What is next for science and R&D in terms of reformulation?

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Why add sugar, salt and fat in the first place?

**Taste and flavour**
- Sweet taste
- Salty taste
- Enhancing aromas
- Oil soluble actives

**Texture**
- Sensory texture
- Product texture

**Preservation**
Technological approaches

✓ Gradual reduction

✓ Replacement

- Enhanced perception
- Food (Micro)Structure
Enhanced perception – spatial distribution

- For bread up to 28% reduction suggested without loss of saltiness intensity and without use of sodium substitutes, taste or aroma additives.

- Sugar reduction

Enhanced perception – crystal size

- Smaller crystals of salt → more salty faster but more rapid loss of saltiness after chewing

- Sodium – salivary protein interaction

Enhanced perception

- Demonstrated feasible for saltiness and sweetness in dry foods
- Consumer acceptance?
- BUT

High moisture foods?
High moisture foods

• Temporal delivery
  ➔ Encapsulation & oral release

• Tastant excluding fillers
  to maximise concentration in continuous product phase

Binding to oral mucosa for
prolonged taste experience
Temporal delivery
“Taste perception can be manipulated through controlled delivery of solutions containing different tastant concentrations.”

Because: While we adapt to constant stimuli we notice change. Delivery of bursts of tastant will be noticed as change and change enhances perception.

- 2 studies from literature – salt
One reference

- Temporal delivery of salty solutions


- 15 s
- NaCl in water or bouillon
- 18 – 21 °C
- 10 mL/min
- 11 experienced panellists
Saltiness perception

Amount of salt delivered:
- 125 mg
- 90 mg
- 45 mg

○ in water
● in bouillon

Saltiness perception

- Bars: Overall saltiness scores
- Diamonds: Overall amount of sodium delivered

Note that this finding is based on a specific system.

• Temporal delivery of salty solutions

Saltiness perception

• High-low pulse perceived saltier

Conclusions

Some indication of enhanced perception through pulsing.

But also

Some indication that pulsing is not always adding to the taste experience.

Apparently contradictory results in published literature

System specificity
Encapsulation & Oral release
Encapsulation & oral release

- **Moisture protect salt or sugar crystals**
  - Barrier that will disintegrate following ingestion
  - Fat...?? Alternative solutions?

- **Complex emulsions – water-in-oil-in-water (wow) emulsions**

Breaking down during oral processing.....
....releasing encapsulated high salt or sugar phase
wow emulsions with encapsulated salt

Hypothesised to be insensitive to oral breakdown.

Per 100g:
- 35 g oil,
- 1.4 g PGPR
- 0.7 g NaCl
- 2 g starch or protein

#OSA starch (N-Creamer 46, Univar, UK)  #pea protein isolate
In-mouth manipulation for 20 s
Sensory evidence

- 120 consumers
- Which sample in each pair was saltier? (holding sample in mouth before swallowing)

<table>
<thead>
<tr>
<th>Test</th>
<th>Sample</th>
<th>g salt in internal water phase</th>
<th>g salt in external water phase</th>
<th>g salt/100 g of sample</th>
<th>No of panellists selecting sample to be saltier</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>OSA</td>
<td>0.2</td>
<td>0.5</td>
<td>0.7</td>
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<tr>
<td></td>
<td>OSA</td>
<td>0.2</td>
<td>0.44</td>
<td>0.64</td>
<td>61</td>
</tr>
</tbody>
</table>

#Samples perceived to be significantly saltier (p<0.05).

##Similarity concluded between the 2 samples (95% confidence interval, p_d 30%).
Additional benefit & Challenge

😊 Fat reduction

😊 Microstructure stability
Overcoming microstructure instability

- **Particle stabilisation of both emulsion interfaces**
  
  Two types of silica particles of different hydrophobicity - triglyceride oil.


- **Osmotic pressure gradient control**
  
  0.4 M glucose v 0.2 M KCl

  Membrane emulsified; Unilever R&D

Tastant excluding fillers
Tastant excluding fillers

Total amount of tastant consumed for same size of serving.

X mg/L tastant

>?

X mg/L tastant

Y mg/L tastant

Microstructure design

=?

Y > X

X mg/L tastant

Y mg/L tastant

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Tastant excluding fillers

- **Wow emulsions ... saltiness**
  

- **Air bubbles ... saltiness and sweetness**
  

(2-Alternate Forced Choice tests, BS ISO 5495:2007; 39 or 41 consumers)
Wrap-up
Challenge for all technological solutions

Sensory perception is multimodal

perception
R&D requirements

- Food materials
- Shelf life
- Consumer satisfaction

Model systems
Close to market formulations
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