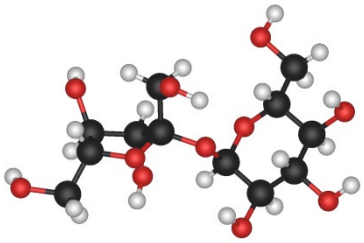
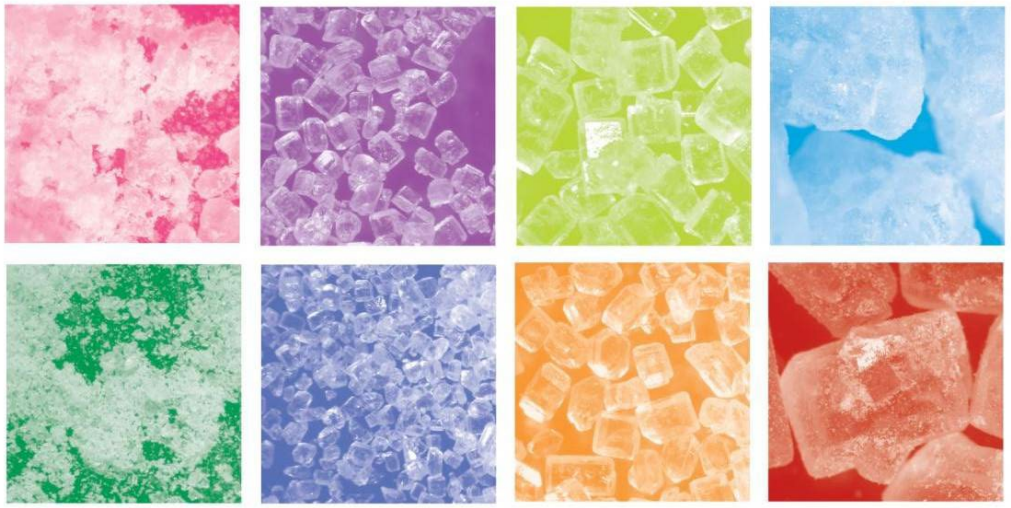




Sugar Reformulation 3!

Professor Julian M Cooper

What is sugar?

- Carbohydrates $C_x(H_20)_y$ (-oses)
- Single units (mono-)
  - **glucose, fructose, galactose**
- Two units (di-)
  - **sucrose, maltose, lactose**

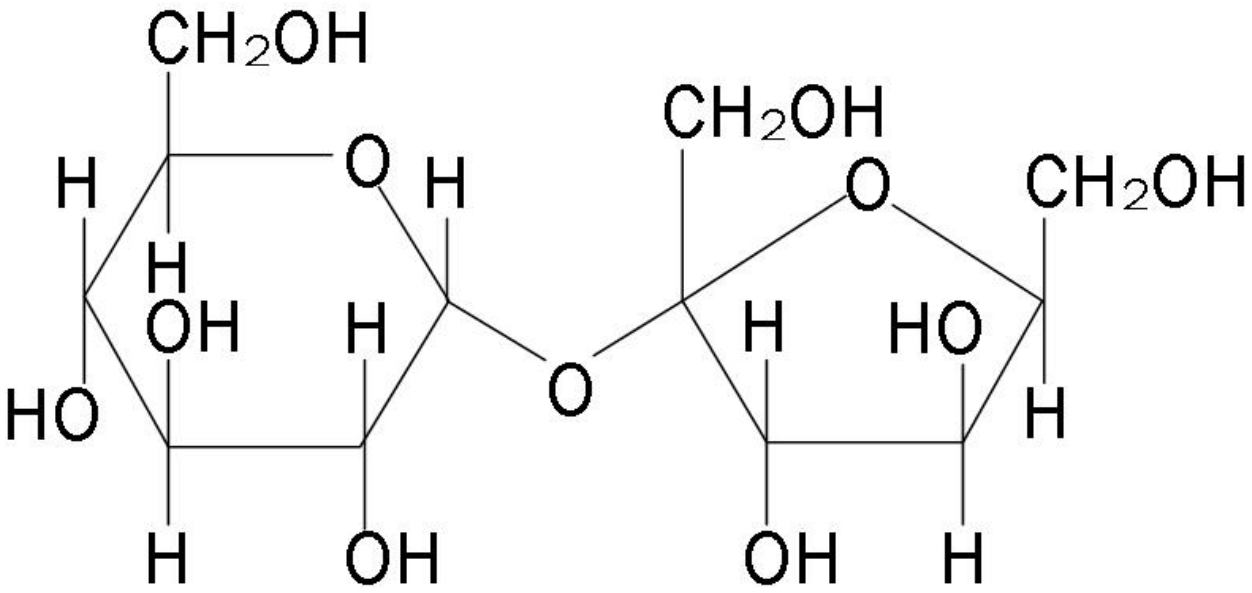
SUGARS

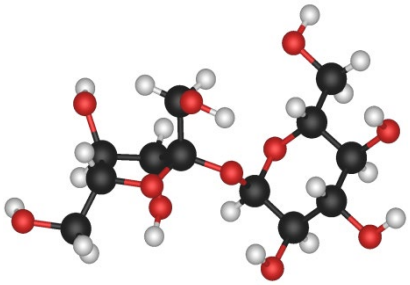
- More Units (3 – 10) (oligo-)
  - **fructo-oligosaccharides**
- Lots of Units (poly-)
  - **starch, pectin, fibre**

Sugars are not just sugar

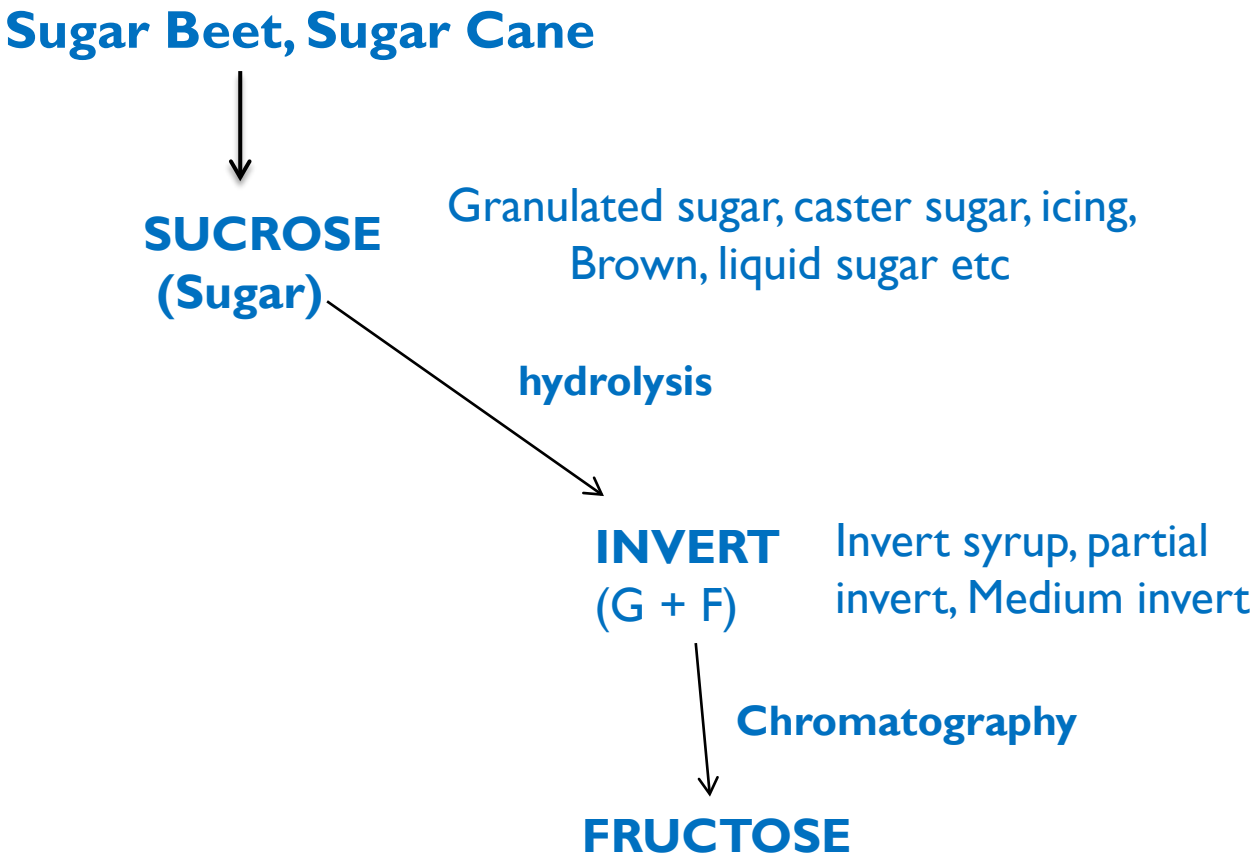
What is sugar?

α-D-Glucopyranosyl-β-D-fructofuranoside

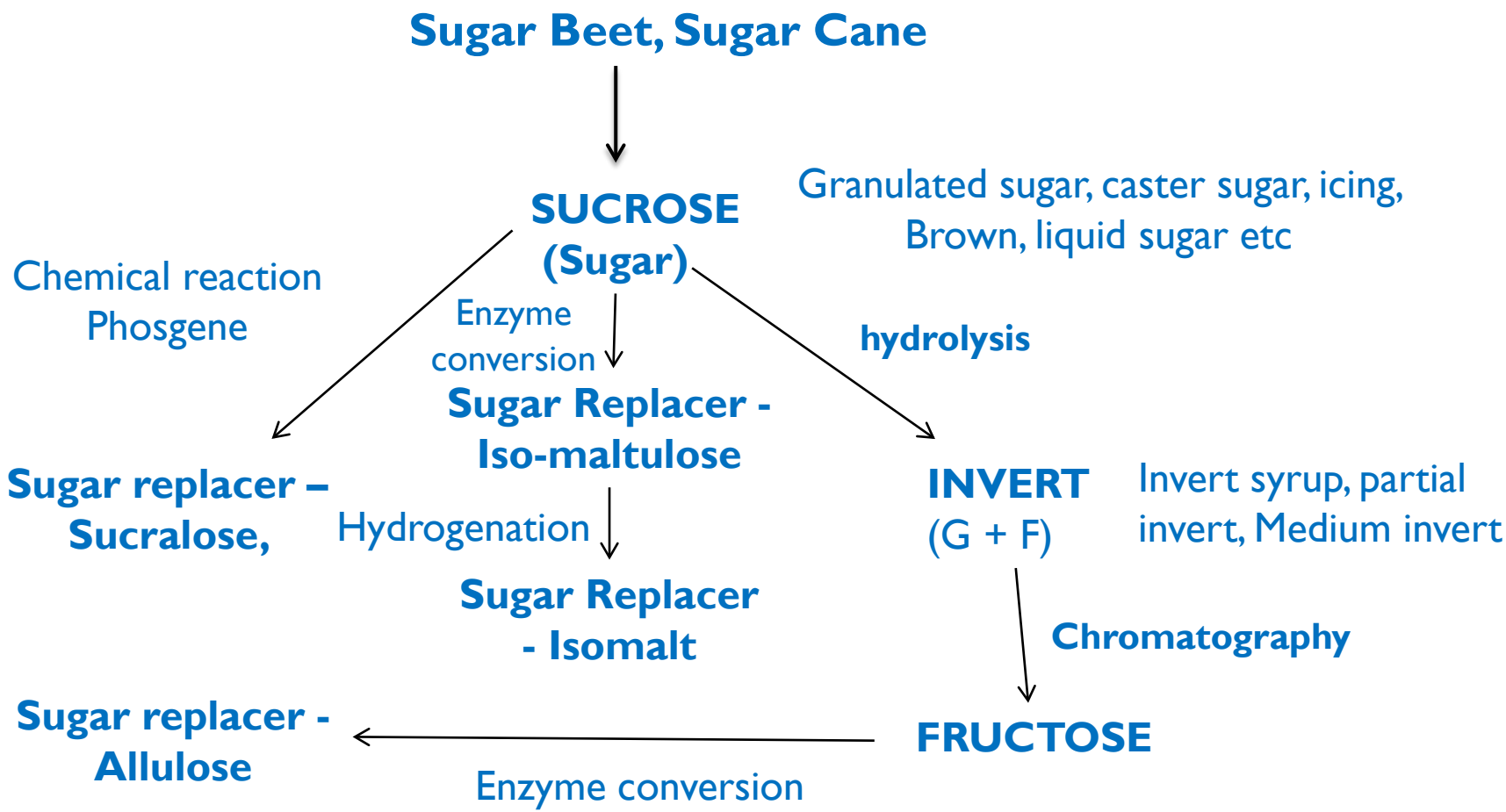




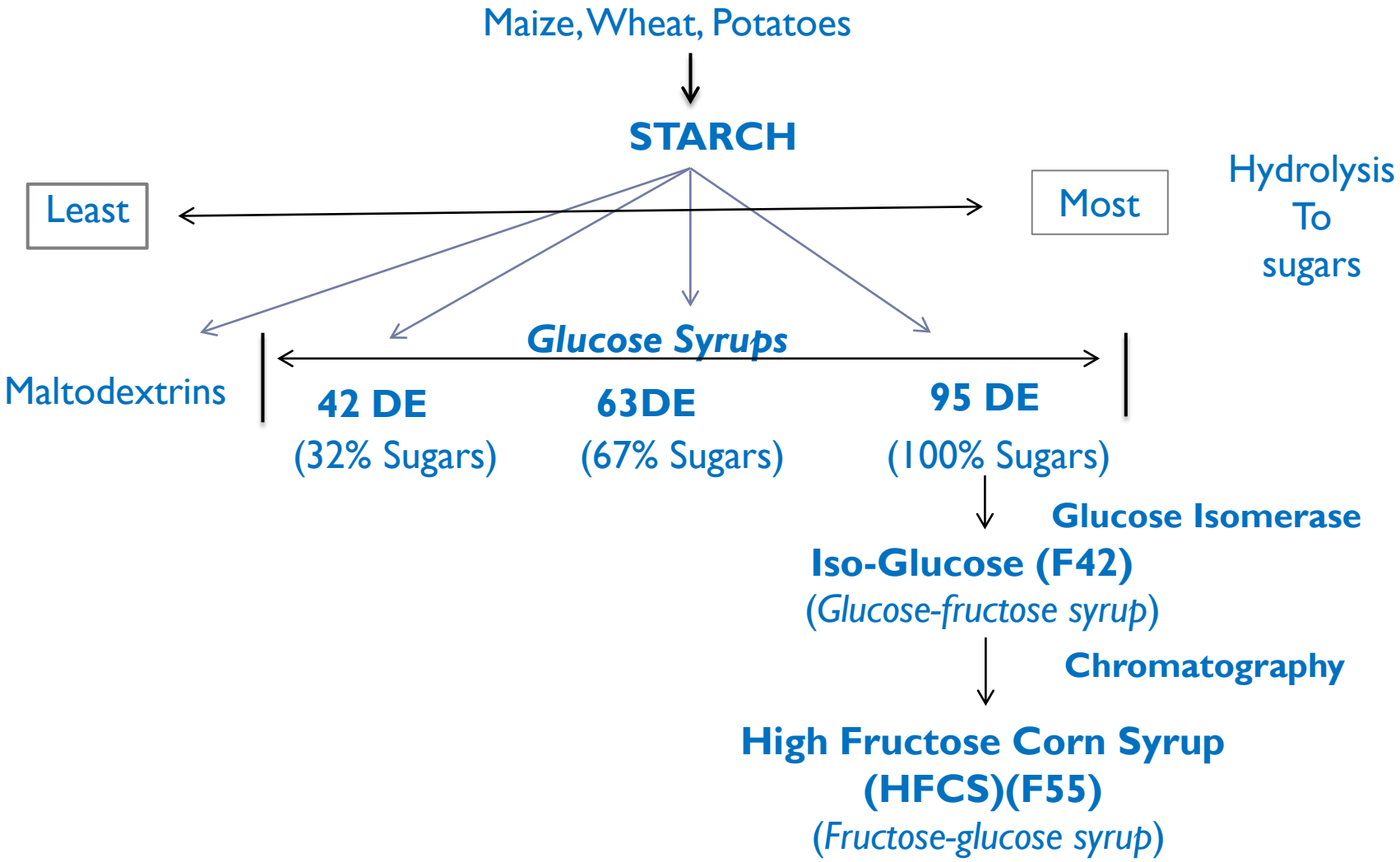
Sucrose Based Sugars



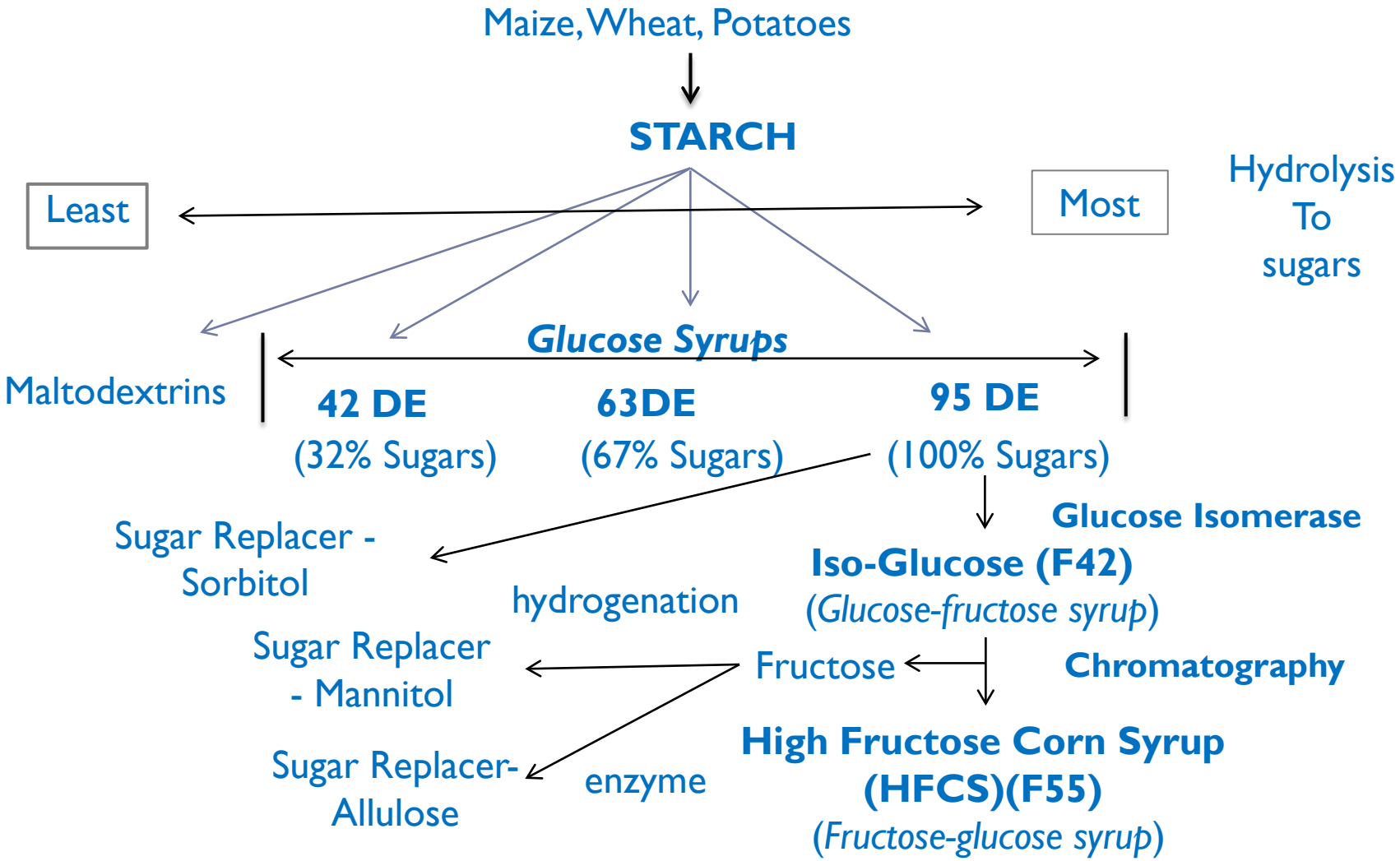
Sucrose Based Sugars



Starch Based Sugars



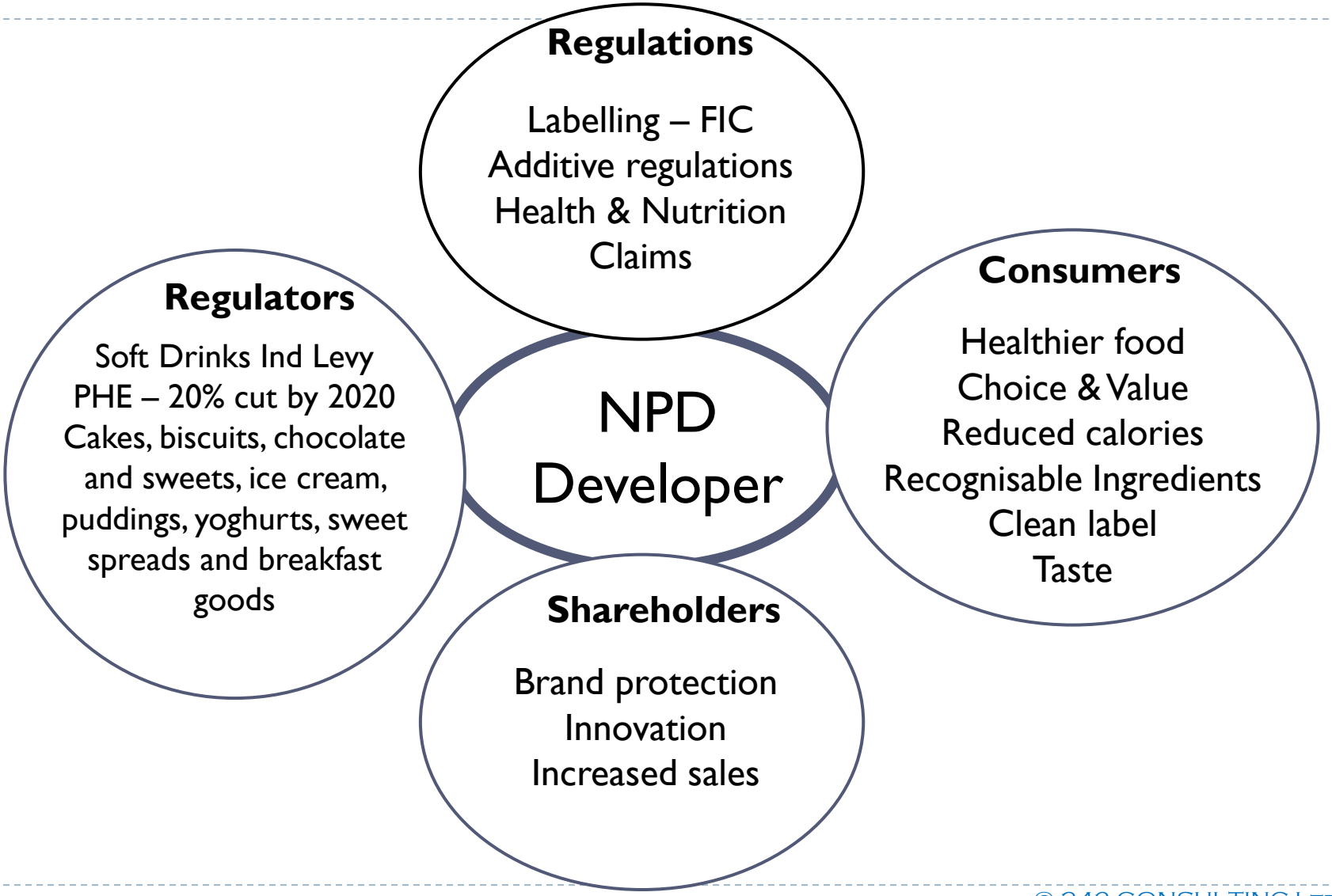
Starch Based Sugars



Why Reformulate?

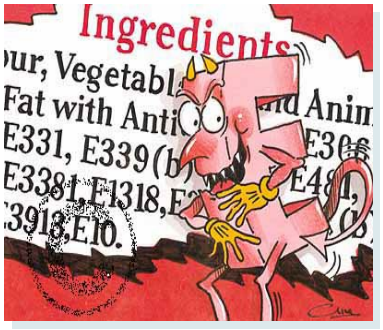
- Replace/reduce certain ingredients
- Develop ‘functional’ products
- Provide choice for consumers
- Develop new products - innovation
- Reduce energy density in products
- **Reduce calories in products**

Reformulation Drivers



The Challenges when reducing/replacing sugar

- Multiple ingredients
- Increased labelling/warnings
- Gastro-intestinal consequences
- Food safety may be compromised
- Reducing sugar may increase calories (energy density)
- Taste and Consumer acceptance (manufacturer)



Sugar Reformulation – What can I use?

Sweetness → High intensity sweeteners, polyols

Mouthfeel/Texture → Hydrocolloids, polyols, sugars

Structure → Bulking agents, polyols, fibres

Colour → Colours

Flavour → Flavours

Stability/Preservation → Benzoates etc

Humectancy → Polyols

Sugars Terminology & Claims

- Total Sugars

Carbohydrates - of which sugars on the label – all mono and disaccharides in the product /100g

- Free Sugars

Term recommended by SACN (replaces NMES). All mono and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juice. Lactose is excluded when naturally present in milk and milk products.

Nutrition & Health Claims – EU Regulation 1924/2006

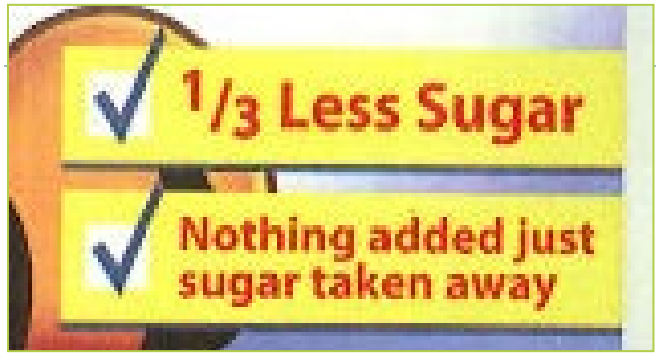
- Reduced (Sugars) reduction must be at least 30% compared to similar product – energy must be equal or less than similar product
- Low in Sugars <5g sugars/100g; <2.5g sugars/100ml
- No Added Sugars – must not contain any added mono or disaccharides or foods added for their sweetening properties
- Sugars Free – max 0.5g sugars /100g or 100ml

Sugar Reduction/Replacement Strategies

- 1. Remove/reduce sugar – add nothing
- 2. Gradually Reduce sugar
- 3. Change sugars form/properties – make it more effective (sweet)
- 4. Add sweeteners (+ water!)
- 5. Add Polyols
- 6. Add bulking agents/fibre
- 7. Add ‘kitchen sink’
- 8. Add only ‘good’ ingredients
- 9. Add a matrix of lower calorie ingredients to match sugar functionalities

1. Remove/reduce Sugars – Add Nothing

‘Reduced Sugar’ products



Product	Sugar g/100g	Energy cals/100g	Salt g/100g	Fat g/100g
Regular Sugar coated Product	37	371	1.15	0.6
‘Reduced Sugar’ Product	25	369	1.4	0.6
Regular Product	8	373	1.75	0.9

2. Stepwise Reduction

Shortbread recipe
Butter 110g; Flour 175g; Caster sugar 50g

Weight of sugar g	'Calories reduced'	Sugar g/100g	
50	0	14.9	
45	20	13.6	
40	40	12.3	
35	60	10.9	

'Calories reduced' = wt of sugar removed x 4cals

2. Stepwise Reduction

Stewise sugar reduction					
Shortbread					
Recipe		Fat g	Carb g	Protein g	Sugars g
Butter	110	88			
Flour	175		122.5	17.5	
Sugar	50		50		50
% composition		26.3	51.5	5.2	14.9
Total Recipe Wt g	335				
Calories		792	690	70	
Total Cals	1552				
Cals/100g	**463**				

2. Stepwise Reduction

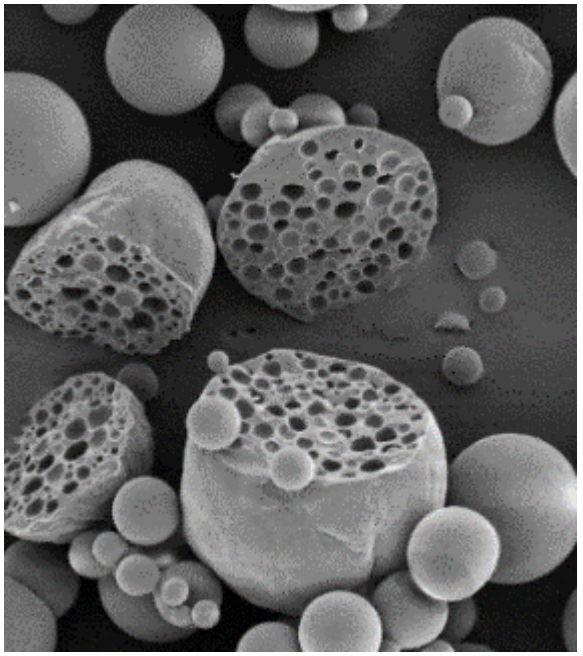
Shortbread recipe
Butter 110g; Flour 175g; Caster sugar 50g

Weight of sugar g	'Calories reduced'	Sugar g/100g	Actual Calories/100g
50	0	14.9	463
45	20	13.6	464
40	40	12.3	465
35	60	10.9	466

'Calories reduced' = wt of sugar removed x 4cals

3. Change Sugars properties - Nestle

- Recent press coverage
- ‘Ground breaking material science’
- ‘Harnessed science to reduce sugar in chocolate’
- ‘Restructured sugar’
- ‘30% less sugar’
- Milky Bar Wowsomes
- White Chocolate plus crispy oat pieces
- 18g bar; 95 cals – 527cals/100g



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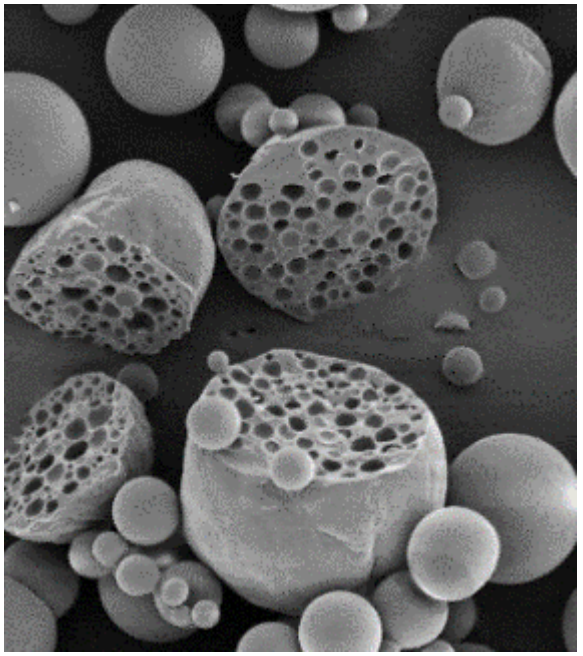
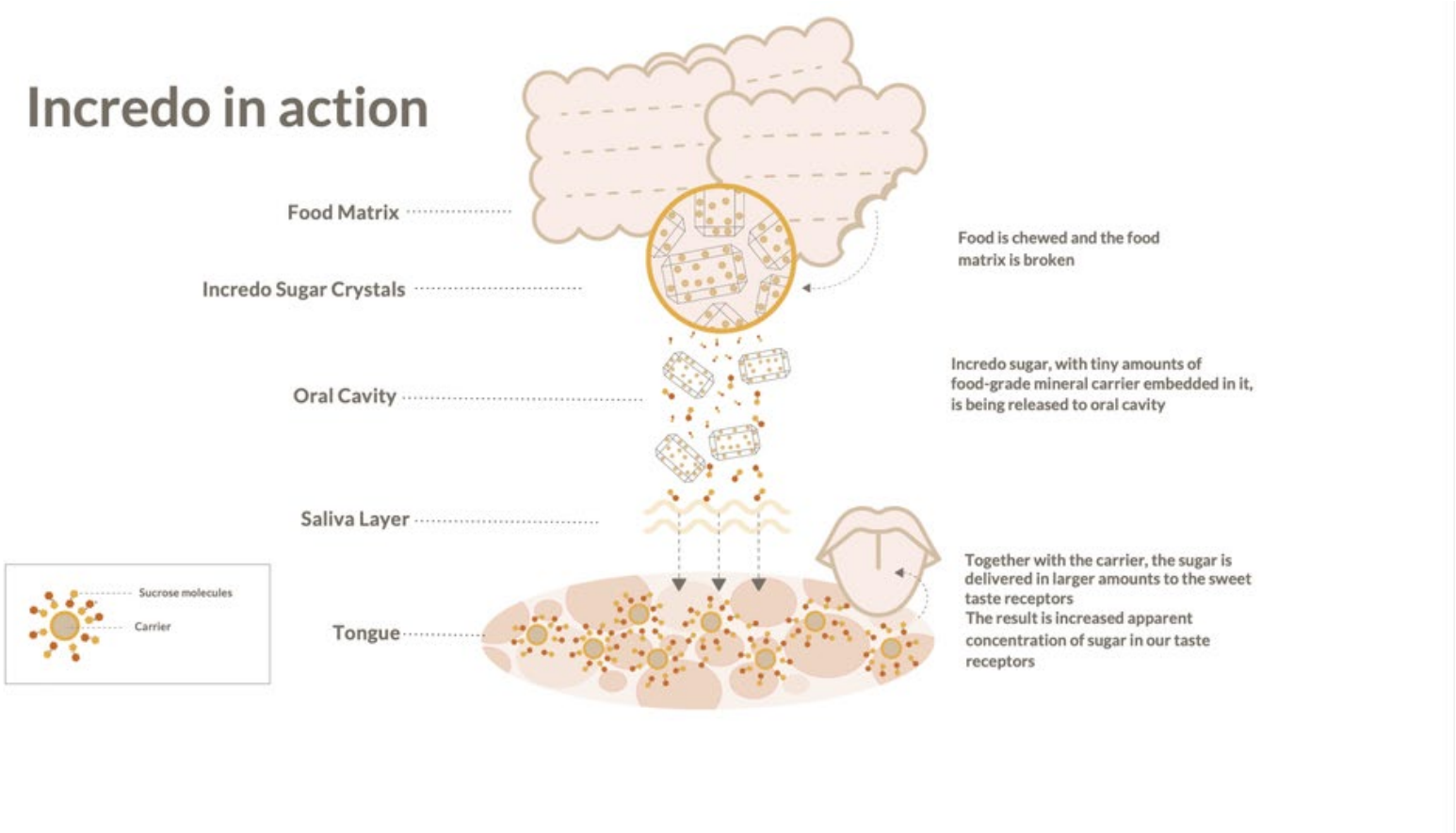
- ‘30% less sugar’
- Milky Bar Wowsomes
- White Chocolate plus crispy oat pieces
- 18g bar; 95 cals – 527cals/100g
- Regular Milky Bar (no cereal fibre!)
- 543 cals/100g – 16 cals more
- For 18g bar 98 cals **– 3% calorie reduction!**

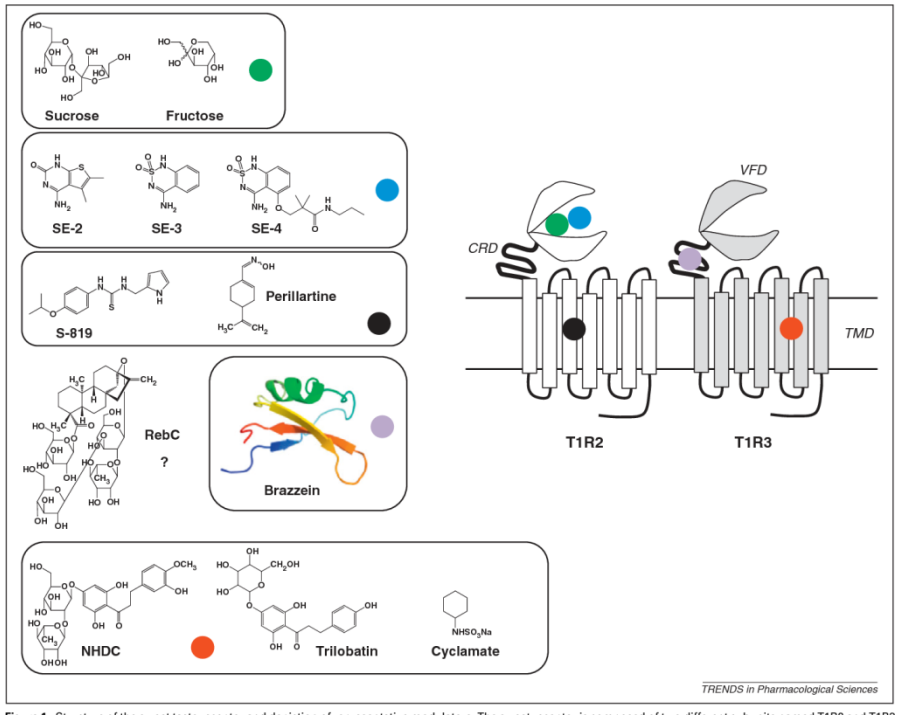


3. Change Sugars properties

Incredo Sugar - Douxmatox



3. Change Sugars properties



Positive Allosteric Modulators – PAMs

Molecules that increase the sweetness perception/intensity of sugars

Senomyx – bought by Firmenich 2018

Designer flavour systems

4. Add Sweeteners

4. Add Sweeteners

Drink	Sugars g/100ml	Energy cals/100ml	Sweeteners
Coca Cola	10.6	42	none
Schweppes Tonic Water	5.1	22	saccharin
Tango Orange	4.2	19	saccharin, aspartame
Schweppes Lemonade	4.2	18	saccharin, aspartame
Oasis Summer Fruits	4.2	18	Aspartame. AceK
Sprite*	10.6	44	none
Fanta Orange	7.1	30	saccharin, aspartame
R Whites Lemonade	2.4	11	Saccharin, aspartame, AceK

- Sprite reformulated with steviol glycosides; sugars 6.6g/100ml; energy 28 cals/100ml
- Sprite now uses aspartame/Ace K; 3.3g/100ml; energy 14 cals/100ml

4. Add Sweeteners

Regular cake			‘Cal reduced’ cake	
Wt(g)	cals	Ingredient	Wt(g)	cals
100	900	Fat	100	900
100	400	Sugar	50	200
100	400	Flour	100	400
300	1700	Totals	250	1500

4. Add Sweeteners

Regular cake			'Cal reduced' cake	
Wt(g)	cals	Ingredient	Wt(g)	cals
100	900	Fat	100	900
100	400	Sugar	50	200
100	400	Flour	100	400
300	1700	Totals	250	1500
	567	**Calories increase/100g**		600

5. Add Polyols

Fruit Flavour Gums

325 Calories per 100g

Ingredients:

Glucose Syrup, Sugar,

Modified Maize Starch, Gelatine, Water, Acids (Malic, Acetic), Flavourings, Hydrogenated Vegetable Oil, Glazing Agent (Carnauba Wax), Colours (E104, E122, E129, E142).

Fruit Flavour Gums with Sugars and Sweeteners

215 Calories per 100g

Ingredients:

Sugar, Polydextrose, Wheat Dextrin, Sweetener (Sorbitol),

Modified Maize Starch, Gelatine, Water, Acids (Malic, Acetic), Flavourings, Hydrogenated Vegetable Oil, Glazing Agent (Carnauba Wax), Colours (E104, E122, E129, E142).

5. Add Polyols

"**Important advice**:

Reduced sugar sweets are **made with sweeteners**. If you eat too many it might temporarily cause you **mild stomach ache** or **laxative effect**. We really want you to enjoy these sweets, so we suggest you only **eat a few at a time**."

6. Add bulking agents/fibre

- Add bulking agents eg Polydextrose (1 cal)
- Add fibres – maize dextrins, inulin,
- Lower calories than sugar
- Great impact on texture

- Cadburys Reduced Sugar Dairy Milk

Milk, Sugar, Soluble Maize Fibre, Cocoa Butter, Cocoa Mass, Vegetable Fats (Palm, Shea), **Milk** Fat, Skimmed **Milk** Powder, Emulsifier (E442), Flavourings, Milk Solids 20 % minimum, Cocoa Solids 20 % minimum, Contains Vegetable Fats in addition to Cocoa Butter

6. Add bulking agents/fibre

/100g	CDM	30% Reduced Sugar
Sugars	56	37 (-34%)
Fibre	2.1	18
Energy (cals)	534	503 (-6%)
Price/100g	£0.89	£1.76

7. Add Kitchen Sink!

- **Regular Jam**
- Strawberries, sugar, glucose, glucose-fructose, pectin, citric acid

- **Sugar Free Preserve**
- Water, strawberries, polydextrose, maltodextrin, locust bean gum, natural flavour, citric acid, potassium sorbate, sucralose, calcium chloride, Red 40 (colour)

7. Add Kitchen Sink!

Regular Jam	Functionality	Sugar Free Preserve
Strawberries, sugar, glucose, glucose-fructose	Sweetness	Strawberries, sucralose
Strawberries, sugar, glucose, glucose-fructose, pectin	Bulk	Strawberries, water, polydextrose, fruit pectin, locust bean gum
Pectin, sugar, glucose, glucose-fructose	Gelling	Fruit pectin, calcium chloride
sugars	Preservative	Potassium sorbate
Citric acid	Acidity	Citric acid
sugars	Flavour	Natural flavour
sugars	colour	Red40

7. Add Kitchen Sink!!

Ingredients:
Water, Thickeners: Xanthan Gum, Cellulose Gum, Colours: Anthocyanins, Carotenes, Acidity Regulator: Critic Acid, Flavour, Preservatives: Potassium Sorbate, Sodium Benzoate, Sweetener: Sucralose. Possible unintentional quantities of: Milk, Soy, Mustard, Celery.

Thickened water, with colours, flavours, sweeteners and preservatives

8 E- numbers!!

8. Add only Good Ingredients

26 vitamins & minerals

High-protein

Ideal healthy snack

Vegan chocolate chips

8. Add only Good Ingredients

Chocolate
Pea Protein, Brown Rice Syrup, Soluble Gluco Fibre, Concentrated Grape Juice, Rice Starch, Brown Rice Protein, **Gluten-Free Rolled Oats**, Chocolate (Cocoa Mass, Coconut Sugar, Cocoa Butter), **Gluten-Free Oat Flour**, Sunflower Oil, Flaxseed Powder, Sunflower Lecithin, Rice Bran, Cocoa Powder (2.5%), Micronutrient Blend*, Medium-Chain Triglyceride Oil (from Coconut), Tapioca Starch, Natural Flavouring.
*Potassium Citrate, Potassium Chloride, Calcium Carbonate, Maltodextrin, Vitamin C, Magnesium Oxide, Niacin (as Niacinamide), Vitamin E (as D-Alpha Tocopheryl), Pantothenic Acid (as Calcium-D-Pantothenate), Zinc Oxide, Riboflavin, Vitamin B6 (as Pyridoxine Hydrochloride), Vitamin B1 (as Thiamin Mononitrate), Potassium Iodide, Vitamin K2 (as Menaquinone-7), L-Methylfolate Calcium, Vitamin A (as Retinyl Acetate), Vitamin D2, Vitamin B12 (as Cyanocobalamin).
Allergy advice: For allergens see ingredients in **bold**. This product is made on equipment that also handles tree nuts & peanuts. May contain mustard.

9. Matrix of Ingredients

THE supplant COMPANY

Less than half the calories of sugar
Low glycaemic response compared to glucose
Prebiotic – good for gut health
Made from plant fibre
Upcycled from agricultural side-streams

Summary & Key Learnings

- Sugar - natural, traditional, multifunctional ingredient
- “Sugars” on nutrition labels are not just sugar
- No unique sugar replacer for all applications – impact on clean label, E numbers, safety, cost & taste
- Reformulation is not the universal panacea it should deliver an improved nutritional profile and ideally a reduction in calories

THANK YOU

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