Sodium Reduction and Product Reformulation
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Campden BRI

- Membership based organisation c.2050 members
- Independent, non-profit distributing
- International – clients in 70 countries
- Turnover: c.£21 m
- Staff: 390
- Industry and Government clients

- The practical application of technical excellence for the food and drink supply chain
• Sources of sodium and functions in foods
• Options for overcoming flavour issues when reducing salt
• Replacing the preservative function of sodium
• Processing issues when reducing sodium
Sources of sodium

• 75% from processed food
  – includes both salt and additive sources such as leavening agents or curing salts

Contribution to sodium intake

- Processed foods: 75%
- Salt shaker: 12%
- Naturally present in foods: 13%
Functions of Salt and Sodium

- Flavour
- Preservation
- Texture
- Helps control the manufacturing process
- Raising agent in bakery products
# Function of salt in food products

<table>
<thead>
<tr>
<th>Food Products</th>
<th>Taste</th>
<th>Texture</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready meals</td>
<td>++</td>
<td></td>
<td>++</td>
</tr>
<tr>
<td>Bread</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Meat products (processed)</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Processed fish</td>
<td>+</td>
<td></td>
<td>++</td>
</tr>
<tr>
<td>Soup</td>
<td>++</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pickled vegetables</td>
<td>+</td>
<td></td>
<td>++</td>
</tr>
<tr>
<td>Savoury sauces</td>
<td>++</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Crisps</td>
<td>++</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakfast cereals</td>
<td>+</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Condiments</td>
<td>++</td>
<td></td>
<td>+</td>
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</tbody>
</table>
Low sodium food products must

• have a good taste and texture
• be able to be commercially manufactured
• be cost effective
• be microbiologically safe
• have a realistic shelf life
Sensory functions of salt

– Enhances flavours
– Described as giving a fuller mouth feel
– Can mask undesirable flavours – bitterness

– Salt Perception depends on
  • Rate of dissolving in the mouth
  • Mixing of food with saliva
  • Amylase activity
  • Differences in individual perception
Approaches for maintaining taste while reducing salt

- Reduction by Stealth
  - gradual reduction used by many food manufacturers
- Salt Substitutes
- Salt Enhancers
- Changing the structure of the salt crystal
- Changing the product structure

No single solution for all applications
Approaches to reduce – Salt Substitutes

• Taste of inorganic salts

<table>
<thead>
<tr>
<th>Salt</th>
<th>Primary taste</th>
<th>Other tastes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium chloride</td>
<td>salty</td>
<td>sweet</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>bitter</td>
<td>salty, sweet</td>
</tr>
<tr>
<td>Calcium chloride</td>
<td>bitter</td>
<td>sour, sweet, salty</td>
</tr>
<tr>
<td>Magnesium sulphate</td>
<td>salty</td>
<td>bitter</td>
</tr>
</tbody>
</table>

• Some sea salts contain other inorganic salts with NaCl
Advantages of Potassium Chloride based replacers

• Allows for a significant reduction in sodium
• Much of the population are deficient in potassium
• Can lower water activity in a similar way to NaCl providing a preservative effect
• KCl has some effect on texture – for example increasing the water holding capacity of meat proteins
• Wide choice of products available
Disadvantages of Potassium Chloride based replacers

• COST
• Increased potassium intake can cause health problems for sufferers of Type 1 diabetes, chronic renal insufficiency, severe heart failure
• DoH currently do not recommend this approach
• Bitter or metallic aftertaste when replacing salt at over 25-40%
• Has to be declared as potassium chloride
Sodium Chloride tastes sweet at a low level

Potassium chloride is the most popular salt substitute
A range of salt substitutes are available

For example

Lo Salt® - 66% KCl, 33% NaCl
AlsoSalt® - KCl and L-lysine
Pansalt® - 57% NaCl, 28% KCl, 12% MgSO₄, I-Lysine hydrochloride 2%
LomaSalt® - 50% NaCl, 46% KCl
Sub4salt® - Sodium gluconate, KCl and NaCl 65%
SOLO™ - Low sodium mineral sea salt, 42% NaCl, 41% KCl, 17% MgCl₂
SaltWell® - Low sodium mineral salt 65% NaCl, 30% KCl
Salt/flavour Enhancers

- Wide range of ingredients available claimed to enhance saltiness - up to 50% salt reduction claimed.
- Yeast extracts
- MSG, glutamates & glutamic acid
- Nucleotides – e.g. adenosine 5’-monophosphate (AMP) blocking bitter taste
- Peptides and amino acids (L-lysine)
- Hydrolysed vegetable protein
- Flavourings – i.e. Givaudan TasteSolutions
- Seaweed based enhancers – e.g. Seagreens
Yeast Extracts

• Yeasts extracts enhance umami and savoury flavours – not suitable for all products
• Have a fairly good consumer perception
• Produce by a ‘natural’ process
  – Yeast strain development
  – Yeast fermentation
  – Enzyme technology – to break yeast cells
  – Separation
Increasing salt perception through manipulating structure

- Smaller salt crystals produce a higher salt intensity and deliver a faster impact
  - Salt products with finer particle size
  - SodaLo™ - microscopic hollow ball
- Flaked salt shown to be more functional in meat – binding and improving cooking yield
- Changing thickener type can alter salt perception
Increasing salt perception through manipulating structure

• Pulsed delivery of salt can enhance salt perception
• Recent publications showing some potential
  – High salt particulates in a soup
  – Inhomogeneous distribution of salt in bread
• Difficulties in manufacturing products and preventing salt migration/equilibrium during shelf life
Reducing salt using aromas to enhance salty taste

• Taste-aroma interactions can enhance perceived saltiness
• Odour-Taste Interaction studies on enhancing saltiness in literature
• Research shows aromas associated with salty foods enhance salt perception – cheese, sardine, bacon, tomato and chicken
• Putting these aromas in either food or packaging can enhance salt perception
Replacing preservative function of salt

Functions

• Lowers the water activity which prevents/slow growth of micro-organisms
• Lowering salt levels may reduce shelf life

Alternative approaches

• Ionic salt substitutes e.g. Potassium chloride
• Potassium lactate based ingredients option in meat products due to bacteriostatic activity
• Preservatives
• Whey salt mixtures in cheese
• Heat processing
• Using other humectants ingredients
Overcoming texture and processing issues in replacing sodium

- NaCl binds water affecting the texture of processed meat, cheese and bakery products
- Sodium chloride controls yeast fermentation and enzyme activity
- Use of gums or starches to bind excess water
- Use of potassium chloride based salt substitutes
- Could process be more tightly controlled to allow production at lower salt content
Product Reformulation Steps

• Identify all the sources of sodium and understand its function in your product
• Determine a realistic level of sodium reduction you need to achieve
• Explore gradual reduction initially without compromising safety, shelf life and quality.
• Be aware of any formulation restrictions— for example clean label or shelf life requirements
• Research a list of alternative ingredients or changes to process or product that could assist in reducing salt
• Review all the costs of the various options
• Undertake development, shelf life, sensory & consumer trials
Current approaches for salt replacement

• No one size fits all for salt replacement
• A tool box of approaches is likely to be more successful
• Where salt is important in the texture, processing and preservation of the product task is more complicated
• Much ongoing research and development in salt reduction
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