Technical strategies to advance sugar replacement

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Campden BRI

- Membership based organisation c.2,400 members
- Independent, non-profit distributing
- International – clients in 75 countries
- Staff: 380
- Industry and Government clients
  - The top 8 UK retailers
  - 8 of the 10 top global manufacturers
- Practical science, technology and knowledge services for the food and drinks industry
Why reduce sugar?

• Government recommendations e.g. responsibility deal pledges, SACN report
• Retailer pressure
• Pressure from lobby groups & media
• Public health – obesity, dental caries
• Changing consumer demands
• Market opportunities
• Provision of safe and high quality products!
Roles of sugar

• Texture/volume
• Appearance/colour
• Flavour balance
• Preservation
• Reduction of freezing point
Options for replacement – other sugars & nutritive sweeteners

- E.g. fructose (agave syrup, honey, fruit juices are high in this)
- Similar calorie content (fructose = 4kcal/g) but sweeter
- Potential for better consumer perception
- Flavour changes
- Not necessarily natural!
Options for replacement – high potency sweeteners

• E.g. Aspartame, acesulfame K, sucralose, steviol glycosides
• Sweeter than sugar, provide no/negligible calories at levels used
• Sweetness not linear
• Consumer perception
• Limited applications & often only in no added sugar / reduced energy products
Options for replacement – bulk, low & no calorie sweeteners

- E.g. Polyols (erythritol, xylitol, etc.), inulin, FOS, polyglycitol syrup
- Similar or less sweet than sugar (sucrose)
- Lower calorie content (polyols = 2.4 kcal/g (erythritol = 0 kcal/g), inulin & FOS classed as fibre = 2 kcal/g)
- Warning labels (polyols, laxative effect)
- Mouth cooling (some polyols)
- Limited applications for polyols
Considerations when selecting sugar replacers

• Application
  – Browning?
  – Is the product heated to elevated temperatures?
  – Is viscosity / bulk required?
  – Amount of sweetness required?
  – Flavour profile?

• Market
  – Consumer attitudes?
  – How much calorie reduction is required?
  – Cost constraints?
  – Health & wellness claims - dental
Challenges when using sugar replacers

- Most are not natural products (sugar is ‘clean label’)
- Sugar has many functions so more than one material is required for its replacement (ingredients list gets longer)
- Some have side effects / requirement for warning statements
- Manufacturing costs may increase
- Product & texture are usually different
- Calorie content can sometimes increase
Sugar reduction in bakery products

- Sugar generally added as sucrose and/or glucose
- Challenge of removing bulk & reducing calories (often fat reduction also required)
The role of sugar in bakery products

- Flavour
- Bulking agent
- Stabilises and controls batter viscosity
- Influences the settling temperature
- Colour / flavour (caramelisation & Maillard reaction)
- Humectant (preservation)
- Softens the texture
## Sugar alternatives for bakery applications

<table>
<thead>
<tr>
<th>Sugar property</th>
<th>Possible low calorie replacer material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavour</td>
<td>Artificial sweeteners</td>
</tr>
<tr>
<td>Bulking agent</td>
<td>FOS, Inulin, Polyols (sorbitol, maltitol etc)</td>
</tr>
<tr>
<td>Stabilises and controls batter viscosity</td>
<td>Hydrocolloids, e.g. Xanthan gum</td>
</tr>
<tr>
<td>Influences the setting temperature</td>
<td>Salt</td>
</tr>
<tr>
<td>Colour/flavour – Caramelisation and Maillard reaction</td>
<td>Reducing sugars</td>
</tr>
<tr>
<td>Humectant</td>
<td>Glycerine, salt</td>
</tr>
<tr>
<td>Softens the texture</td>
<td>Air, water, fat</td>
</tr>
</tbody>
</table>
Case study 1 – high ratio yellow cake

• Example formulation
  – Sugar, flour, egg, fat, water, glycerol, skimmed milk powder, baking powder, emulsifier, salt

• Challenges
  – Maintaining flavour profile & appearance (colour, structure, volume)
  – Achieving sufficient calorie reduction (fat reduction may also be required)
  – Water activity

• Approaches to reduction
  – Remove / reduce sugar & fat and replace with bulk replacers (e.g. gel system, FOS, inulin, polyol)
  – Alterations to raising agents & baking profile may be required
Case study 2 – filled biscuits (short dough shell)

• Example formulation
  – Flour, fat, sugar, water, skimmed milk powder, salt, raising agents (e.g. sodium bicarbonate & ammonium bicarbonate)

• Challenges
  – Maintaining flavour
  – Maintaining visual properties (colour, shape, etc.)
  – Maintaining texture

• Approaches to reduction
  – Bulk sugar & fat replacers (polyols, inulin, FOS, etc.)
  – Increase flavouring
Case study 2 – filled biscuits (filling)

• Example formulation
  – Hard fat, sugar, skimmed milk powder, lecithin, flavouring, colouring

• Challenges
  – Maintaining texture
  – Maintaining flavour
  – Water activity

• Approaches to reduction
  – Bulk sugar & fat replacers (polyols, inulin, FOS, etc.)
  – Increase flavouring
Sugar reduction in beverages

• Sugar in beverages may be…
  – Added: e.g. granular sugar (sucrose), glucose fructose syrup
  – Naturally present in ingredients: e.g. fruit juice
• In soft drinks due to low pH sucrose inversion to fructose & glucose increasing sweetness and leading to changes in flavour profile
The role of sugar in beverages

• Sweetness
  – ‘Gold standard’ of flavour

• Flavour perception
  – Enhancement / complementing of flavours
  – Reduction in perception of acid flavour in soft drinks
  – Moderation of ‘alcohol burn’ in some alcoholic beverages

• Texture (mouthfeel)
  – Provides viscosity

• Stabilisation of clouds and pulps via viscosity contribution

• Fermentation substrate in alcoholic beverages

• Preservation
Approaches for reduction/removal

- Stealth reduction – difficult with additive restrictions
- Replacement…

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<tr>
<td>Bulk</td>
<td>Water, lower sugar alternatives?</td>
</tr>
<tr>
<td>Flavour (sweetness)</td>
<td>High potency sweeteners, fructose, flavouring, sweet taste modulators</td>
</tr>
<tr>
<td>Flavour (enhancement)</td>
<td>Flavouring</td>
</tr>
<tr>
<td>Texture</td>
<td>Gums, pectin's</td>
</tr>
</tbody>
</table>

- Sweet taste modulators – bind sugar to sweet taste receptors to enhance sweetness
- Masking agents – usually may be listed as natural flavourings on ingredients declarations
Case study 1 – carbonated soft drink

- **Typical formulation**
  - Water, sugar, (fruit juice concentrate), colouring, acid, (preservative), flavouring

- **Challenges:**
  - Maintaining sweetness
  - Maintaining flavour profile

- **Approaches for reduction**
  - Remove / reduce added sugar and replace with high potency sweeteners
Case study 2 – fruit juice based drink

• Typical formulation
  – Fruit juice

• Challenges:
  – Maintaining sweetness
  – Maintaining flavour profile
  – Maintaining viscosity

• Approaches for reduction
  – Replace some juice with water
  – Add high potency sweetener, thickener, acid & flavouring
  – Incorporate vegetable juice?
Case study 3 – dairy based drink

- Typical formulation
  - Milk (skimmed / whole), fruit juice / puree, sugar, flavouring, stabilisers, colouring

- Challenges:
  - Maintaining sweetness & flavour
  - Maintaining viscosity
  - Sugars from milk
  - Energy from milk, etc.

- Approaches for reduction
  - Remove / reduce added sugar
  - Add high potency sweetener, adjust levels of thickener & flavouring
Summary

- Reducing sugar is not easy!
- Considerations for removal / reduction
  - Role of sugar in product
  - Regulatory constraints
  - Simply removing sugar may not be enough (fat reduction is sometimes also required)
- Toolbox approach
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