

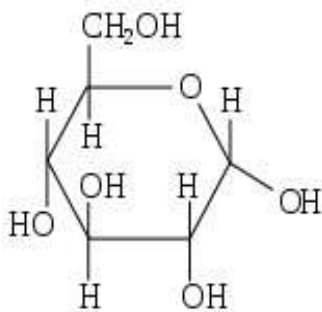


## ***Evaluating carbohydrate quality – what measures are available?***

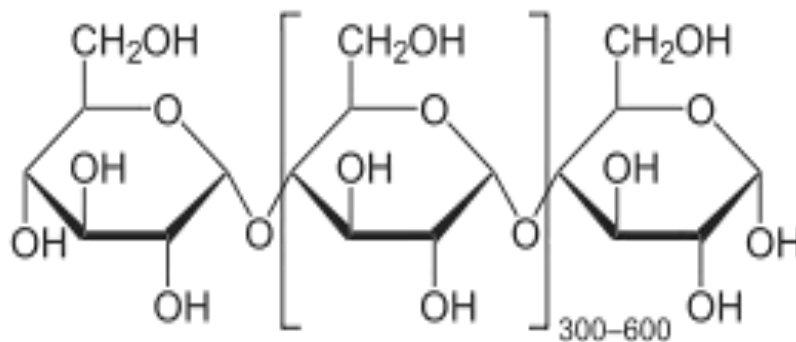
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# What are carbohydrates?

Class (Polymerisation)	Sub-Group	Components
<b>Sugars (1-2)</b>	Monosaccharides	Glucose, galactose, fructose
	Disaccharides	Sucrose, lactose, maltose
	Polyols	Erythritol, Glycerol, Lactitol, Maltitol, Mannitol, Sorbitol, Xylitol
<b>Oligosaccharides (3-9)</b>	Malto-oligosaccharides	Maltodextrins
	Other oligosaccharides	Raffinose, stachyose, fructo-oligosaccharides
<b>Polysaccharides (&gt;9)</b>	Starch	Amylose, amylopectin, modified starches
	Non-starch polysaccharides	Cellulose, hemicellulose, pectins, hydrocolloids



**glucose**



**starch**

# Definitions

## Starch

- Polysaccharides with 10+ degrees of polymerisation
- Starch = “complex carbohydrate” (term should no longer be used)  $\neq$  low GI
- Refined grains  $\neq$  starch
- Starches are found in refined and unrefined foods

## Sugars

- Mono-, di-saccharides *and* polyols
- “Simple sugars” meaningless
- Sugars  $\neq$  high GI
- Sugars are found in refined and unrefined foods

# Definitions

## Fibre

- No Single definition globally.
- FSANZ<sup>2</sup>:

“that fraction of the edible part of plants or their extracts, or synthetic analogues that –

a) are resistant to the digestion and absorption in the small intestine, usually with complete or partial fermentation in the large intestine; and

(b) promote one or more of the following beneficial physiological effects –

(i) laxation;

(ii) reduction in blood cholesterol;

(iii) modulation of blood glucose;

and **includes polysaccharides, oligosaccharides (degree of polymerisation > 2) and lignins.**”

# Definitions<sup>1</sup>

## Intrinsic sugars

Sugars that are an integral part of certain unprocessed foods, that is enclosed in the cell, the most important being whole fruits and vegetables (containing mainly fructose, glucose and sucrose).

*Intrinsic sugars are therefore naturally occurring and are always accompanied by other nutrients.*

## Extrinsic sugars

Those sugars that are not located within the cellular structure of a food. Extrinsic sugars are mainly found in fruit juice and processed foods.

However, lactose in milk is also extrinsic and milk has important nutritional benefits...

# Definitions<sup>1</sup>

## Non-milk extrinsic sugars

Defined as all extrinsic sugars, which are not from milk - that is excluding lactose. Includes fruit juices and honey and those sugars added to foods as a sweetener in cooking or at the table, as in hot drinks and breakfast cereal, or during processing.

Indicates the group of sugars, other than intrinsic and milk sugars, that *should be restricted in the diet*.

This terminology has remained popular among nutritionists in the UK, and is used in dietary surveys and other reports where intakes are described in that country. However, it is not well understood by the public and is not used in public communications about sugars.

# Definitions<sup>2</sup>

## Wholegrain

- FSANZ Food Standards Code<sup>2</sup>:

*“...the intact grain or the dehulled, ground, milled, cracked or flaked grain where the constituents – endosperm, germ and bran – are present in such proportions that represent the typical ratio of those fractions occurring in the whole cereal, and includes wholemeal.”*

# Definitions

## Glycemic / available carbohydrate<sup>1,2</sup>

- “*Carbohydrate for metabolism*”, calculated by summing the average quantity of total available sugars, oligosaccharides, starches, glycogen and maltodextrins.

1. Carbohydrates in human nutrition. 1998. FAO Food and Nutrition Paper – 66
2. FSANZ, Food Standards Code, 2013.



# Definitions

## Glycemic index (GI):

- compares equal quantities of available carbohydrate in foods
- is a measure of their effect on blood glucose levels in 10+ healthy people over a 2 hr period
- is a percentage



# Glycemic Index (GI): Ranking

## Individual food portion<sup>3</sup>:

Low	55 or less
Moderate	56 - 69
High	70+

## Whole day<sup>4</sup>:

Low	45 or less
Moderate	46-59
High	60+

3. Australian Standard. Glycemic Index of Foods AS4694-2007. Standards Australia. 2007.

4. Atkinson et al. Diabetes Care. 2008; 31(12):2281-3.

# Definitions

## Glycemic load (GL)

- a function of a food's glycemic index and its total available carbohydrate content and defined as:

$$\textit{Glycemic Load} = \textit{GI} (\%) \times \textit{Carbohydrate} (\textit{g})$$

- Using an apple as an example:

GI value = 38%; Carbohydrate per serve = 15 g

$$\text{GL} = 0.38 \times 15 = 6$$

The GL of a typical apple is 6

# Glycemic Load (GL): Ranking

## Individual food portion<sup>5</sup>:

Low	0-10
Moderate	11-19
High	20+

## Whole day<sup>6</sup>:

Low	< 95 g 8,400 kJ/d diet
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5. Brand-Miller JC, Holt SHA, and Petocz P. Glycemic load values:2002. Am J Clin Nutr. 2003; 77 (1): 993-5.

6. Livesey et al, AJCN. 2013.

# Glycemic Load

- 1 unit of GL ~ 1 g of glucose
- The higher the GL, the greater the elevation in blood glucose and insulin levels<sup>7</sup>.

# Glycemic Index vs Glycemic Load

While the effects on post-prandial glycaemia may be essentially the same...

there is evidence that the two approaches will have different metabolic effects on

- insulin sensitivity<sup>8</sup>,
- free fatty acid levels<sup>9</sup>
- total and LDL cholesterol levels<sup>10</sup>.

8. Wolever TMS and Mehling C. Br J Nutr. 2002; 87(5):477-87;

9. Wolever TMS and Mehling C Am J Clin Nutr. 2003 Mar;77(3):612-21.

10. McMillan-Price et al. Arch Intern Med. 2006; 166: 1466-1475.

# Both amount *and* type of carbohydrate are important predictors of BGLs

- The total amount of carbohydrate ingested (whether in a single food or as part of a meal) accounts for 57–65% of the variability in blood glucose response.
- The type (GI) of carbohydrate explains a similar amount (60%) of the variance.
- Together, the amount and the type of carbohydrate accounted for 90% of the total variability in blood glucose response<sup>11, 12</sup>.

11. Wolever TM and Bolognesi C. J Nutr 1996;126:2798–2806

12. Wolever TM and Bolognesi C. J Nutr 1996;126:2807–2812

# GL is the most important predictor of insulin response<sup>13</sup>

10 healthy young people consuming 121 types of single foods (study 1) and 13 mixed meals (study 2):

For foods: GL was a more powerful predictor of insulin response than GI or available carbohydrate - explaining 59%, 55% and 49%, respectively (P=0.005).

For mixed meals: GL was the only predictor of postprandial insulin response, explaining 46% (P = 0.01) of the variation.

Carbohydrate content alone predicted the insulin responses to single foods (P<0.001) but not to mixed meals.



# Carbohydrates and food labelling

## Ingredient Lists<sup>2</sup>

- 1) Ingredients must be declared in the statement of ingredients in descending order of ingoing weight.
- 2) The label on a package of food must include a declaration of the proportion of characterising ingredients and characterising components of the food, calculated and expressed in accordance with this Standard.

# Carbohydrates and food labelling

## Ingredient Lists

3) The Labelling Logic<sup>14</sup> review recommended:

*“That where sugars, fats or vegetable oils are added as separate ingredients in a food, the terms ‘added sugars’ and ‘added fats’ and/or ‘added vegetable oils’ be used in the ingredient list as the generic term, followed by a bracketed list (e.g., added sugars (fructose, glucose syrup, honey), added fats (palm oil, milk fat) or added vegetable oils (sunflower oil, palm oil)).”*

# Ingredient list

## Why shouldn't we also group added starches together?

### Food ingredient names for sugars vs starches



Sugar	Starch
Dextrose	(1400) Dextrin roasted starch
Disaccharides	(1401) Acid-treated starch
Fructose	(1402) Alkaline-treated starch
Glucose	(1403) Bleached starch
Glucose syrup	(1404) Oxidized starch
Golden syrup	(1405) Starches, enzyme-treated
Honey	(1410) Monostarch phosphate
Lactose	(1412) Distarch phosphate
Malt/extract	(1413) Phosphated distarch phosphate
Maltose	(1414) Acetylated distarch phosphate
Monosaccharides	(1420) Starch acetate
Raw/brown sugar	(1422) Acetylated distarch adipate
Sucrose	(1440) Hydroxypropyl starch
	(1442) Hydroxypropyl distarch phosphate
	(1443) Hydroxypropyl distarch glycerol
	(1450) Starch sodium octenyl succinate
	(1451) Acetylated oxidized starch



# Carbohydrates and food labelling

## Nutrition Information Panels (NIPs)<sup>2</sup>

- 1) Most commonly **total carbohydrate** is “*carbohydrate by difference*’, calculated by subtracting from 100, the average quantity expressed as a percentage of water, protein, fat, dietary fibre, ash, alcohol... ”<sup>5</sup>. Not:
- 2) “*available carbohydrate*’, calculated by summing the average quantity of total available sugars and starch, and if quantified or added to the food, any available oligosaccharides, glycogen and maltodextrins.”

# Current NIP



## Nutrition Information

**Serving size = 150g**

**Servings per packet = 2**

<b>Energy</b>	<b>190 kJ</b>
<b>Protein</b>	<b>5.0 g</b>
<b>Fat</b>	<b>1.0 g</b>
<b>Saturated fat</b>	<b>0.5 g</b>
<b>Carbohydrate</b>	<b>8.0 g</b>
<b>Sugars</b>	<b>5.0 g</b>
<b>Sodium</b>	<b>70 mg</b>
<b>Fibre</b>	<b>0 g</b>
<b>Erythritol</b>	<b>1 g</b>

# Ideal NIP?



## Nutrition Information

**Serving size = 150g**

**Servings per packet = 2**

<b>Energy</b>	<b>190 kJ</b>
<b>Protein</b>	<b>5.0 g</b>
<b>Fat</b>	<b>1.0 g</b>
<b>Saturated fat</b>	<b>0.5 g</b>
<b>Carbohydrate</b>	<b>8.0 g</b>
<b>Sugars</b>	<b>5.0 g</b>
<b>Starches</b>	<b>1.0 g</b>
<b>Sugar alcohols</b>	<b>1.0 g</b>
<b>Other</b>	<b>1.0 g</b>
<b>Sodium</b>	<b>70 mg</b>
<b>Fibre</b>	<b>0 g</b>

# Alternate Ideal NIP?



## Nutrition Information

**Serving size = 150g**

**Servings per packet = 2**

**Energy 190 kJ**

**Protein 5.0 g**

**Fat 1.0 g**

**Saturated fat 0.5 g**

**Carbohydrate 8.0 g**

**Sodium 70 mg**

**Fibre 0 g**

**Glycemic Index 35%**

# Summary

- There are many different ways of describing the type of carbohydrate that we consume
- Structural models have been used for decades, but are not physiologically meaningful
- The GI and GL describe the physiological affect of foods, and are the best predictors of blood glucose and insulin response
- Food labels contain incomplete information on carbohydrates and this is contributing to the confusion around the role of carbohydrate in human nutrition