

# Tackling the issues of reducing the sugar in cakes

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# Content

- Update on sugar issues in the UK – the challenges facing the industry
- Functions of sugar and the alternatives
- The future

# Update on sugar issues in UK

- UK government published draft legislation for a tax on sugar-sweetened drinks, to begin from April 2018.
- Ministers hope it will help tackle the obesity problem.
- Two bands; >5g of sugar per 100ml and a higher band for drinks with >8g per 100ml (amounts to an extra 6p on a regular can of Fanta and Sprite, and 8p on Coca-Cola, Pepsi and Irn-Bru).
- Many companies have already begun cutting the amount of sugar in their drinks.
- The government has said it expects the levy to raise £520m in the first year.

# Sugar claims



- Low sugar
  - $\leq 5.0\text{g}/100\text{g}$  (solids)
  - $\leq 2.5\text{g}/100\text{ml}$  (liquids)
- Sugar-free
  - $\leq 0.5\text{g}/100\text{g}$  or 100ml
- With no added sugars
  - *Contains naturally occurring sugars*
- Reduced sugar
  - *At least 30% less than a comparable product*



# What's next?

- Other high sugar products will follow such as bakery products '.....they are high in free sugars but offer little nutritional value'.
- 20% reduction by 2020 (PHE, 30 March 2018)
  1. Reformulating
  2. Reducing portion size
  3. Shifting consumer purchasing habits
- Includes all sugars whether added or natural
- Without increasing saturated fat or calories

# Sugar Reduction: Achieving the 20%

- Recognise some businesses will need technological solutions to achieve sugar reductions, but encourage industry to consider simple solutions first.
- Data from the National Diet and Nutrition Survey showed foods that contributed most sugar to children's intakes: biscuits; breakfast cereals; cakes; chocolate confectionery; ice cream, lollies and sorbets; morning goods (e.g. pastries, buns and waffles); puddings (including pies and tarts); sweet confectionery; sweet spreads and sauces; and yogurt and fromage frais.

# How is sugar content measured?

- Regulation (EU) No 1169/2011 FIC defines sugars for labeling purposes as the sum of all monosaccharides and disaccharides present in food, but excludes polyols
- Monosaccharides – glucose, fructose, galactose
- Disaccharides – maltose, sucrose, lactose
- Therefore no higher sugars such as maltotriose

# Analytical methods

- Most common is HPLC – gives a profile – requires capital investment and analytical skill
- Enzymatic – specific to each sugar, analytical dexterity required
- Titration of reducing sugars (Lane Eynon and Luff Schoorl) - gives total sugars after inversion of sucrose with acid
- Brix refractometry – use with caution, measures dissolved solids not specifically sugars, is matrix dependant

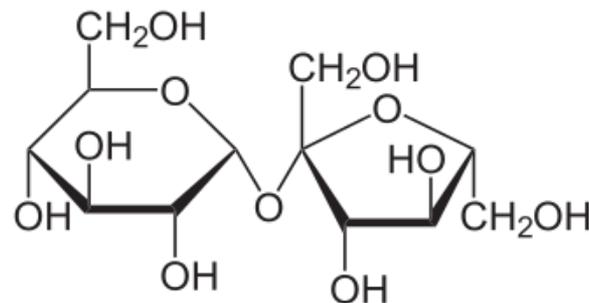
# The Functionality of sugar (in cakes)

1. **Flavour**
2. Bulking agent
3. Stabilises and controls batter viscosity
4. Influences the setting temperature
5. Colour (Caramelisation and Maillard)
6. **Humectant (preservative)**
7. Softens the texture

# 1. Role in flavour (sweetness)

- Sucrose is often referred to as sugar
- Sugars give sweetness (obvious statement but important) - industrial cakes contain a lot of sugar so sweetness is less important
- Sweetness can mask bitterness
- Natural sugars are blends that give complex flavours (e.g. Honey)

Sucrose  
 $C_{12}H_{22}O_{11}$



# 'Industrial' cakes are very sweet

Typical bakery products per 100g (%)			
	Pound cake	Wholemeal bread	Madeira cake
Protein	6.0	10.0	5.3
Carbohydrate	49.0	37.8	56.4
<b>Sugars</b>	<b>28.0</b>	<b>4.1</b>	<b>34.2</b>
Fat	20.0	1.8	15.2
Saturates	12.0	0.4	9.2
Fibre	0.5	6.8	1.1
Salt	1.0	0.9	0.7

<b>Name</b>	<b>Sweetness</b>
Lactose	0.27
Lactitol	0.4
Sorbitol	0.6
Erythritol	0.81
Sucrose	1.00 (reference)
<b>Fructose</b>	<b>1.70</b>
Stevia	40 – 300
Aspartame	180 – 250
Saccharin	300 – 675
Sucralose	300 - 1100
Nutrasweet	7,000 – 13,000

## Alternative sugars (sweetness)

High fructose corn syrup

# High intensity regions

- Tried with salt reduction – topical additions, layers, inclusions
- Sugar crystals on top will work if shelf life is short – will dissolve with longer SL retailer cakes
- Fillings and icings can contain higher sugar or high intensity alternatives – but caution with water migration if  $a_w$  is not matched

# Complex flavours; sour dough

- Numerous flavour compounds generated during bacterial and yeast fermentation
- Changes flavour profile so sweetness less relevant
- Some sugar generation during fermentation
- More acceptable to adults than children

## 2. Role as a bulking agent

- Sugars take up volume in a product
- Have to replace this when formulating low sugar products  
e.g. 30% reduced sugar cake would be about 30% smaller
- **Polyols, fibres (inulin) offer bulking**
- Caution with sugar analysis method – can give falsely high values

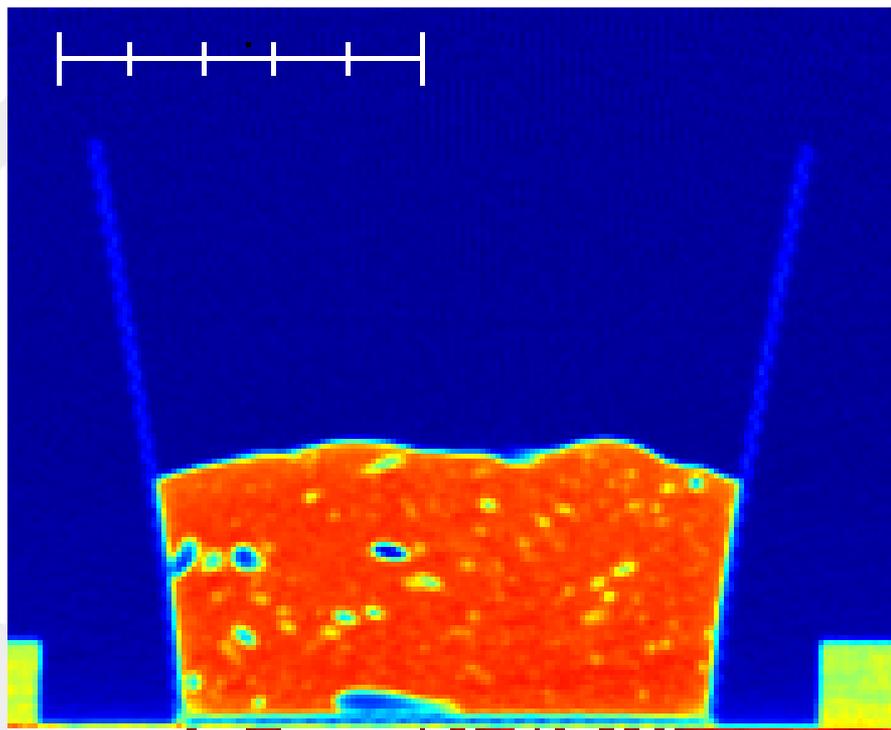
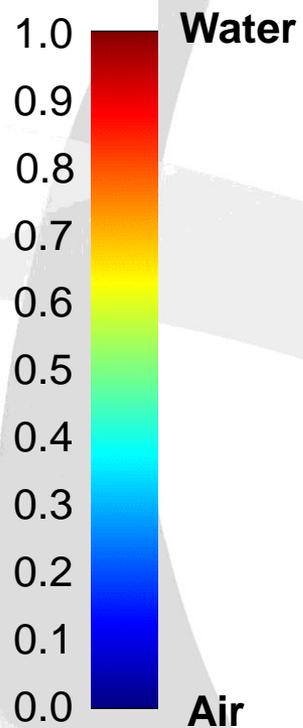
# 3. Role in stabilising and controlling batter viscosity

- Sucrose dissolves in the aqueous phase of a batter – controls batter viscosity
- Stabilises the batter by preventing air bubbles from coalescing or rising, and suspending starch granules
- Hydrocolloids, gums, gels used to increase viscosity

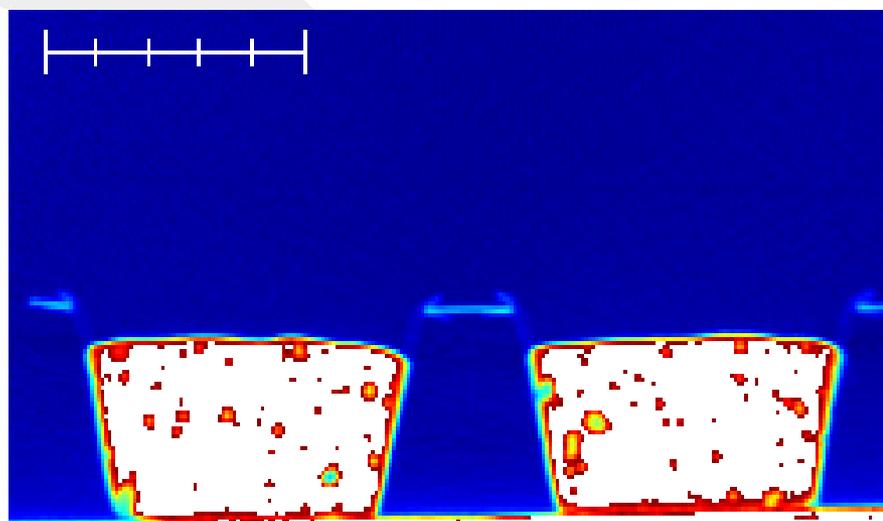
## 4. Role in influencing the setting temperature

- Competition for water raises the starch gelatinisation temperature by affecting hydration
- Allows longer for the gases to expand and contributes to higher volume and softer texture
- Helps to create soft, 'almost' baked textures with muffins and brownies
- **Other humectants do a similar job**

Relative  
absorbance



**High sugar  
cake**



**Muffins**

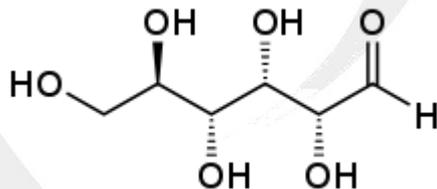
# 5. Role in colour development

- Caramelisation

>150°C, sugars break down to highly reactive compounds, these polymerise into dark brown substances we know as caramel.

- Maillard Reaction

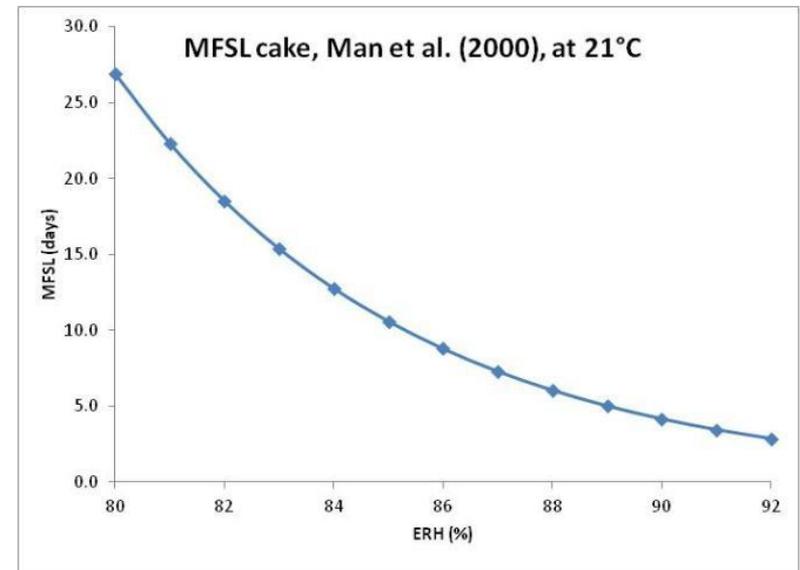
>105°C, reaction between reducing sugars and amino acids, forming highly reactive products that polymerise into yellow-brown compounds



Reducing form of glucose

## 6. Role as an humectant

- Sucrose binds water, preventing microorganisms using it for metabolism
- Reduces the Water Activity ( $a_w$ ) and slows growth
- Extends the mould-free shelf life (MFSL) of bakery products
- Options; kill or slow mould growth



# Alternatives: Killing mould on the surface

- Heat treatment in the pack (e.g. Heinz sponge pudding in a can, Aunt Bessies and many others in a plastic pot, some Bagels and bread)
- Issues – staling if eaten fresh
- Surface sprays also work, as do UV and pulsed light (to some extent)



# Alternatives: Slowing growth - different humectants

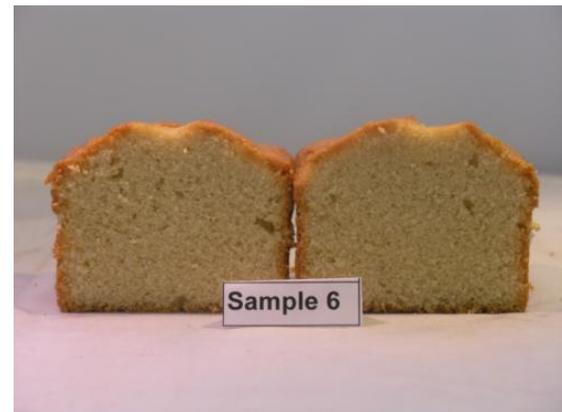
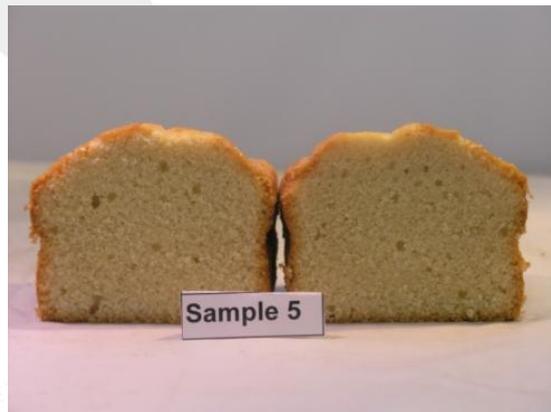
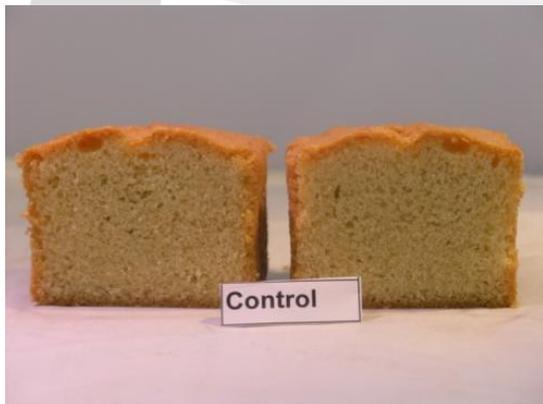
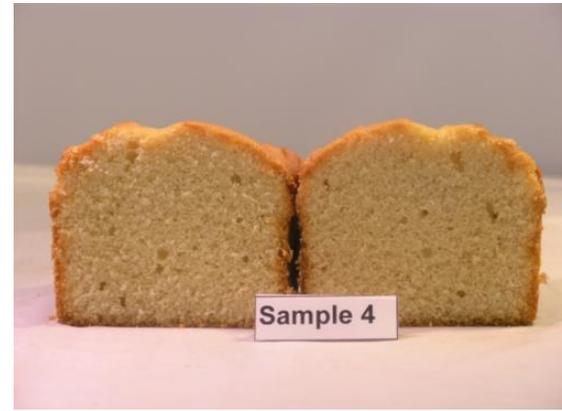
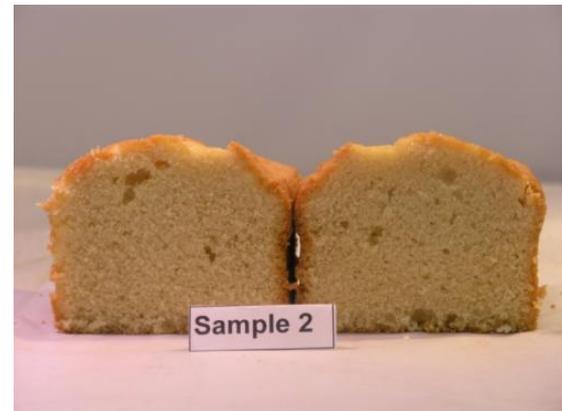
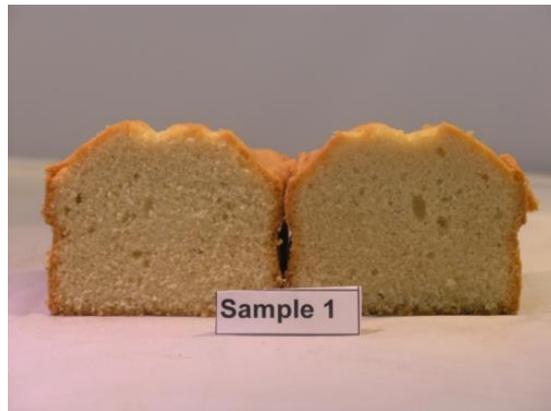
<b>Name</b>	<b>Sucrose Equivalent</b>
Glucose Syrup 42DE	0.6
Sucrose	1.0 (reference)
Lactose	1.2
Dextrose	1.3
Fructose	1.4
Sorbitol	2.0
Baking powder	3.0
Glycerol/ine	4.0
Salt	11.0

# Alternatives: Slowing growth - natural antimicrobial compounds

- Sour dough cake – numerous natural antimicrobial compounds generated, mostly organic acids (ethanoic, propionic, sorbic...)
- More acceptable to consumers / retailers than sorbate (no E-numbers)
- Mould growth rates slowed
- Favoured by low pH

# Sour dough cake

Sample	Details
1	Flour and water, no ferment
2	Added sour, no ferment
3	Flour and water, 1hr ferment
4	Added sour, 1hr ferment
5	Flour and water, 2hr ferment
6	Added sour, 2hr ferment
Control	Standard pound cake



Sample	Details	pH	$a_w$	MFSL
1	Flour and water, no ferment	8.05	0.86	23 days
2	Added sour, no ferment	7.40	0.86	23 days
3	Flour and water, 1hr ferment	7.98	0.87	23 days
4	Added sour, 1hr ferment	7.40	0.86	23 days
5	Flour and water, 2hr ferment	7.90	0.86	21 days
6	Added sour, 2hr ferment	7.34	0.87	26 days
Control	Standard pound cake	8.05	0.83	31days (!)

Calculated MFSL about 10 days

# MFSL commercial cakes

Product Description	$a_w$	pH	Preservative	MFSL (days)
Marble Cake	0.728	7.35	0.19% P. Sorbate	225
Orange and Raspberry Muffin	0.673	6.04	0.20% P. Sorbate	1205
Blueberry Muffin	0.713	6.29	0.20% P. Sorbate	643
Marble Brownie - Plain	0.765	6.89	0.154% P. Sorbate + 0.174% C. Propionate	101
Marble Brownie - Chocolate	0.789	6.85	0.154% P. Sorbate + 0.174% C. Propionate	63
Marble Cake	0.798	7.57	0.10% P. Sorbate	48
Trifle Sponge Cake	0.806	7.64	0.205% P. Sorbate	45
Christmas Cake	0.811	6.22	0.04% P. Sorbate	34
Banana and Walnut Muffin	0.950	7.95		3
Chocolate and Date Muffin	0.920	7.59		4
Christmas Cake	0.787	5.39	0.10% P. Sorbate	186
Fruit Cake	0.741	5.00		84

# Sour ferment cake thoughts

- Sours and ferments lowered the pH due to acid production
- Cakes with flour + water added or sour starter had lower shelf life due to the diluting effect on the sugar, hence higher  $a_w$
- Sour/fermentation times were not long enough to replace the antimicrobial effect of higher sugar content, although 2 hours ferment time had a positive effect
- Shows potential - more work needed to reduce sugar and achieve MFSL

# 7. Role as texture softening agent

- Sucrose binds water within its structure, keeping products soft over shelf life
- Water is one of the best texture softening materials (fat and air are others)
- Water and air are zero calorie – but water reduced MFSL

# Disadvantages of sugar replacers

- Sugar (sucrose) is clean label
- Sugar has many functions so more than one material is required for its replacement (ingredient lists get longer)
- Manufacturing cost increases
- Product texture and flavour will be different
- Calorie content can increase (fat proportion increases)
- Inulin can 'contain' sugar as measured

# The future?

- Sugar debate has not finished yet
- Some bakery products are high in sugar and are open to bad press
- Efforts are needed to reformulate low sugar bakery products
- Retailer cakes already contain high sugar levels (for MFSL) – sweetness is not the problem
- MFSL is a major challenge - Sour starters and extended fermentation is an option to address MFSL

# 20% sugar reduction with retailer cakes

	Sugars/100g	After 20% reduction
Party cake	43.7	35.0
Chocolate cake	38.3	30.6
Vanilla cake	44.6	35.7
Angel cake	34.6	27.7
Genoa	42.5	34.0
Madeira	34.2	27.4
Walnut	33.9	27.1
Pound cake	28.0	-

# An alternative future?

- Cake has the potential to play a more important part in our diet
- It can be much healthier – lower sugar, higher fibre and dietary benefits of extended fermentation
- Cake does not require such high quality wheat as with bread – cheaper and more sustainable
- Is there a need for heat treated flour?
- What shelf life is required?

Date for your diaries:

**4th International Bakery Technology Conference**  
**23-24 May 2018**

at Campden BRI

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