

Charting New Horizons in Education

Carbohydrates II

O4 Biochemistry

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Introduction – don't memorize the blue colored texts

- Nucleophiles: Nucleophiles are electron-rich species that contain one or more lone pairs of electrons or are negatively charged, such as hydroxide ions (OH⁻).
- Electrophiles: Electrophiles are electron-deficient species that have a strong attraction for electrons, Common examples include carbonyl compounds (like aldehydes and ketones).
- Reaction Mechanism: The nucleophile approaches the electrophilic site, a new covalent bond is formed, and sometimes other bonds are broken or rearranged.
- Ether: R-O-R', example: Dimethyl ether \rightarrow CH3-O-CH3
- Intramolecular (Intra): This prefix refers to interactions or phenomena that occur within a single molecule.
- Intermolecular (Inter): This prefix refers to interactions or phenomena that occur between different molecules or entities.
- Acetyl: CH3CO-

Manual & Hemiketal

V.A



Monosaccharide cyclization



Monosaccharide cyclization VA CH₂OH 2 C=0НО-С-Н **D**-fructose Н-С-ОН Linear form H-C -OH6 CH₂OH cyclization Cyclikation ⁶CH₂OH ⁶CH₂OH () OH ¹CH₂OH () HO Η 5 HO Η CH₂OH OH Η Η OH OH Η α-D-fructose β-D-fructose

- N Pyranoses & Furanoses
- Sugars with six-membered rings are known as pyranoses (e.g. glucopyranose) as they resemble the heterocyclic compound pyran.



• Sugars with five-membered rings are known as furanoses (e.g. fructofuranose) as they resemble the heterocyclic compound furan.



» Pyranoses & Furanoses

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» Pyranoses & Furanoses



» Pyranoses & Furanoses

Isomeric Forms of Fructose



Hexose or pentose can exist in pyranose and furanose forms (the most stable rings). e.g in solution, glucose and fructose are mostly pyranoses whereas ribose is mostly furanose

Anomers

- In cyclic sugars, the carbonyl carbon becomes a chiral center (asymmetric carbon) with two possible configurations: α and $\beta \rightarrow$ This new carbon is called anomeric carbon.
- Anomers are pair of stereoisomers that differ in spatial arrangement of atoms at the anomeric carbon. In α-anomer, the OH group of the anomeric carbon is projecting down the plane of the ring and on the opposite side of the terminal CH2OH group (in Fisher projection) and vise versa in βanomer.
- <u>The anomers freely interconvert in aqueous solution, e.g. at equilibrium D-glucose is a</u> <u>mixture of β-anomer (63.6%), α-anomer (36.4%) and extremely tiny amounts of the</u> <u>straight chain.</u>

Maworth Projection

Haworth projection is a simple 3D way to represent the cyclic monosaccharides.



Conformers

The geometry of the carbon atoms of monosaccharide ring is tetrahedral (bond angles are close to 109.5°), so sugar rings are not actually planar. For example, pyranoses take on either Chair or Boat conformations (conformational isomers or conformers).



Carbon atoms are tetrahedral

KA Conformers



Conformers are stereoisomers with different rotations about single bonds

Conformers

The geometry of the carbon atoms of monosaccharide ring is tetrahedral (bond angles are close to 109.5°), so sugar rings are not actually planar. For example, pyranoses take on either Chair or Boat conformations (conformational isomers or conformers). Steric repulsion, also known as steric hindrance or steric strain



Sugar modification

- Aldonic acids: Oxidation of aldehyde (C1) to carboxylic acid; e.g. D-gluconic acid
- Uses:
- 1. Some drugs are injected in the form Of gluconate (the salt of gluconic acid)
- 2. Calcium gluconate solution (I.V) as cardioprotective agent in patients with high blood level of K+ (6.5 mmol/L) occurring due to kidney failure





Sugar modification



Sugar modification

deoxyribose

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HOCH,

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«Wherever the art of medicine is loved, there is also a love of humanity.»

- Hippocrates-



