Enhancing the sensory properties of food to maintain satiety and reduce energy intake

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Outline

- Sensory influences on food intake control
- A functional role for sensory cues, beyond liking
  - Taste
  - Texture
  - Meal size
  - Food selection
- Optimising foods for satiety
- Sensory enhanced satiation and satiety

The sensory experience and energy intake control

- Cognitive and sensory cues are integrated with post-ingestive nutrient effects to influence eating behaviour
- The traditional view is that sensory cues influence food choice and satiation (meal size)
- This has been attributed to the positive hedonic response associated with certain sensory cues: palatability

Chambers, McCrickerd & Yeomans “Optimising foods for satiety” Trends in Food Science and Technology (2015)
Sensory cues and energy reduction

- Sweet taste is a driver of palatability
- No or low calorie sweeteners are one way to remove energy from the diet whilst maintaining the sweet sensory experience

This approach is not without its controversies, but is it effective?

Sensory cues and energy reduction

139 kcal 89 kcal 0 kcal

Incomplete compensation for the calories replaced by sweeteners from one meal to the next, means a likely net saving of energy intake over the course of the day

139 kcal 89 kcal 0 kcal

Short term ... reduced total energy intake from one meal to the next for foods and beverages sweetened with LES vs. sugar ...

Longer term ... consumption of LES vs. sugar sweetened foods and beverages led to relatively reduced body weight ...

A functional role for sensory characteristics

- The use of low calorie sweeteners is a good example of reducing the energy in a product whilst maintaining liked sensory qualities
- An alternative approach is to consider the sensory experience could be used to reduce energy intake through:
  - Moderating meal size
  - Expected hunger and fullness
  - The experience of satiety post-consumption
- Taste intensity and texture have been identified as having an important influence on these behaviours

Chambers, McCrickard & Yeomans "Optimising foods for satiety" TIFS (2015)
Considering the functional role of sensory cues

**Meal size: Sensory intensity**

Independent effect of taste intensity on food intake

From: McCrickerd & Forde, Obesity Reviews (2015)
Meal size: Slow vs. fast foods

<table>
<thead>
<tr>
<th>Solid</th>
<th>Semi-solid</th>
<th>Liquid</th>
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</thead>
<tbody>
<tr>
<td>53 g/min</td>
<td>141 g/min</td>
<td>619 g/min</td>
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Reductions in intake with little or no awareness as people tend to eat in response to the textures served, by taking smaller bites and chewing for longer.

Expectations of hunger and fullness

- People often choose how much how much they will consume
- In this instance, beliefs about the satiating power of foods and beverages can guide behaviours

Expectations of hunger and fullness: Portion selection

Wilkinson et al., Appetite (2012)
What is the basis for these expectations?

Sensory cues have nutritional meaning

- People eat in response to tastes and textures
- Food texture is an important driver of eating rate and calories consumed
- Taste and texture cues may be an important predictive cue for nutrients, which drive expectations about how satiating a food might be.
- Can sensory modification be used to improve a product’s anticipated and actual satiating power?

Optimising foods for satiety

1. Expectations of hunger and fullness
2. Selected intake
3. Experience of satiety
Optimising satiety: Strengthening the sensory input

McCrickerd, Chambers, Brunstrom & Yeomans, *Flavour*, 2012

**Optimising satiety**

McCrickerd, Chambers, Brunstrom & Yeomans, *Flavour*, 2012

McCrickerd, Chambers & Yeomans, *Appetite*, 2013

Optimising foods for satiety

McCrickerd, Chambers, Brunstrom & Yeomans, *Flavour*, 2012
**Sensory enhancement of nutrient-based satiety**

Satiety-relevant sensory characteristics act as cues for energy delivery


**Conclusions**

People eat in response to tastes and textures

- Thicker, chewier, harder foods are eaten slower and consumed in smaller portions (these reductions don’t appear to be missed)

Sensory modification can be used to enhance expectations of satiety

- Satiety-relevant sensory cues are associated with enhanced feelings of fullness and reduced hunger.
- Foods/beverages with these properties may be selected in smaller portions

The sensory experience interacts with energy delivered to influence satiety

- Higher energy products are experienced as more satiating when their sensory characteristics predict nutrient delivery

Optimising foods for satiety means considering the congruency between the sensory experiences and the energy that is delivered post-ingestion.

**Sensory Enhanced Satiety**

- Improved satiety responses when energy is consumed in a satiety-relevant sensory context

**Sensory enhanced satiation and satiety**

- Fluid or Fuel? The Context of Consuming a Beverage Is Important for Satiety
Sensory enhanced satiation and satiety

1) Identify the foods and beverages that could benefit from sensory modifications

2) Understand how sensory modifications can be combined with energy reduction to optimise satiety.

3) Determine the longer term impact of ‘sensory enhanced’ foods and beverages for weight management