THE HNSB. LTD. SCIENCE COLLEGE, HIMATNAGAR

- PAPER: CHN 701(O)
- UNIT:1- (B)

CARBOHYDRATES

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SYLLABUS

- Type of Naturally occurring Sugars, Deoxy sugars, Amino sugars. General method of structure and ring size determination with reference to Starch and Cellulose
- Photosynthesis of Carbohydrates.
- Purine & Nucleic Acid :-
- Chemistry of Uric Acid, Adenine, Caffeine
- Structure of Nucleotides, Nucleosides, DNA, RNA and Conformations, Protein synthesis, Perbiotic Chemistry.

Reference Books

- Organic Natural Products by O.P. Agrawal

COs

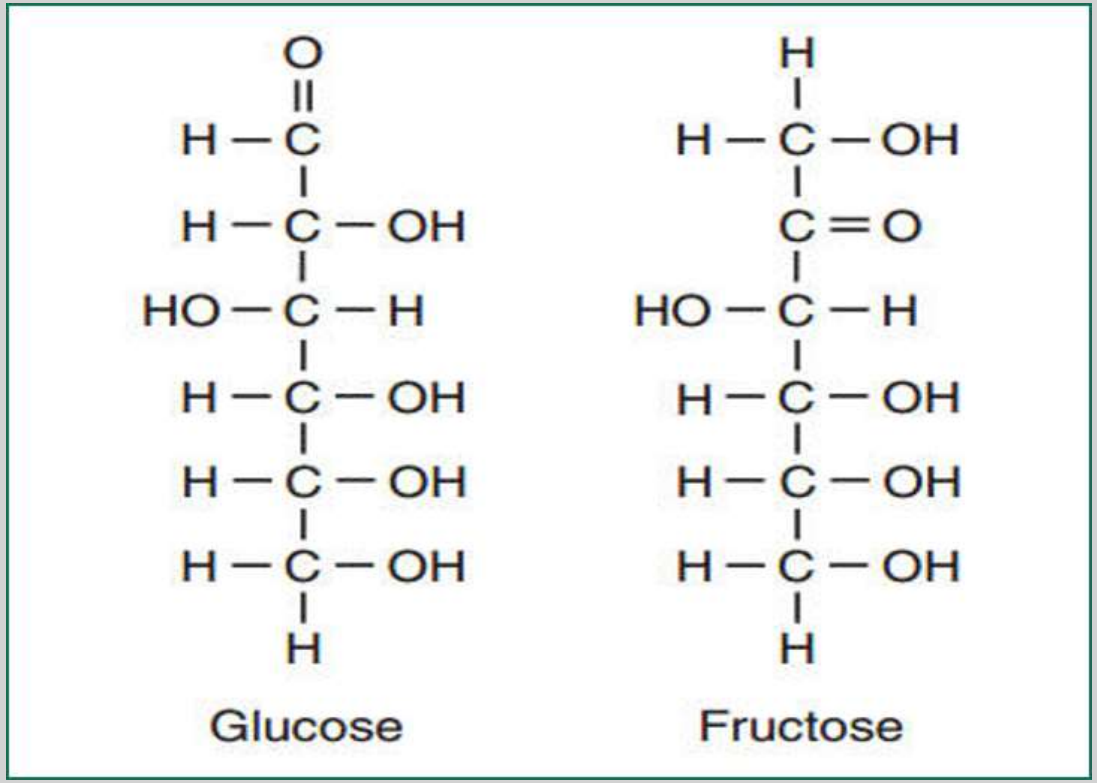
- To enable students about the knowledge of amino sugar, deoxy sugar, polysaccharide like cellulose and starch, photosynthesis of carbohydrates,

Definition of Carbohydrates

- M.F.: Cx (H2O)y
- Having functional group like hydroxyl, aldehyde or ketone = carbohydrate
- H:O = 2:1

Examples of carbohydrates:(Mono Saccharide)

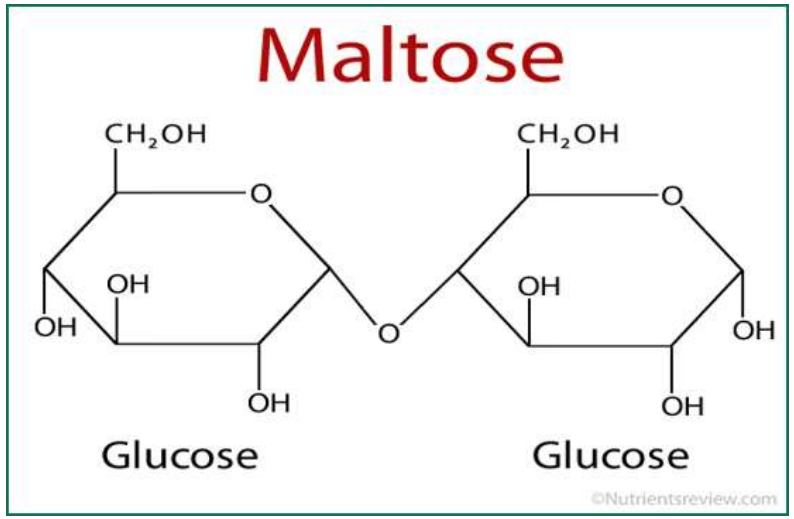
- Triose: $C_3H_6O_3$
- Tetrose: $C_4H_8O_4$
- Pentose: $C_5H_{10}O_5$
- Hexose: $C_6H_{12}O_6$

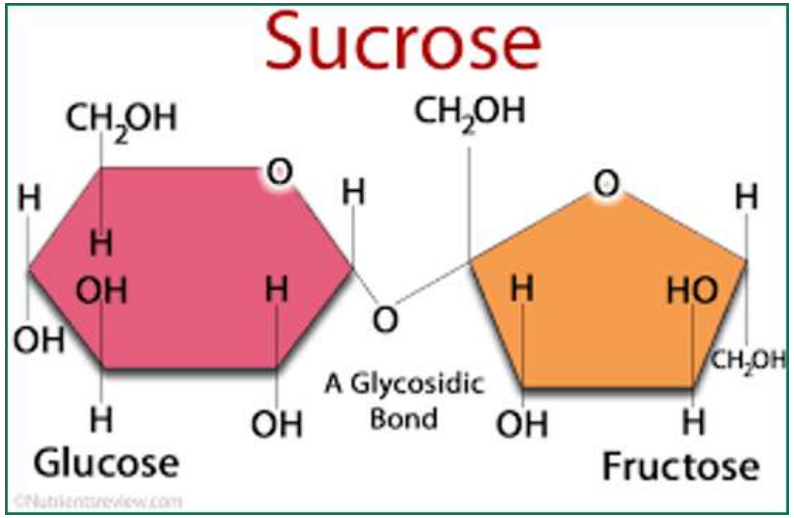


Disaccharide

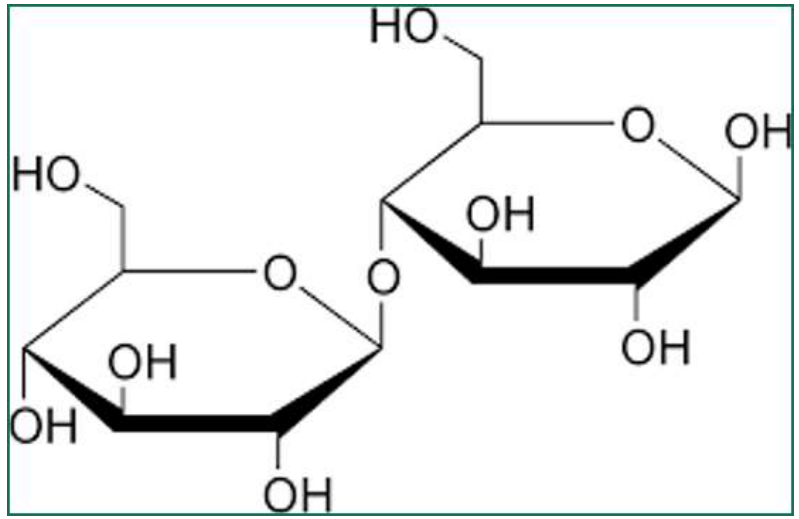
- Sucrose:

- Maltose:

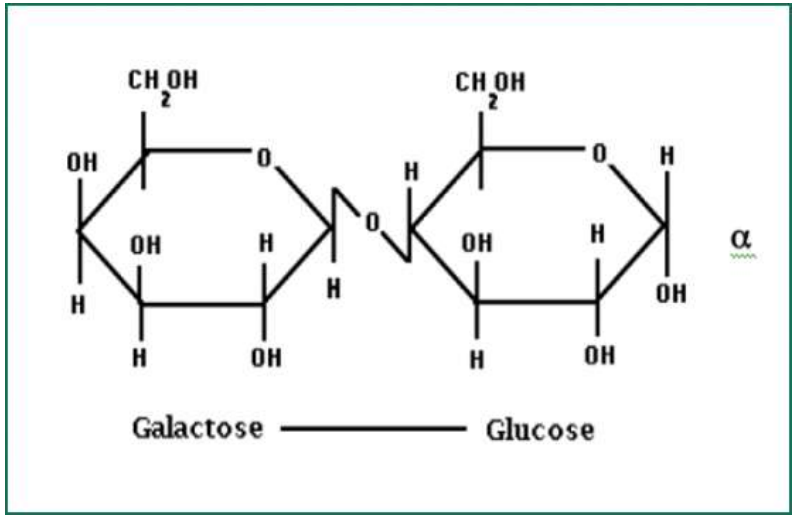




- Lactose:

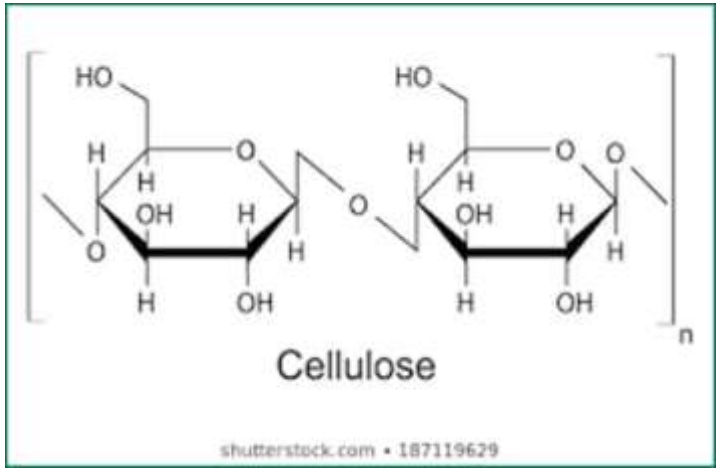


- Cellobiose:

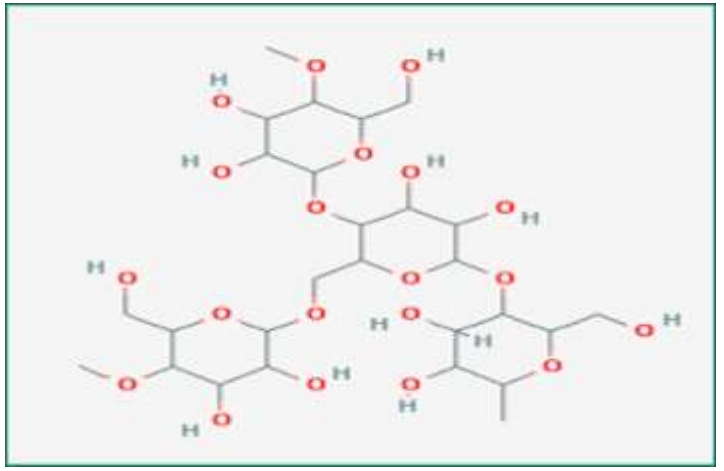


Polysaccharide

- Cellulose:



- Starch:



CELLULOSE :

Cellulose is a chief compound of wood & plants fibers

Cotton is a 100% pure Cellulose.

It is insoluble in water & tasteless.

It is non reducing carbohydrate.

The Cell wall of plants cell is made from Cellulose.

Like body skeletal of man, the structure of plant is made from Cellulose.

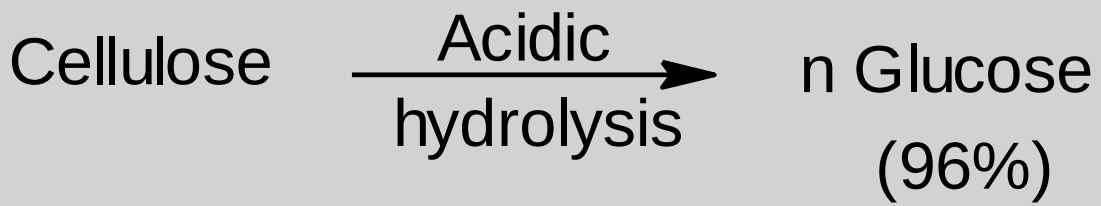
USES : It is useful for making of different types of clothes, chemicals, papers, film and rayon

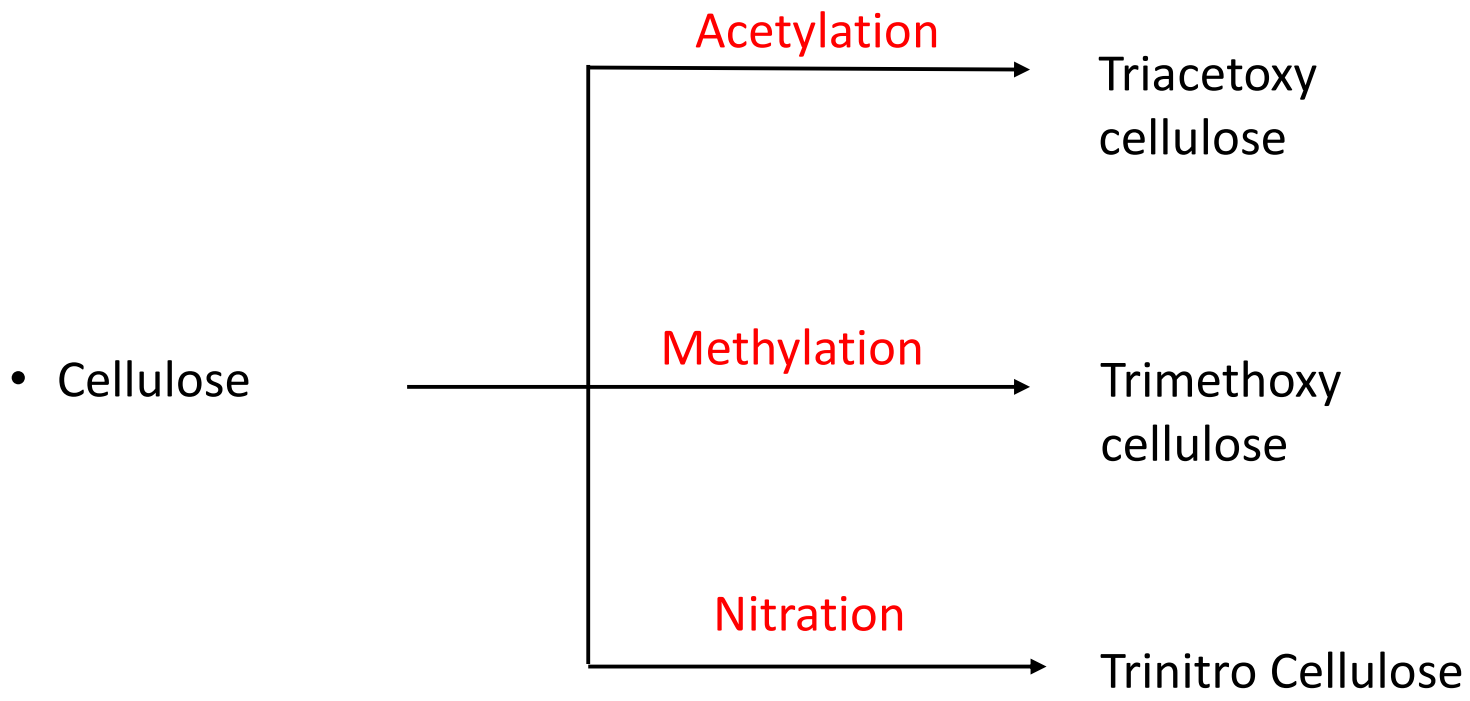
Constitution of Cellulose:

- M.F.:[C6H10O5]n
- Present groups:

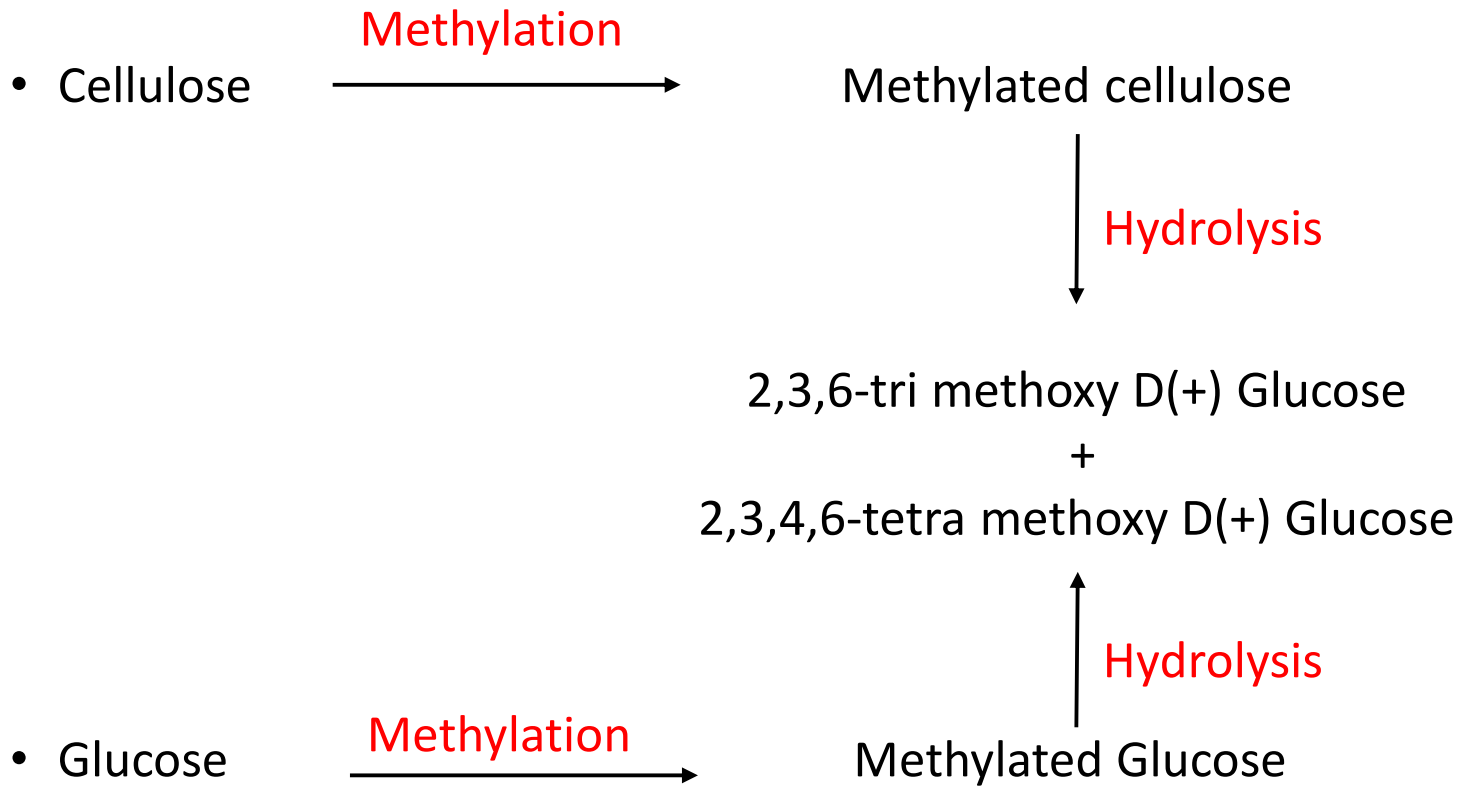
∴ No. of D(+) Glucose unit = 100 to 200

- ∴Polysaccharide
- M.W. = 20000 to 40000 gm/mole





- ∴3 –OH present in each glucose unit


Methylation
Cellulose
Methylated cellulose
Hydrolysis
2,3,6-tri methoxy D(+) Glucose
+
2,3,4,6-tetra methoxy D(+) Glucose
Hydrolysis
Methylation
Glucose
Methylated Glucose

- Glucose units → joint → C1-C4 linkage
- Glucose units → Pyranose cycle

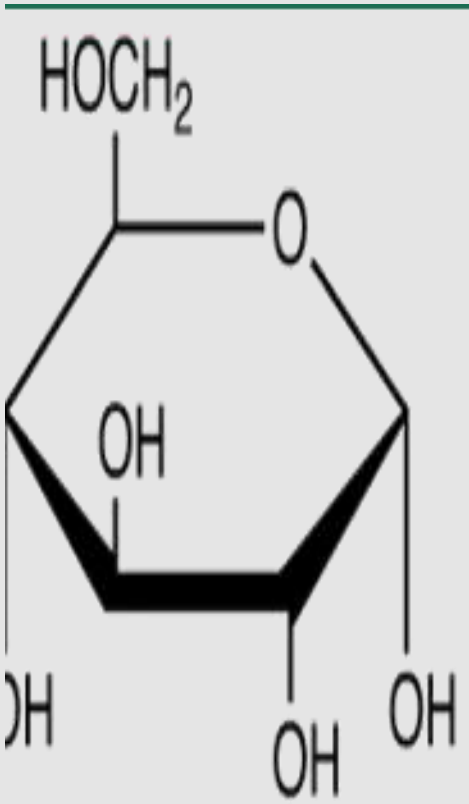
↓

on C2,C3 & C6 3 –OH

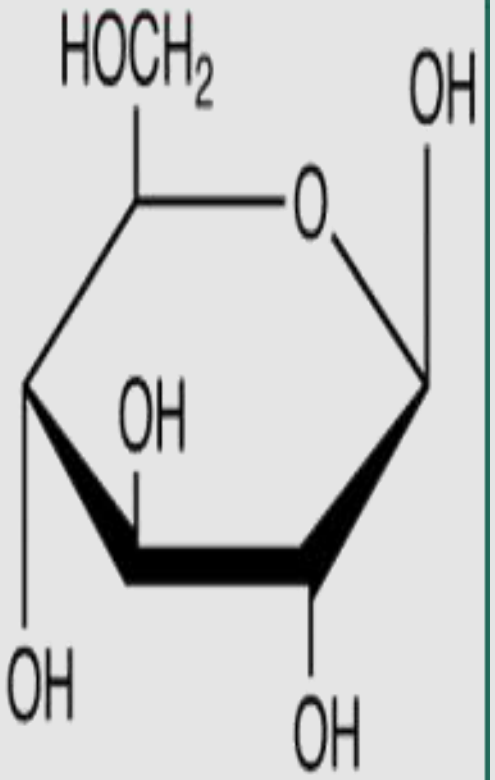
- 2,3,4,6-tetra methoxy D(+) Glucose → C1 → –OH

&

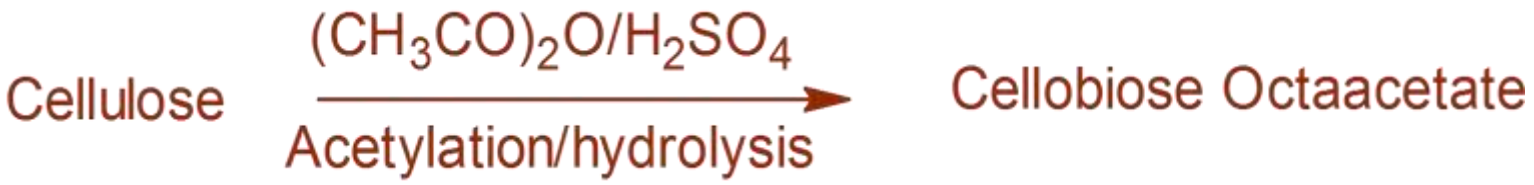
- 2,3,6-tri methoxy D(+) Glucose → C4 → –OH



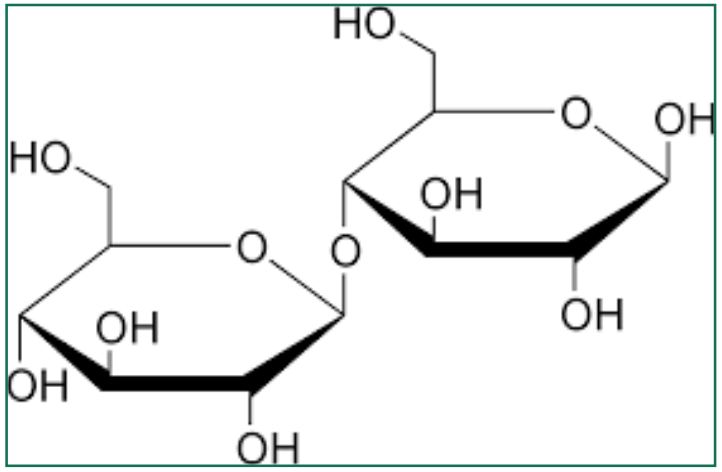
a pyranose



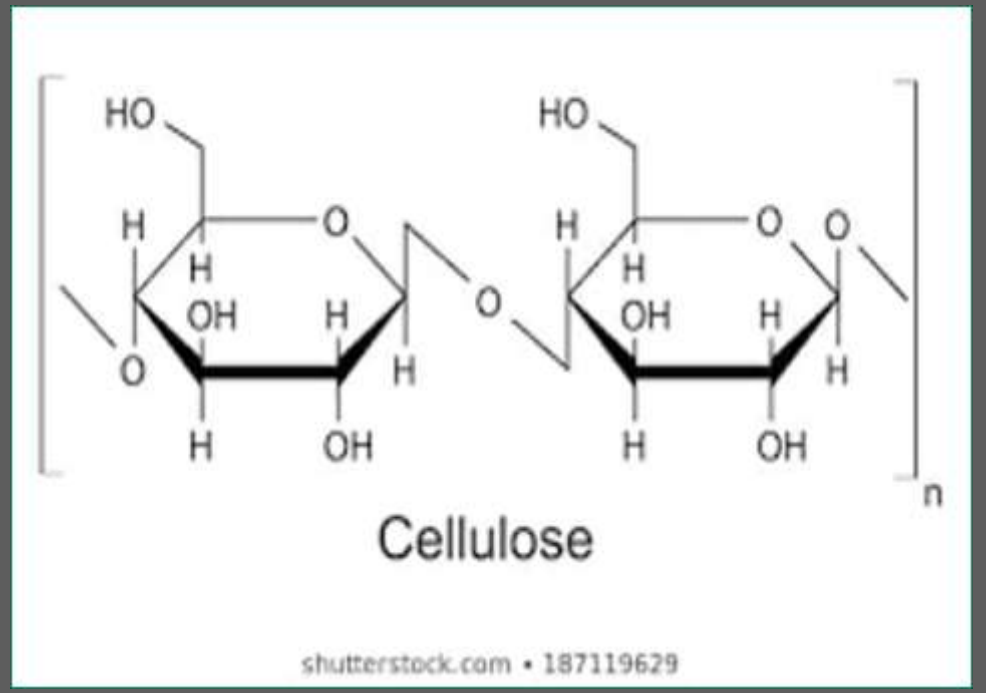
a pyranose



∴ Cellulose → have → no. of Cellobiose units



S.F. of Cellulose



Starch

Sources : From maize, beat, rice, wheat, and potato's tumor

It is insoluble in cold water. Its make a paste with hot water.

Uses : It is used as a sizing material in paper industries, Finishing agent in textile industries, and Calico printing.

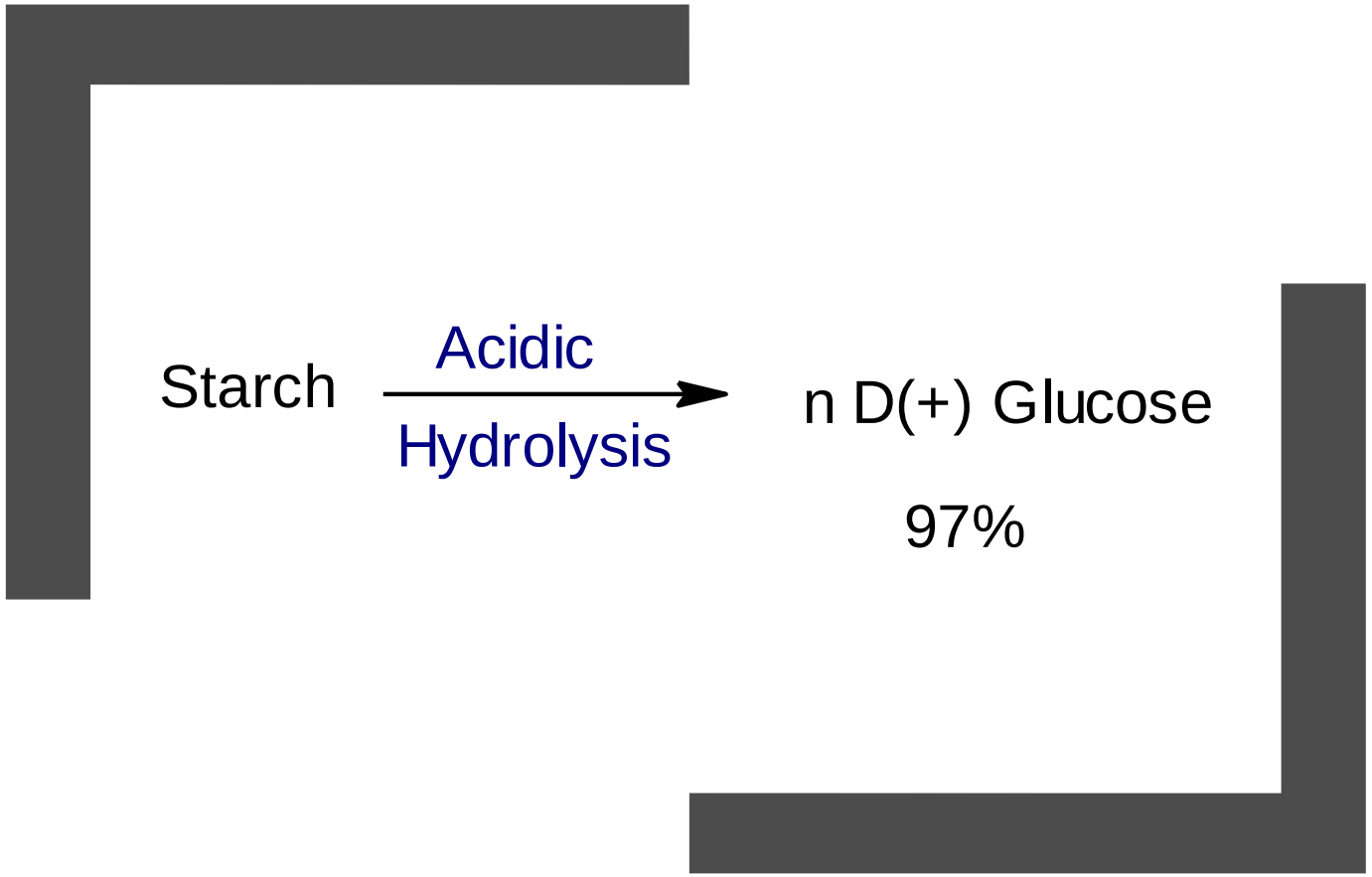
It is also used in laundries for finishing of clothes.

It is also used for manufacture of glucose, alcohol, dextrin, & explosives.

It is also used as a indicator in Kinetic titration.

Starch contain 20 % water soluble fraction called Amylose & 80 % water insoluble fraction called Amylopectin.

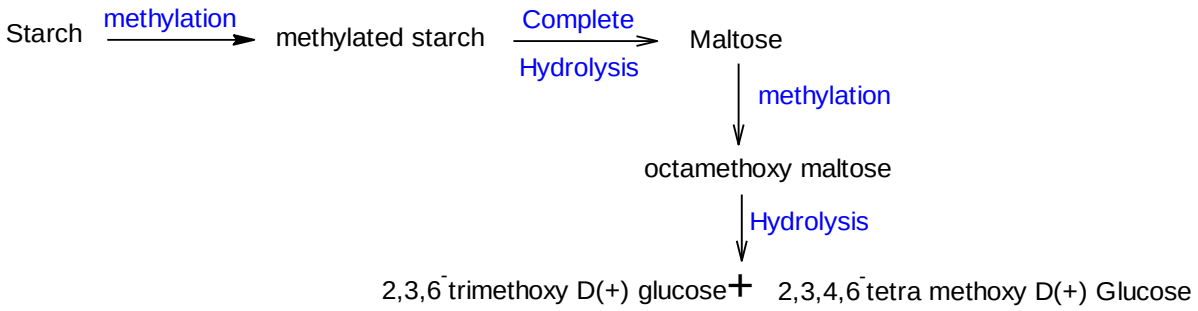
Constitution of Starch



- M.F.:$[C_6H_{10}O_5]_n$
- Present groups:

∴ No. of D(+) Glucose unit = 300 to 350

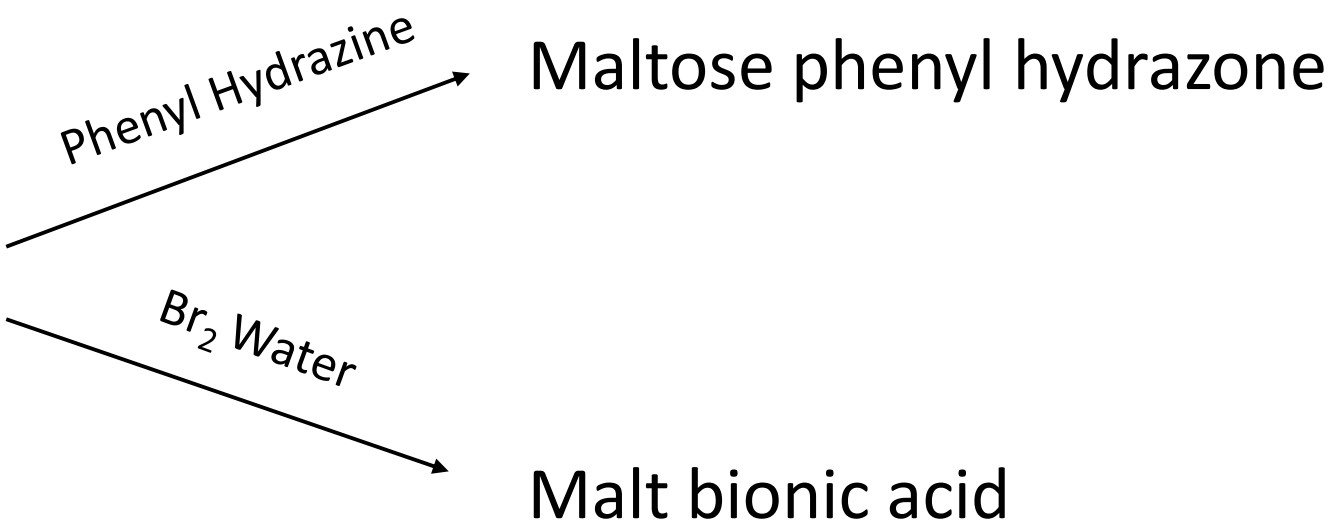
- ∴Polysaccharide
- M.W. = 15000 to 60000 gm/mole

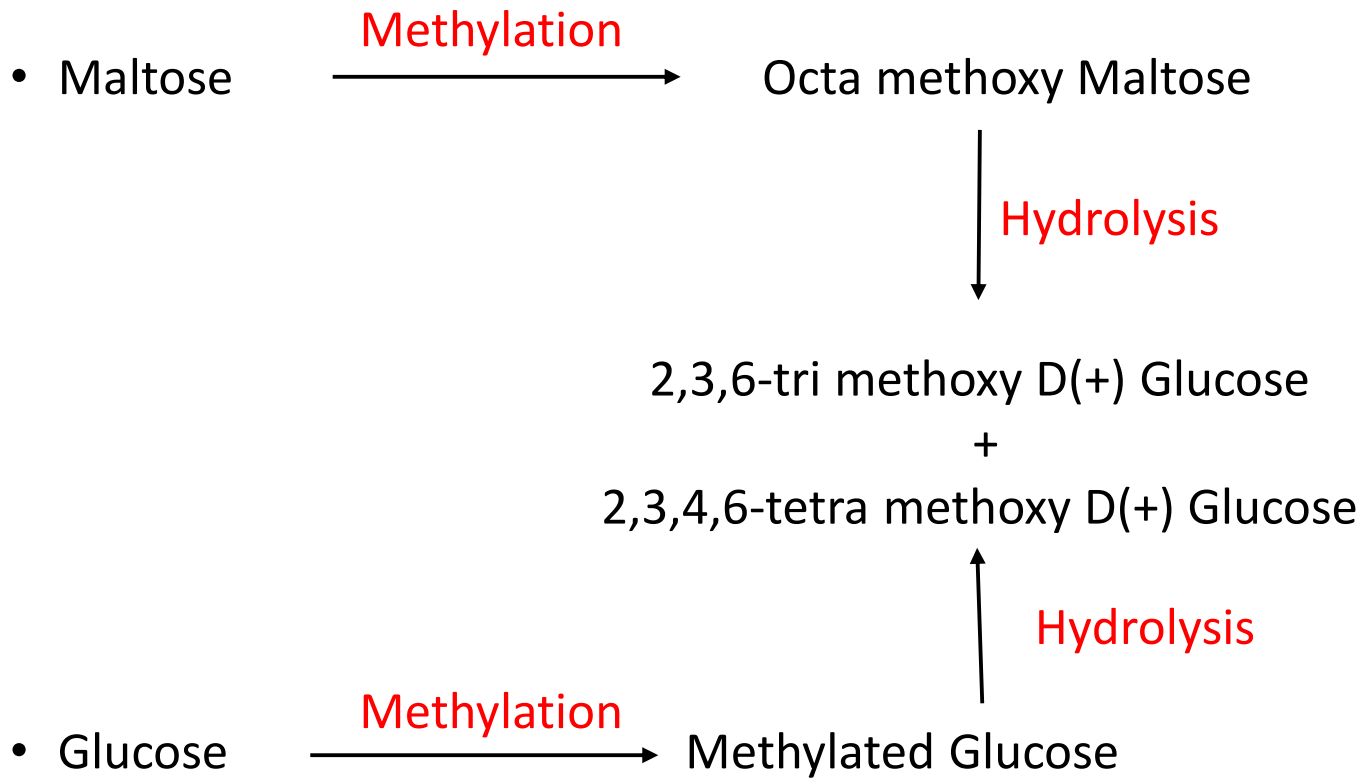


Starch $\xrightarrow[\text{enzyme}]{\text{hydrolysis}}$ n Maltose

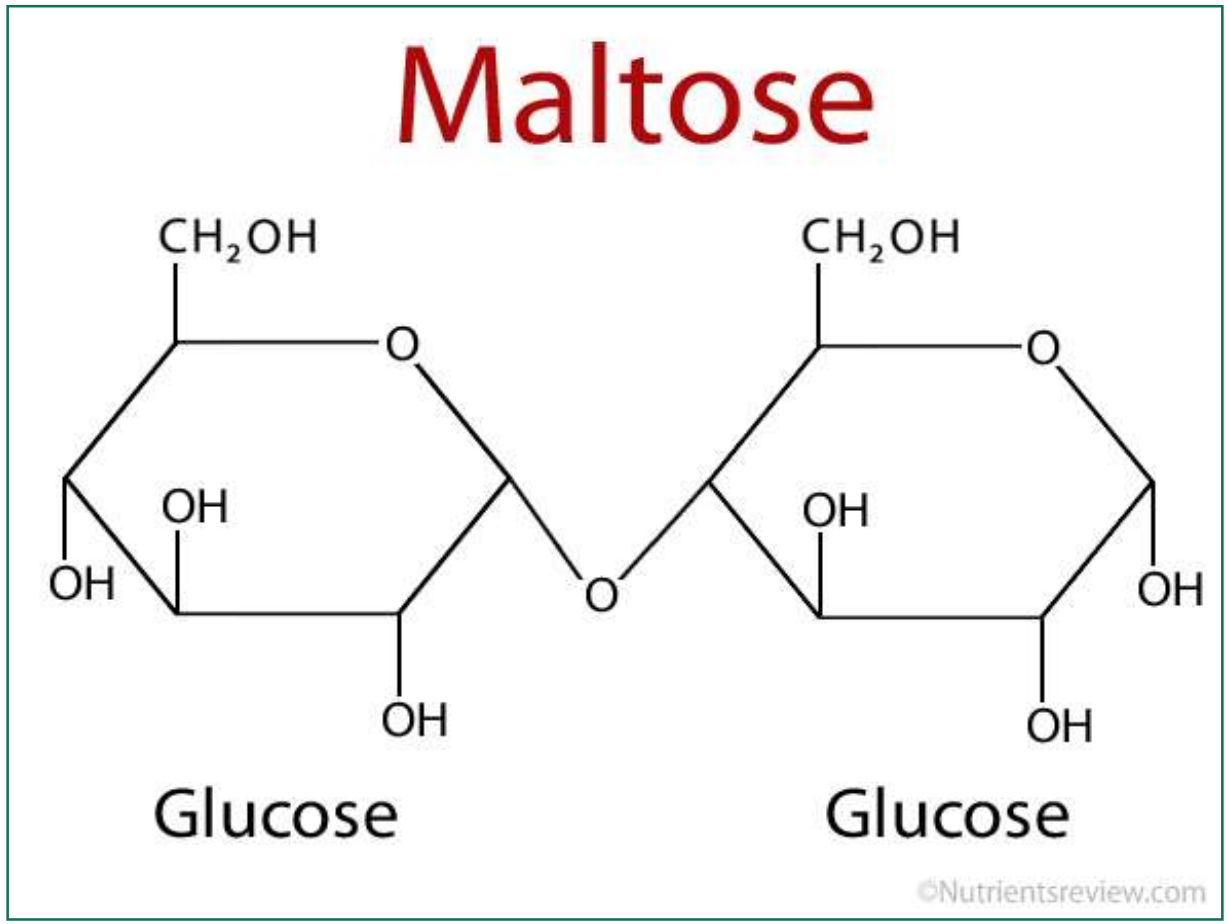
Structure of Maltose

- M.F. : $C_{12}H_{22}O_{11}$
- Present Groups:
- Maltose

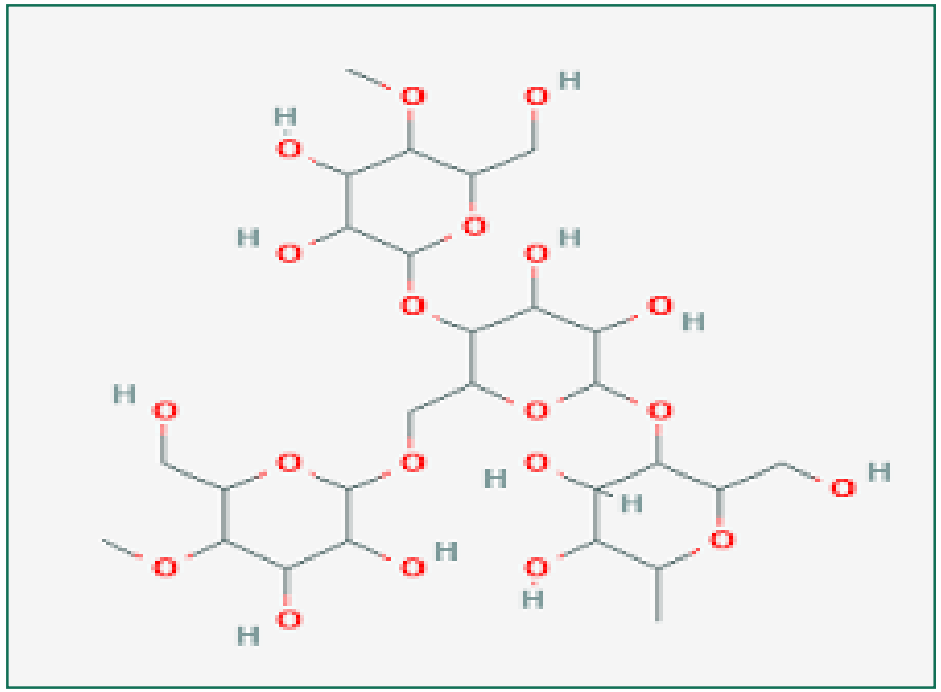



Methylation
Maltose
Octa methoxy Maltose
Hydrolysis
2,3,6-tri methoxy D(+) Glucose
+
2,3,4,6-tetra methoxy D(+) Glucose
Hydrolysis
Methylation
Glucose
Methylated Glucose

Structure of maltose



Structure of Starch



General Information of Alpha & Beta Amylose

Starch contain 20 % alpha Amylose & 80 % beta Amylose.

When we add n Butanol in hot solution of Starch and allow to stand at room temperature and filter it then we will get PPTs of alpha Amylose and filtrate contain beta Amylose.

I_2 is added in the hot solution of alpha Amylose then it gives blue color and I_2 is added in the hot solution of beta Amylose then it gives violate color.

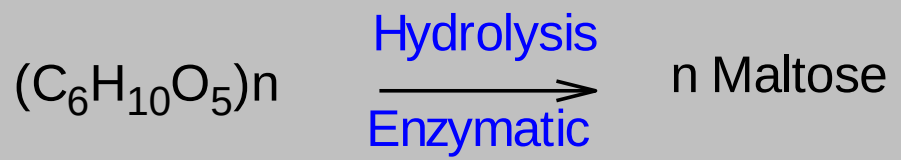
Enzymatic hydrolysis of alpha Amylose gives Maltose While enzymatic hydrolysis of beta Amylose gives 62 % Maltose and 38 % Amylopectin.

The structure of alpha Amylose has linear structure and beta Amylose has branched structure.

Constitution of α- Amylose

- M.F. :$[C_6H_{10}O_5]_n$
- Hydrolysis: **Acidic & Enzymatic**

- M.W. = 50000 gm/mole
- Acidic Hydrolysis indicates that 300 – 350 Glucose units are present.
- Enzymatic Hydrolysis indicates that in alpha Amylose no. of Maltose units having glucose are present.
- **Maltose is 4- O- D- GlucoPyranose**
- **@ Pyranose Cycle & C1-C4 linkages**

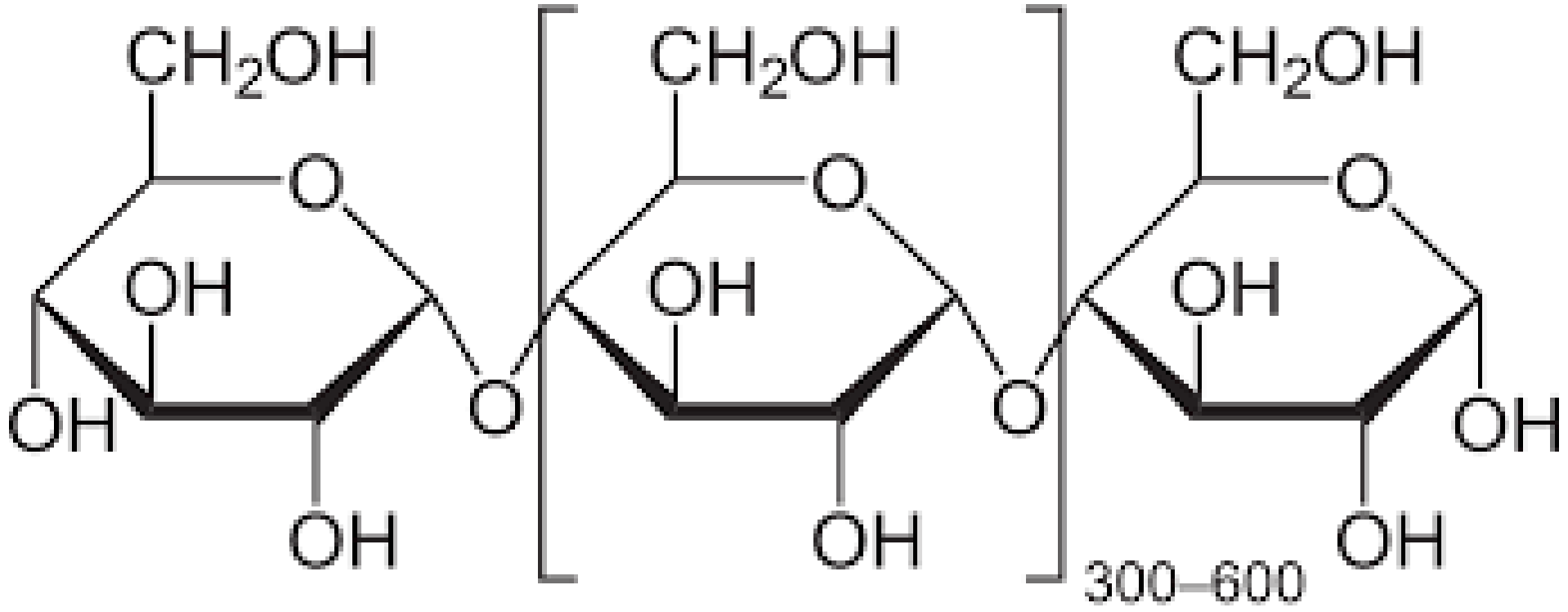


- Methylation: Reaction :

- α- Amylose $\xrightarrow{\text{Methylation}}$ Methylated Amylose
- $(CH_3)_2SO_4/NaOH$
- dil HCl/H-OH
- **2,3,4,6-tetra methoxy D(+) Glucose** + **2,3,6-tri methoxy D(+) Glucose**

@ Pyranose Cycle
@ C1-C4 linkages
@ Linear structure

Structure of α- Amylose



Constitution of ß-Amylose (Amylopectin)

- M.F. :$[C_6H_{10}O_5]_n$
- Hydrolysis:
- M.W. = 50000 to 1000000 gm/mole
- Average M.W = 550000 gm/mole

@ 3000 Glucose units are present.

- **Oxidation:**
- Oxidation with **HIO_4** it gives formic acid. It is possible when 24-27 D(+) Glucose units are present in linear chain & then after one branch of non reducing group is present.

$$(C_6H_{10}O_5)n \xrightarrow{\text{Hydrolysis}} n\ D(+)\ \text{Glucose}$$

- Methylation: Reaction :

- Amylopectin —Methylation→ Methylated Amylopectin

Methylated Amylopectin —Hydrolysis→

- 2,3,6- tri methoxy D(+) Glucose
- \+
- 2,3-dimethoxy D(+) Glucose
- \+
- 2,3,4,6- tetra methoxy D(+) Glucose

- Pyranose Cycle
- Branched structure
- 120 branches

Enzymatic Hydrolysis : Diastase

Amylopectin → **1,6 alpha linked di Glucose (32%) + Maltose (62%)**

In Maltose Glucose units joint with each other in linear chain (main chain) with C1-C4 linkages and in Iso maltose Glucose units joint with each other with C1-C6 linkages(branches chain)

Structure of Amylopectin