LECTURE NOTE

On

BCH

By

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CHEMISTRY OF CARBOHYDRATE

Carbohydrate may be defined as polyhydroxy aldehydes or katones or as substances that yield one of these compounds on hycholysis. They are undely distributed in plants – cellulosestance and ammals – glucose, glycogen.

Carbohydrates are classified into;

Monosarcharides

Disaccharides

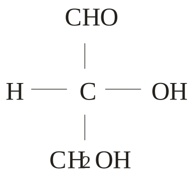
Phgosarcharides

Monoccharides – Are simple sugards that cannot be hydrolyzed into simpler sugars or CHO. Have the formula $(CH_20)n$ can be classified into trioses, tetroses, pentoses Lexosen depending on the no of C alone and as aldoses or ketoses depending on the preserve of aldelyde or ketone gp

Trooses Clyceraldelycle

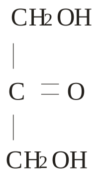
All the sample monosall are white crystallme solids that are soluble in water but unsoluble in nonpolar solienly most have a sweet taste

	Aldose	Ketone
Tehose	Erythrone	Erythrulose
Pentose	Rebose	Rebulose
Hexoses	Glucose	fruclose



$H-\overset{\overset{CHO}{|}}{\underset{\underset{CH_2OH}{|}}{C}}-OH$

D – Glyceraldelyde



$\overset{\overset{CH_2OH}{|}}{\underset{\underset{CH_2OH}{|}}{C}}=O$

D-hydroxyacetone

Glucose is the most input because all others are converted to it in mammals.

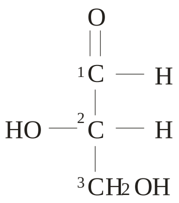
ISOMERISM

Stereoisomers are compounds that have the same structural formula but differ in special configuration

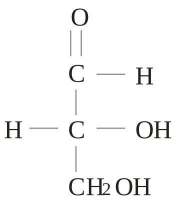
Most common over with monosacchander or glucose are ;

1. **D L Isomer**: This is determined by its special relationship to the parent compound of the CHO family- glycarablehyde. The orientation of the – H and OH groups around the penultimate C i.e. aC^5 for glucose determine this. When the OH is to the right it is D series, if it is to the left = L series.

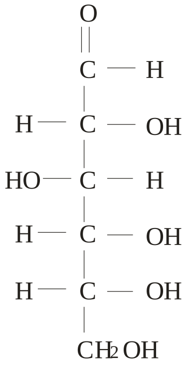
The presence of asymmetric C atoms also consider optical activity on the compound when a beam of plane-polarized light is passed this a solution of an optical isomers it will be rotated other to the right- dextrorotatory (+) or to the left levorotating (_) when equal anti of D & L isomers are present, the resulting mixture has no optical actively, since the achievers of each isomer cancel one another. It is used to be a racemic or DL mixture



L-glyceraldehyde



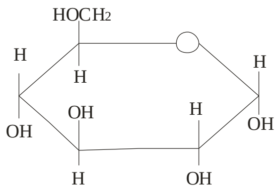
D-glyceraldehyde



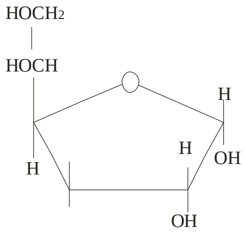
D-glucose

2. **Pyranose and furanose ring structures**

The stable ring structures of monosaccharide are similar to the ring structures of either pyran or furan.

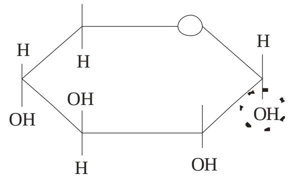


$\partial - D - Glucopyranose$

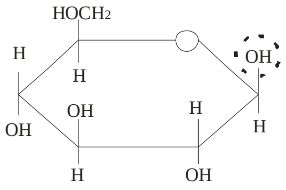


$\partial - D - Glucofuramox$

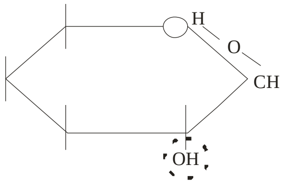
3. ***∂ and βanomers***: When isomerism takes place about position 1 the carbonyl or anomeric C atom, $\partial\ or\ \beta$ forms of isomers are produced.



α-D-Glycopyranose

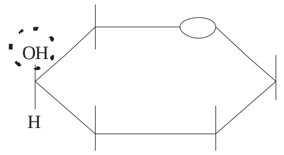


$\beta - D - glycopyranose$

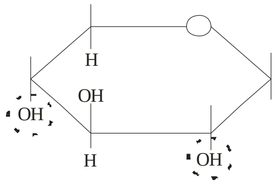


Mutarotation of glucose α and β forms exits making the chain to open

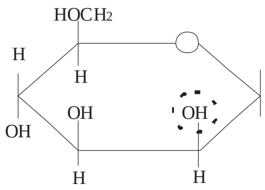
4. **Epumers**: isomers differing as a result of variation in configuration of the -OH and H on A atoms 2, 3, and 4 of glucose are known as epumers. Mannose differ from glucose in C 2 while galallose in C4.



α-D-Galactose



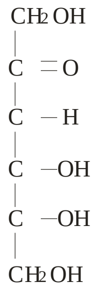
Glucose



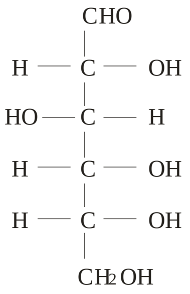
α-D-Mannose

5. **Aldose - Ketose isomerism**: - Aldose sugar has an aldehyde group in position the anomeric C while ketose sugars keto group in equation 2.

e.g.



D-fructose (ketose)



D-glucose

Hexoses of physiological

Glucose – fruit juices, starch, cane sugar, maltose, Lachine, forbid sugar

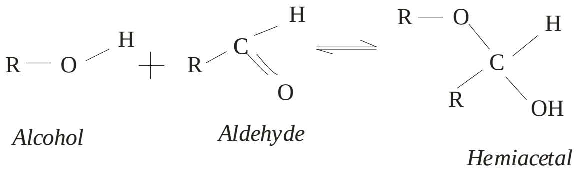
Fructose- fruit juices, honey, hydrolysis of cane sugar

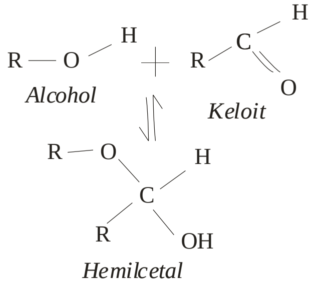
Gala chine – hydrolysis of lactose change to glucose in the lactose also a constituting glycolyds, glycopotium

Maltose- hydrolysis of manners and gums-consistent of glycoprotein

Properties of Monosacchandes:

1. when monosacchandes react with alcohol, hemketal or hemacetal are formed.





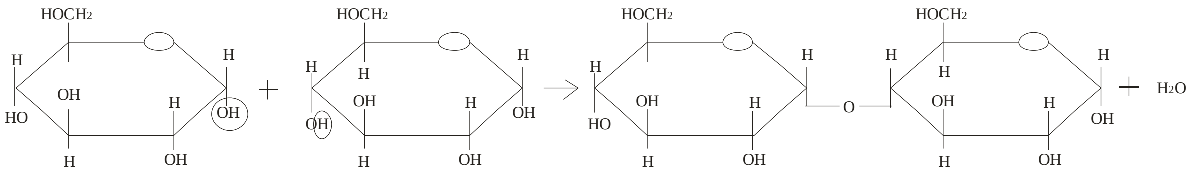
2. *Glycosides formation*: Formed by Condensation between the hydroxyl gp of the anomeric carbon of a monosacchande and a second compound that may or may not be another monosacchande. They form glycosides or acetals. Glucose forms glucosides, galactine – galacloside the bond between the 2 sugars is called Pentoses – Ribose, Ribulose, Arabinose, Xylulone etc Hexoses – Glucose, Fructose, Galactine, Manmore.
Glycosidic bond, Glycosides are found in many drugs and spices. Caidacglycosides, antibiotics such as streptonyan are very input in medicine.

3. *Ester Formation*: e.g. When X – D – glucopyranoside is heated with acetic anhydride all the hydroxyl functions are acetylated to yield the penta – O – acetyl glucose. Important ones are phosphate esters – when CHO react with ATP in the presence of appropriate enzyne Glucine + ATP = GbP.

4. *Oxidation*: Aldoses are oxidized at the ealdehydric C atom by weak oxidizing agent or specific enzymes to form corresponding sugar acids or carboxylic acies e.g. glucore form gluconic acid oxidized at c$_1$. If stronger oxidizy agent is used (e.g. HN$_0$3) aldane acids are formed – glucose form glucaric acide. When oxidized at c1 and c6 It can further form glucuronic acid when oxidijed at c6 by enzyme.

5.*Disacchande formation*: Condensation of 2 monosacchandes give a disacchande while H20 is eliminated .

Glucose + Glucose = Maltose



O – *X* – D– Glucopyranosye
(1 → 4) – *X* – D glucopyranose

6. *Reduction*: Monosaccharides may be reduced to their corresponding alcohols by reducing agents such as sodium amalgam or enzymes, Glucose yields sorbitol, mannore – mannilol.

7. *Reducing sugar*: Sugars are classified as reducing or non reducing sugars. They act as reducing agents because free or potentially free aldehyde and ketone groups are present in the molecule. They reduce metal was such as Cu, Ag in allcaho solution.

Benedict solution of refilling solution is the reagent for defecting reducing sugars. They cu^{2t} α reduced to cu^{f} forming a brick red precipitate.

8. *Action of Acids and Bases*: Monosace are stable to hot dilute mineral acides conc acids came dehychation of sugars to yield furfurals. Furfurals condense with phenols e.g. orcenol to give characteristic cilored products often used for colorimetric analysis of sugars.

b. Dilute aqueous bases at room temp cause rearrangement about the anomic C and its adjacent C atom. At high temp they undergo further rearrangement or polymerization.

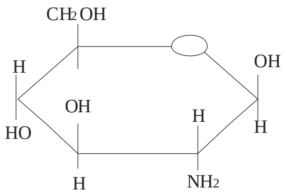
Formation of phemylosazones: Monosacchades in slightly acid solution at 1000C reat with excess phenylhydragine to form phenylosazones which are insoluble in water and are easily crystallized. Glu, Fruc and Manna form the see osazone but galactine form a deft crystal i.e. used to identify galactine.

Derivatives of Monosacchandes:

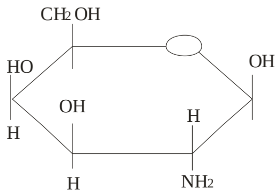
1. *Deoxy sugars*: Are throne in which a hydrocyl gp attached to the ring structure has been replaced by a H gp e.g. DNA.

2. *Lodo Compd*: An aldose heated with conic hydriodic acid (H1) loses all of its oxygen and is converted unto an lodo compd. (glucose to iodohexane C_6 H_{12} 0_6 f Hi –> C_6 H_{13}^{1}

3. *Amino sugars* e.g. 2 amino sugars of made distribution are D – glucosamine and D galactosamine in which the 0H gp at C atom 2 is replaced by an amino gp



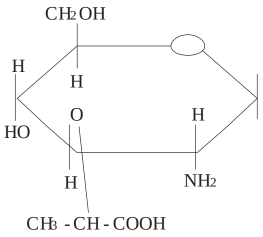
β - D glucosamine



β – D – Galactosamine

Several antiholics (e.g) crythonycine contain amino sugar

4. *Muramic and Neuramic acid*: They are components of polysacchaudes of higher organis and bacteria cell avally. They are glucosamines linked to 3C acids at the C – 1 or C – 3 positions.



Muramic acid

Sugar acids, sugar alcoholics, sugar estem are also denvotes of monosacelenda.

5. *O–methyl derivatives:* The OH gp of monosacchades can be methylated esp the OH gp on the anomoic C reats with methanol in the presence of acid to yield methyl glycosides which are acetals.

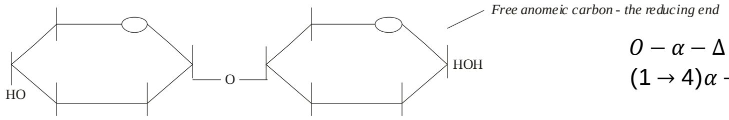
6. *Honey*: Bees Processing of honey consorts of (1) reducing the water content of the rectar (2) hydrolysing the suciose in nectar to glucose and fructose by the action of the enz invertase (3) producing small amount of gluconic acid from glucose by the action of the enz glucose oxidase. The fuel product is sucrose 1%, fructose 38%, glucose 31% by wt.

DISSACCHARIDES:

2 Monosacchande musts looked by a glycosidic bond. The most common are succour, maltore and laclose. Each is a reducing agent except succore became of the presence of one free anomeic C atom.

Maltone: Is produced from starch by the action of anylase enz and is a component of malt (a substance obtained by allowing grain (esp barley) to soften in water and germinate, the enz diastase produced during the germination process hydrolye starch to maltose). The glucose units are 1→4 linked.

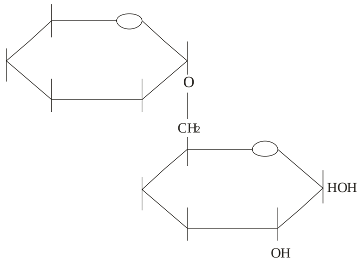
Isomaltore is obtained in the hydrolyen of dextrain but the glycoside bond is 1 → 6 and the configuration is α.



Free anomeic carbon - the reducing end

$O - \alpha - \Delta\, Glycopyranosyl$
$(1 \to 4)\alpha - \Delta -\ glucopyranose$

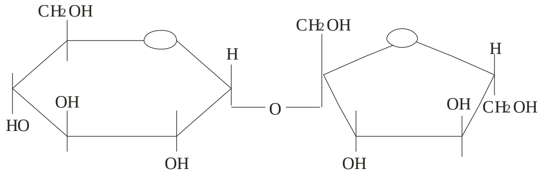
Maltone



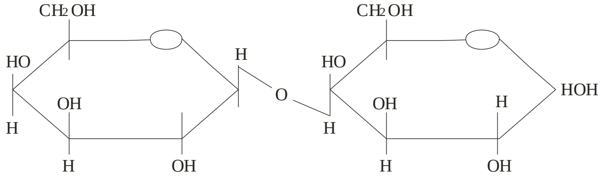
Isomaltone

$(1 \to 6)$

Sucoree: known as table sugar. It is confirmed of fructose and glucose. It is hydrolyzed by the enzyine invertase of science in the intestine. It is non reducing sugar because of the absence of free anomeric C i.e. has no free OH gp both anomie C are substituted and cannot be converted to the aldehydic configuration nor participate in the oxidation – reduction reaction as in other reducing sugars.



Lactose: $O - \beta - D$ – Galactopyranosy (1 → 4) $p - D$ – glucopynanose



Carbohydrate in milk. Hydrolyed by caltase to galactore and glucose with β (1 →4) link. Has a free anomeic C i.e. 4 is a reducing sugar some that cannot tolerate lactose has diarrhoea and intestural pan when they consume milk.

Trehalose – is a non reducing disarcharide found in insect blood (hemolymp).

Ohgosacchardes: Yield 2 – 10 monosacchanides units on hydrolysis e.g. stachyose is found in peas, beans bran and whole grains they are not affected by digesture enz but are metabolized by bacteria. This is the source of the flatulence often accompany consumption of such foods.

POLYSACCHARIDES

Also called glycans. If it contains only one kind of monosacc. It is called homopolysarchands where it contain more than one kid = heteropolysacchandes.

<u>Storage</u> <u>Polysac</u> : - prondo stores of energy
Starch storage polysarc in pits

Exists as <u>α – anylose</u> and <u>anylopection</u>
15 – 20% 50 – 55%

Storage Polysacehened e.g. Starch in plants, glycogen in animals are deposited in the form of large granules in the cytoplasm of cells.

Starch: Exists in 2 forum α anylose and anylopectin – yields only glucose in hydrolysin. It is the most input food source of CHO and is found in cereals, potatoes legumes and other vegetables α - anylose (15 – 20% of starch) it consist of long unbranched chains (linear) in which all the glucose units are bound in α (1 → 4) linkages it is poorly soluble in water. It reacts with iodine to give a blue color.

Amylopection: Is a highly branched chain of glucose units. The backbone glycoside linkage is α (1 → 4) but the branch points are α (1 → 6) linkages. It reaction with iodine to produce a red violet color.

Any lose may be hydrolyzed by α amylase which is present in pancreatic juiced saliva participate in the digestion of starch in the GIT it hydrolyse it to glucose and maltose Amylase may be hydrolyzed by α – amylase an enz present in malt.

Amylopection is also hydrolyzed by α and α amylases. The intermediate Polysacchande formed during amylase action is called DEXTRIN starch is stored in pit calls in the form of granules in teh stroma of plastics of 2 types – the chloroplasts (where photosynthesis takes place) and amyloplasts that are specialised starch accumulation bodies. When the starch is to be mobilized & used by the plant it is split into its monosaccharde by starch phosphorylare (1 → 4) cleavase for form GIP in anylopection the (1 → 6) bud is attacked by α (1 → 6) glucosidance → to give GIP.

Glycogen: It is a polysarc of glucose an α (1 → 4) (1 → 6)linkages. Major form of storage polysarchande in animals. It is food mainly in the liver and skeletal muscle it yields a red nolet colour with volume. It can be hydrolysed by both α and b amylases yields glucose and maltose and by glycogen phosphonylane to release glucose I – P. It is non reducing and highly branched like amylopection.

Dextrans: They are α (1 → 6) linked polysarcharides of D – glucose with branched chains food in yeast and bacteria. The repeating unit is isomaltose Gluc α 1 → 6 Glucose. The branch pts may be 1 → 2, 1 → 3, 1 → 4 in various species.

Bacteria going on the surface of teeth produce accumulation of dextrans an inpt composed of dental pleaque. Bacteria dexhains are also used as support medium in column chromatography e.g. sephedex, Biogel etc.

Fructans: Cont. D – fructore units.
Inulini : Starch found in tubers and roots of dahlias, dandelions etc. It is a fructosan.

STRUCTURAL POLYSACCHARIDES

Cellulose: It is the most abundant natural polymer in the world. Found in cell walls of plts it provides physical structure and strength. Wood and bark of trees are formed for cellulore and lignin. Cotton is pure cellulose. Cellulose acetales are used in dresses etc.

It is a linear homopolyner of D – glucose units linked by α (1 → 4) glycosidic bonds strengthened by H bonds. It is resistant to hydrolysis whether by acid or amylases in GIT most animals including humans cannot digest it because of the hydrolase that attacks the α linkage but ruminant animals because of the bacteria linking in their rumen which secret cellulose a α – glucosidare hydrolyze it.

Celluline gives no color with iodine and is not soluble in ordinary solvents strong acid can give glucore but partial hydrolysis yields cellobiose. It is an input source of bulk in the diet.

Chitin:- Similar to cellulose in function and viscore – is a viscouns solution of cellulose med in ranking fibres for cloths structure. It is found in cell walls of fungi and exoskeletons of crustaceans, insects and spiders. Consist of N – acetyl – glucosamire units joved by α $(1 \rightarrow 4)$ glycosidic linkages.

Rhamnogalacturonan II is the most complex polysacc on earth and is found in red wine court II driff sugar monomers.

Agarose: Polysacc isolated fun marne red algae consist of agarose and agaropection Agarose is a chain of alternating D- galactore and 3, 6 – an hydro – C – galaclose with side chains of 6 – methyl D – galaclose.

Agaropectum is similar but cont sulphate ester side chains and D – glucuronic acid.

Aganose and aganopectin readily form gels (used as Sephedex) in purification of macrounilec.

Mucopolysacchandes: (Glycosaminoglycans)

They are heteropolysarchardes. Consist of chains of complex CHO characterised by their contentof amino sugars and uromic acids.

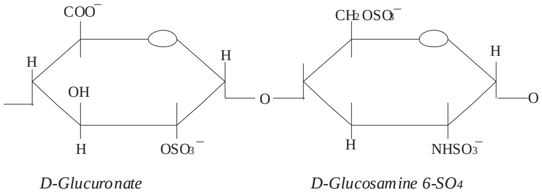
The acid mucopolysacchardes – hyaluronic and, chondronlin sulfales and heparin are found in the connecture tissues of aminds. They gave connective tissues toughness and flecibility.

HJeparum – a natural anticoagulant substance the disacchesde contain D – Glucuronate 2 surfate and D – glucosamme 6 – sulphate. It institutes bed clothing.

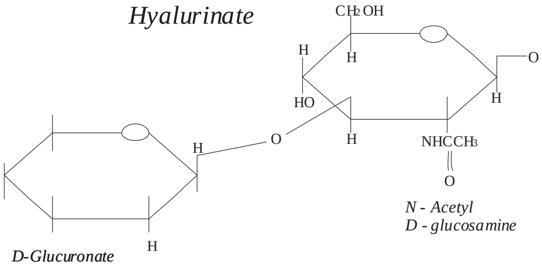
Hyaluronate are input components of the intreous humour in the eye and synovial fluid the lubricant of the joints in the body. The disacchanda count D – Glucononate ed N – Acety/D-glucosamine.

The chondrontuns and Keratan sulphate and found in tendious cartilage and other connecture tissues e.g. chordiunton 4 sulfate count D – Glucumate and N – acetyl D – galactosamme – 4 sulfate. But if chondinlin 6 – supphate subst 6 for 4.

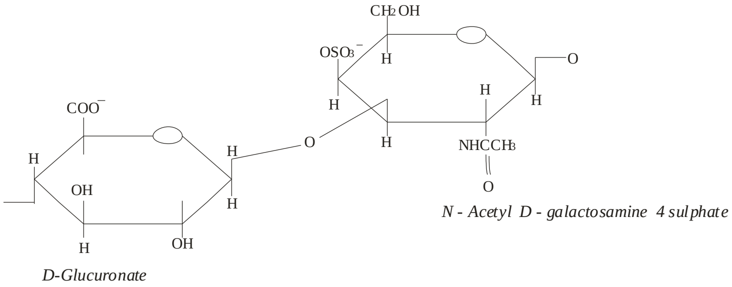
Heparin



Hyalurinate



Chondiontion 4 – sulphate



Glycoproteins (mucoproteins) occurrence in many different situations in fluids mucus secretions and tissues including the cell membranes. They are proteins containg carbohydrates in barying ants. They do not contain uronic acids unlike glycosamnoglycans but contain acetyl + melthyl neutone and siasic acids.

Polysaccharides provide strength and rigidity to bacterial cell walls which provide protection for the cellular contents.

Peptidoglycan is the polysacchande of bacterial cell walls. The back bone is a α (1 →4) linked polymer of alternating N – acetylghicosamine and N – acetylmuramic acid units. It is joined to a tetrapeptide L-Ala-D-Glu-L-Lys-D-Ala Grain positive bacteria have a thick cell wall but giar negative is thinner.

BIOCHEMISTRY

Biochemistry is the study of biology at the molecular level.

- It is concerned with the molecules that make up the structure of cells and organs
- And also with the function of molecules in carrying our the needs of the cells and organs.
- Now biochem is making an impact on medicine – (i) assays for enz. Activities now play an important role in clinical diagrams and also a basis for the design of drugs
- Most of the questions that remained unsolved for a long time can now be solved by bioch e.g.
    1. How does a cell give rise to cells as diff as those in muscle brain, and the liver
    2. How is the growth of cells controlled?
    3. What is the mechanism of memory
    4. What are the causes of cancer etc.

All these have been solved by Biochemistry today.

Introduction: CHO are widely distributed in both plant and animal tissues

- In plants – cellulose and starch due to photosynthesis

- In animals – glucose and glycogen

Chemistry of Carbohydrates:

Definition: CHO may be defined as polyhydroxy aldehydes or ketones or as substances that yield one of these compounds on hydrolysis

classified into :
Monosaccharudes
Oligosaccharides
Polysaccharides

Monosacchaides – formula CmH2m on (n = m or n – 1) simple sugars that cannot be hydrolyszed into smaller units trioses, tertoses,pentoses, hexosers hoses e.g. glyceraldehydes; dihydioxyacelone Oligosacchanides – are hydrolysable polymers of monosaccharides that contain 2 -6 mol s of simple sugars.
Polysaccharides: 1r long chains or polymers of monosaccharides that may be either linear or branched in structure. Testeless, insoluble compounds with long mol cot.

<u>Properties of monosaccharides:</u>

1. *Mutarotation:* This is a property exhibited by the hemiacetal and ketal forms of sugars that are free to form the open chair sugar e.g. when glucose is exposed to dilute alkali for several hours the mixture contains both fructose and mannose this is due to enolization of these sugars in the presence of alkali. At higher cone of alkah; monosaccharides are mistable and undergo oxidation degradation and polymerization.

They are stable in dilute numerical acids even on healing. But when aldo hexoses are healed with strong numerial acids they are dehydrated and hydroxymethyl furfural is formed.

This dehydration reaction is the basis of cellar qualitative tests for sugars since the furfurals can be reacted with & naphthol and other aromatic compounds for form characteristic colored products.

2. *Reducing Sugars*: Sugars
reducing
non reducing

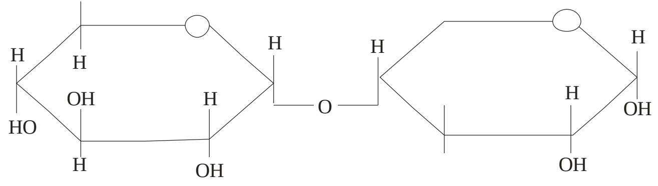
Act as Reducing agents because free or potentially free aldehyde and ketene groups are present – the molecule.

Reduce – metal ions (cu, Ag in alkaline solution).

Benedicts solution is the reagent for detecting reducing sugars – the cu^{2+} is reduced to cu^{+} founding a precipitate.

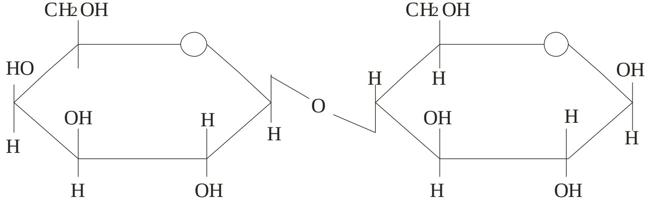
Sucrose is neither a hemicetal nor hemiketal. It does not undergo mutarotation, it does not react with phenylhydrozine to formal ozazones and it does not act as a reducing sugar.

Maltose



$O - \alpha - D -$ *Glucopranose* $(1 \rightarrow 4)$
$\alpha - D -$ *glucopyranoside*

Lactose



$O - \beta - D -$ *Galactopyranosyl* $- (1 \rightarrow 4)$
$\beta - D -$ *glucopyranoside*

Trisaccharides – e.g. Raffinose- cont. Fructose, glucose and galactose.

Polysaccharides: - Most of the CHO found in nature occur as polysaccharides of high mol wt. On complete hydrolysis with acid or specific enzymes. They yield monosaccharide and or single monosaccharide derivatives. Glucose is the most frevalent, although polysaccharides of mannose, fracture galactore are also common.

Polysaccharide differs in the nature of the monosaccharide units in the length of their chains and is the degree of branching.

There are two types

1. Homopolysaccharides e.g. starch consisting of only a single type of monomeric unit
2. Heteropoltsaccharides- cont. 2 or more different monomeric units e.g. hyaluronic acid cont. D glucuronic acid and N- acetyl glucosamine

Storage Polysacc: - e.g. starches in plants glycogen in animals are deposited in the form of large granuses in the cytoplasm of cells.

Starch: -- It is a homopolymer called a glucose or glucan fond in cereals, potatoes & other vegetables. The 2 chief constituents are α - amylase and amylopectin

α - Amylose: - Not truly soluble in water but forms hydrated micelles, which give a blue color with iodine. It consists of long unbranched chains in which all the glucose units are bound in α linkages.

Amyl pectin is highly branched the backbone glycosidic linkages is α (1 → 4), but the branch points are α (1 → 6) linkages. It gives a red or red hole colour with iodine. Anylose may be hydrolyzed by α - amylase which is present in pancreatic juice and saliva participates the digestion of starch in the GIT. It hydrolyses it to glucose and maltose. Amylose may be hydrolyzed by β - amylase an enzymes present: - malt.

Amyl pectin is also attacked by the α and β amylases the intermediate polysacc formed during amylase action are called dextrins.

Innlin- starch found in tubers and not of dahlas, dandelions etc, it is fructosan.

Glycogen: - found in animal tissue especially liver and muscle. It is polysaccharides of glucose in α

(1 → 4) (1 → 6) linkage the branch linkages as same as in amylopechin but it is more highly branched.

It is non reducing and given a red color with iodine.

Other Storage Polysaccharide:-

Dextrans – Glucose units

Linkage – α (1 → 6) found in yeast α bacteria they form highly viscous slimy solutions

Fructans – cont D – fructore units

Check small sheet – INULIN etc:

Structural Polysaccharides:-

Cellulose: - Cell walls of plants on hydrolysis with strong acids yields glucose, but partial hydrolysis yields cellobiose. Enzymes cellulases. It gives no color with iodine and is not soluble in ordinary solvents. It consists of straight of β -d- glucopyranose. It is insoluble and consist of β – D – glucupyranose units linked by β (1 → 4) bonds to form long st chains strengthened by hydrogen bonds. It cannot be digested by many mammals because of the absence of a hydrolacase that attacks the β - linkage. It's an important since of bulk in the diet. In get of herbinores, there are lincongalic that hydrolyses the β linkage.

Mucopolysaccharides

This is used to describe heteropolysaccharides that contain residues of both uronic acid and hexosamine the acidic mucopolysaccharides, hyaluronic acid, the chondroitin surface and heparin are found in the connection tissues of animals. They give the connective tissues toughness and flexibility.

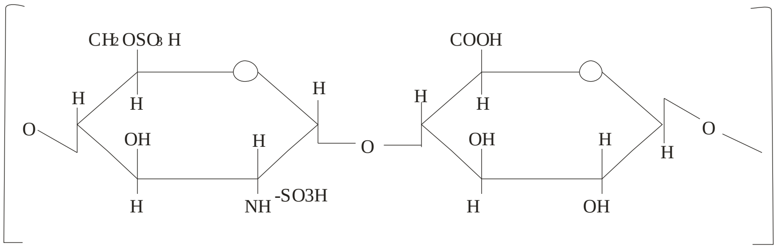
Heparin act as a blood anticoagulant and as an antilipemic agent.

(Other ions of CHO)

Ascorbic acid: - Vitamin C.

Salic acids

Muramic acids



Sulfated Glucosamine *Sulfated Glucoronic acid*

Glycoprotein (Mucuproteins):- Are protein polysaccharide compounds occurring in the tissues especially mucous secielion and fluids. E.g. ∝ 1 and ∝ 2 globulins of plasma. They do not contain uronic the glycosaminoglycans but they contain acclylhexosamines.Hexoses such as mannose or galactose are fond, also present. Other e.g. of glycoproteins are

(1) isoagglutinogens (the blood group substances of the crytholytes responsible for the major unmutiologic reactions of blood.

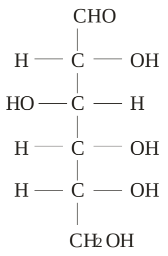
(2) Heg and luteninizy hormones.

Quantitative Tests of CHO

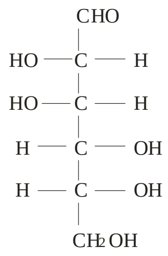
Chitin:- structural polysaccharide in invertebrates –aspect etc consist of N- acetyl- D-glucosame joined by (1→4) glycoside linkages.

Carbohydrate also occurs in cell membrane as glycoproteins and glycolyrides. Also CHO is in lyroprotein as low density lyroproteins (:DL).

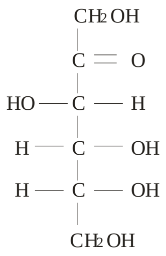
Hexoses Monosacc:



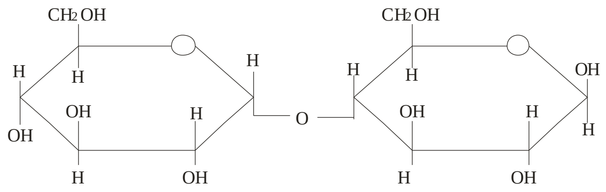
Glucose (aldose)



Mannose (aldose)



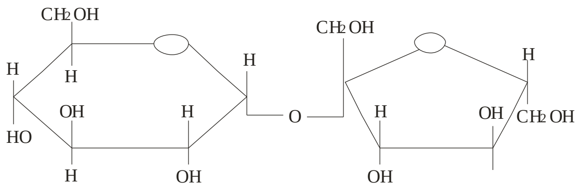
Fructose (ketose)



Maltose

Or

$4-O-\alpha-D-Glucopyranosyl-(1\rightarrow 4)$
$\alpha-D-glucopyranose$



Sucrose

Or

$O-\alpha-D-Glucopyranosyl-(1\rightarrow 2)$
$\beta-D-fructfuranoside$

Lactose

$o-\boldsymbol{\beta}-$D- Galactopyranosyl 1 →4 $\boldsymbol{\beta}$ -D- glucopynanose

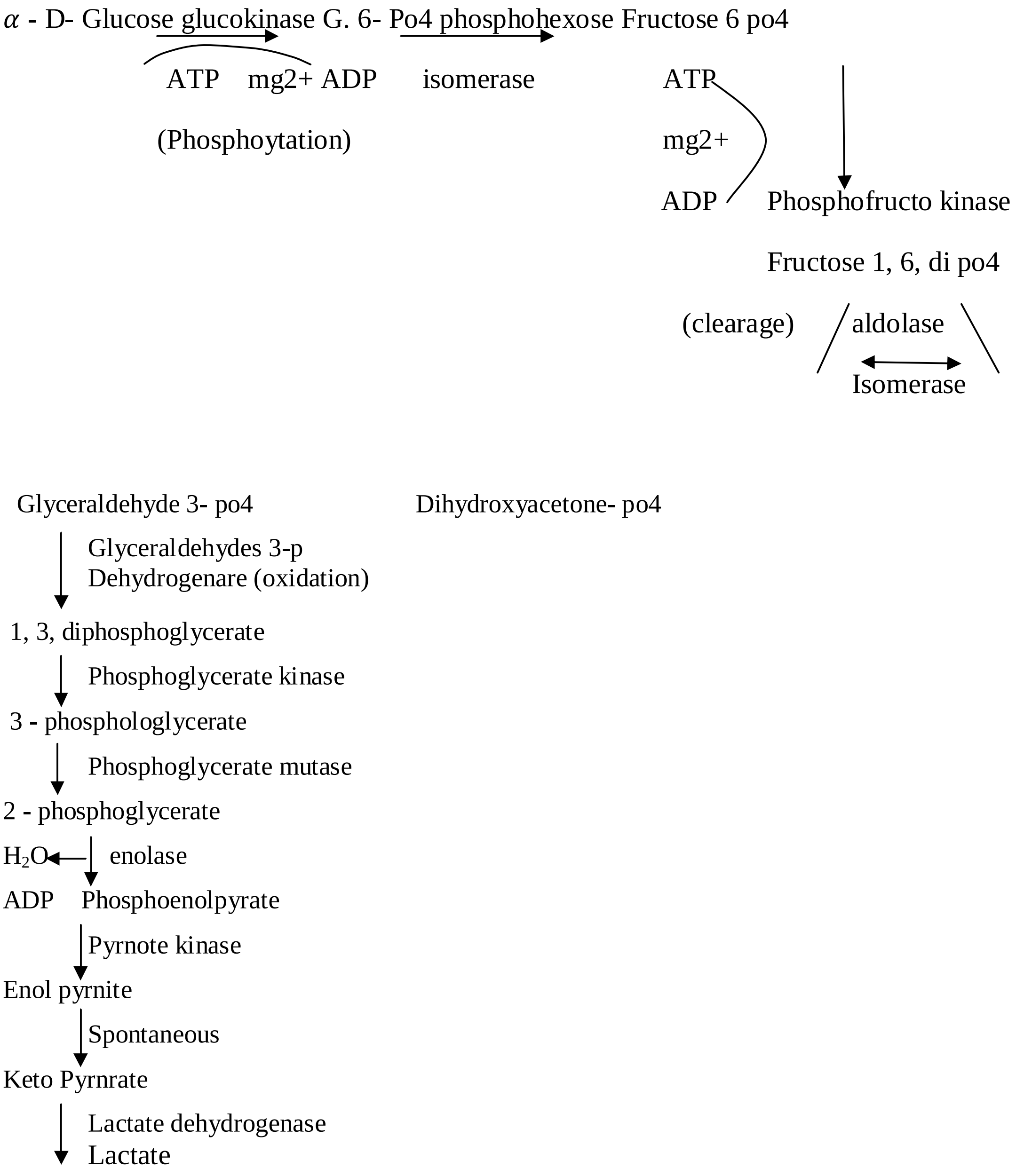
Metabolism of CHO Divided into

1. Glycolysis
2. Glycogenesis
3. Glycogenolysis
4. Oxidation of pyravate to
5. Hexose monopo4 shint
6. Gluconeogenesis.

This is the anaerobic oxidation of glucose to lactate in the presence of O2, the pathway stops at pyruvic acid intermediate and then proceed on to the TCA cycle. It occurs in the cytoplasm overall equation outside the units chrodia

Glucose + 2 ADP + 2 Pi → 2 L- lactate + 2 ATP + 2H2O.

Sequence of reactions



TCA: - This is the final pathway for the oxidation of glucose, lipids, protein under aerobic condition. Occurs in the unit chindra. It brings about oxidation of oxidation of acetyl residues to CO_2 liberating H equivalents which eventually form water.

CH_3 – CO – S – COA. (Acetyl C OA

Significance: -

1. Oxidation of foodstuffs
2. It is the mechanism by which much of the free energy liberated during the oxidation of CHO etc is made available
3. The intermediate of the cycle are also sources of molecules for anabolic processes in faulty acid, amino acid synthesis & gluconeogenesis