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 my 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

What is that?

APCI-MS

Real time

liquid sample, air

9

5

6

7

8

9
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
APCI-MS
Taylor and Linforth (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

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

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

\[ y = -0.036x + 1.98 \]

\[ y = -0.31x + 2.12 \]

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)

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