Glycosides

Introduction

- **Definition:**
  - Glycosides are non-reducing organic compounds that on hydrolysis with acids, alkalis or enzymes yield:
    - A sugar part (or glycone, formed of one or more sugar units).
    - A non-sugar part (or aglycone, also called genin).

Classification:

- **Atom from the aglycone involved in the glycosidic linkage:**
  - Aglycone- O- Sugar — O-glycosides
  - Aglycone- C- Sugar — C-glycosides
  - Aglycone- S- Sugar — S-glycosides
  - Aglycone- N- Sugar — N-glycosides
- **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

- Type of the glycosidic linkage:
  - α- glycosides
  - β- glycosides
- Botanical source:
  - Digitalis glycosides
  - Senna glycosides.
- Therapeutic use:
  - Analgesic glycosides.
  - Purgative glycosides.
  - Cardiac glycosides.
- Chemical nature of the aglycone:
  - Flavone glycosides.
  - Steroidal glycosides.
  - Aldehydic glycosides.

Physical Characters:

- Solids either amorphous or crystalline.
- Non volatile.
- Usually bitter in taste.
- Soluble in water and polar organic solvents.
- Reduce Fehling's solutions only after hydrolysis.

Stability of Glycosides:

1- Effect of acid hydrolysis:

- Acids split sugars from the aglycones.
- The acetal linkage is more readily cleaved than the linkage between the individual sugars of the sugar chain.
- C-glycosides are resistant to acid hydrolysis.

2- Effect of alkaline hydrolysis:

A- Strong alkalis:

- Hydrolysis of ester groups.
- Opening of lactone rings e.g. Cardiac glycosides.

B- Mild alkalis:

- Hydrolysis of ester groups e.g. Lanatoside A to Purpurea A
- Opening of lactone rings e.g. Cardiac glycosides.

3- Enzymatic hydrolysis:

- Split the sugars stepwise starting from the terminal sugars.
- All plants producing glycosides have enzyme that can hydrolyze these glycosides.
- Enzymes are specific for the type of glycosidic linkages:
  - Emulsin can hydrolyze β- glycosides
  - Invertase can hydrolyze α- glycosides
  - Myrosin can hydrolyze s-glycosides.

Extraction and Isolation

- **Because of the wide range of physical and chemical properties of glycosides and other constituents associated with them, no common general method for their isolation is recommended.**
- **Water, methanol, water-ethanol and ethanol are the most common solvents for extraction of glycosides.**

- **Precautions before extraction**
  - **Deactivation of enzymes:**
- **Drying** for 15-30 min at **100 oC** followed by slow drying at a low temperature.
- Dipping the fresh material into **boiling water** or **boiling alcohol** for 10-20 min.
- **Boiling** the fresh plant material with **acetone**.
- Carrying out the extraction at very low temp.
- **Freeze-drying** of the plant material **before extraction** (lyophilization).
- Carrying the extraction in the presence of $(NH_4)_2SO_4$.

Maintenance of neutral conditions:

- Neutral pH should be assured before and during extraction because:
- Acidity may result in hydrolysis. This is overcome by addition of $CaCO_3$.
- Mild alkalinity may sometimes produce racemization.

Defatting of fat-rich organs (e.g. seeds) before extraction:

- High amounts of lipoids hinder glycoside extraction. Defatting is usually carried with petroleum ether

Alcoholic and Phenolic Glycosides

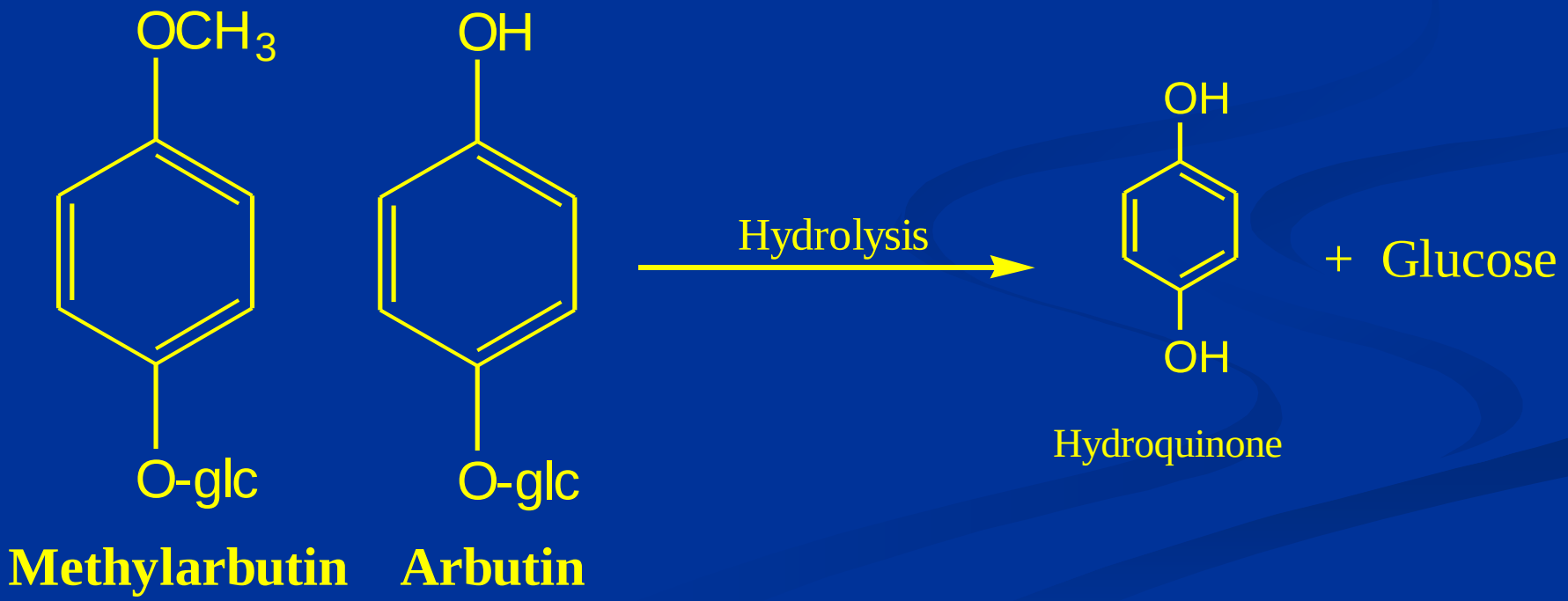
1- Salicin

- **Source:** Salix species (Willow bark).
- **Nature:** Primary achholic and Phenolic glycoside (monoside).
- **Uses:** Analgesic- Antipyretic- Anti-inflammatory.

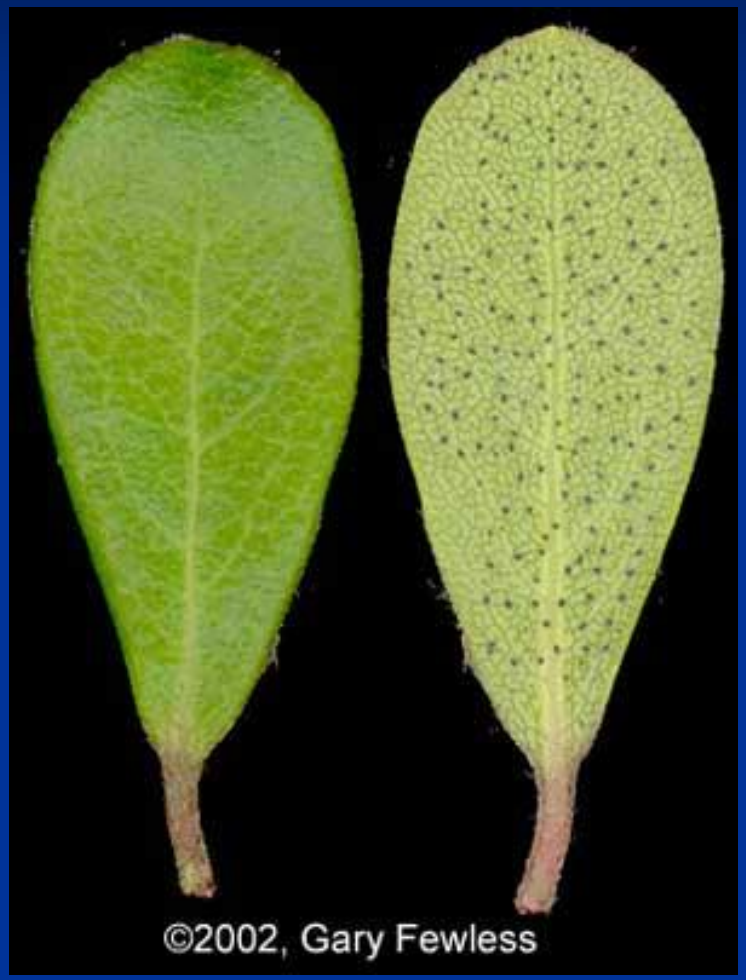

STARWEST
BOTANICALS

2- Arbutin & Methyl Arbutin

- **Source:** Uva Ursi (Bearberry leaves).
- **Nature:** Primary Phenolic glycoside (monoside).
- **Uses:** Diuretic- Bactericidal.



Methylarbutin **Arbutin**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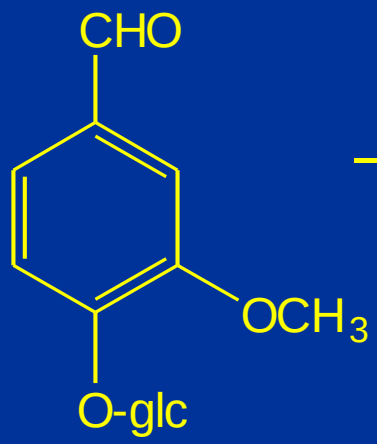
Aldehydic Glycosides

1- Glucovanillin

- **Source:** Vanilla pods.
- **Uses:** Flavouring agent- Spray reagent.

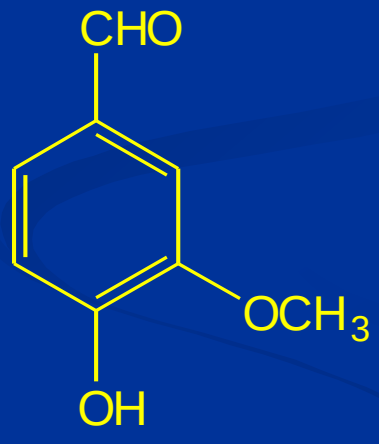
Glucovanillin



Green vanilla pods
Bitter in taste
Odourless

Enzymatic Hydrolysis

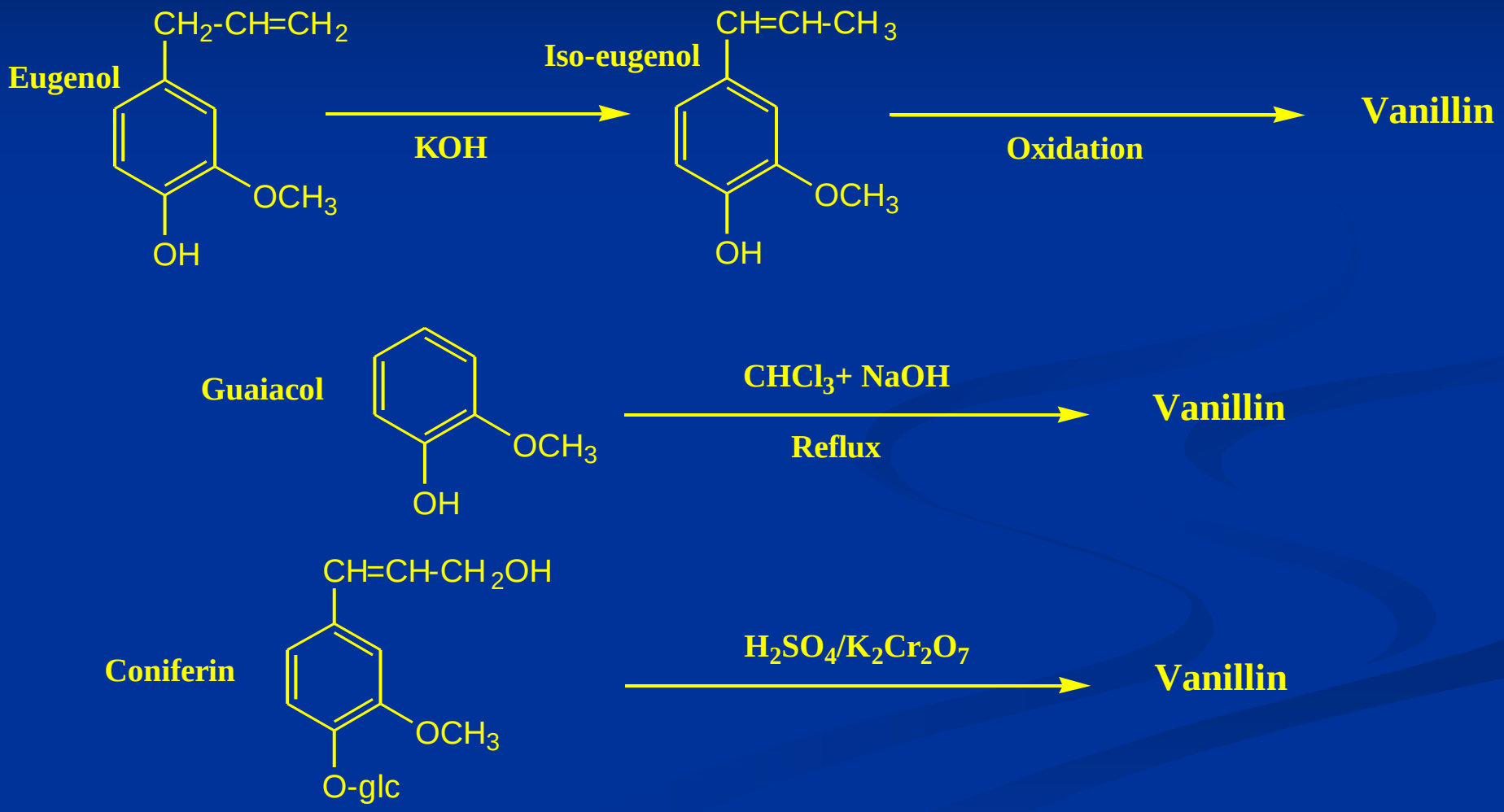
Vanillin



Brown vanilla pods
Sweet in taste
Vanilla odour

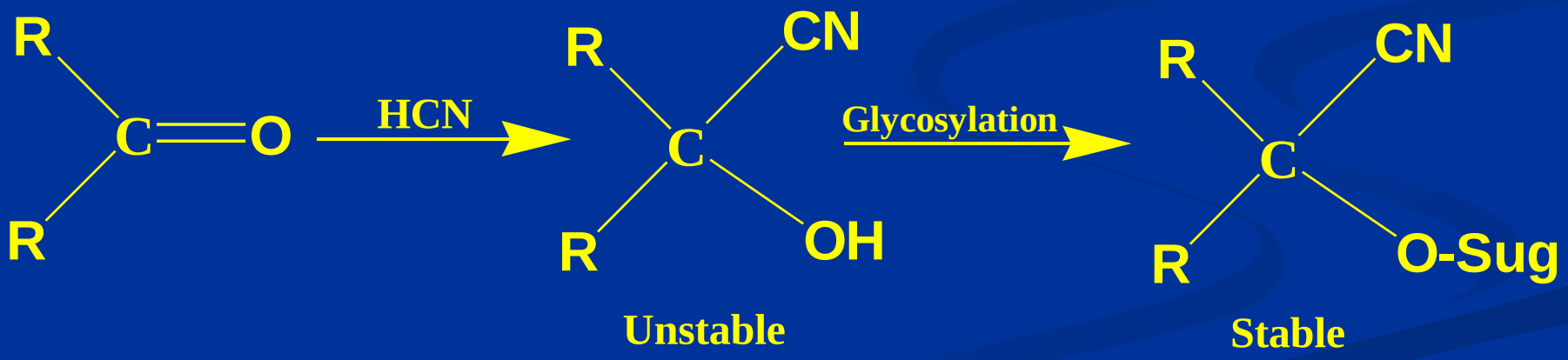
+ Glucose

Commercial Preparation of Vanillin



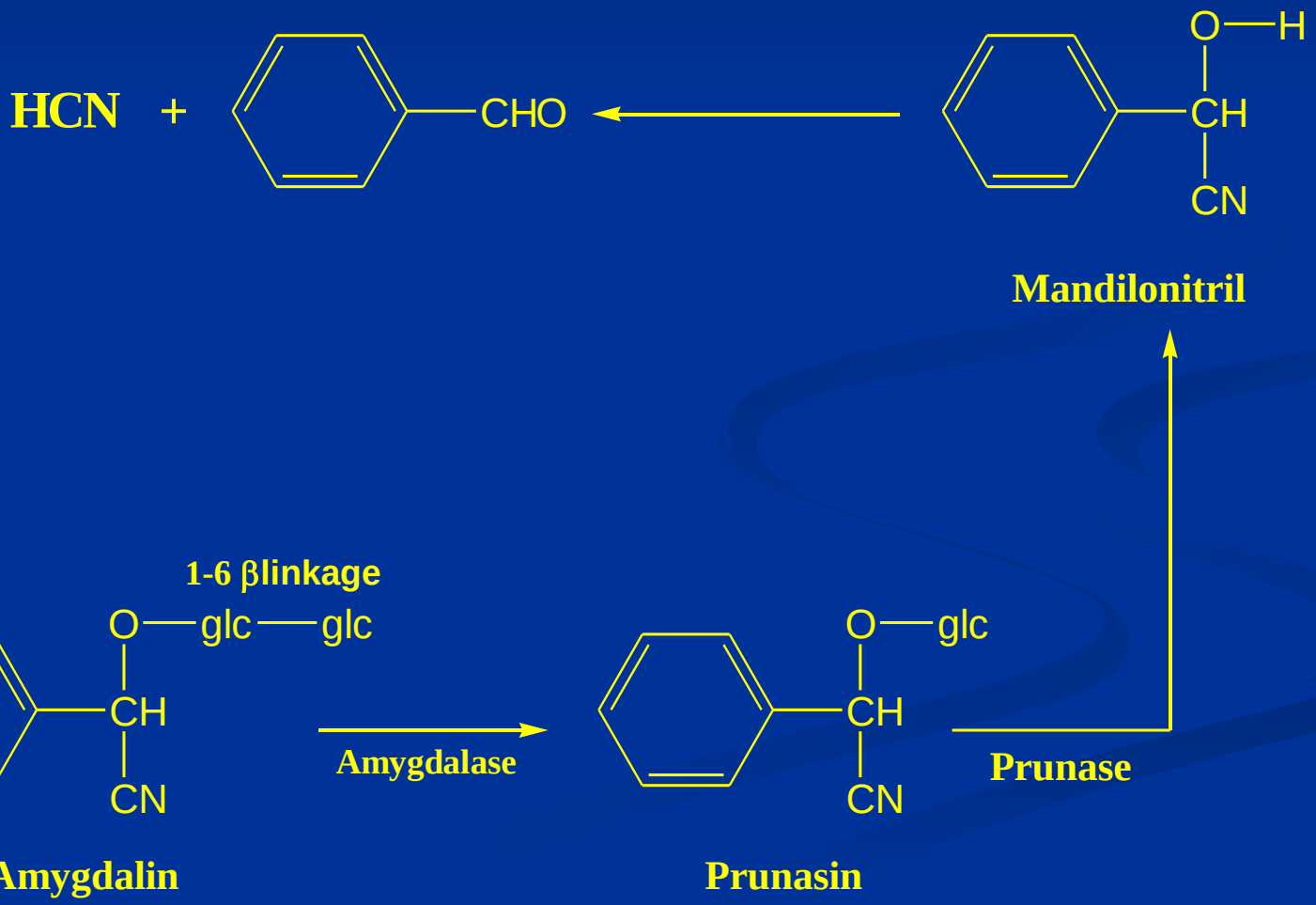
Cyanogenic Glycosides

- **Cyanogenic glycosides** (Cyanogentic or Cyanophore Glycosides) are **O-glycosides** yielding **HCN gas on hydrolysis** .
- They are condensation products of HCN to a carbonyl compounds (Cyanohydrin).



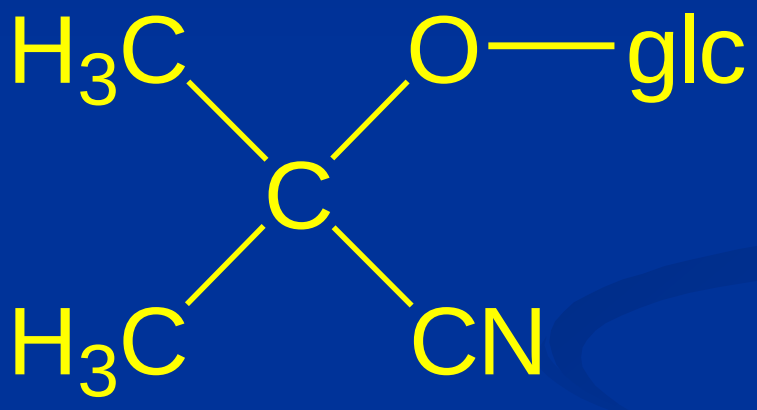
1- Amygdalin

- **Source:** Bitter Almond.
- **Structures:** It is a Bioside of mandilonitril.



2- Linamarin

- **Source:** Linseed.
- **Structures:** It is the glycosidic derivative of the cyanohydrin of acetone.



- **Uses:**
  - Linamarin has a molluscecidal activity.
  - Amygdalin is used for the preparation of Benzaldehyde.
  - Cyanogenic glycosides have role in cancer treatment.

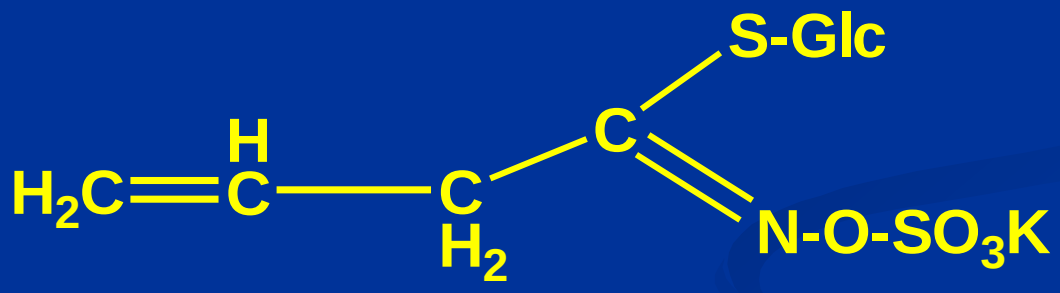
Test for Cyanogenic Glycosides:

- Reduce plant material to small pieces and moisten with water.
- Incubate at temp. less than 45 ^{0}C for 30 60 mins with the neck of the flask stoppered and have suspended sodium picrate paper.
- The paper will turns brick red due to the release of HCN gas.

Thioglycoside

Glucosinolates- Sulphur Glycosides

- They are S-glycosides widely distributed in family Cruciferae.
- **Sinigrin:** In seeds of *Brassica nigra* (black mustard).
- **Sinalbin:** In Seeds of *Brassica alba* (white mustard).



Sinigrin

- **Uses:** Rubefacients, Counter irritants and condiment.

Garlic

- It consists of the bulb of *Allium sativum* Fam. Liliaceae.
- The intact cells of garlic contain an odorless, sulfur-containing amino acid derivative (+)-*S*-allyl-*L*-cysteine sulfoxide, commonly known as alliin.
- Alliin is hydrolyzed by the effect of alliinase enzyme present in different cells after crushing into allicin (diallyl thiosulfinate).
- Allicin is responsible for the characteristic odor and flavor of garlic.
- Allicin is a potent antibacterial, antihyperlipidemic, and it inhibits platelet aggregation and enhances the blood fibrinolytic activity.

Alliin *Allicin*