

# FLAVOR RELEASE RESEARCH

## Value to you?

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# Flavor Release?

- From a food during processing, storage, home preparation (encapsulation)
- From a food during eating

# Release during eating

Considered one of primary reasons that:

- low-fat foods do not taste as good as full-fat counterparts
- high potency sweetened products do not taste like bulk sweetened products
- Why you have flavorings tailor-made for specific food products

# Flavor perception depends, in part, upon:

1. Amount and nature of the flavor components present (**Analytical lab & you**);
2. Availability of these flavorings to the sensory receptors (**Your job!**)
  - a. Breakdown of food matrix to enhance release and
  - b. Transport of the released flavorings to sensory receptors

# Flavor release - help for you?

1.Amount and nature of the flavor components present;

Help from instrumental lab services – GC/MS

1.Availability of these flavorings to the sensory receptors.

Help from flavor release research (let's explore)

# Why not released?

- Reduced volatility

- Chemically bound to some food component (protein, or carbohydrate) (math treat.)
- Volatility decreased by dissolution in fatty components of a food

- Physical barrier to release

- Dry food must be hydrated
- Viscosity may limit spreading in mouth or slow diffusion of flavor to air interface

# Release from the food in the mouth (or its simulation)

Goal is to provide a scientific understanding of this event

Must have tools to measure release

(Theoretically) permits adjusting formulations based on objective measurements to give desired release (flavor perception)

- strawberry in yogurt → SAME strawberry in cake
- SAME strawberry on ingredient substitution

(Does GC/MS help you? Same potential here)

# Many “tools” available

- Static headspace - above product
- Dynamic headspace - above product
  - Concentration of sample to improve sensitivity
- In mouth (Artificial or real mouth)
  - Real time - Not Real time

# Static Headspace

- Monitor accumulation of aroma in the headspace above a food (equilibrium)
- Sensitivity generally an issue
- Equilibrium method – no mass transfer component (binding/solubility only)

# Dynamic Headspace

- Pass a gas across or through sample of food
  - Isolate aroma compounds in an adsorbent (e.g. Tenax)
  - Desorb trap into GC or GC/MS
- 
- Better sensitivity and considers both solubility and mass transfer

# Dynamic Headspace

- Criticism

- Not “real” time thus get “cumulative data over sampling period (so what?)

# “In mouth” methods

- Real or “artificial”

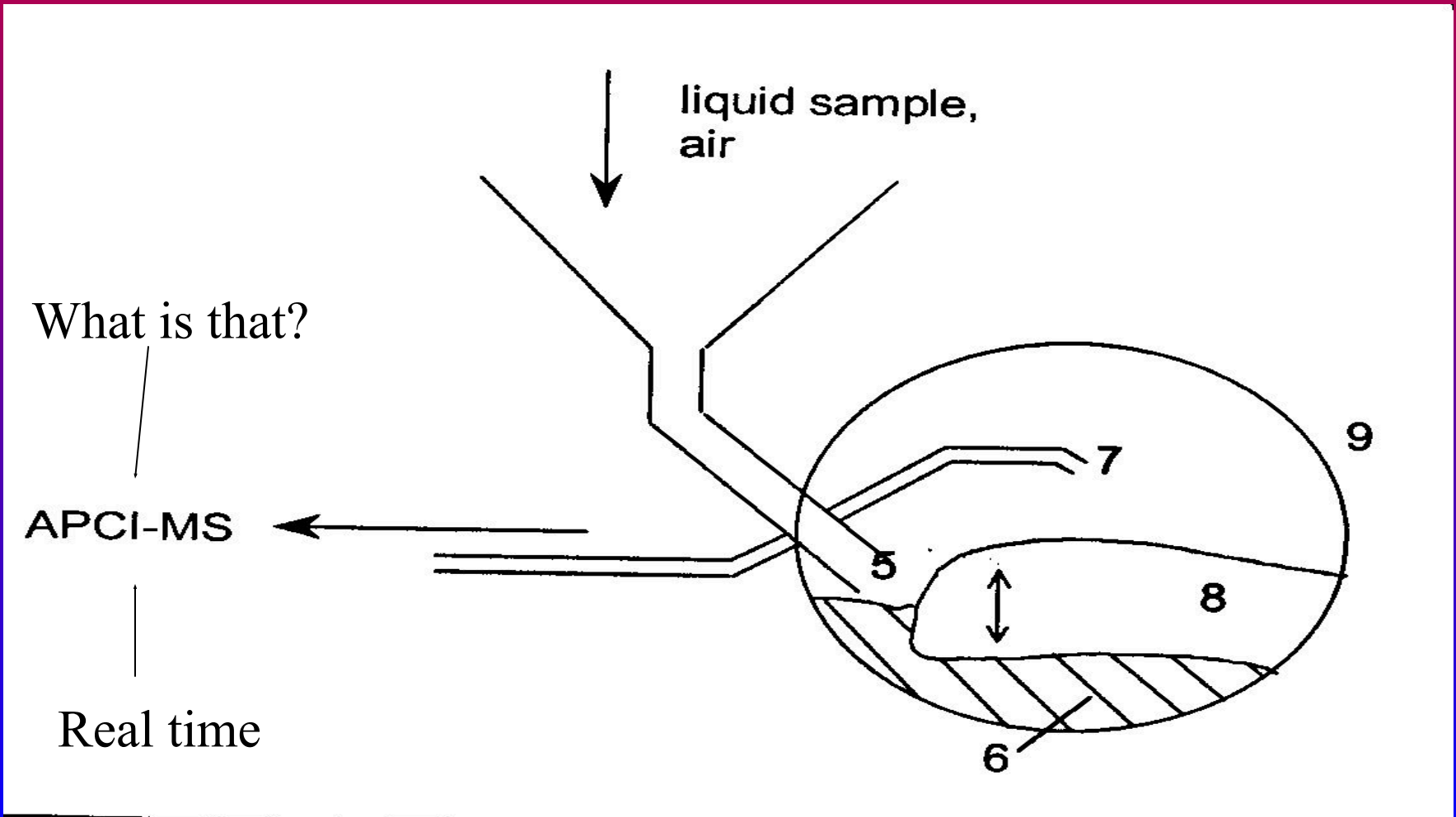
# Artificial mouths

- T. Acree - Cornell
- J. Roozen - NIZO (The Netherlands)
- R. Berger – Germany
  
- Several others

# Principle

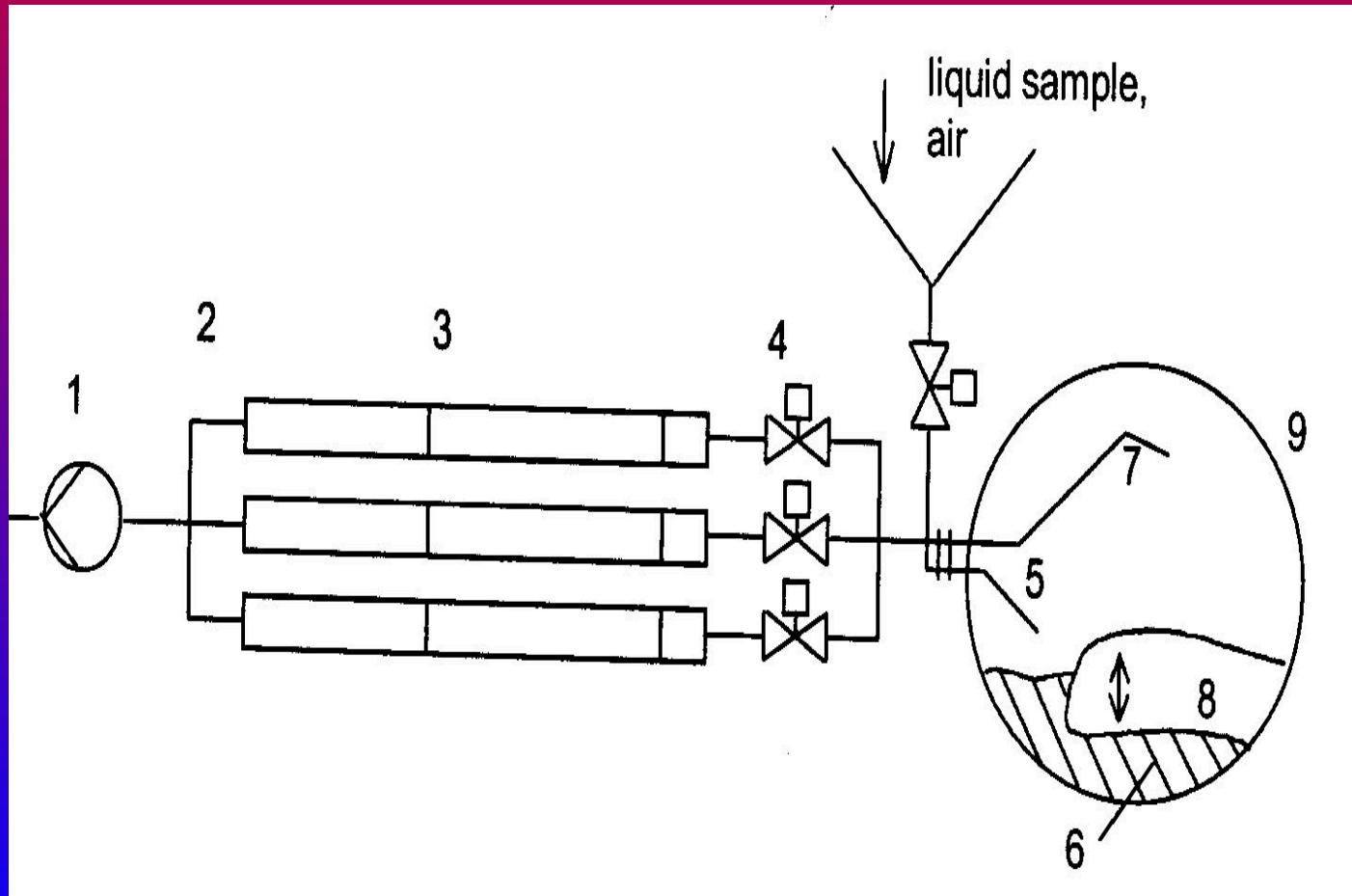
- Simulate the conditions in the mouth but have much more controlled system
- Eliminate human variability

# Rabe et al., 2004. Chem. Senses 29: 163–173



# Analysis portion (ibid)

(2, 3 and 4 are traps for GC)



# Artificial mouths

- The best method to determine the effects of changing some food variable on “potential” release.
- Want to study release/perception issues - real in-mouth systems have advantages
  - Study human factors

# Real mouth research

# Real-Time in-mouth (MS)

- Has been problematic depending upon sample
  - Foods have water
  - Breath has water, carbon dioxide, oxygen, plus other volatiles
  - Low concentrations of volatiles (sensitivity) – rapid sampling

# Rob Linforth – University of Nottingham, UK



# APCI-MS

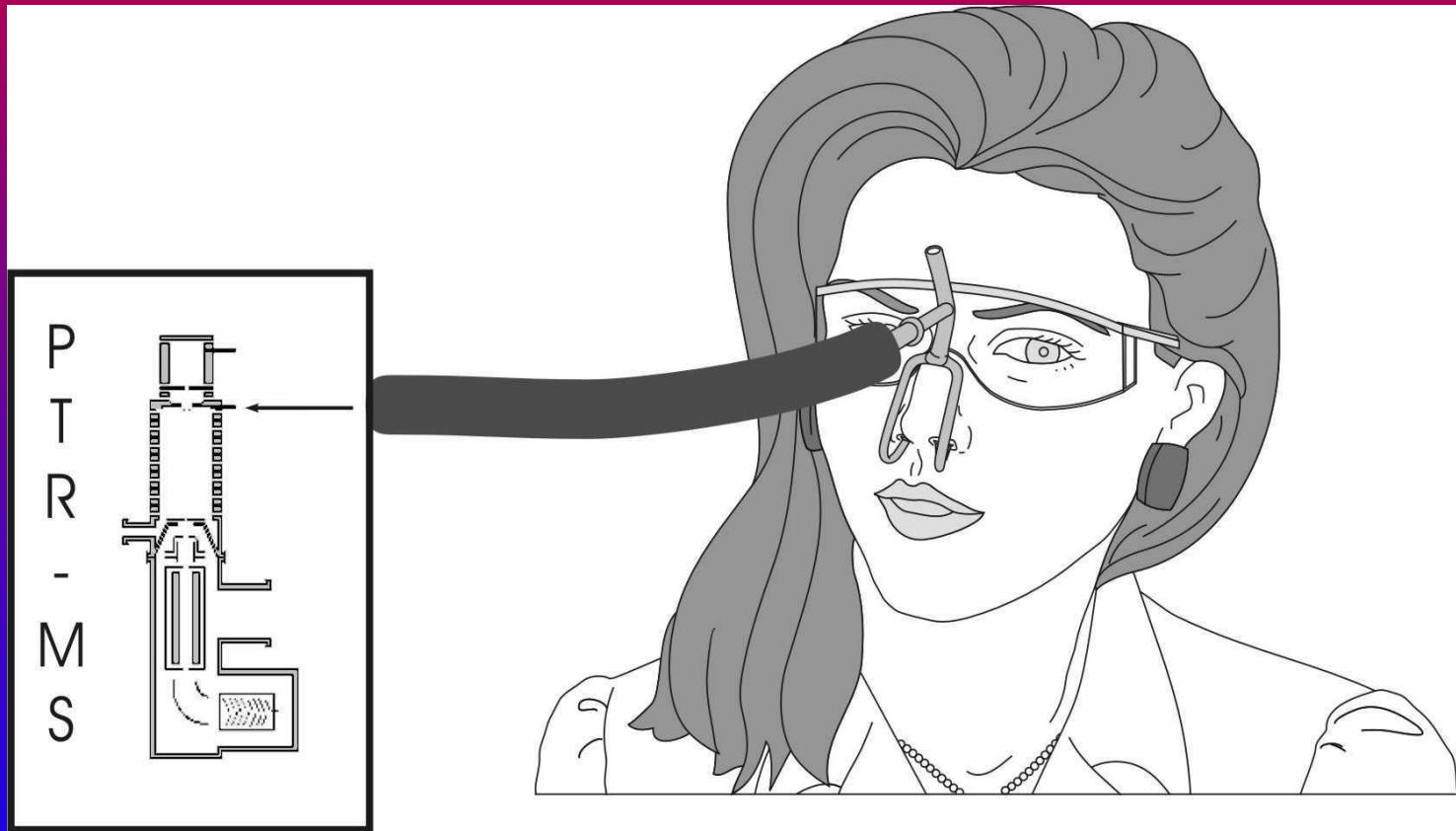
Taylor and Linfoth (University of Nottingham, UK)

- Interface an APCI MS with a human (robust instrument/technique)
- Problems:
  - a. Sensitivity – concentration in breath is very low; can get to a few ppb for some volatiles - not bad but variable!
  - b. Cost – ca. \$150,000+ dedicated person
  - c. Selectivity is poor – low resolution MS.

# Proton Transfer Reaction (PTR) MS

- Theoretically offers some advantages
  - Quantitative data
  - Sensitivity

# Breath sampling (Roberts et al. 2003)

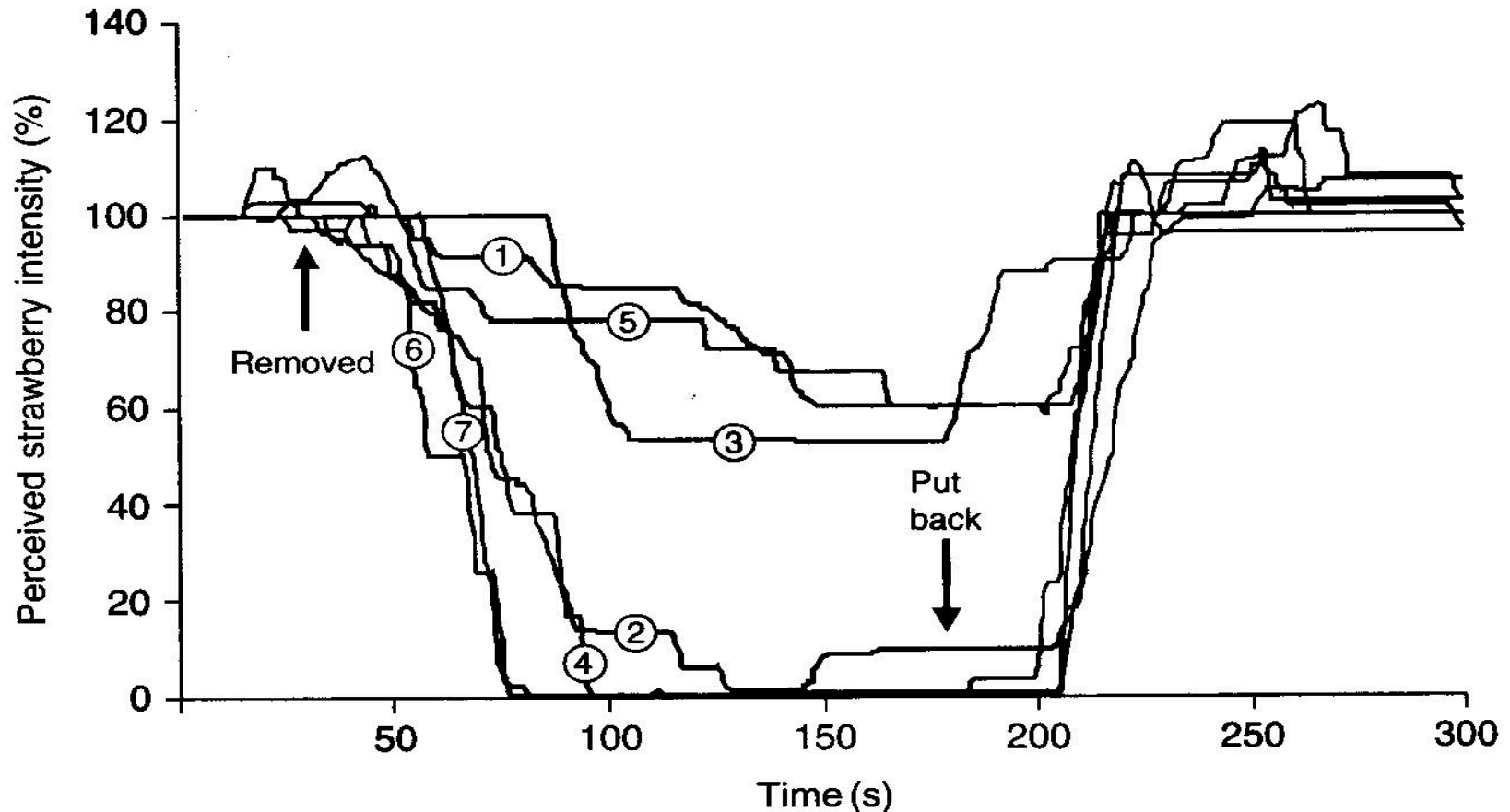


What have we learned?

# Chewing gum - menthone, sucrose and perceived intensity

*(Harvey et al. 2000. In. "Frontiers of Flavour Science".  
271-274. )*

1 - Remove acid; 2 - Remove sucrose; 3 - Remove aroma; 4-7 - Remove combinations of two stimuli



Taylor, A.J. 2004. In: Flavour Research at the Dawn of the Twenty First Century. J.L. LeQuere and P.X. Etievant, eds. Lavoisier: Cachan

# Taste is REALLY important

- Taste must be engineered into a food product  
– not just aroma (cognitive effects)
- Traditionally taste left to your customer
- You must work with both to your advantage

Texture? Does texture interact like  
taste?

Idea – texture provides a barrier to release

# Texture/perception interactions

“Bottom line” - Increasing viscosity or gel strength reduces *flavor* intensity (sensory methods)

Does not change character (in most cases)

# Why is there a texture effect?

- Influence on taste/aroma release
  - **Binding** by ingredients may occur resulting in reducing the driving force for release
  - **Physical barrier** to release
    - reduced diffusion rates,
    - spreading in mouth, or food breakdown in mouth

# Binding

- Studies shown that some hydrocolloids will bind specific flavor components (change in flavor character)
- But the effect too common – less flavor when no measurable binding

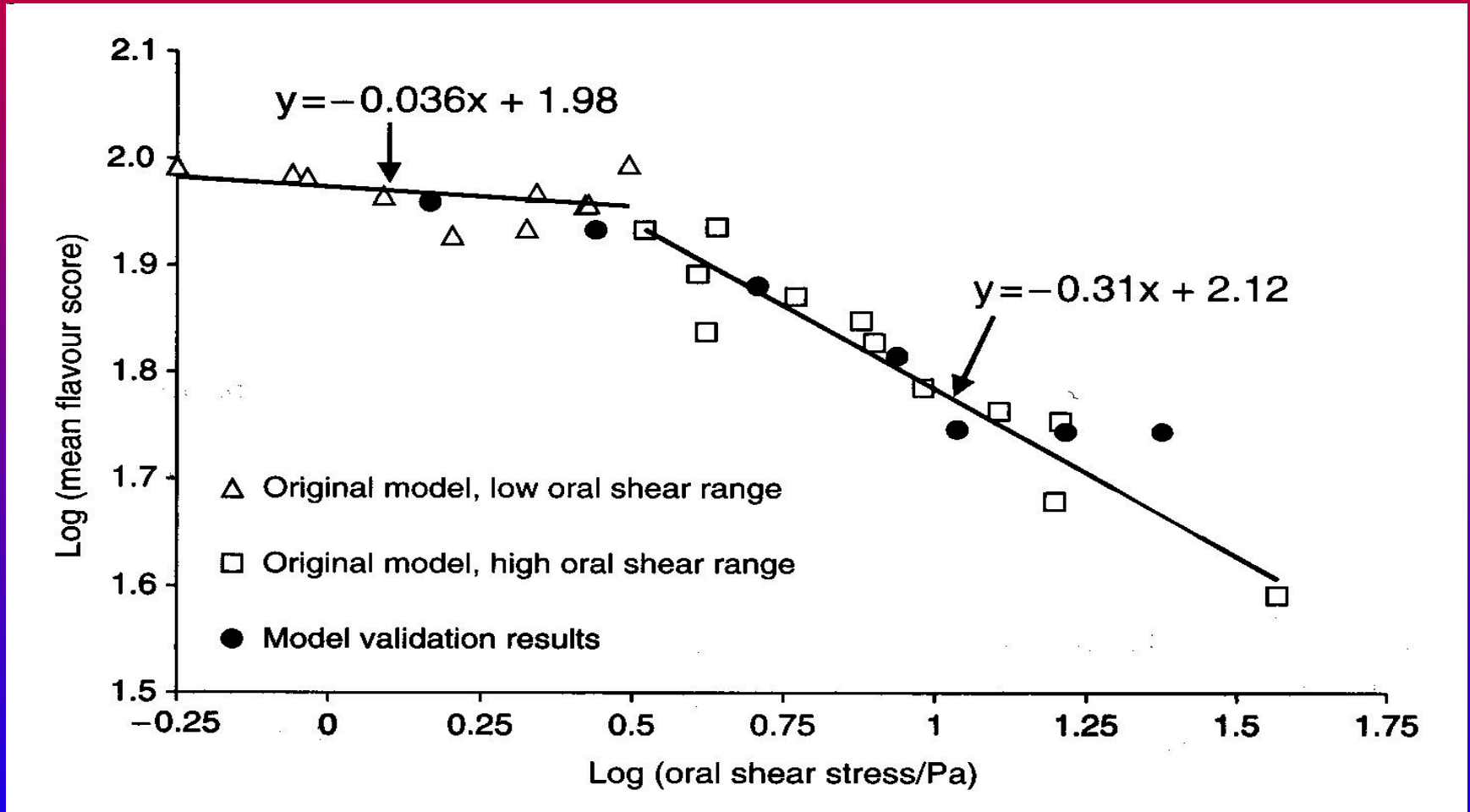
# Physical Barriers to Release - Reduced Diffusion?

- Reduced diffusion rates to air:product interface?
- Effect of food solids
  - Generally little effect of hydrocolloides on diffusion rates – or release - too much free water
  - If viscosity limits diffusion, why does a 20,000 fold change in viscosity result in only a 30% change in release?
- So why is there this effect?

Spent last 10 years studying this

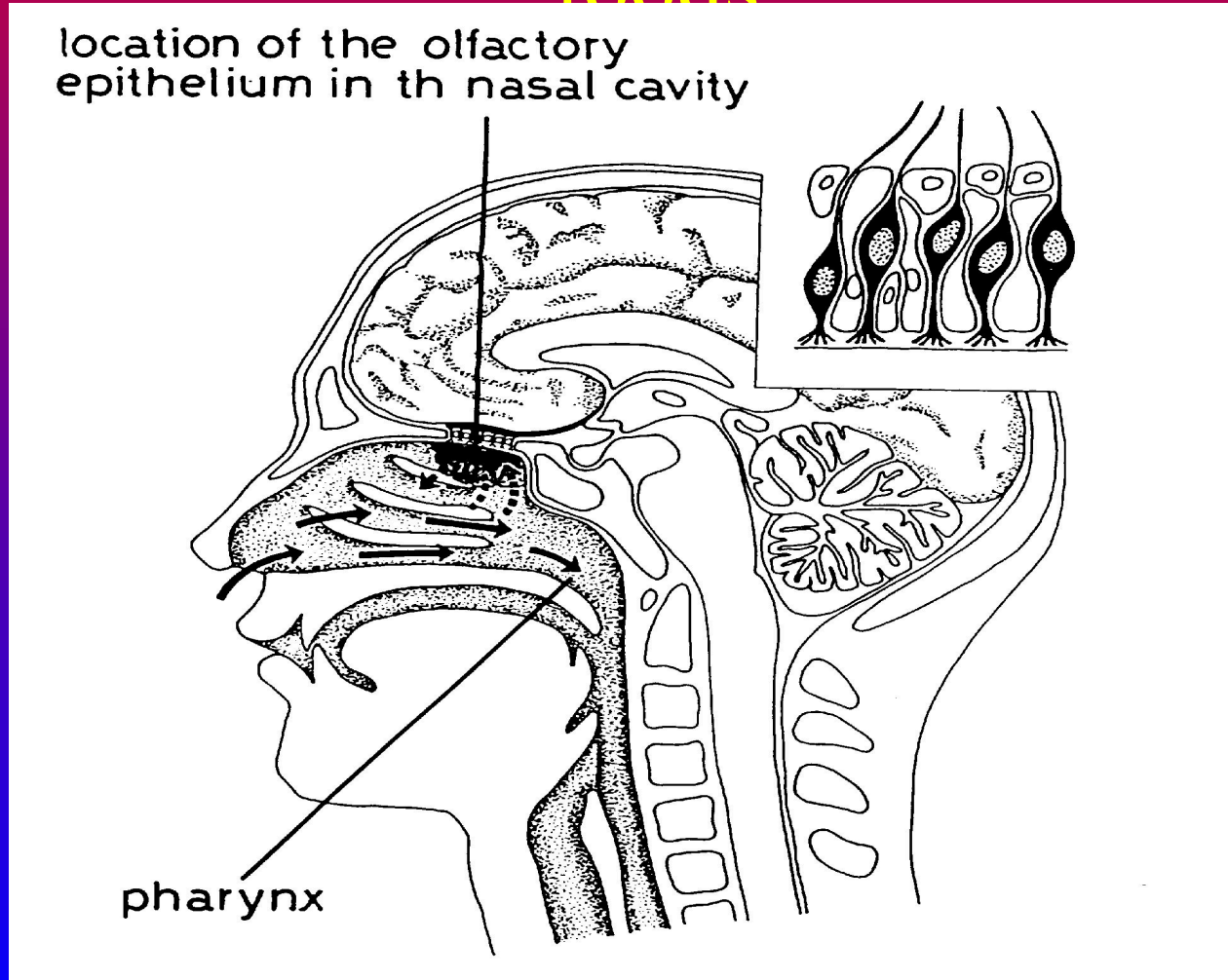
Belief last year was that this is due to a learned effect – we have learned over time that viscous foods have less flavor (even if they do not)

# Prediction of Sensory Intensity based on Oral Shear Stress



New data

# Transport to olfactory receptors – velum closed when drinking liquids or chewing soft foods



# Reason a soft gel has more flavor?

- Chewing a soft gel gives no dose of aroma – no conditioning (greater impact) - during chewing
- Chewing a hard gives dosage of aroma – during chewing - conditions subject to aroma (lesser sensory impact)
- Mestres et al. 2006 J. Agric. Food Chem. 54(5), 1814-1821.

# Does texture influence flavor?

- Yes!

- binding changes character (ingredient dependent)
- Texture causes weakening of flavor but only at some texture level (when person is forced to chew with open air passage)

# Flavor release research and you

- Will detect binding that may influence character of your product
- Can provide guidance in balancing a flavor similar to MS
  - Key word is “guidance”

# Learning

- Taste is REALLY important in supporting aroma – holistic approach
- We understand more about how texture influences perception

# Do you have the needed research capabilities?

- Artificial mouth – can be simple
- Instrument to detect what is released – can be trapping and GC analysis
- Expertise – people and time