Glycosides

Introduction & Classification

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GLYCOSIDES

- Glycosides are the molecules in which a sugar part is bound to some other non-sugar part.
- Glycosides play numerous important roles in living organisms.
- Plants store important chemicals in the form of inactive glycosides; if these chemicals are needed, the glycosides are brought in contact with water and an enzyme and the sugar part is broken off, making the chemical available for use.
- Many such plant glycosides are used as medications.
GLYCOSIDES

Formally, a glycoside is any molecule in which a sugar group is bonded through its anomeric carbon to another group via a glycosidic bond.

The sugar group is known as the Glycone and the non-sugar group as the Aglycone or Genin part of the glycoside.

The glycone can consist of:
- Single sugar group (Monosaccharide) or
- Several sugar groups (Oligosaccharide).
Glycosidal Sugars:

Sugars found in glycosides may be

- **Monosaccharides**
  - Glucose
  - Rhamnose
  - Fructose

- **Deoxysugars (more rare)**
  - Cymarose
    - found in the cardiac glycosides
A Glycoside is a

- **Glucoside**
  - Has glucose as the sugar component
- **Pentoside**
  - Has a sugar such as arabinose
- **Rhamnosides**
  - Contains rhamnose
- **Rhammoglucosides**
  - Contains both rhamnose and glucose
Glycosidic bond

• A glycosidic bond is a certain type of a **functional group** that joins alcoholic group of a **Carbohydrate** molecule to an **aglycone** molecule.

• A substance containing a glycosidic bond is a **Glycoside**.
Glycosidic bond
Classification of Glycosides

Glycosides can be classified by:

• The nature of Glycone
• Number of sugars
• Nature of the glycoside
• Botanical source
• Therapeutic use
• The type of Glycosidic Bond
• The Glycosidal Linkage and
• Chemical nature of Aglycone.
By Glycones

• If the glycone group of a glycoside is glucose, then the molecule is a Glucoside.

• If it is fructose, then the molecule is a Fructoside.

• If it is glucuronic acid, then the molecule is a Glucuronide.
Number of sugars:

- One sugar monosides e.g. Salicin.
- Two sugar Biosides e.g. Diosmin.
- Three sugars Triosides e.g. Digoxin.

Nature of the glycoside:

- **Primary glycosides:** Originally present in the plant
  - e.g. Purpurea A
- **Secondary glycosides:** Resulted from removal of one sugar from the primary glycosides
  - e.g. Digitoxin
• **Botanical source:**
  • Digitalis glycosides
  • Senna glycosides.

• **Therapeutic use:**
  • Analgesic glycosides.
  • Purgative glycosides.
  • Cardiac glycosides.
Classifications of glycosides according to their therapeutic effects

CHF and cardiac muscles stimulators:

- Digitalis glycosides: digoxin, digitoxin, gitoxin (Fox glove leaves)
- Ouabain: *Strophanthus gratus* seeds
- K-strophanthin -*Strophanthus kombe* seeds
- Scillaren A,B which isolated from red and white Squill bulbs
- Convolloside: *Convallaria majalis* – Lily of the Valley.
Laxative group of glycosides:
- Sennoside A,B,C,D (Senna leaves and fruits)
- Cascaroside A,B (Cascara bark)
- Frangulin and glucofrangulin (Frangula bark)
- Aloin and barbaloin (Aloe vera and A. barbadensis)

Local irritant group:
- Sinigrin (Black mustered seeds _Brassica nigra_)
- Sinalbin (White mustered seeds _Brassica alba_)

Analgesics and antipyretics:
- Salicin $\xrightarrow{\text{hydrolysis}}$ Salisylic acid (Willow or Salix bark)

Keeping elasticity of blood vessels like:
- Rutin, Rutoside (Bitter orange peels, Lemon peels)

Anti-inflammatory group:
- Aloin for acne &
- Glycyrrhizin in the treatment of peptic ulcer
By type of glycosidic bond

Depending on whether the glycosidic bond lies "above" or "below" the plane of the cyclic sugar molecule, glycosides are classified as:

» α-glycosides

» β-glycosides
α- & β-glycosides

α - methyl glucoside

β - methyl glucoside

α - methyl glucoside

β - methyl glucoside
By Linkage

Atom from the aglycone involved in the glycosidic linkage:

- Aglycone- O- Sugar  \( \rightarrow O\)-glycosides
- Aglycone- C- Sugar  \( \rightarrow C\)-glycosides
- Aglycone- S- Sugar  \( \rightarrow S\)-glycosides
- Aglycone- N- Sugar  \( \rightarrow N\)-glycosides
O,C,S & N – GLYCOSIDES

Sennoside
(O - Glycoside)

Barbaloin
(C - Glycoside)

Sinigrin
(S - Glycoside)

Adenosine
(N - Glycoside)
Glycosides are also classified according to the chemical nature of the aglycone.
For purposes of biochemistry and pharmacology, this is the most useful classification.

- Anthraquinone glycosides
- Simple phenolic glycoside
- Thioglycosides
- Flavonoid glycosides
- Steroidal glycosides or cardiac glycosides.
- Saponins
- Coumarin glycosides
- Cyanogenic glycosides
Anthraquinone glycosides

(I) Anthraquinone

(II) Anthranol

(III) Anthrone

(IV) Oxyanthrone

Emodine

Aloe emodine

Alizarine

Emodindianthron

Rizofanoldianthron

Rhein

Frangula emodine

Fizacine
Simple phenolic glycoside

Arbutin

Methyl arbutin

Salicine

Salidroazine

Glycoside of Salicylic acid
Thioglycosides

S - Glucose

$CH_2 = CH - CH_2 - C = N - O - SO_3K$

Sinigrin

$O_5H_{11}C_6 - S : N - H_2C - O - CH : CH . CO$

Sinalbin

$OCH_2 . CH_2 . N(CH_3)_3 . H_2SO_4$
Flavonoid glycosides

- Flavone
- Flavanone
- Flavanol
- Flavanonol
- Chalcone
- Catechine
- Aurones
- Naringin
- Pelargonidine
- Cynadine
- Anthocyanidine
- Rutin
- Glucose - Rhamnose
- Glucose - Rhamnose
- Glucose - Rhamnose
Steroidal glycosides or cardiac glycosides

- Digitoxigenin
- Gitoxigenin
- Strophanthidin
- Gitaloxigenin
- Digitoxigenin
- Gellebrigenol
Saponins

Diosgenin

Hecogenin

α-amyrin

β-amyrin

Lupeol

Damaran
Coumarin glycosides

Coumarin
Cyanogenic glycosides

Amygdalin

Linamarin