



Glycosides

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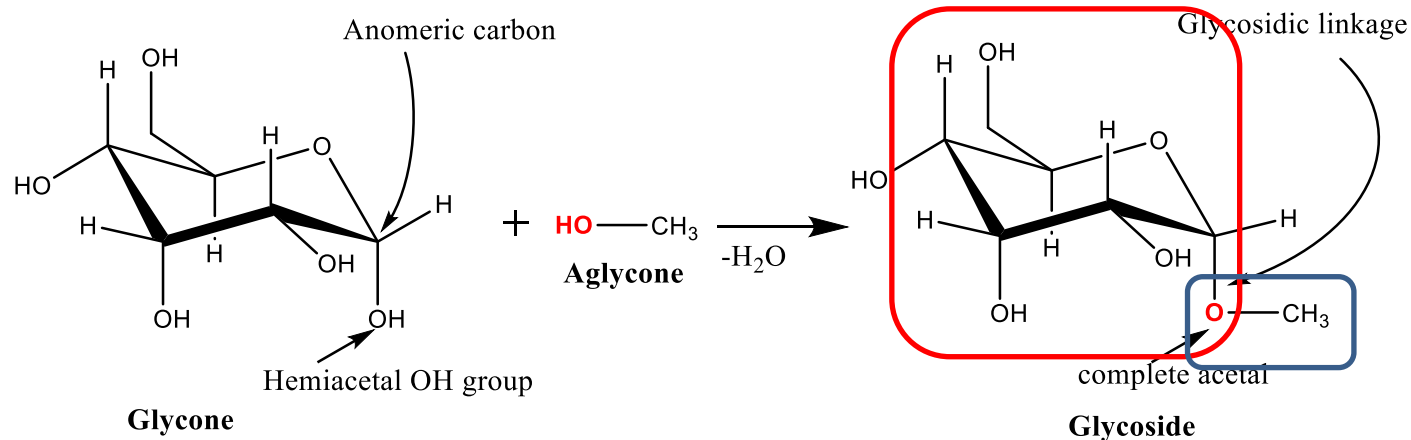
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Learning Outcomes

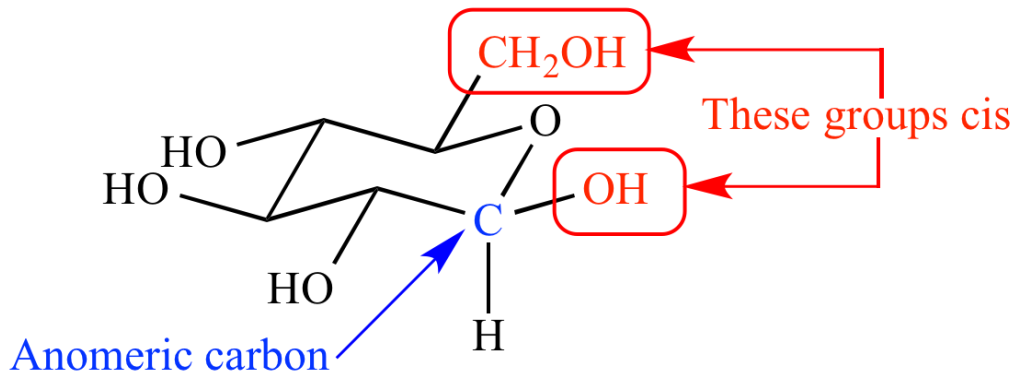
- At the end of this lesson students will be able to
 - Define glycosides
 - Chemistry of glycosides
 - Classify different types of glycosides
 - Roles of natural glycosides

Glycosides

- They are compounds in which a **carbohydrate (sugar)** is bound to another molecule (**carbohydrate or noncarbohydrate**) via a **glycosidic bond**.
- The **carbohydrate** group is **attached through its anomeric carbon (carbon 1)** to another group.
- The **carbohydrate (sugar) component** is known as the **Glycone**.
- The **noncarbohydrate component** is known as the **Aglycone or Genin**.

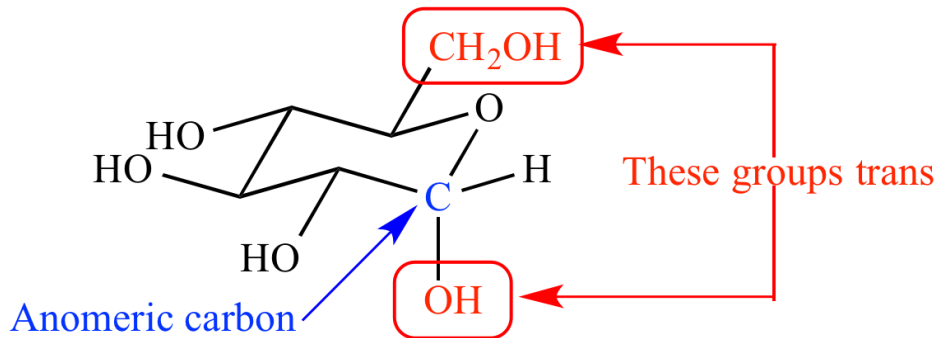


- **Beta-anomer (β -anomer):** A carbohydrate in which the group bonded to the anomeric carbon is **cis** to the **CH₂OH** group on the other side of the **pyranose or furanose ring ether oxygen atom**.



β -D-glucopyranose
(anomeric OH is cis to the CH₂OH)

- **Alpha-anomer (α -anomer):** A carbohydrate in which the group bonded to the anomeric carbon is **trans** to the **CH₂OH** group on the other side of the **pyranose or furanose ring ether oxygen atom**.



α -D-glucopyranose
(anomeric OH is trans to the CH₂OH)

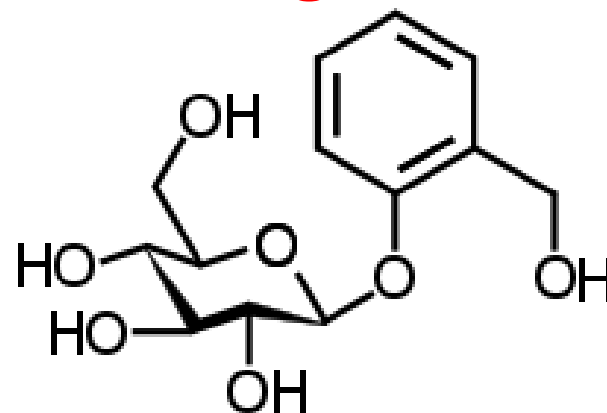
Classification of Glycosides

- **Classification based on**
 - ☐ **Configuration**
 - ☐ **Glycosidic linkage**
 - ☐ **Sugar or carbohydrate moiety**
 - ☐ **Non-carbohydrate moiety**
 - ☐ **Properties or functions**

Classification of Glycosides Based on Configuration

Beta-glycoside (β -glycoside):

- Glycoside with a β -configuration at the anomeric carbon.
- Majority of plant glycosides are β -glycoside

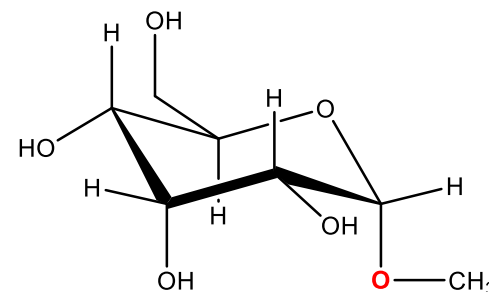


Salicin

(anti-inflammatory, antipyretic, analgesic substance)

Alpha-glycoside (α -glycoside):

- Glycoside with an α -configuration at the anomeric carbon.
- Only few medicinal α -glycosides are known, mainly rhamnosides

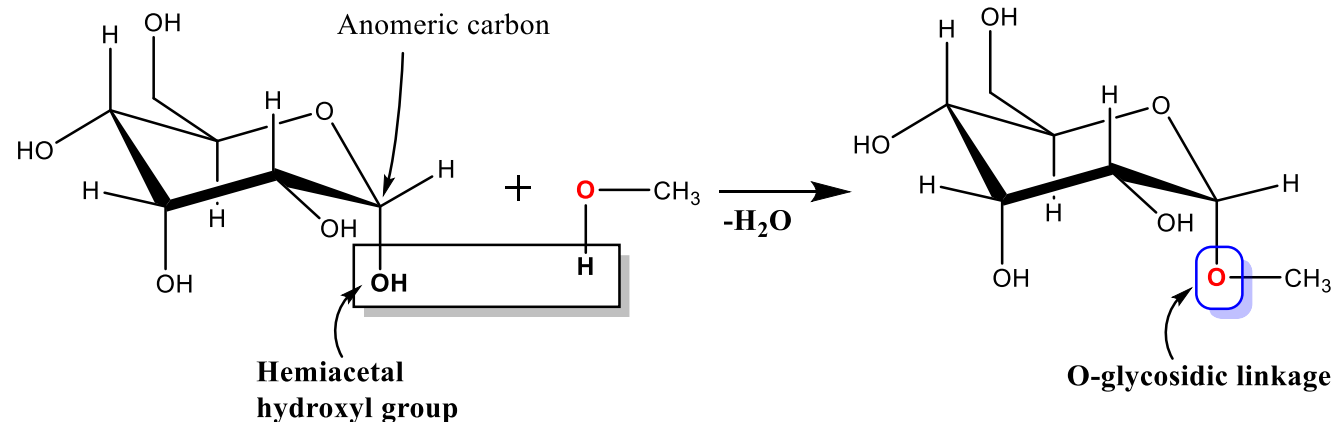


Methyl α -D-glucopyranoside

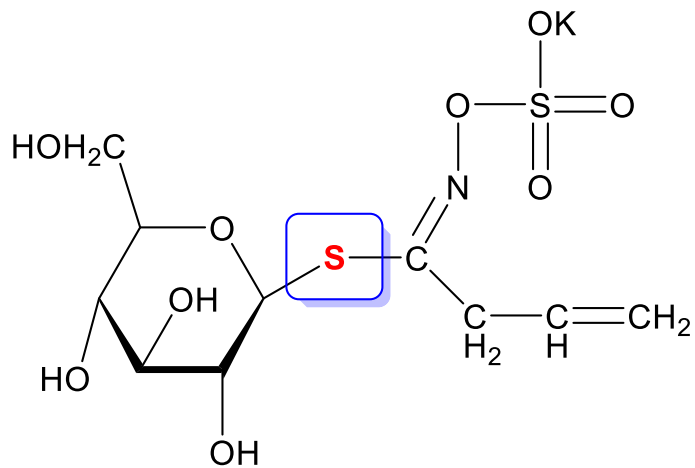
Classification of Glycosides Based on Glycosidic linkage

Glycosidic bond or linkage is a type of **covalent bond** that joins a carbohydrate (sugar) molecule to another group, which may or may not be another carbohydrate.

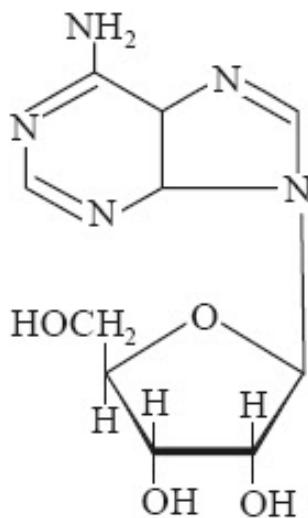
- **O-glycosides:** Glycosidic bond is formed between the anomeric (hemiacetal/hemiketal) group of a sugar with the **hydroxyl group (OH)** of a second molecule.



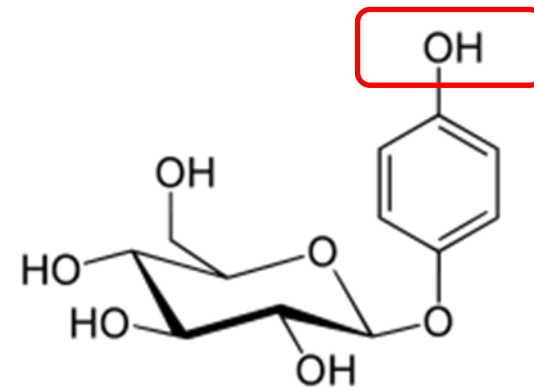
- **N-glycosides**
- **S-glycosides** (thioglycosides)
- **C-glycosides** (C-glycosyl compound, IUPAC) - more resistant to hydrolysis



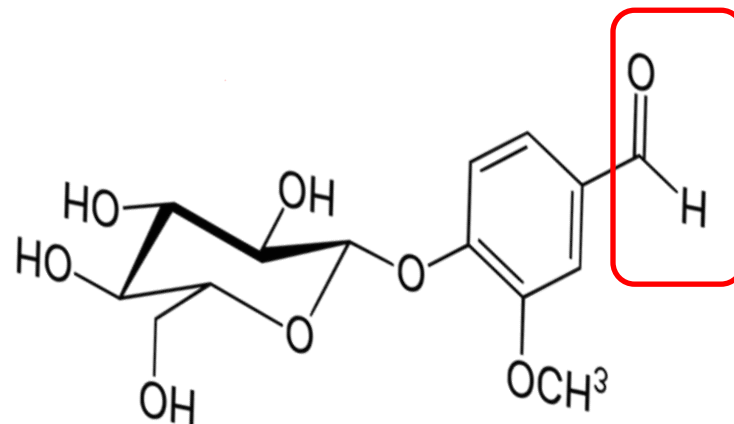
S-glycoside (Isothiocyanate glycoside)
Sinigrin (Black mustered seed)



N-glycoside
Adenosine (human body, yeast nucleic acid)



O-glycoside (Phenolic glycoside)
Arbutin (treatment of UTIs)



O-glycoside (Aldehyde glycoside)
Vanillin glucoside

Classification of Glycosides Based on Carbohydrate/Glycone

- **Glucoside:**
 - If the **glycone** group of the glycoside is **glucose**
- **Fructoside:**
 - If the **glycone** group of the glycoside is **fructose**
- **Rhamnoside:**
 - If the **glycone** group of the glycoside is **rhamnose**
- **Glucuronide:**
 - If the **glycone** group of the glycoside is **glucuronic acid**
 - Toxic substances are often excreted as glucuronides in the body

Classification of Glycosides Based on Non-carbohydrate

Glycosides are also classified based on the chemical nature of the aglycone

- **Saponin:** aglycone is **sapogenin**
- **Flavonoid glycosides:** aglycone is a **flavonoid**
- **Anthocyanin:** aglycone is **anthocyanidin** (oxonium cations)
- **Cyanogenic glycosides:** aglycone contains a **cyanohydrin** group
- **Isothiocyanate glycosides:** aglycone contains **isothiocyanate** group
- **Phenolic:** aglycone is **phenolic structure**
- **Aldehyde glycosides:** aglycone contains an **aldehyde** group
- **Coumarin glycosides:** aglycone is **coumarin** or derivatives
- **Terpene glycosides:** aglycone contains an **terpene** group
- **Tannin glycosides:** aglycone contains an **tannin** group

Classification of Glycosides Based on Properties or Functions

Glycosides are also classified based on their biological functions

- **Cardiac glycosides:**
 - Stimulate cardiac muscle contractions and used therapeutically (CHF)
- **Saponins:** Possesses soap like properties, eg. Quilaic acid (Quillaja bark)
- **Laxative glycosides:**
 - **Sennoside A,B,C,D** (Senna leaves); Aloin (Aloe vera)
- **Analgesic, and antipyretic glycosides:**
 - **Salicin** (Salix bark) hydrolysed to salicylic acid
- **Anti-inflammatory glycosides:**
 - **Centalloside** (Centella leaves) – Rheumatic arthritides
- **Glycosides as local irritant:**
 - **Sinigrin** (Black mustered seeds), **Sinalbin** (White mustered seeds)

Role of Natural Glycosides

- Many glycosides occur in flowers and fruits as pigments eg. anthocyanins.
 - Attract birds, insects and flies to facilitates pollination
- Various medicines, condiments, and dyes from plants occur as glycosides
 - Cardiac glycosides (Digitalis) to treat CHF
- Saponin glycosides lower the surface tension of water,
 - used as detergent, emulsifier etc.

REFERENCES

Textbooks:

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2. **Fundamentals of Pharmacognosy and Phytotherapy. A Guide for Health Care Professionals by Carol A. Newal, Linda A. Anderson and J. David Phillipson. (2010). the Pharmaceutical Press, London, UK; ISBN: 0 85369-474-5.**

Websites:

1. <http://www.chem.ucla.edu/~harding/IGOC/G/glycoside.html>
2. https://www.powershow.com/view4/80b9cd-ODk4M/25_13_Glycosides_powerpoint_ppt_presentation

BOOKS

