

## Partial work N°2 : Chemical characterizations of carbohydrates

### (Furfuralic reactions)

#### 1. Introduction :

Sugars can be divided into two groups :

- **Oses or monosaccharides**

They cannot be hydrolyzed into simpler sugars. depending on the number of their carbon atoms we find: trioses, tetroses, pentoses, hexoses.

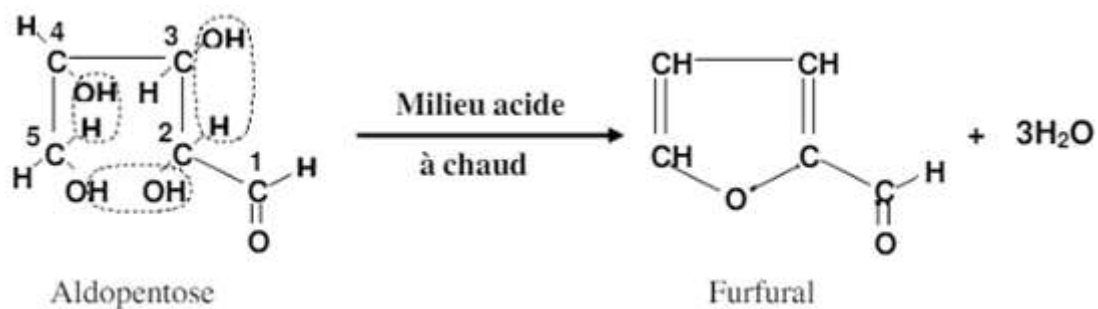
- **Polysaccharides**

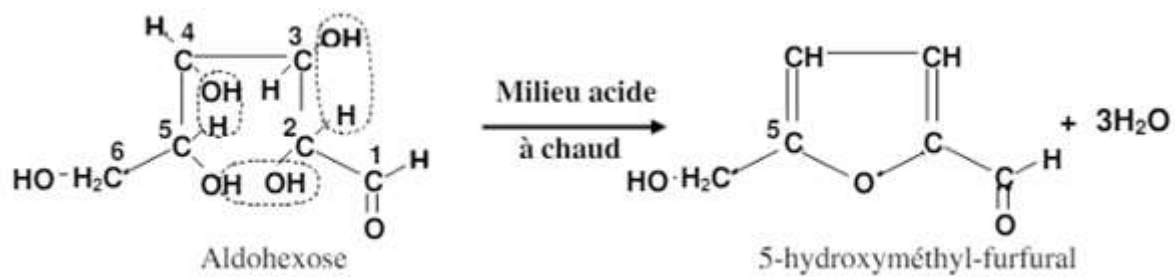
They are formed by the sequence of several oses. Depending on the number of oses we can divide them into :

- **Holosides** : made up of a number of oses generally less than 10. The most important are the disaccharides. Exemple : maltose, sucrose, lactose.
- **Polysaccharides** : made up of a large number of oses which can reach hundreds. Example: glycogen, starch, cellulose.

#### 2. Principle

In a strongly acidic and hot environment, oses having at least 5 carbon atoms undergo dehydration and are transformed into furfural (if the ose is a pentose) or into a derivative of furfural (if the ose is an hexose).





Furfural and its derivatives can condense with substances such as phenols, aromatic amines to form characteristic colored products.

### 3. Material

- Test tubes
- Balance
- Boiling water bath
- Pipettes

### 4. Reagents

- Glucose, fructose, ribose, sucrose and solutions at 1% in distilled water.
- Concentrated HCl
- HCl 1N
- Concentrated H<sub>2</sub>SO<sub>4</sub>
- Lugol (mix 1g of iodine with 2g of potassium iodide in 100ml of distilled water)
- Molisch reagent (2g  $\alpha$ -naphthol + 100ml Ethanol)
- Seliwanoff reagent (2g resorcinol + 0.5ml concentrated H<sub>2</sub>SO<sub>4</sub> + 100ml water)
- Bial reagent (0.2g d'orcinol + 100ml concentrated HCl + 5 drops FeCl<sub>3</sub> at 10%)

### 5. Operating mode

#### a. Molisch reaction

It's a general reaction to all sugars (oses or osides). In the presence of sulfuric acid, sugars form a furfural derivative which condenses with  $\alpha$ -naphthol to give a product colored purple.

#### Operating mode

1. Prepare 4 test tubes : put in the first tube 2ml of glucose solution, in the second 2ml of fructose solution, in the third 2ml of sucrose solution and the forth one 2ml of distilled water.
2. Add to each tube 3 drops of Molisch reagent
3. Shake the tubes to mix the contents
4. Flow gently down the wall of each tube 2ml of concentrated H<sub>2</sub>SO<sub>4</sub>
5. Observe and note the coloring obtained

### **b. Seliwanoff reaction**

This reaction is characteristic of ketoses which, in the presence of concentrated hydrochloric acid and heat, condense with resorcinol to form a red compound.

#### ***Operating mode***

1. Prepare 4 test tubes : put in the first tube 2ml of fructose solution, in the second 2ml of glucose solution, in the third 2ml of sucrose solution and the fourth one 2ml of distilled water.
2. Add to each tube 2ml of Seliwanoff reagent
3. Add to each tube 1ml of concentrated HCl
4. Heat the tubes for 5 minutes in a boiling water bath and leave to cool
5. Observe and note the coloring obtained

### **c. Bial reaction**

This reaction is specific to pentoses. In concentrated HCl medium and in the presence of  $\text{Fe}^{+3}$  ions, pentose condense with orcinol to form a green compound.

#### ***Operating mode***

1. Prepare 3 test tubes : put in the first tube 1ml of glucose solution, in the second 1ml of ribose solution and in the third 1ml of distilled water.
2. Add to each tube 1ml of Bial reagent
3. Heat the tubes for 5 minutes in a boiling water bath and leave to cool
4. Observe and note the coloring obtained

### **4.4. reaction to iodine**

Lugol or iodized water ( $\text{I}_3^-$ ) attaches to the polysaccharide chains to give colored complexes. the reaction of lugol with glycogen gives a brown color while we obtain a blue-black color with starch amidon.

#### ***Operating mode***

1. Prepare 4 test tubes : put in the first tube 2ml of unknown solution A, in the second 2ml of fructose solution, in the third 2ml of distilled water.
2. Add to each tube 1ml of HCl 1N
3. Add to each tube 2 drops of diluted lugol

4. Observe and note the coloring obtained

**Questions**

Justify your observations in each test 1, 2, 3 :

- Coloring of the ring in the Molisch reaction (purplish red)
- Coloring obtained in the Seliwanoff reaction
- Coloring obtained in the Bial reaction

By specifying for each test whether it is a pentose or hexose, a cetose or aldose.

In the test 4, Identify the nature of the polysaccharide in solutions A. Justify.