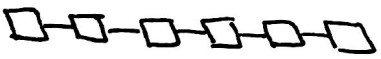
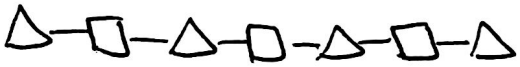
Polysaccharides

سکریات متعددة

* according to Structure:
  - Homopolysaccharides
    Consist of one type of monosaccharide
    
  - Heteropolysaccharide
    Consist of different types of monosaccharide
    usually 2 different types
    

* according to Function:-

Polysaccharides

Storage

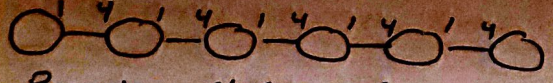
* Starch → plant
* Glycogen → Animal
  in liver and muscle

Structural

* Cellulose (cell walls of Plant)
* Chitin (skeleton of insects)

Starch

- Homopolysaccharid from α-D-glucose

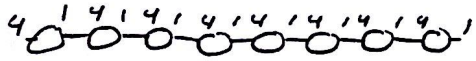


- Bonds α(1-4)
- In plants.

Starch

Amylose

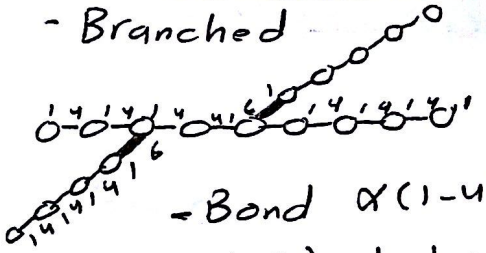
- linear (Not branched)



- Bond α(1-4) only
- arranged in helix each turn 6 glucose
- Iodin (I_2) + amylose ⇒ Dark Blue
- One reducing end and One Non-reducing end
- Digested by amylase (Break α(1-4))
  - α
  - β

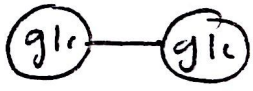
Amylopectin

- Branched



- Bond α(1-4) α(1-6) at branch points
- amylopectin + Iodine → ~~Red Brown~~
- Digested by Amylase α(1-4) and Debranching Enzyme α(1-6)

β-amylase → Break at non-reducing end
Exoglycosidase = β amylase
Produce maltose



α-amylase → Break anywhere
α-amylase Endoglycosidase
Produce maltose (non-reducing end) and glucose (reducing end)

Notes: Animal and human can digest Starch

* Glycogen (animal starch)

- Homopolysaccharide, from α-D-glucose
- In animals: Liver / Muscles

Similar to Amylopectin

α (1-4)

α (1-6) at branch points

Amylopectin	Glycogen
- In plant	- In animals
- 6000 Glucose	- 6000 glucose
- less branched (branches every 25 glucose)	- Highly branched (branches every 10 glucose)
- average chain length 23 glucose	- average chain length 13 glucose
- No glycogenine at the center	- at the center there is glycogenine كرويتين.

Both have One reducing End and many Non-reducing Ends.

What is the importance of Glycogen branching?

- easy to break
- easy to synthesize
- water Soluble

] easy to metabolize

* For degradation of Glycogen we need :-

- glycogen phosphorylase → Break $\alpha(1-4)$

cleave at non-reducing-End

producing Glucose-1-Ⓟ

- Debranching Enzymes → Break $\alpha(1-6)$

* if glycogen less branched → less Soluble

→ Crystals → accumulate in Liver

Glycogen Storage disease

Structural Polysaccharides :-

- Cellulose
- Chitin

* Cellulose (most abundant organic molecule on earth) أكثر مركب عضوي

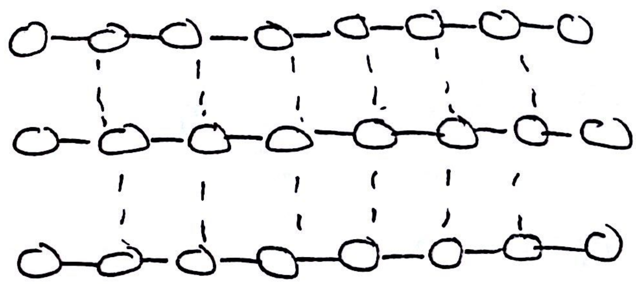
- Homopolysaccharide from β-D-glucose

- Bonds β(1-4)
- Linear (Not-branched)
- Straight
- Found in cell wall of plant cells.
- Human can't digest cellulose

But some bacteria can → Termit intestine امعاء النمل الابيض
→ Cow, horse intestine

bacteria ↓ Has Cellulase

In plant cell wall



* cellulose fibers are insoluble in water.

* stimulate digestion

H-bonds make it strong

* Amylose resemble α-helix in proteins

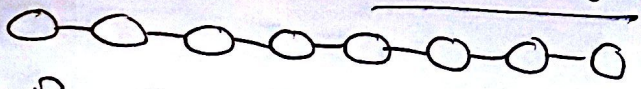
* Cellulose resemble β-sheet in proteins.

Chitin

* linear (Not-branched) Homopolysaccharide

from N-acetyl-β-D-glucoseamine

Amino-sugar



- Bonds β(1-4)

- found in the exoskeleton الهيكل الخارجي of - insects

- Crustaceans قشريات

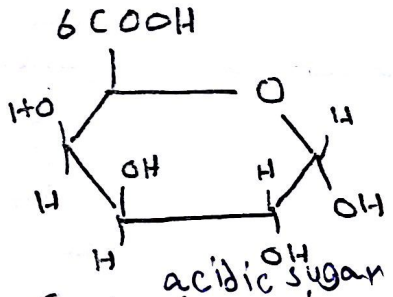
- also found in Fungi, فطريات yeast algae Cell wall

Shrimp lobster

Cell wall :- found in → plant, Bacteria

Plant Cell wall :-

Consist of



① - Cellulose

② - Pectin (Polysaccharide of D-Galactourinic acid)

③ - lignin (polymer of Coniferyl-alcohol) (not sug

not Polysaccharide.

Bacterial Cell wall

Consist of peptidoglycan

هذه المادة موجودة فقط في البكتيريا

(sugar)
Hetropolysaccharide

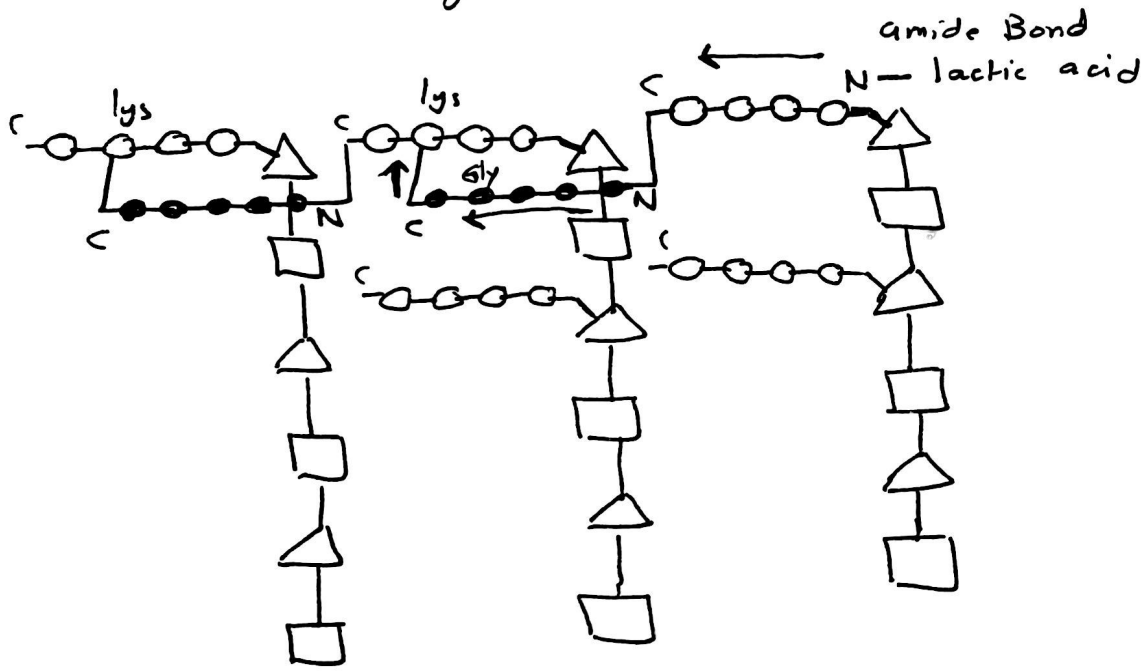
- N-acetyl-β-D glucosamine
- N-acetyl β-D-muramic acid
  - Lactic acid

2 small peptide

- 5 Glycin
- 4 amino-acid

D.Gln D-ala
L.ala L.lys

Cross linking (تشابك)



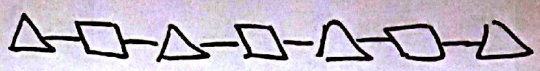
① Lactic acid bind to N-terminal of 4 a.a by amide Bond

② C-terminal of 4.a.a bind to N-terminal of 5-glycin

③ C-terminal of 5-glycin bind to lysin

Glycosamino-glycan :-

type of Heteropolysaccharide, from Repeating Disaccharide



- One of them is Amino Sugar
- at least one of them has negative charge → acidic sugar { SO_4^- Sulfate, Carboxyl COO^- }

Examples

1) Heparin ($\alpha(1-4)$) → natural anticoagulant (مضاد للتجلط)

2) Hyalurinic acid ($\beta 1-3$) → Vitrus humor of eyes (داخل العين), Synovial fluid of Joints (سائل المفاصل)

3) Chondritin Sulfate (β 1-3) → Connective tissue
   Keratin Sulfate (β 1-4) → Sulfate and Carboxyl give elasticity

4) Dermatan Sulfate (β 1-3) في الجلد

Glycoproteins

Glyco + protein (there is more protein than sugar)

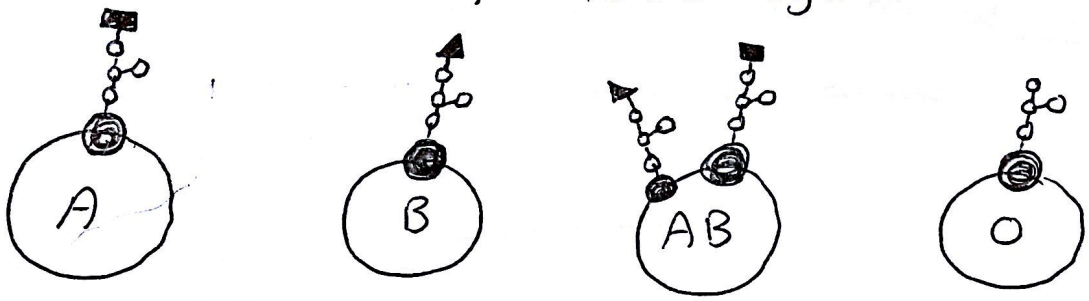
Protein + oligosaccharide

Examples:-

① Antibodies → important in Immunity

② Antigens

ex:- Blood Groups ABO system



- all blood Groups have glycoprotein on the Surface of RBCs, differ in the Oligosaccharide Part

- A → β-Nacetyl-galactosamine in non-reducing End
- B → α-D-galactose in non-reducing End
- AB → Both
- O → Neither

* all blood groups Contain β-L-Fucose
β-L-6-deoxygalactose
* the Oligosaccharide part is very important in antigenic determinant.

* proteoglycan

85 - 95 % Carbohydrate + protein

- Hurler Syndrom: هيرلر

No lysosomal enzymes that break down Proteoglycan → accumulate

→ skeletal deformities, Mental retardation, early death

The End

wish you the Best

Dr. Tariq Jibril

07998467 84

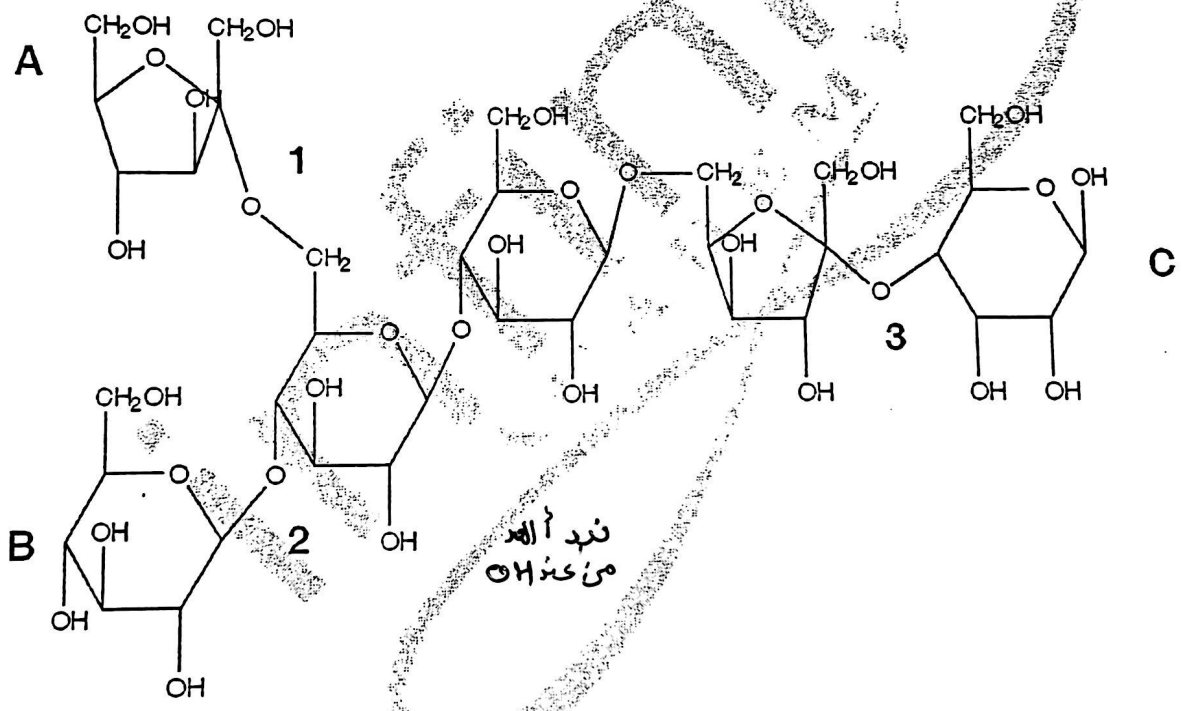
O → universal donor

AB → universal acceptor

Q: Humans are not able to digest cellulose as a food source because:
a. Cellulose is very insoluble.
b. It is more important that the cellulose is used as fiber in our bodies.
c. We lack the enzyme to break the β linkage in the cellulose.
d. Cellulose is insoluble and we lack the enzyme to break the β linkage in the cellulose.
e. All of these are reasons why we cannot digest cellulose.

Q: In bacterial cell walls
a. polysaccharides form nonspecific mixtures with preteins
b. polysaccharides are hydrogen bonded together
c. peptides form crosslinks between polysaccharides
d. oligosaccharides form crosslinks between proteins

Q: A polysaccharide.



Q: Which lettered subunit is the nonreducing end? dont have a numric end
a. A
b. B
c. C
d. There is more than one nonreducing end on this carbohydrate.
e. There are no nonreducing ends on this carbohydrate.

Which lettered subunit is the reducing end?

a. A
b. B
c. C
d. There is more than one nonreducing end on this carbohydrate.
e. There are no nonreducing ends on this carbohydrate.

best describes bond #3?

a. α[1,3]
b. β[1,3]
c. α[2,4]
d. β[2,4]
e. None of the above is a proper description.

Which best describes the polysaccharide?

a. homopolysaccharide
b. heteropolysaccharide
c. aminopolysaccharide
d. cryptopolysaccharide

Glycogen breakdown proceeds from the nonreducing ends.

True
False

Glycogen is sometimes called animal starch

True
False

The blue color in a well-known test for the presence of starches is due to

a. the formation of crosslinks between molecules of starch, caused by the addition of Cu^{2+}
b. the reaction of the silver-ammonia complex ion with the hydroxyl groups of the starch
c. the formation of a complex between iodine and amylose
d. none of these

Amino or acid derivatives of sugars are very important in which of the following biological functions?

a. Structural roles
b. Lubricating fluids
c. Cell surface sugars used in cell identity
d. Both structural roles and lubricating fluids.

e. all of the above

Q: The most common biopolymer on earth is this carbohydrate:

a. Glucose
b. Cellulose
c. Starch
d. Chitin
e. None of these carbohydrates is very common.

Q: Insoluble fiber in the diet is better at better at providing bulk and stimulating peristaltic action than soluble fiber.

True
False

Q: Polysaccharides used in cell wall structure contribute rigidity to the wall due to covalent cross-linking between the fibers.

True
False

Q: One advantage of branched sugar polymers is the availability of more ends for chemical reaction.

True
False

Q: Cartilage and mucous are both slippery because:

a. Short polymers comprise these compounds.
b. The charge repulsion between the many acid groups in these polymers.
c. The sticky nature of sugars.
d. Both charge repulsion of acidic groups and the sticky nature of sugars.
e. All of these

Q: Which of the following is true about the ABO blood groups?

a. all three of the blood groups have an α-L-fucose group attached
b. type O blood is the universal donor because it has an α-L-fucose group
c. type A blood has a β-N-acetylgalactosamine group
d. type AB blood is the universal donor