

باسم الله الذي لا يهز مع اسمه شيء في الأرض ولا في السماء
 "رب اشرح لي صدري وير لي أمري وأحل عقدة من لاني يفتقوا قولي"

formation of a ring structure:

- pentagonal ring: furanose
 Glu not Fru
- hexagonal ring: pyranose

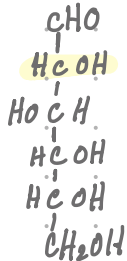
Monosaccharides

they contain anomeric carbon
 C-1 in aldoses
 C-2 in ketoses
 $\alpha \rightleftharpoons \beta$ (by open up the ring and re-close it).

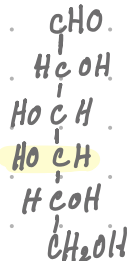
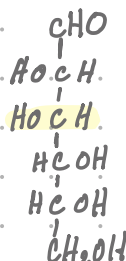
* of isomers = 2^n

Aldoses → $n = \# \text{ of carbon} - 2$
 Like:

- Glucose
- Mannose
- Galactose



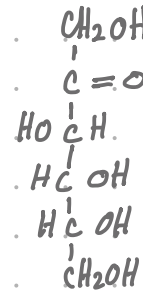
- ▷ mild sweet
- ▷ blood sugar
- ▷ building block for other sugars.



hardly sweet

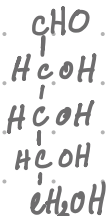
- ▷ Galactosemia
- missing a galactose-metabolizing enzyme
- accumulation of galactose within the cell
 → become galactitol → can not escape the cell
 → swelling (water is drawn into cells) → damage
- brain cells + eye (leads to cataract).

- Fructose



sweetest sugar

- Ribose



Modified Sugars (monosaccharides)

- N-glycosides (@ anomeric carbon)
- O-glycosides (@ anomeric carbon)
- Amino Sugar (C @ any carbon, but not the anomeric one).

same for Glu and Fru

oxidation (they are not for a sugar)

C-1:

- ▷ The ring will open
- ▷ —onic/onate
- like Gluconate

- ▷ half reaction → lactone
- ▷ using weak oxidizing agent

C-6:

- ▷ from OH → COOH or
- ▷ —uronic acid

Sugar ester

2 type of bonds:

- phosphate ester linkage (with C-6)
- phosphoacetal linkage (with C-1)

Sugar alcohol (reduction)

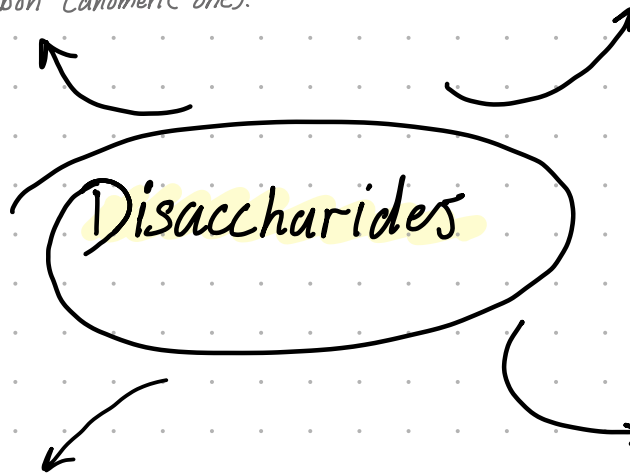
- 3C sugar alcohol → Glycerol
- 6C sugar alcohol → sorbitol & Mannitol

other type of reduction:

- Deoxy. sugar → DNA, @ C-2, ribose
- A-fucose → RBC, @ C-6, galactose

General informations:

- Could be either homo- or hetero-
- type of reaction: Condensation
- enzyme: glycosyltransferase
- mutarotation $\Rightarrow$ free anomeric Carbon
 $\rightarrow$ ring will open up $\rightarrow \alpha \rightleftharpoons \beta$
- Reducing sugars have an oxidized carbon (anomeric one).



① Maltose:

- homo
- Glu + Glu
- reducing
- (1-4) α

③ Lactose:

- hetero
- (1-4) β
- reducing
- Gal + Glu

▷ Lactulose:

- modified Lactose
- treat constipation
- growing of gut-bacteria

▷ lactose intolerance:

- deficiency of lactase
- elderly people
- bloating & diarrhea

② Sucrose:

- hetero
- (1-2) α $\rightarrow$ according to the first anomeric carbon
- non-reducing
- no mutarotation
- Glu with Fru

▷ Sucralose:

- artificial sweetener
- modified sucrose
- Cause: DNA-damages
- + increase cancer risk

■ $\rightarrow$ this color for drugs.

■ $\rightarrow$ this color for disease.

سُورَةُ الْأَنْعَامِ

وَتَمَّتْ كَلِمَتُ رَبِّكَ

صِدْقًا وَعَدْلًا لَا مُبَدِّلَ لِكَلِمَتِهِ ۚ وَهُوَ السَّمِيعُ الْعَلِيمُ ﴿١١٥﴾

وَإِنْ تُطِيعُوا أَكْثَرَهُمْ فِي الْأَرْضِ يُضِلُّوكُمْ عَنْ سَبِيلِ اللَّهِ إِنْ

يَتَّبِعُونَ إِلَّا الظَّنَّ وَإِنْ هُمْ إِلَّا يَخْرُصُونَ ﴿١١٦﴾

يقول الفضيل بن عياض رحمه الله:
 اسلك طريق الحق ، ولا يغرك قلة السالكين .
 وإياك وطريق الباطل ، ولا يغرك كثرة الهالكين .
 اللهم اجعلنا من عبادك المتقين الصالحين المفلحين .

Oligosaccharides

(3-10) carbon

Raffinose

▷ Found in: beans and vegetables like: cabbage, brussels, sprouts, broccoli, asparagus.

• consist of :

Galactose $(1-6)\alpha$ Glucose $(1-2)\alpha$ Fructose
galactosemia

Some drugs

- modified sugar :

• Streptomycin & erythromycin.
(antibiotics).

• Doxorubicin.
(Cancer chemotherapy).

• Digoxin.
(cardiovascular disease).

Polysaccharides

• they are not a reducing sugar

Storage

Glycogen:

residue: glucose, homopolysaccharides
highly branched, $(1-4)\alpha$ in the chain.
 $(1-6)\alpha$ in the branching point, flexible
found in animals and humans.
branch occurs every 10 Glu.

Starch:

homopolysaccharides, residue: glucose, found in plant

Ⓐ amylose:

(10-20)%, not-branched, $(1-4)\alpha$ in chain.

Ⓑ amylopectin:

(80-90)%, branched, $(1-4)\alpha$ in chain, $(1-6)\alpha$ in branching point $(1-6)\alpha$, branch occurs every 25 Glu.

Dextran:

primitive beings (yeast & bacteria)

$(1-6)\alpha$ in chain, $(1-[2/3/4])\alpha$ in branching point

Structural

cellulose

homopolysaccharide, residue: β Glu
 $(1-4)\beta$, rigid, form H.B.,
found in plants,

chitin

homopolysaccharide, $(1-4)\beta$, rigid
modified residue: N-acetyl β glucoamine

pectin

residue: galactose
in plant (cell wall).
→ extra: it is able to form gels.

mucopolysaccharides (Gag's)

Derivative of :
amino sugars
(glucosamine, galactosamine)

repeated disaccharide
(one of the residue or both:
carrying negative charge)
bcz of carboxyl group

Some examples

■ Hyaluronate :

- Synovial fluid, vitreous humor, ECM of C.T.
- Lubricant fluid, shock absorbing

■ Chondroitin sulfate :

- Cartilage, bone, valves of the heart.
- most abundant Gag's.

■ Heparin :

- intracellular granules, lining the arteries of the lungs, liver, skin.
- natural anticoagulant.

• proteoglycans

- lubricants.
- C.T.
- Mediate adhesion of cells in ECM.
- cell-cell communication.
- Bind to the growth factor.

• **Bacterial cell wall** : (2 type of gag's) $\xrightarrow{\text{peptidoglycan}}$
- modified sugars
- carrying negative charges

$\text{NAM} + \text{NAG}$
 $\downarrow$
contain lactic acid
 $\downarrow$
contain N-acetyl
connected by oligopeptide

• **Glycoprotein** : $\rightarrow$ function: protein folding + targeting

+ prolonging protein half-life
+ cell-cell communication
+ signaling

- Carbs bind to the protein by either
O- or N- glycosidic bond.

- O- glycosidic bond : Asn
- N- glycosidic bond : Ser, Thr, HL

• **Blood type** :
A : N-acetylgalactosamine
B : galactose
O : None

• **Sialic acid** $\rightarrow$ precursor: amino sugar, neuraminic acid.
sugar acid, @ the terminal of oligosaccharides chains of glycoproteins and glycolipids.

$\rightarrow$ كانت اللحم وجمدك، فشهد أن لا إله إلا أنت، نتخفرك وتوب إليك