OBJECTIVES

1. Define the term "Qualitative Test."
2. Describe the basis of qualitatitive tests for Monos, Disacc, and polysacc.
3. Use the qualitative tests to distinguish specific sugars from each other.

* You are given (provided with) solutions containing;
  - → Glucose
  - → Fructose
  - → Lactose
  - → Sucrose
  - → Maltose
  - → Ribose
  - → Ribulose
  - → Cellulose
  - → Starch
  - → Glycogen

4. Devize a scheme by which you may systematically identify these compounds.

TESTS FOR CARBOHYDRATES

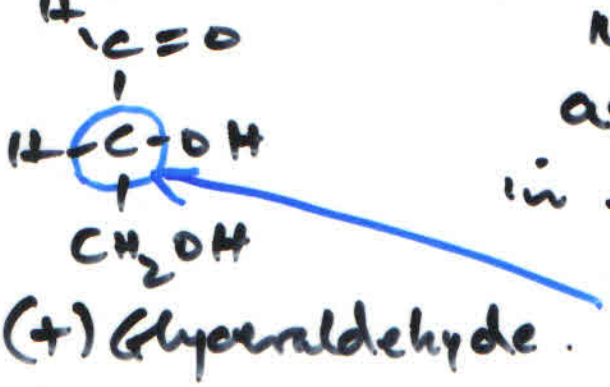
Carbohydrates ($C_n(H_2O)_n$) < Monosaccharides – Single units
Oligosaccharides – ≥ 2 units–10
Polysaccharides – Very large no. of units.

1) Monosaccharides

– Polyhydroxy compounds < aldehyde / Ketone } functional group
Aldoses
Ketoses

– Asymmetric – contain assymetric carbon atoms so exist in different optically active forms.

* Glyceraldehyde – most simple monosaccharide with an assymetric carbon. Occur in + or – form.



D(+) Glyceraldehyde.

Examples: Trioses, Tetroses, Pentoses, Hexoses

2) Oligosaccharides

e.g. Disaccharides < Maltose α1-4 Glc-Glc
Lactose β1-4 Gal-Glc
Sucrose α1-2 Glc-Fre
Cellobiose β1-4 Glc-Glc
Trehalose α1-1 Glc-Glc

* Maltose, Lactose and Cellobiose possess a free aldehyde group - therefore qualify as reducing sugars. ← Anomeric carbon

Sucrose = non-reducing sugar.

$$R-\overset{O}{\overset{\|}{C}}-H + Cu^{2+} \xrightarrow{\text{(Blue)}} R-\overset{O}{\overset{\|}{C}}-O^- + Cu_2O \quad \text{(Brick-red)}$$

* Fructose also turns positive for reducing sugar - because it is an α-hydroxy-ketone. It is converted to glucose and mannose by the base in the reagent.

3) Polysaccharides

e.g. Starch 10,000 - 1,000,000 mwt.

* Amylose (10,000 - 20,000) - minor component.
  - Straight chain of α1-4 linkages.
  - Soluble in hot water.
  - Gives a blue color with iodine.
  - Non-reducing.
* Amylopectin (500,000 - 1,000,000) - major
  - branched α1-4 and α1-6 linkages
  - Insoluble in hot water
  - Forms a reddish-black color with iodine.

e.g. Glycogen 1,000,000 - 5,000,000
Highly branched.

Reactions of Sugars

e.g. Dehydration with mineral acids

Sugar + Conc. H_2SO_4 ⟶ Carbon

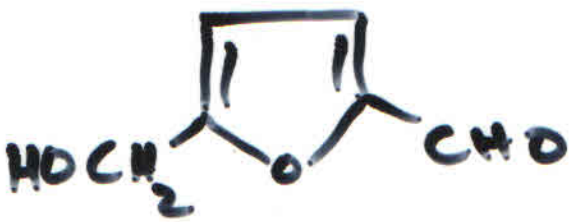
Sugar + Mild acids ⟶ furfural or its derivatives

DEHYDRATION OF SUGARS

Pentoses $\xrightarrow{H^+}$

furfural

Hexoses $\xrightarrow{H^+}$



5-hydroxymethylfurfural

Furfural and its derivatives condense with phenols to form colored compounds. This characteristic is the basis of many qualitative tests e.g. Selivanoff's, Bial's, Molisch's, Tollen's, Resorcinol, Orcinol.

Table 1: Reaction of Sugars with Phenols

TEST	CONC. ACID	PHENOL	+ Reaction	Color of Compound
Molisch's	H_2SO_4	α-naphthol	All CHO's	Purple
Seliwanoff's	HCl	Resorcinol	Ketoses and Sucrose	Red
Bial's	HCl	Orcinol	Pentoses and Uronic acids	Green
Tollen's	HCl	α-naphthol resorcinol	Uronic acids	Blue

Uronic acids are sugars in which the $-CH_2OH$ group of the ultimate carbon has been oxidized to a $-COOH$ group e.g. Glucuronic acid.

Table 2: Qualitative Scheme for Carbohydrate Chemistry