SUBJECT - CHEMISTRY
CLASS - B.Sc (Hons) PART-II
PAPER - IV
TOPIC - Ring Structure of glucose:

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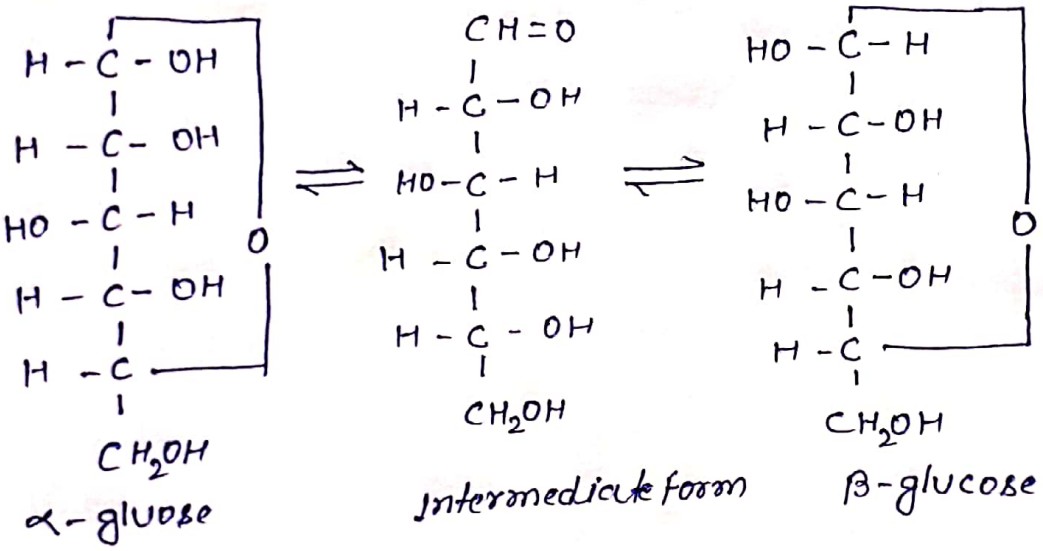
Q Discuss the evidence on which the ring structure of glucose is based?

Ans Points in favour of ring structure of glucose:

Haworth et al (1927) proposed a 6-membered heterocyclic ring structure with oxygen as one of the atoms for glucose. It involves the formation of an intramolecular hemiacetal ring between the -CHO and -OH groups at C_5.

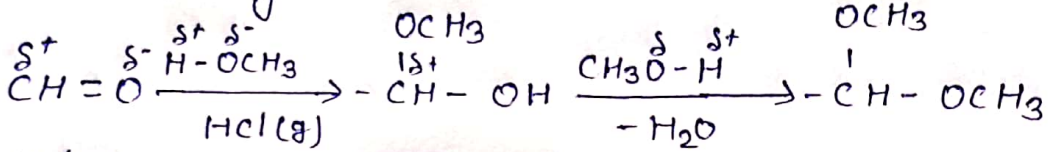


This 6-membered (Pyranose) ring structure of glucose explains satisfactorily the objections raised against its open chain structure:

(a) Since the aldehydic C-atom becomes asymmetric on ring formation therefore glucose has two isomeric forms: α & β.

b Corresponding to α and β-glucose, we have two stereoisomeric methyl glycosides α-and β. These glucoside being acetals, are very stable in aqueous solution and therefore do not respond to mutarotation.

These are also stable to alkali and as such they are not hydrolysed to the open chain form by alkali present Fehling's or Tollen's reagents. Hence these anomeric (stereoisomers differing only in configuration at C1 are called anomers) glucosides are non-reducing.



aldehyde hemiacetal acetal

(c) Since glucose ring is not very stable and hence broken up by strong reagent like HCN, NH_2OH, $H_2N \cdot NHph$ etc. to give the intermediate aldehydic form which reacts with them just like an aldehyde. Weak reagents e.g NH_3, $NaHSO_3$ etc are unable to break the ring and hence cannot react with them.

(d) It explains mutarotation. Both α and β-glucose are hemiacetals and are hydrolysed in aqueous solution to an equilibrium mixture via open chain structure. In aqueous solution α-glucose slowly changes into an equilibrium mixture (38% α glucose + 62% β-glucose) with specific rotation of +52.5° Similarly the aqueous solution of β-glucose with specific rotation of +19° changes to the same equilibrium mixture.