Carbohydrate —as a macro nutrient

Key Words

Photosynthesis: The process by which green plants trap energy from the sun and form carbohydrates
Sugars: a group of carbohydrates that taste sweet
Monosaccharides: a group of sugars made up of one sugar molecule
Disaccharides: a group of sugars made up of two sugar molecules
Polysaccharides: (Complex carbohydrates): a group of carbohydrates made up of many sugar molecules joined together but do not taste sweet
Glucose: the carbohydrate the body uses for energy production during respiration
Non starch polysaccharide: also known as dietary fibre. Bulks to the digestive system so that waste food moves along and is removed easily
Insoluble fibre: dietary fibre which helps prevent constipation
Soluble fibre: dietary fibre which helps reduce cholesterol

What they are and what they are made of:

•A macronutrient found in plant foods. The process by which plants make carbohydrates is photosynthesis
•Carbohydrates are classified into two main groups: sugars and complex carbohydrates
•Sugars: a group of carbohydrates tasting sweet. Plants produce 2 types during photosynthesis:
-Monosaccharides: one sugar molecule. Fructose, glucose, galactose
-Disaccharides: two sugar molecules. Sucrose, maltose, lactose
Complex carbohydrates: Do not taste sweet. Plants produce several types called **Polysaccharides**: Starch, pectin, dextrin, dietary fibre (also called non starch polysaccharide NSP) Also glycogen (made in mammals and humans) from the foods eaten.

Functions in the body (what they do in the body)
•Main energy source
•NSP (insoluble fibre) helps the body get rid of waste products: NSP helps to produce soft, bulky faeces (solid waste) which are easy to pass out of our body when we go to the toilet. Keeps digestive system healthy; controls weight; helps us feel fuller for longer. Soluble fibre (oats, nuts, peas, beans, lentils, prunes, bananas, pears, sweet potatoes + carrots slows down digestion and absorption of carbs. So helps to control blood sugar levels, which helps you stop feeling hungry. Could help reduce cholesterol levels.

Effects of deficiency: This is rare in the U.K.
•Lack of weight, tiredness
•Severe weakness
•Not enough NSP = constipation. May lead to cancer of the bowel

Effects of excess: If the diet has more energy (carbs) than it needs, the body converts and stores as fat.
Refined and processed:
•Refined carbohydrates are quickly broken down + absorbed by the body. = rapid rise in the blood sugar level. If eaten frequently throughout the day, over a period of time, = stress on the pancreas (produces hormone – insulin). Insulin allows glucose to enter body cells to use it for energy. Eventually the pancreas may stop working or its cells may become resistant to insulin so Type 2 diabetes may result.
•Too much NSP could result in the body not being able to absorb iron and calcium.
•Sugar might = tooth decay. Sugars released from foods or commercially added are set free. (Inside unprocessed foods they are intrinsic)

Sources:
Sugar: monosaccharides
Glucose: ripe fruit + veg. Available in drinks, tablets + powders.
Fructose: fruits, veg. + honey. Sweetener (HFCS) High Fructose Corn Syrup used as a sweetener in processed foods)
Galactose: milk from mammals.
Sugar: Disaccharides
Maltose: Cereals e.g. barley
Sucrose: extracted from sugar cane. AKA sugar.
Lactose: milk from mammals and products made from it e.g. yogurt, cheese)
Complex carbohydrates:
Starch: cereals e.g. wheat, oats, barley + maize and cereal products e.g. breakfast cereals, pasta, bread); starchy veg. e.g. potatoes, yams, parsnip, peas + butternut squash
NSP: wholegrain cereal + cereal products e.g. breakfast cereal + pasta. Veg. fruit, pulses
Pectin: some fruits e.g. oranges, apples, plums + apricots + some root veg. e.g. carrots

Amount needed for different life stages Is calculated as a percentage of total daily energy intake. Rather than by weight (except NSP). The energy value of carbohydrate is 3.75g/16kJ of energy.
From 2 years+ this is the recommended intake:

Type of carbohydrate	**% of food energy per day**
Total carbohydrate	50%
Free sugars	No more than 5% of total carb. intake. Meaning no more than: (tsp. = teaspoons) 19g/day (4 tsp.) free sugars children 4 – 6 years 24g/day (5 tsp) children 7 – 10 years 30g/day (6 tsp) for children11 **and** adults
Non Starch Polysaccharide (NSP) dietary fibre	**Adults:** at least 30g each day **Children**: each day **2 – 5**: 15g **5 – 11**: 20g **11 – 16**: 25g **16 – 18**: 30g

Watch out for: Hidden sugars mainly in processed foods: Look for these names – Molasses, Glucose syrup, Glucose-fructose syrup, treacle, maltose, fructose, sugar cane, sucrose, granulated sugar.

Carbohydrates —Functional and chemical properties

Key words:

Caramelisation: The breaking up of sucrose (sugar) molecules when heated = a change in colour, flavour + texture of the sugar as it turns into a caramel.

Dextrinisation: The breaking up of starch molecules into smaller groups of glucose molecules when they are exposed to dry heat

Gelatinisation: the swelling of starch granules when they are cooked with a liquid to the point where they burst and release starch molecules

Dextrinisation:

when foods containing starch e.g. bread, cakes, biscuits, scones and pastries are cooked using dry heat e.g. baking = grilling, they change to a brown colour on the outside.

Dry heat (oven/grill) causes starch to change colour, texture and flavour.

The starch molecules break down to change to dextrin (a smaller group of glucose molecules)

Caramelisation

Sugar (sucrose) used for cooking (disaccharide made from glucose + fructose) is heated and melts to a syrup. The syrup boils. It is important **not to stir** the syrup as it caramelises.

The sucrose molecules break up and water molecules are formed.

As heating continues, water evaporates, the syrup gets thicker and changes from a colourless and clear syrup to a golden brown

caramel. If you stir, the sugar will **crystallise** into large, hard lumps. The ideal temperature of caramelising sugar is 160°C to 170°C.

It will eventually burn and become bitter if cooked for too long

because too much water is driven off and carbon is left behind, which makes the caramel dark and bitter.

Foods that contain natural (intrinsic) sugar e.g. onions (glucose, fructose) which they store during growth will caramelise. When sautéing (means frying them gently in oil for several minutes (the

structure of the onion softens and breaks down and the sugars are released. The heat changes the sugars in the onions and caramelises them, so that they turn a golden -brown colour and develop a characteristic flavour.

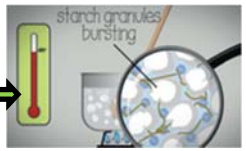
Gelatinisation—What happens:

Starch is found in small packets (granules).

Starch molecules are made of thousands of glucose molecules joined in **long straight** chains or **short chains with branches.** They sink to the bottom of cold liquids. If not stirred = lumps.

When **heated** to 60°C starch granules absorb water and swell up = the sauce starts to **thicken**, because there is less room for the starch granules to move around

At 80°C starch granules are very swollen and start to burst, letting starch out into the liquid.



At 100C the starch molecules form a 3D network that traps water stopping them moving around so much. At 100°C the liquid completely thickens – it has gelatinised.

As it cools the starch molecules form longer chains and the water molecules stay trapped so it becomes a solid gel.

Sauces must be stirred all the time to prevent starch granules sticking together at bottom of pan where they will swell up, stick together and make lumps

As the sauce cools down the starch molecules start to form longer chains and the water molecules stay trapped inside them so the sauce gradually becomes a **solid gel.**

If the sauce is not stirred, the starch granules will stay at the bottom of the pan whilst this is happening and will stick together and to the bottom of the pan, where some of them may burn. The sauce will have an unpleasant texture because the starch granules will have formed lumps as they swelled and they will not be distributed throughout the sauce.