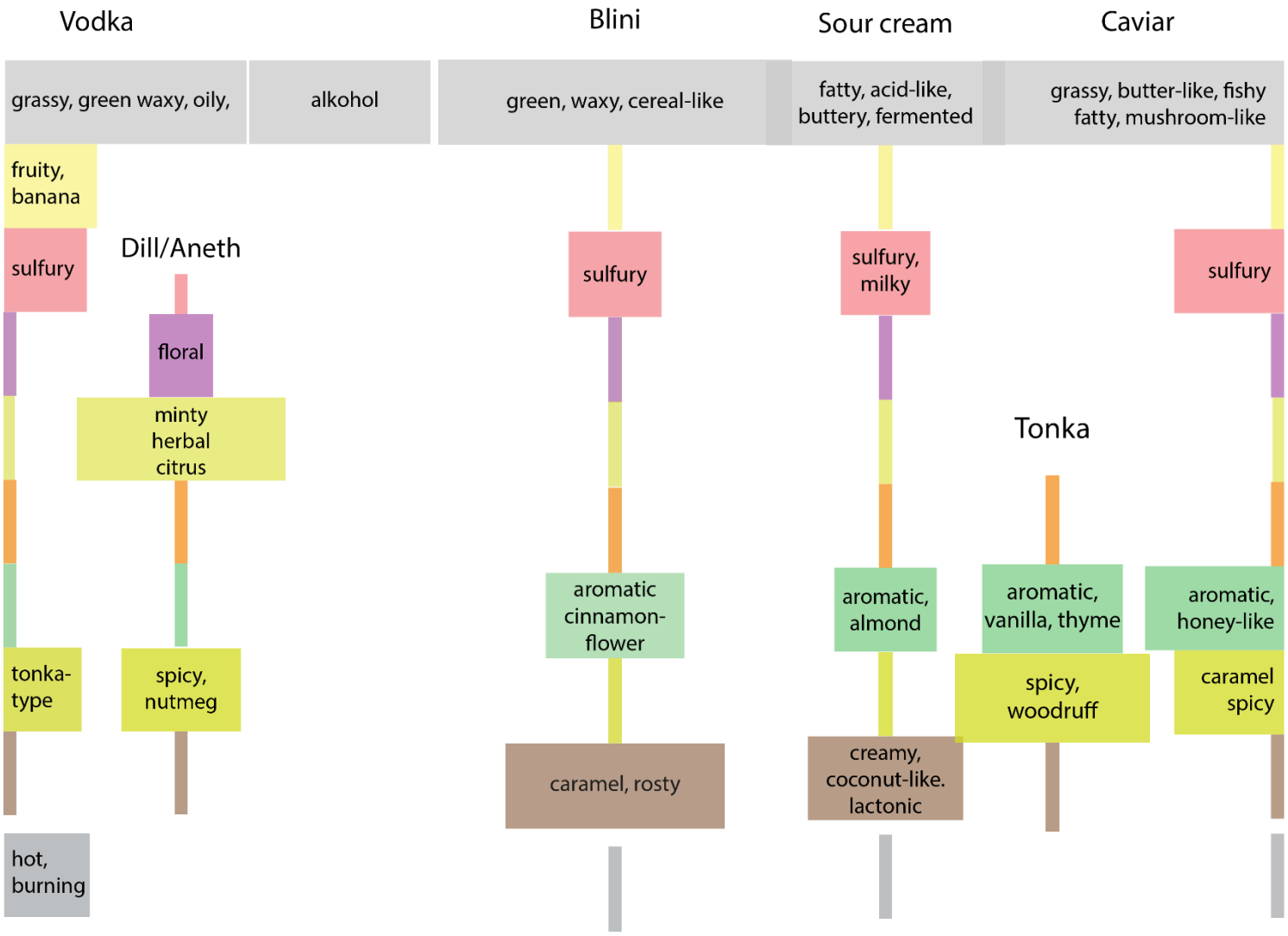

Make it even more exciting? E.g. Sake

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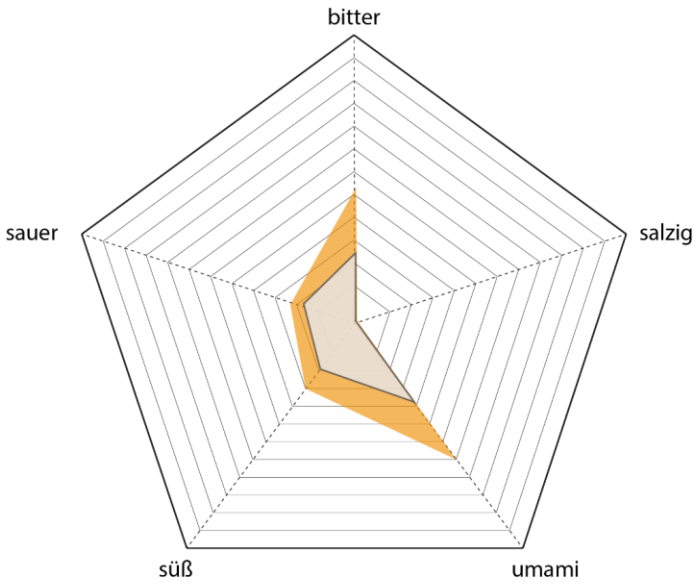

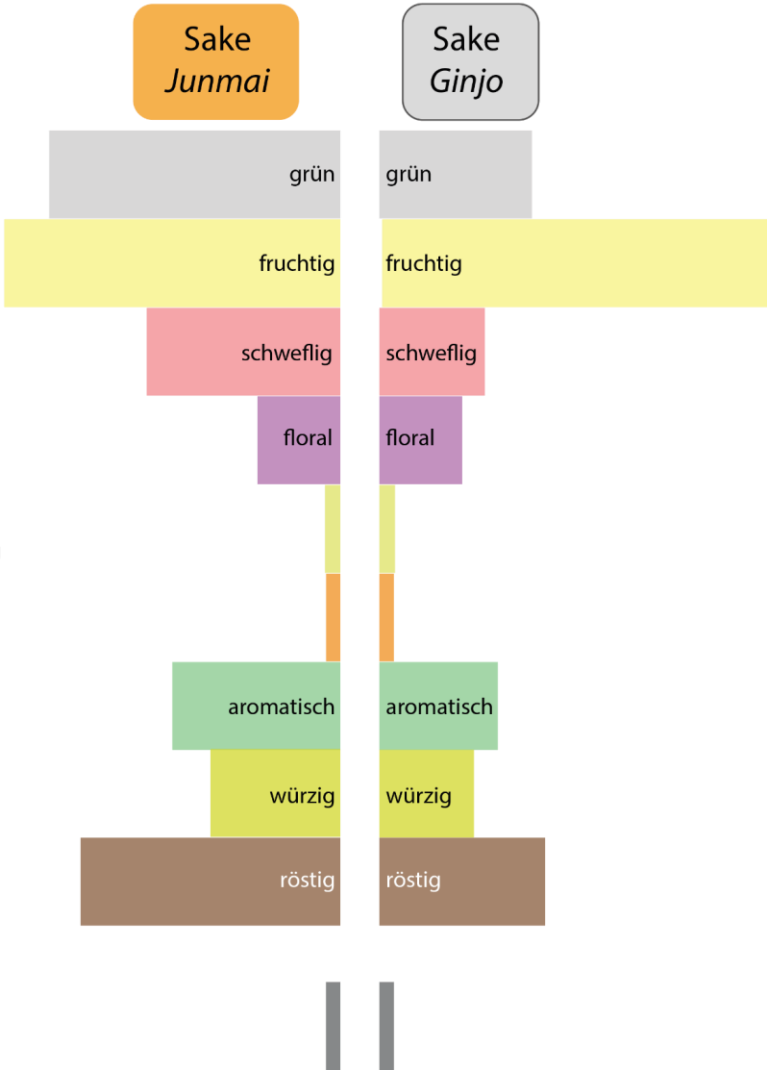

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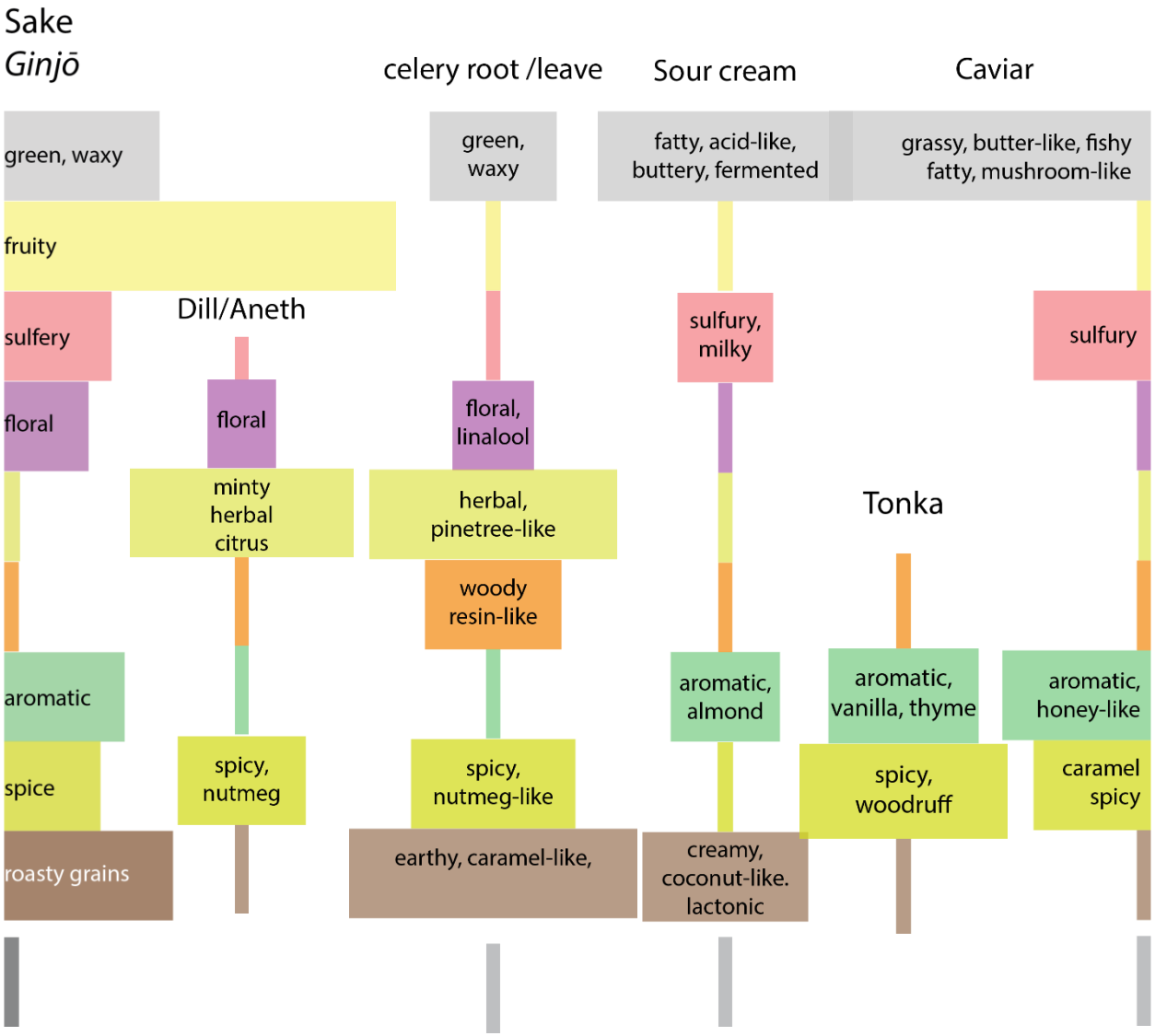

Thank you for listening

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Opinion paper

The physics of the mouthfeel of caviar and other fish roe

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ARTICLE INFO

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Fish roe
Texture
Collagen
Mechanical analysis
Food physics

ABSTRACT

Caviar and other fish roe are among the most popular culinary sensations in gastronomy. The perception of fish eggs in the mouth is mostly driven by physical quantities. The skin, a soft solid layer of the eggs bursts under pressure during oral processing and releases the taste and aroma compound in the mouth. The mechanical properties of fish eggs are investigated and analyzed using physical methods.

further reading

happy seasons!