



Glucose for Metabolism is Stored as a Polymer in Plants

Bilal Bashir

Department of Speciality trainee doctor endocrinology, diabetes and general internal medicine. University of Manchester, UK

***Corresponding author:** Bilal Bashir, Department of Speciality trainee doctor endocrinology, diabetes and general internal medicine. University of Manchester, UK.

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Description

Glucose is a simple sugar with the molecular formula $C_6H_{12}O_6$. Glucose is the most abundant monosaccharide, a subcategory of carbohydrates. Glucose is mainly made by plants and most algae during photosynthesis from water and carbon dioxide, using energy from sunlight, where it is used to make cellulose in cell walls, the most abundant carbohydrate in the world. In energy metabolism, glucose is the most important source of energy in all organisms. Glucose for metabolism is stored as a polymer, in plants mainly as starch and amylopectin, and in animals as glycogen. Glucose circulates in the blood of animals as blood sugar. The naturally occurring form of glucose is d-glucose, while l-glucose is produced synthetically in comparatively small amounts and is of lesser importance. Glucose is a monosaccharide containing six carbon atoms and an aldehyde group, and is therefore an aldohexose. The glucose molecule can exist in an open-chain (acyclic) as well as ring (cyclic) form. Glucose is naturally occurring and is found in its free state in fruits and other parts of plants. In animals, glucose is released from the breakdown of glycogen in a process known as glycogenolysis. Glucose, as intravenous sugar solution, is on the World Health Organization's List of Essential Medicines, the safest and most effective medicines needed in a health system. It is also on the list in combination with sodium chloride.

Chemical Properties

Glucose forms white or colorless solids that are highly soluble in water and acetic acid but poorly soluble in methanol and ethanol. They melt at $146\text{ }^\circ\text{C}$ ($295\text{ }^\circ\text{F}$) (α) and $150\text{ }^\circ\text{C}$ ($302\text{ }^\circ\text{F}$) (β), and decompose starting at $188\text{ }^\circ\text{C}$ ($370\text{ }^\circ\text{F}$) with release of various volatile products, ultimately leaving a residue of carbon. Glucose has a dissociation exponent (pK) of 12.16 at $25\text{ }^\circ\text{C}$ ($77\text{ }^\circ\text{F}$) in methanol and water. With six carbon atoms, it is classed as a hexose, a subcategory of the monosaccharides. D-Glucose is one of the sixteen aldohexose stereoisomers. The d-isomer, d-glucose, also known as dextrose, occurs widely in nature, but the l-isomer, l-glucose, does not. Glucose can be obtained by hydrolysis of carbohydrates such as milk sugar (lactose), cane sugar (sucrose), maltose, cellulose, glycogen, etc.

Dextrose is commonly commercially manufactured from cornstarch in the US and Japan, from potato and wheat starch in Europe, and from tapioca starch in tropical areas. The manufacturing process uses hydrolysis via pressurized steaming at controlled pH in a jet followed by further enzymatic depolymerization. Unbonded glucose is one of the main ingredients of honey. All forms of glucose are colorless and easily soluble in water, acetic acid, and several other solvents. They are only sparingly soluble in methanol and ethanol.

Structure and nomenclature

Glucose is usually present in solid form as a monohydrate with a closed pyran ring (dextrose hydrate). In aqueous solution, on the other hand, which interconvert (see mutarotation). From aqueous solutions, the three known forms can be crystallized: α -glucopyranose, β -glucopyranose and β -glucopyranose hydrate. Glucose is a building block of the disaccharides lactose and sucrose (cane or beet sugar), of oligosaccharides such as raffinose and of polysaccharides such as starch and amylopectin, glycogen or cellulose. The glass transition temperature of glucose is $31\text{ }^\circ\text{C}$ ($88\text{ }^\circ\text{F}$) and the Gordon–Taylor constant (an experimentally determined constant for the prediction of the glass transition temperature for different mass fractions of a mixture of two substances).

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