Benefits of satiety enhancement – do functional foods deliver?

Professor Marion Hetherington
Benefits of satiety to the consumer

Aim:
To consider and evaluate research on possible benefits of enhanced satiety and appetite control to the consumer

Main questions:
1. How is functionality defined?
2. How do we describe and measure satiety?
3. What foods or ingredients promote satiety?
4. What do consumers understand by “satiety” claims?
5. What are the benefits?
6. Do functional foods deliver?
How is functionality defined?
Defining functionality
Ashwell (2001) PHN a food is functional if

a) provides a benefit beyond nutritional content by improving health and well being or reducing risk of disease e.g. lowering cholesterol

b) not pills nor capsules but part of a normal food pattern e.g. whole foods or enhanced foods
Food products with hunger control or satiety claims
Food products with weight claims

“To help with your weight maintenance plan”
Defining functionality: EU

EC Concerted Action on Functional Food Science (FUFOSE) proposed a working definition

http://www.ilsi.org/Europe/Pages/FUFOSE.aspx

**those foods which are intended to be consumed as part of the normal diet and that contain biologically active components which offer the potential of enhanced health or reduced risk of disease.**

e.g. foods that contain specific minerals, vitamins, fatty acids or dietary fibre, foods with added biologically active substances such as phytochemicals or other antioxidants and probiotics.....
changes in **appetite ratings** after consumption of a “test” food should also be observed after chronic consumption of the food (e.g. after one month)

• tests performed on a **single occasion** insufficient for substantiation

changes in **energy intake** must be shown over **time**; after chronic consumption of the food (e.g. after one month),

• tests performed on a single occasion insufficient for substantiation.
Satiety claims would be considered function claims based on the modulating effects of foods on sensations of appetite, such as increased feeling of fullness and/or reduced sense of hunger. These effects could potentially be beneficial to individuals who wish to control their energy intake.

.....satiety claims must be comparative claims....beneficial effects on measures of satiety when compared to a reference (control) food
<table>
<thead>
<tr>
<th>Type</th>
<th>Acceptable</th>
<th>Unacceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comparative</strong></td>
<td>Comparing magnitude of effect for a specific length of time (duration of effect must be included). A serving [of stated size] of product X is more filling than a serving [of stated size] of product Y for up to 2 hours.</td>
<td>Product X increases feelings of fullness longer than product Y (amounts of products X and Y must be stated if the serving sizes are not the same).</td>
</tr>
<tr>
<td></td>
<td>Comparing duration of effect. A serving [of stated size] of product X gives feelings of fullness longer than a serving [of stated size] of product Y.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Comparing both magnitude and duration of effect. A serving [of stated size] of product X is more filling and for longer than a serving [of stated size] of product Y.</td>
<td></td>
</tr>
<tr>
<td>Unacceptable</td>
<td>A serving (of stated size) of X with Y grams of ingredient Z can suppress hunger longer than the same amount of X without ingredient Z.</td>
<td></td>
</tr>
<tr>
<td>Unacceptable</td>
<td>Ingredient Z helps suppress hunger (no comparator; extrapolation of the effect of an ingredient or generic macronutrient content across product types or forms cannot be made without supporting evidence).</td>
<td></td>
</tr>
<tr>
<td><strong>Absolute (Non comparative)</strong></td>
<td>A serving (of stated size) of X helps reduce the desire to eat for up to 4 hours.</td>
<td>A serving (of stated size) of X is satisfying for up to 4 hours (vague and not an outcome based on VAS).</td>
</tr>
</tbody>
</table>

The serving sizes in brackets do not need to be stated if they are the same for the products being compared.
## “Satiety” claims

<table>
<thead>
<tr>
<th>Food product</th>
<th>Claim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition shake</td>
<td>“freedom from hunger”</td>
</tr>
<tr>
<td>Vanilla milkshake</td>
<td>“re-programs appetite to reduce hunger and cravings”</td>
</tr>
<tr>
<td>Oatmeal, cereal, milkshakes</td>
<td>“helps satisfy your hunger”</td>
</tr>
<tr>
<td>Yoghurt, ready-to-eat meals</td>
<td>“Fuller for longer”</td>
</tr>
<tr>
<td>Egg protein</td>
<td>“helps you want to eat less”</td>
</tr>
<tr>
<td>Protein shake</td>
<td>“keep me going to prevent hunger”</td>
</tr>
</tbody>
</table>
How do we describe and measure satiety?
Defining satiety

**Satiation**
the process by which food intake is terminated; measured by within meal ratings of appetite and *ad libitum intake* of single food or meal

**Satiety** (post-prandial)
inhibition of further eating, modulation of hunger in post-ingestive period

Measured by **magnitude** or **duration** of changes in subjective ratings of appetite-related sensations usually by visual analogue scales (VAS)
Hunger precedes meal intake

Breakfast
Satiation

Lunch
Satiation

Dinner
Satiation
What foods or ingredients promote satiety?
Properties of foods which could promote satiety

Macronutrient content (e.g. protein > fat)

Fibre content (high fibre > low fibre)

Glycaemic index (low GI > high GI)

Energy density (low kcal/g > high kcal/g)

Structure (solid food / viscous food > liquids)
Effect of low fat yoghurt enriched with protein and fibre

• Casein protein
• Guar gum

Protein and fibre yoghurt suppressed hunger for 2hr
Reduced energy intake at lunch (~65kcal)

What do consumers understand by “satiety” claims?
Evidence from consumers

**Health** benefits are important to consumers, e.g. cholesterol lowering ingredients.

Preventing disease and concerns about body weight are commonly cited health considerations.

**Managing hunger** is also mentioned in relation to weight control.

However, satiety effects are experienced immediately and are easily discernible.
Consumers describe **fullness** as

- “a feeling of food in the stomach”
- “stomach stretch”
- “satisfaction”
- “lack of the desire to eat”

- The term « satiety » is not typically used

Murray & Vickers Appetite (2009)
What do consumers understand about satiety?

Bilman et al (2012) assessed understanding in 1504 respondents in UK, Italy, France and Germany.

Most correctly interpreted satiety claims.

Majority did not extend satiety claim to include weight loss (no magic bullet) identifying personal efforts to achieve weight loss.

But restrained eaters more likely to over-interpret satiety claims for weight loss benefits.
Weight loss can only be achieved by sustained, goal-directed changes in lifestyle including diet and activity.

Satiety enhancement per se cannot produce weight loss.
What are the benefits?
Potential benefits of satiety

Reduced **opportunistic eating** (some consumers)

Strengthen weak **internal cues** of satiety

**Pleasure** associated with lower energy food products without feeling “deprived”

Reduced **hunger dysphoria**

Improved **hunger management**

Improved **compliance** with goal directed behaviours

**Adjunct** to achieving weight loss and **reducing** the risk of weight gain
Goal directed behaviour

Satiety enhancement may increase compliance with a healthier diet.

Lower ED foods/liquids may promote weaker satiety than high ED foods/liquids.

Hunger management increases eating self-efficacy so healthy eating goals may be more easily achieved.

Satiety enhancement may increase compliance with a weight loss diet (hunger and food cravings may impair compliance).
Targeting appetite using specific foods or meals can be a means of managing hunger arising from periods of energy restriction.

Hunger management may help individuals resist the strong environmental and situational cues to overconsume.

Success of pharmacological agents to manage hunger — can foods provide a similar if more subtle effect on satiety (e.g. d-fenfluramine)?
Perceived hunger predicts failure to lose weight in clinical trials (Womble et al., 2001)

Higher fasting state ratings of appetite associated with lower weight loss (Drapeau et al., 2007)

Hunger is associated with weight regain (Pasman et al, 1999)

Market research reasons for non-compliance to weight loss diets:

“Cravings for foods I love”

“Always being hungry” (Unilever Strategic Segmentation Study, 2007, US)
Reduced hunger with high protein low CHO diets

Mean (SEM) daily hunger (mm), HPLC (ketogenic) diet and HPMC (nonketogenic) diet. Over the 4-wk period, hunger was significantly lower with the LC diet than with the MC diet.

Overweight adults (n = 773) from 8 EU countries lost at least 8% of their body weight on an 800 kcal low-calorie diet (LCD) then randomised to one of 5 ad libitum diets to prevent weight regain over a 26-week period.

Maintenance diets were either high or low in protein and GI according to a two-by-two factorial design or a control diet. Completion rate and maintenance of weight loss were highest with the high-protein low GI diet; (Larsen et al., 2010).
High protein and low GI promote weight loss maintenance

![Graph showing change in body weight over weeks with different conditions: LP-HGI, LP-LGI, Control, HP-HGI, HP-LGI.](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Week 0</th>
<th>Week 2</th>
<th>Week 4</th>
<th>Week 6</th>
<th>Week 8</th>
<th>Week 10</th>
<th>Week 12</th>
<th>Week 14</th>
<th>Week 16</th>
<th>Week 18</th>
<th>Week 20</th>
<th>Week 22</th>
<th>Week 24</th>
<th>Week 26</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP-LGI</td>
<td>150</td>
<td>116</td>
<td>121</td>
<td>118</td>
<td>112</td>
<td>104</td>
<td>101</td>
<td>97</td>
<td>106</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LP-HGI</td>
<td>155</td>
<td>118</td>
<td>114</td>
<td>118</td>
<td>108</td>
<td>104</td>
<td>95</td>
<td>91</td>
<td>97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP-LGI</td>
<td>159</td>
<td>132</td>
<td>136</td>
<td>131</td>
<td>125</td>
<td>116</td>
<td>118</td>
<td>114</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP-HGI</td>
<td>155</td>
<td>130</td>
<td>124</td>
<td>121</td>
<td>118</td>
<td>114</td>
<td>100</td>
<td>104</td>
<td>107</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>154</td>
<td>126</td>
<td>131</td>
<td>125</td>
<td>131</td>
<td>125</td>
<td>118</td>
<td>110</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Model to understand benefits

Hetherington et al (2012) NRR submitted
Summary

Satiety enhancement may be desirable to some consumers. May strengthen internal cues of satiety. Offers pleasure without feeling deprived. Potential for improved dietary compliance (healthy diet or weight loss) since perceived hunger is a barrier to dietary compliance. Functional foods for satiety may confer consumer benefits including those related to weight management.

Do functional foods deliver? Good short term evidence, but long term studies are yet insufficient.
Acknowledgements

ILSI expert panel

Louise Dye, University of Leeds
Leigh Gibson, Roehampton University
Nikolaj Gregersen, University of Copenhagen
Jason Halford, University of Liverpool
Clare Lawton, University of Leeds
Hans van Trijp, Wageningen University
Karen Cunningham (Coca Cola)
Anne Lluch (Danone)
David Mela (Unilever)

ILSI staff

Athanasia Baka
Frederic Timmermans