

Tikrit University

College of Nursing

Basic Nursing Sciences



1st stage - 2023-2024

Biochemistry

(Lecture (3) Disaccharides & polysaccharides)

by:

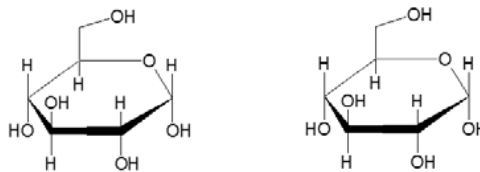
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Disaccharides

Monosaccharides are rare in nature. Most sugars found in nature are disaccharides. These form when two monosaccharides react.

Maltose – a disaccharide

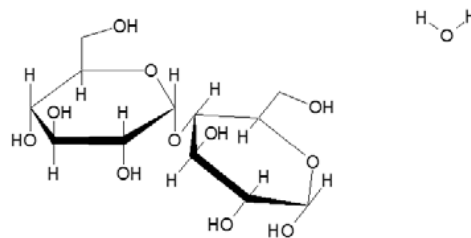
A maltose molecule is formed from two α -glucose molecules



A water molecule splits out – this is a condensation reaction
...



... and the two glucose units are linked by a glycosidic bond (or link)



A condensation reaction takes place releasing water. This process requires energy. A glycosidic bond forms and holds the two monosaccharide units together.

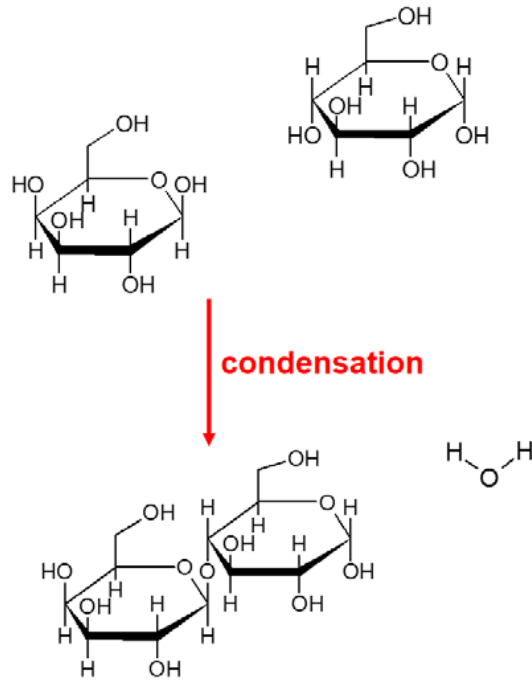
Lactose – a disaccharide

An α -lactose molecule is formed from one β -galactose molecule and one α -glucose molecule

A water molecule splits out – this is a condensation reaction

...

... and the two monosaccharide units are linked by a glycosidic bond (or link)



The three most important disaccharides are **sucrose**, **lactose** and **maltose**. They are formed from the α forms of the appropriate monosaccharides. Sucrose is a non-reducing sugar. Lactose and maltose are reducing sugars.

Monosaccharides	Disaccharide
α -glucose + α -fructose	from sucrose
α -glucose + α -glucose	from maltose
α -glucose + β -galactose	from α -lactose *

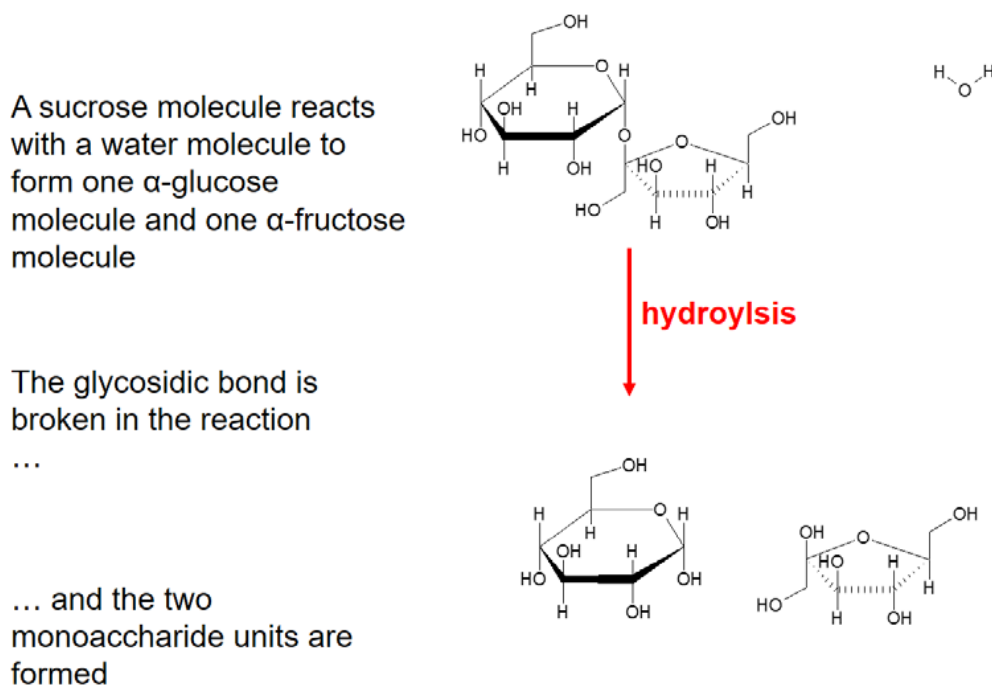
Lactose also exists in a beta form, which is made from β -galactose and β -glucose. Disaccharides are soluble in water, but they are too big to pass through the cell membrane by diffusion. They are broken down in the small intestine during

digestion to give the smaller monosaccharides that pass into the blood and through cell membranes into cells.



This is a hydrolysis reaction and is the reverse of a condensation reaction. It releases energy.

Hydrolysis of sucrose



Monosaccharides are used very quickly by cells. However, a cell may not need all the energy immediately and it may need to store it. Monosaccharides are converted into disaccharides in the cell by condensation reactions. Further condensation reactions result in the formation of polysaccharides. These are giant molecules which, importantly, are too big to escape from the cell. These are broken down by hydrolysis into monosaccharides when energy is needed by the cell.

Polysaccharides

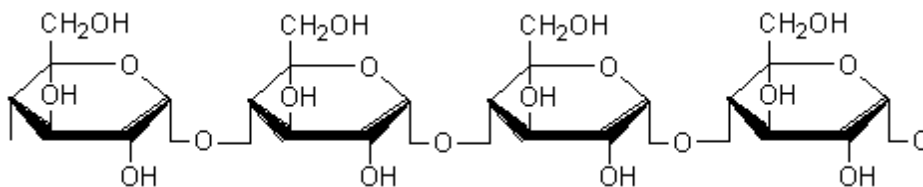
Monosaccharides can undergo a series of condensation reactions, adding one unit after another to the chain until very large molecules (polysaccharides) are formed. This is called condensation polymerisation, and the building blocks are called monomers. The properties of a polysaccharide molecule depend on:

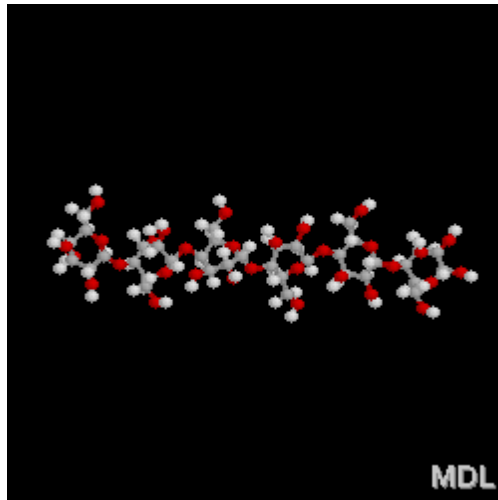
- its length (though they are usually very long)
- the extent of any branching (addition of units to the side of the chain rather than one of its ends)
- any folding which results in a more compact molecule
- whether the chain is 'straight' or 'coiled'

Starch

Starch is often produced in plants as a way of storing energy. It exists in two forms: amylose and amylopectin. Both are made from α -glucose. Amylose is an unbranched polymer of α -glucose. The molecules coil into a helical structure. It forms a colloidal suspension in hot water. Amylopectin is a branched polymer of α -glucose. It is completely insoluble in water.

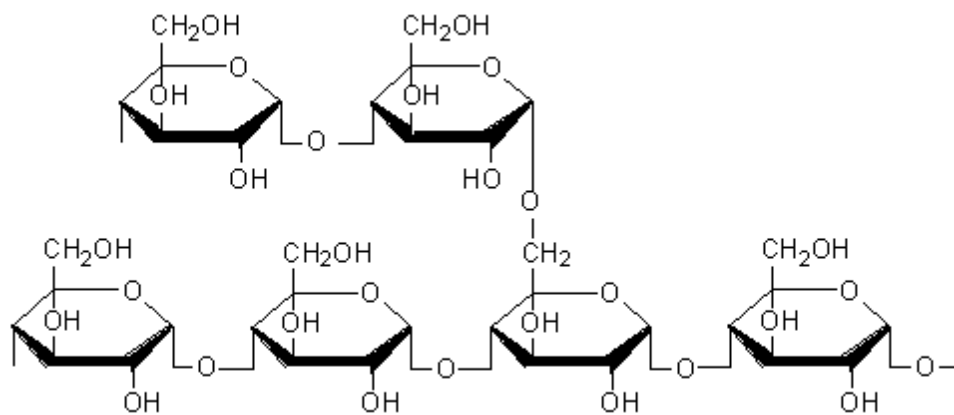
Section of the amylose molecule

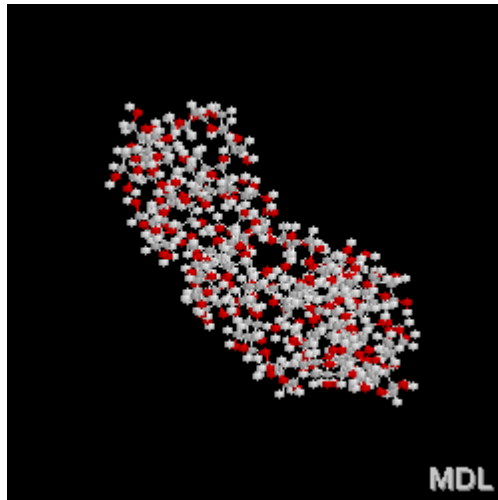




A section of the amylose molecule

Section of the amylopectin molecule





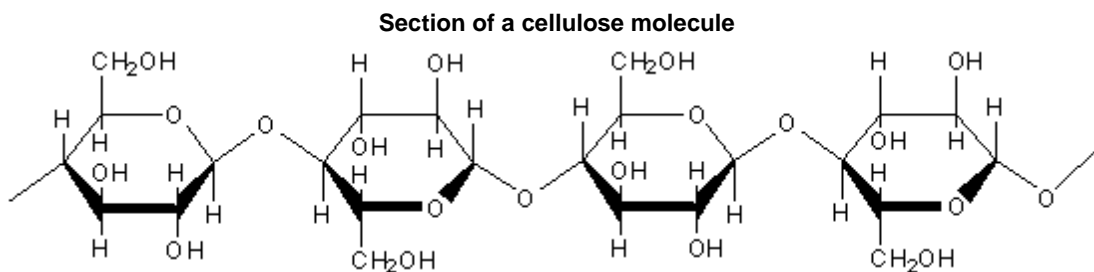
A section of the amylopectin molecule

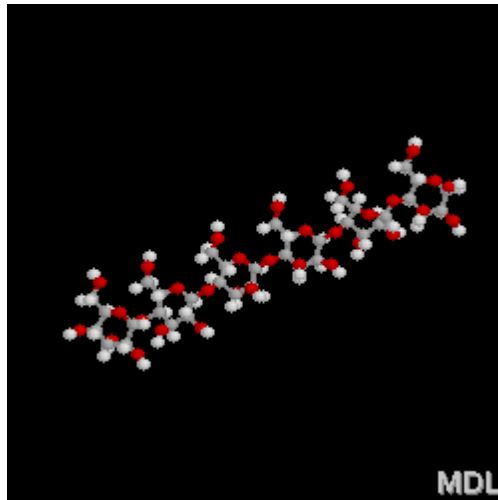
Glycogen

Glycogen is amylopectin with very short distances between the branching side-chains. Starch from plants is hydrolysed in the body to produce glucose. Glucose passes into the cell and is used in metabolism. Inside the cell, glucose can be polymerised to make glycogen which acts as a carbohydrate energy store.

Cellulose

Cellulose is a third polymer made from glucose. But this time it's made from β -glucose molecules and the polymer molecules are 'straight'.





Cellulose

Cellulose serves a very different purpose in nature to starch and glycogen. It makes up the cell walls in plant cells. These are much tougher than cell membranes. This toughness is due to the arrangement of glucose units in the polymer chain and the hydrogen-bonding between neighbouring chains.

Cellulose is not hydrolysed easily and, therefore, cannot be digested so it is not a source of energy for humans. The stomachs of Herbivores contain a specific enzyme called cellulase which enables them to digest cellulose.

Test your knowledge

Take quiz on *Carbohydrates*