1-

Traditional System (T.S.)

T.S. of medicine is defined as an ancient and culture bound healthcare practise which existed before the application of Science to health matters. Most of drugs used in traditional systems are from plant origin. It is the system of medicine which is native to a particular country. Since it is practised traditionally in the particular country, it is also called "indigenous system of medicine."

Various traditional / indigenous or alternative systems of medicines used in different parts of world are :-

1) Chinese and Kompoh system of traditional medicine
2) Ayurveda - Indian system of medicine.
3) Unani system of medicine
4) Homeopathic system of medicine
5) Aromatherapy

Chinese system of medicine & Kompoh system:-

In China, many medicinal plants had been in use since 5000 B.C. The oldest known herbal is Pen-t-Sao written by Emperor Shen Nung in 3000 Bc. It contains 365 drugs, one for each day.

The Chinese system of medicine is still prevalent. The yellow emperor's herbal "Classic of Internal medicine" (Huang Di Nei Jing), is believed to be prepared between

200 BC and 100 AD. This herbal is based on the idea that all life is subject to natural laws. The hypothesis includes two quite different systems →

1) The Yin and Yang theary 2) The five elements theary

The Yin and Yang theary says that everything in the universe consists of Yin (Dark) and Yang (light) side. These are complimentary opposites like wet and dry, up and down or day and night. According to this theary, diseased conditions are the expression of imbalance in Yin and Yang that is excess or deficiency of either of the two e.g. shivering occurs due to excess of Yin and fever occurs due to excess of Yang.

The treatment makes use of various herbs and their formulations. The important herb from the system are Ephedra Sinica, Rheum palmatum, Carthamus tinctorius, Clerodendron, Panax ginseng etc.

The five elements theary (water, metal, earth, fire and wood) proposes that each element leads to the next in a continuous fashion like fire to metal, to wood, to earth, to water and so on. The elements are the five phases indicating the process of continuous movement of life. The elements play a dynamic role in the chinese system of medicine like in making groups of herbal tastes and parts of body.

Kampoh or Traditional system of Japanese medicine

The form in which the traditional Chinese system of medicine has spread to Japan and Korea is called Kampoh. The basic ideas remains the same i.e. Yin and Yang theory, but Japanese has given it the style of simplicity and naturalness.

Ayurveda- Indian system of medicine:- It is the oldest system of medicine practised in India since 5000 yrs. and is the most noted systems of medicine in the world. It developed in close association with religion and mythology. It is considered to be the fifth veda of India (the other four vedas are Rigveda, Yajurveda, Atharveda and Samveda) and is based on vedas, samhitas and other books. Ancient Indian medicine practitioners computed the authentic information on Ayurveda in forms called Samhita. (e.g. Charak Samhita and Sushruta samhita).

The first mention of traditional medicine in India was found in Rigveda and Yajurveda both around 2000 BC. The Rigveda mention 67 and Yajurveda contains 81 traditional drugs. Atharvaveda (1600 - 1100 BC) includes 290 traditional drugs. Charak samhita (900 BC) is the first recorded treatise of Ayurveda and describes 341 plants and plant products for use in medicine. So Charaka is also known as father of ayurvedic medicines.

→ The next landmark in Ayurveda is Sushruta Samhita (600 BC) containing 395 medicinal plants.

→ Ayurveda is regarded an ancient science of life and is based on principle of "maintaining the health of a healthy person and relieving the patient from the diseased condition."

→ Ayurveda is based on hypothesis that entire universe is composed of ~~life~~ five basic elements called Panchmahabhuta and includes space (akasha), air (vayu), energy (teja), liquid (jal) and solid (prithvi). These occur in human body in combined form like :-

Vaata → (Space and air) → Concerned ε physical & mental activities. Represents Nervous system.

Pitta → (Liquid and Energy) → Indicates biochemical & energy systems.

Kapha → Includes hormonal, digestive & metabolic systems.
(Solid and liquid)

Concerned ε integration of structural elements of the body.

→ Vaata, Pitta and kapha are collectively known as Tridosha (three pillars of life). It is believed that these are in harmony with each other but in every human being one of them is dominating which in turn is called as the "Prakruti of that person."

→ Tridosha exist in human body in seven forms called Saptadhatu that is Rasa (lymph), Rakta (Blood), Meda (adipose tissue), Mamsa (flesh), Majja (nervine tissue), Shukra (reproductive tissue) and asthi (bone).

→ These saptadhatu undergo wear and tear so that Mala (excretory material) is formed from them.

→ When tridosha, Saptadhatu and Mala are in balance with each other, it is called as as healthy condition while their imbalance cause a pathological condition.

→ Ayurvedic medicines make use of vegetables, animals, ③ minerals and even physical forces. More than 70% of ayurvedic drugs are of vegetable origin. The collection of plants, identification, season of collection and parts of plant used etc. are greatly emphasized in Ayurveda.

→ Some important herbs from Ayurveda are Rauwolfia Serpentina, Asparagus racemosus, Cassia angustifolia, Withania, Sesamum indicum, Piper longum etc.

Various Ayurvedic formulations are :-

1) Solid forms - Churana (Powders)
Vatika (Pills)
Nasya (Snuff)

2) Viscous liquids → Kalka (Paste)
Yavagu (Gruel) → Viscous liquid in milk or water

3) Aqueous liquids → Kashaya (extract)
Swarasa (Juice)

4) Oily liquids - Tala (Medicated oils)
Mantha (Emulsion)

5) Spirits - Asava (Tincture)
Arishta (Perment)

Unani System of Medicine :- The roots of this system go deep to the times of the well known Greek Philosopher Hippocrates (460-370 BC) and Aristotle (384-322 BC), made valuable contributions to it. This system of Greek origin was further carried to Persia (Iran), where it has been

improved by Arabian physicians. Two Arab physicians Rhazes (925 AD) and Avicenna (980 AD) have made significant contribution to this system. In India it was introduced by Muslims.

This system is based on two theories that is the Hippocratic theory of four humours and the Pythagorian theory of four proximate qualities.

The four humour are- Blood, Phelgm, Yellow bile & Black bile. The four qualities are the states of living human body like Hot, Cold, moist and dry. These are represented as-

Earth ↓ Water ↓ Fire ↓ Air ↓

→ Imbalance of any of these four humours, produces a disease.

→ The Unani system of medicine aims at treating the cause of disease and not its symptoms. For this purpose, thorough history of the patient is recorded in addition to his pulse, urine and stool examinations. The drugs are polyherbal formulations and their collective effect is considered. Unani system emphasises on a correct diet.

→ Unani system of medicine is called by various names in different parts of world such as Arab medicine, Greco-Arab medicine, Loniah medicine, Islamic medicine and also Oriental medicine.

Homeopathic system of medicine:-

→ In comparison to other systems, it is a newer one and has been developed in 18th century by Samuel Hahnemann. a German physician and Chemist.

→ he proposed that the cause of disease itself can be used for its treatment. he gave the law of similars which says that

"Like cures Like (Similae similibus curentur)"

e.g. Cinchona can produce the symptoms of malaria.

→ he compiled all his results with a large number of extracts prepared from plants, animals and minerals in "The Organon of medicine."

→ In Homeopathic system, the drug treatment is not specified, but the choice of drug depends on symptoms and the clinical condition of the patient.

→ This is based on the concept of "Proving and Prover". A healthy person called prover, the symptoms created by different doses of drug extracts are noted, which is called proving and it specially considers ~~as~~ physical, mental and emotional changes of the prover.

→ Consequently, these symptoms are compared with a patient with similar symptoms and accordingly, same type of extract is given for treatment. During treatment, the drug extracts are extremely diluted, which is believed to cause potentiation and enhancement of curative effect.

→ The drugs are extracted in the form of mother tincture, which is further diluted in terms of decimal or centesimal potencies.

→ Various medicinal plants used in homeopathy are- Nux vomica, Thuja occidentalis, Colchicum autumnale, Aconitum napellus, etc.

Aromatherapy:-

→ It is one of the most ancient healing arts and traces its origin to 4500 B.C., When Egyptions used aromatic substance in medicines.

→ Greek also used plant essences for aromatic baths and scented massage.

→ In Ayurveda, there is mention of scented baths (abhyanga).

→ Prof. Gantle Gfosse, A french cosmetic chemist coined the term "Aromatherapy" and described healing properties of essential oils.

→ In this, different essential oils from various parts of plants are massaged into skin or inhaled or taken as part to treat a range of diseases, as well as, to have an effect on the mind and emotions.

→ They have been shown to heal wounds, promote formation of scar tissue, treat acne & skin problems, pre-menstrual tension, rheumatism, poor circulation and also nervine disorders like headache, stess, insomnia etc.

→ Various essential oils used in aromatherapy are Basil, Black pepper, calendula, caraway, Eucalyptus, Fennel, Garlic, Ginger, Gasmin, Lavender, rosemary and Sandalwood.

Other traditional systems are:-

Siddha system of medicine:-

It is practised mainly in Tamilnadu. It originated from pre-vedic period. It was practised even in the era of Mohenjodaro (5000-3000 BC). It consists of 96 principles described in the work of 18 Siddhas.

Siddha medicine make use of 'Herbal drugs in addition to metals and minerals particularly mercury, Sulfur, and Salt. Neem, Lemon, Garlic are the highly value plants in this system.

Bach flower remedies:-

→ It was discovered by Edward Bach, a physician in the early decades of the twentieth century.
→ These includes 38 remedies prepared from flowers of wild plants, bushes or trees.
→ The remedies are prescribed as per the patients state of mind like depression, anger, fear, worry etc.
→ The prescription is meant for achieving vitality and a harmonious state of mind, the lack of which cause sickness.
→ According to Dr. Bach, the remedies enrich the body with vibrations of human's superior ~~nature~~ nature, rather than attacking a disease.
→ Some of the remedies prescribed are white chestnut, wild rose, gentian, chicory etc.
→ For the purpose of medication, the mother tincture are prepared and dispensed in a diluted form as in homeopathic potentiation.

Introduction to ayurvedic preparations:-

1) Arishtas and Asvas = Pg. No. 335-336
2) Lehyas / Avelha = Pg No. 336-337
3) ~~Guttat~~ Gutika = Pg. No. 340
4) Tailas = Pg. No. 339
5) Churnas = Pg - No. 338-339
6) Bhasmas = Pg. No. 342-343

Test book of Pharmacognosy By Handa & Kapoor.

Module-4 Traditional system of medicine and Introduction to Secondary Metabolites

Scope- This module includes role of Pharmacognosy in Allopathy and various traditional system of medicine. Also include detailed information on a number of secondary metabolites.

Learning outcomes-

1. Student will able to learn role of Pharmacognosy in Allopathy and various traditional system of medicine like Ayurveda, Unani, siddha, Homepopathy and Chineese system.
2. Student will able to learn the introduction, classification, properties and chemical tests for a number of secondary metabolites like Alkloids, Glycosides, Flavonoids, Resins, Tannins and Volatile oils.

Alkaloids

Alkaloids

Definition: the term “alkaloid” (alkali-like) is commonly used to designate basic heterocyclic nitrogenous compounds of plant origin that are physiologically active.

Distribution and occurrence:

- Rare in lower plants.
- Dicots are more rich in alkaloids than Monocots.
- Families rich in Alkaloids: Apocynaceae, Rubiaceae, Solanaceae and Papaveracea.
- Families free from Alkaloids: Rosaceae, Labiatae

Distribution in Plant:

- All Parts e.g. Datura.
- Barks e.g. Cinchona
- Seeds e.g. Nux vomica
- Roots e.g. Aconite
- Fruits e.g. Black pepper
- Leaves e.g. Tobacco
- Latex e.g. Opium

Forms of Alkaloids:

- Free bases
- Salts with Organic acids e.g. **Oxalic, acetic acids**
- Salts with inorganic acids e.g. **HCl, H_2SO_4.**
- Salts with special acids:
  e.g. **Meconic acid** in Opium
  Quinic acid in *Cinchona*
- Glycosidal form e.g. Solanine in *Solanum*.

Function in Plants

- They may act as **protective** against insects and herbivores due to their bitterness and toxicity.
- **Source of nitrogen** in case of nitrogen deficiency.
- They, sometimes, act as **growth regulators** in certain metabolic systems.
- They may be utilized as a **source of energy** in case of deficiency in carbon dioxide assimilation.

Nomenclature:

Trivial names should end by **"ine"**. These names may refer to:

- The **genus** of the plant, such as Atropine from *Atropa belladona*.
- The plant **species**, such as Cocaine from *Erythroxylon coca*.
- The **common name** of the drug, such as Ergotamine from ergot.
- The name of the **discoverer**, such as Pelletierine that was discovered by Pelletier.
- The **physiological action**, such as Emetine that acts as emetic, Morphine means God of dreams acts as narcotic.
- A prominent **physical character**, such as Hygrine that is hygroscopic.

Prefixes and suffixes:

Prefixes:

- **"Nor-"** designates N-demethylation or N-demethoxylation, e.g. norpseudoephedrine and nornicotine.
- **"Apo-"** designates dehydration e.g. apomorphine.
- **"Iso-, pseudo-, neo-,** and **epi-"** indicate different types of isomers.

Suffixes:

- **"-dine"** designates isomerism as quinidine and cinchonidine.
- **"-ine"** indicates, in case of ergot alkaloids, a lower pharmacological activity e.g. ergotaminine is less potent than ergotamine.

Physical Properties:

I- Condition:

- **Most** alkaloids are crystalline **solids**.
- Few alkaloids are amorphous solids e.g. emetine.

- **Some** are **liquids** that are either:
  Volatile e.g. nicotine and coniine, or
  Non-volatile e.g. pilocarpine and hyoscine.

II- Color:

The **majority** of alkaloids are **colorless** but **some** ~~are~~ **colored** e.g.:

- Colchicine and berberine are yellow.
- Canadine is orange.

Physical Properties:

III- Solubility:

- Both **alkaloidal bases** and their **salts** are **soluble in alcohol**.
- Generally, the **bases** are **soluble in organic solvents** and **insoluble in water**

Exceptions:

- Bases **soluble in water**: caffeine, ephedrine, codeine, colchicine, pilocarpine and quaternary ammonium bases.
- Bases **insoluble or sparingly soluble in certain organic solvents**: morphine in ether, theobromine and theophylline in benzene.

- **Salts** are usually **soluble in water** and, **insoluble ~~or~~ sparingly soluble in organic solvents.**

Exceptions:

- ~~Salts **insoluble in water**~~: quinine monosulphate.
- Salts **soluble in organic solvents**: lo~~beline~~ and apoatropine hydrochlorides are soluble in chloroform.

Extraction, Purification and Isolation of Alkaloids from Powdered plants

Extraction and purification

Method I:

The powder is treated with alkalis to liberates the free bases that can then be extracted with water immiscible organic solvents.

Method II:

The powdered material is extracted with **water or aqueous alcohol** containing **dilute acid**. **Alkaloids** are extracted as their **salts** together with accompanying **soluble impurities**.

Method III:

The powder is extracted with water soluble organic solvents such as MeOH or EtOH which are good solvents for both salts and free bases.

Classification of Alkaloids

- Biogenetic.

  Based on the biogenetic pathway that form the alkaloids.

- Botanical Source.

  According to the plant source of alkaloids.

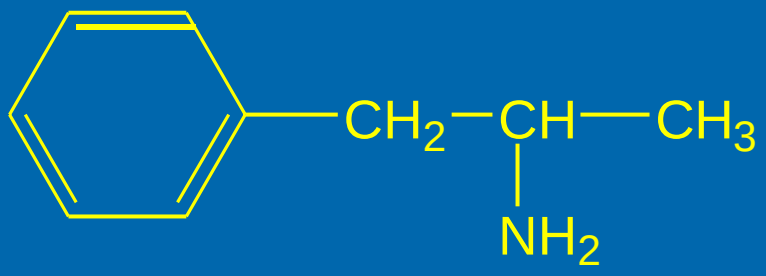
- Type of Amines.

  Primary, Secondary, Tertiary alkaloids.

- Basic Chemical Skeleton

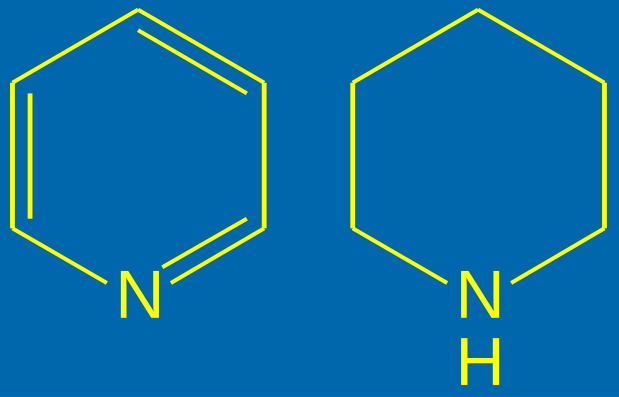
- **Phenylalkylamines:**

  e.g. Ephedrine



- **Pyridine and piperidine**

  e.g. lobeline, nicotine

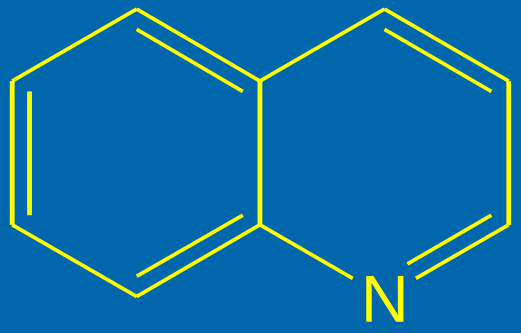


- **Tropane**

  e.g. Atropine.

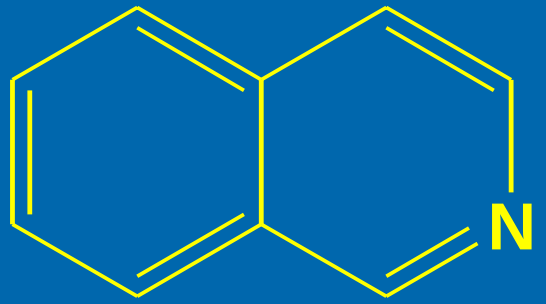
- **Quinoline**

  e.g.quinine and quinidine



- **Isoquinoline**

  e.g.Papaverine,Emetine

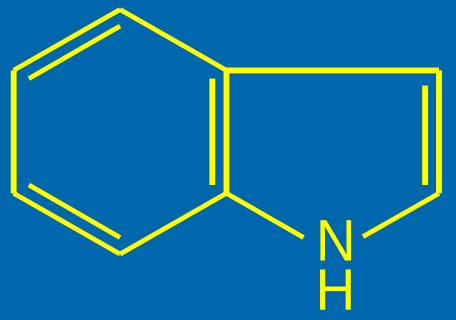


- **Phenantheren**

  e.g. Morphine

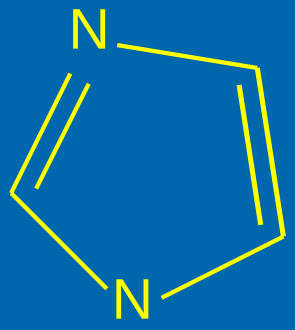
- **Indole**

  e.g.ergometrine



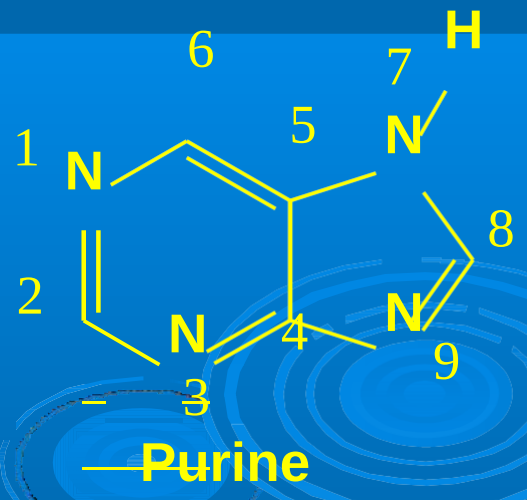
- **Imidazole**

  e.g. pilocarpine



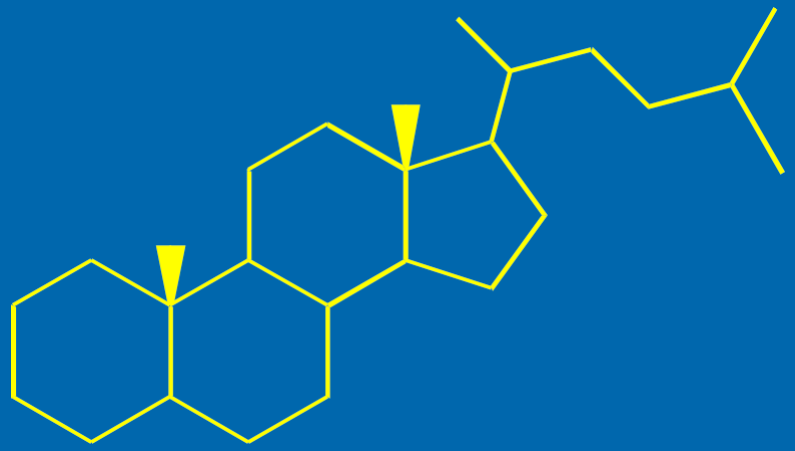
- **Purine**

  e.g. caffeine



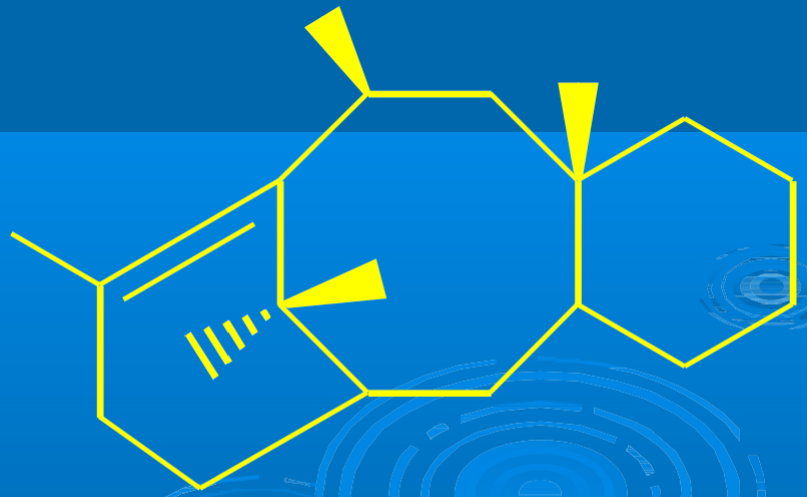
- **Steroidal**

  e.g. Solanum and *Veratrum* alkaloids



- **Terpenoid**

  e.g. Taxol



PHYSICAL-PROPERTY

I) They are colorless, crystalline solid. Exception - Berberin (Yellow), Nicotine Coniine (liquid).

II) They are insoluble in water (exception liquid alkaloids soluble in water), soluble in organic solvent ($CHCl_3$, Ethyl alcohol ether)

III) Taste: They are bitter in taste.

IV) Optically active, Most of levo ratatory but few are -Dextro rotatory e.g. Coniine, some inactive- e.g.- papaverine.

CHEMICAL TEST OF ALKALOIDS

1. Mayer's Test:

Specimen with Mayer's reagent give Cream or pale yellow ppt.

2. Dragendroff Reagent Test:

Specimen with Dragendroff Reagent give orange ppt.

3. Wagners Test:

Specimen with Wagner's Reagent give brown or reddish brown ppt.

4. Hager's Test:

pecimen with Hager's reagent give yellow ppt. (Special Type)

5. Amonium Rinker Test:

Specimen with Ammonium Rinket solutions with ~~HCL~~ give flocculent pink ppt.

Flavonoids

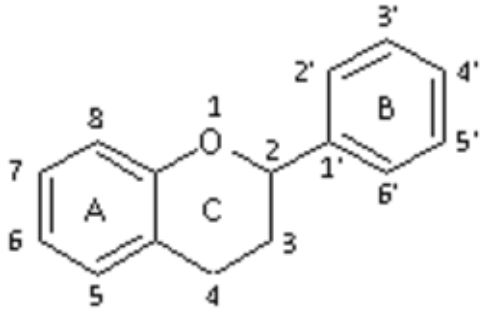
CONTENTS

- Introduction
- Structure of Flavonoids
- Classification and Chemistry of Flavonoids
- Sources of Flavonoids
- Biosynthetic Pathway of Flavonoids
- Role of Flavonoids in Plants

Introduction

- Flavonoids are a group of plant polyphenolic secondary metabolites showing a common three ring structure *(Wiley J. & Sons, Inc., Publication, 2010).*
- Widely distributed in different amounts, according to the plant species, organ, developmental stage and growth conditions.
- The Flavonoids have aroused considerable interest recently because of their potential beneficial effects on human health as well as their role in plant metabolism.
- They have been reported to have antiviral, antitumor, anti-allergic, anti-platelet, anti-inflammatory and antioxidant activities.

▪ Structure of Flavonoids

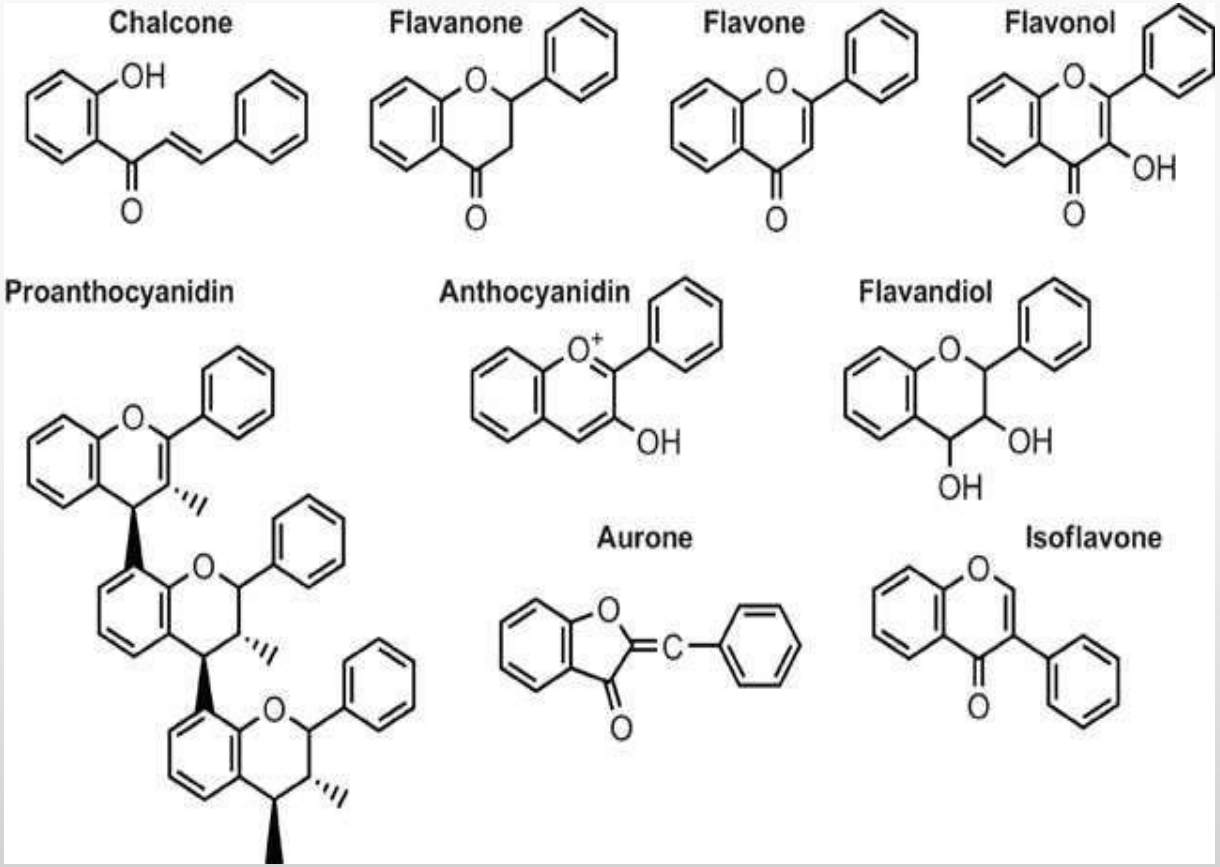


➢ Their basic structure is a skeleton of **diphenylpropane**, namely, two benzene rings (ring A and B, see figure) linked by a three carbon chain that forms a closed pyran ring (heterocyclic ring containing oxygen,the C ring) with benzenic A ring.

➢ Therefore, their structure is also referred to as C6-C3-C6. In most cases, B ring is attached to position 2 of C ring, but it can also bind in position 3 or 4; this, together with the structural features of the ring B and the patterns of glycosylation and hydroxylation of the three rings, makes the flavonoids one of the larger and more diversified groups of phytochemicals.

Classification and Chemistry of Flavonoids.

Flavonoids are classified in 6 major subgroups depending on the carbon of the C ring on which B ring is attached, and the degree of unsaturation and oxidation of the C ring.



B ring is linked in position 3 of the ring C- **isoflavones.**

B ring is linked in position 4, **Neoflavonoids.**

B ring is linked in position 2 , **flavones, flavonols, flavanones, flavanols,catechin, and anthocyanidin.**

open C ring – **Chalcone**

Wiley J. & Sons, Inc., Publication, 2010)

Flavonol

Isoflavonoids

Chalcones

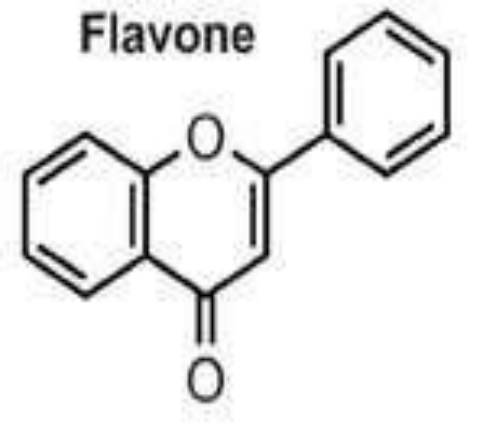
SOURCES OF FLAVONOIDS

Anthocyanins

Flavanone

Flavone

Classification of Flavonoids

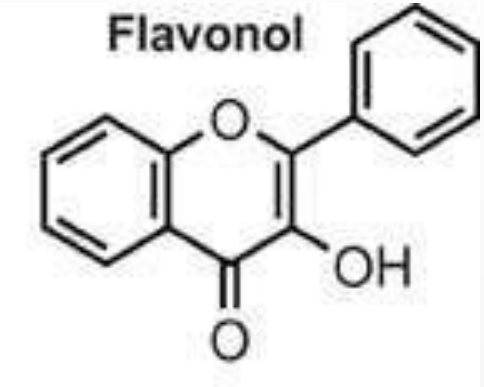


- **Class: <u>Flavone</u>**
- **Structure:**
- **Subclasses:**
  - Apigenin
  - Luteolin
  - Tangeritin
  - Diosmetin
- **Sources:**

Celery, Parsley, Red Pepper, Ginkgo biloba.

- **Class: <u>Flavonol</u>**

- **Structure:**



- **Subclasses:**
  - Kaempferol
  - Rutin
  - Myrecetin
  - Quercetin
  - Morin

- **Sources:**

Yellow Onions, scallions, broccoli, Apple, berries.

- **Class: <u>Flavanone</u>**

- **Structure:**

- **Subclasses:**
  - Naringin
  - Naringenin
  - Hesperitin
  - Eriodictiyol

- **Sources:**
  - Oranges, Lemons, Grapes

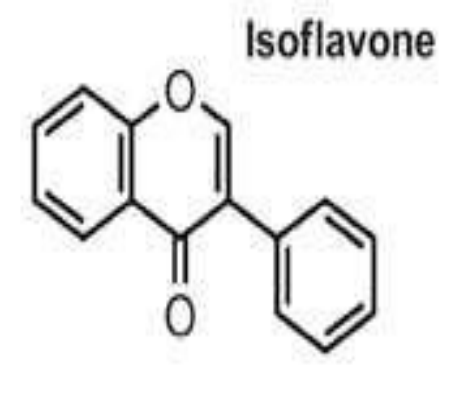
- **Class: <u>Anthocyanin</u>**

- **Structure:**

- **Subclasses:**
  - Cyanidin
  - Malvidin
  - Pelargonidin
  - Peonidin
  - Delphinidin

- **Sources:**
  - Blue-berries, plum, brinjal, grapes

- **Class: <u>Isoflavonoids</u>**



- **Structure:**

- **Subclasses:**
  - Genistin
  - Daidzin
  - Glyceitin

- **Sources:**
  - Soyabean, soy foods, legumes

- **Class: <u>Chalcone</u>**

- **Structure:**

- **Subclasses:**
  - Phloretin
  - Arbutin
  - Chalchonaringenin

- **Sources:**

Tomatoes, pears, strawberry, wheat products

▪ Role Of Flavonoids In Plant Defense

➢Phenylpropanoids, act as key chemical modulators of plant communication with insects and microbes, either as attractants or repellants , or as phytoalexins against pathogens and herbivores.

➢Derivatives of the initial phenylpropanoid scaffold play vital roles in plant structural integrity, protection against UV radiation and phytopathogens, internal regulation of plant cell physiology and signaling. (Koes *et al* 1994, Shirley, 1996)

➢Induce root nodulation when excreted by symbiotic nitrogen-fixing rhizhobia (Mandal *et al*;2010).

➢Some flavonoids provide stress protection, for example act as scavengers of free radicals such as reactive oxygen species (ROS), as well as metal chelating agents that generate ROS. (Mol *et al*., 1998; Winkel-Shirley, 2002; Bradshaw and Schemske, 2003)

▪ Beneficial effects associated with consumption of Flavonoids

- Reduced risk of cardiovascular diseases.
- Reduction in Blood Pressure due to its vasodilatory effect.
- Delays or prevents the onset of diseases caused by free radicals
- Best antioxidant
- Anti-inflammatory activity
- Improvement of endothelial functions
- Inhibits LDL oxidation by free radicals
- Inhibits platelet Aggregation
- Antiviral
- Antibacterial

GLYCOSIDES

Introduction: No of medicinal plants containing organic constituents in conjugation with a sugar moiety .It can be 1or2 .such compounds are called as glycosides. They exert therapeutically significant effect on human and animals .Traditionally used in modern medicine because of their cardio tonic, purgative, analgesic, anti-arrhythmic, demulcent action.

Defination:-glycosides are define as organic compound from plants and animal source, which on enzymatic hydrolysis gives one or more sugar moieties along with anon sugar moiety. Sugar moiety is called glycon and non sugar moiety is called aglycon or genin.

CLASSIFICATION:-

1) BASED ON THE CHEMICAL NATURE OF NON SUGAR MOIETY :-

- Anthraquinone glycoside : - anthraquinone moiety as aglycon . Ex: senna
- Sterol or cardiac glycoside: - aglycon portion is steroid molecule. Ex: digitalis
- Saponine glycoside
- Cyanogentic glycoside Ex : white cherry bark
- Isothiocynate glycoside Ex: black mustard.
- Flavonoid glycoside Ex : rutra graveolens, citrus bio flavonoid
- Coumarin glycoside or furano coumarine glycoside:- Ex : celery fruit
- Aldehyde glycoside Ex: vanilla pods
- Phenol glycoside Ex salcive
- Steroidal glycoside
- Glucosidal bitter or miscellaneous glycoside Ex salix species

2) BASED ON TE NATURE OF SUGAR MOITY:-

- Glucoside : sugar portion is glucose
- Rhamnoside : sugar portion is rhamnose
- Pentoside sugar portion is pentose
- Fructoside sugar portion is fructose
- Arabinoside sugar portion is arabinose

3) BASED ON LINKAGE BETWEEN GLYCON AND AGLYCON PORTION:-

OH groups reacting with any of the following medicates like, OH, CN, SH, NH product in aglycon part

a) C-glycoside:-

Glycon-OH + HC –aglycon --> glycone-c-aglycon +H2O

Some of the anthraquinone glycoside like cascaroside in cascara, aloin in aloes shows the particular linkage.

C-glycosides are called aloin type glycoside present in aloes. They do not hydrolyzed by heating with dil acid or alkalis but by oxidative hydrolysis with Fecl3. cochical contains c-glycoside in the form of coloring matter called carminoic acid

b) O-glycoside

They are common in higher in plants Ex senna, rhubarb
They are hydrolyzed by treatment wit acid or alkali into glycon and aglycon portion.

c) S-glycoside

They occurrence of this glycoside is restricted to isothiacyanate glycoside like sinigirin in black mustard formed by the condensation of sulphohydryl group aglycon to OH group of glycon.

d) N-glycoside

They most typical representation of this is nucleoside where the amino group reacts with OH group of ribose or deoxyribose resulting into N-glycoside

4) BASED ON THERAPEUTIC NATURE OF GLYCOSIDE:-

- Cardiac glycoside Ex : Digitalis
- laxative glycoside Ex : Senna
- Anti-ulcer glycoside Ex : Liquorice
- Bitter glycoside Ex : quassia wood

GENERAL CHARACTERISTICS

1) Glycoside contains sugar but still the physical, chemical and therapeutic activity is based on aglycon portion. Sugar facilitates the absorption of the glycoside .helping it to reach the site of action

2) Glycoside are crystalline, amorphous substance which are soluble in water, and dilute alcohol but in soluble in the CHCl3 and ether. The aglycon moiety is insoluble in non polar solvent like C6H6

3) Glycosides are easily hydrolyzed by mineral acids, water and enzyme. They show optical activity normally they are levorotatory

4) Glycoside can not reduce fehling's solution until they are hydrolyzed

5) They are believed to facilitates growth and protection of plant

ISOLATION OF GLYCOSIDE

The method by which glycoside are isolated is called stas-otto method. The drug containing glycoside is finely powdered and subjected to successive extraction in a soxhlet apparatus with alcohol or suitable solvent.
During this method at first take drug containing glycoside, finely powdered that, and it is extracted with alcohol or water by using soxhlet apparatus. After extraction, collect the extract and treat with lead acetate to precipitate tannins after that filter it and to the filtrate pass H2S gas, no lead acetate the precipitate as lead sulphide as this is toxic. Now after the extract again filter. The filtrate is subjected to fractional crystallization, distillation or chromatography gives pure component and the extract molecular structure is determined by the spectrophotometer, Ultra Red assays, Infra red , NMR and mass spectroscopy etc.

Cardiac Glycosides

Cardiac glycosides are a class of organic compounds that increase the output force of the heart and increase its rate of contractions by acting on the cellular sodium-potassium ATPase pump. Their beneficial medical uses are as treatments for congestive heart failure and cardiac arrhythmias; however, their relative toxicity prevents them from being widely used.[2] Most commonly found as secondary metabolites in several plants such as foxglove plants, these compounds nevertheless have a diverse range of biochemical effects regarding cardiac cell function and have also been suggested for use in cancer treatment.

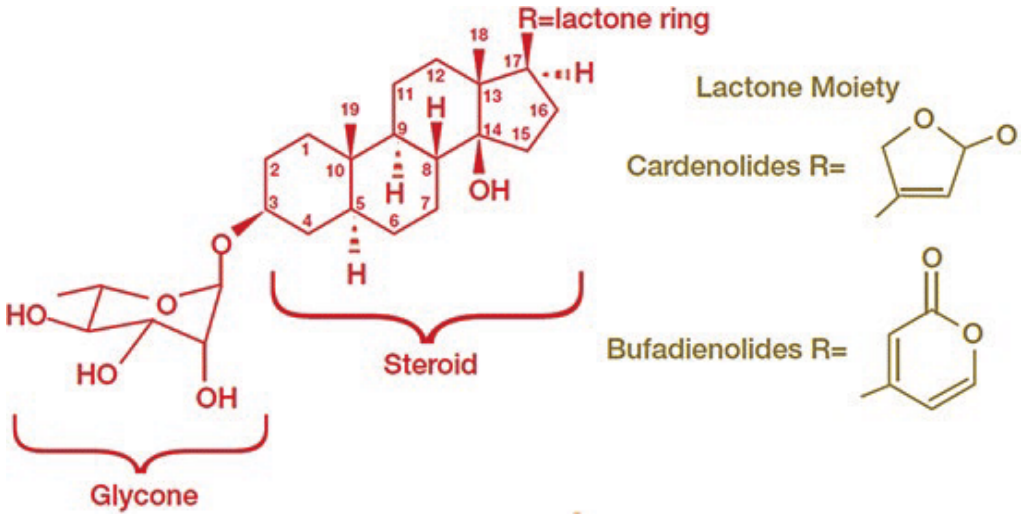
General structure

The general structure of a cardiac glycoside consists of a steroid molecule attached to a sugar (glycoside) and an R group.[4] The steroid nucleus consists of four fused rings to which other functional groups such as methyl, hydroxyl, and aldehyde groups can be attached to influence the overall molecule's biological activity.[4] Cardiac glycosides also vary in the groups attached at either end of the steroid. Specifically, different sugar groups attached at the sugar end of the steroid can alter the molecule's solubility and kinetics; however, the lactone moiety at the R group end only serves a structural function.[5]

In particular, the structure of the ring attached at the R end of the molecule allows it to be classified as either a cardenolide or bufadienolide. Cardenolides differ from bufadienolides due to the presence of an "enolide," a five-membered ring with a single double bond, at the lactone end. Bufadienolides, on the other hand, contain a "dienolide," a six-membered ring with two double bonds, at the lactone end.[5] While compounds of both groups can be used to influence the cardiac output of the heart, cardenolides are more commonly used medicinally, primarily due to the widespread availability of the plants from which they are derived.

Classification

Cardiac glycosides can be more specifically categorized based on the plant they are derived from, as in the following list. For example, cardenolides have been primarily derived from the foxglove plants *Digitalis purpurea* and *Digitalis lanata*, while bufadienolides have been derived from the venom of the cane toad *Bufo marinus*, from which they receive the "bufo" portion of their name.[6] Below is a list of organisms from which cardiac glycosides can be derived.



Plants from which cardenolides can be derived[edit]

- *Convallaria majalis* (Lily of the Valley): convallotoxin[7]
- *Antiaris toxicaria* (upas tree): antiarin
- *Strophanthus kombe* (*Strophanthus* vine): ouabain (g-strophanthin) and other strophanthins
- *Digitalis lanata* and *Digitalis purpurea* (Woolly and purple foxglove): digoxin, digitoxin
- *Nerium oleander* (oleander tree): oleandrin
- *Asclepias sp.* (milkweed): oleandrin
- *Adonis vernalis* (Spring pheasant's eye): adonitoxin
- *Kalanchoe daigremontiana* and other *Kalanchoe* species

Organisms from which bufadienolides can be derived[edit]

- *Leonurus cardiaca* (motherwort): scillarenin[7]
- *Drimia maritima* (squill): proscillaridine A
- *Bufo marinus* (cane toad): various bufadienolides
- *Kalanchoe daigremontiana* and other *Kalanchoe* species: daigremontianin and others

Chemical test-

Killer killiani test: Glycoside is dissolved in a mixture of 1 % ferric sulphate solution in (5%) glacial acetic acid. Add one or two drop of concentrated sulphuric acid. A blue colour develops due to the presence of deoxy sugar.

Raymond's test:

To the drug, add a few ml of 50% ethanol and 0.1 ml of 1 % solution of m- dinitrobenzene in ethanol. To this solution, add 2-3 drops of 20% sodium hydroxide solution. Violet colors appears, this is due to presence of active methylene group.

Legal test:

To the drug add few ml of Pyridine and 2 drops of Nitroprusside and a drop of 20% NaOH solution. A deep red colour is produced.

Baljet test:

Take a piece of lamina or thick section of the leaf and add sodium picrate reagent. If glycoside is present yellow to orange colour will be seen.

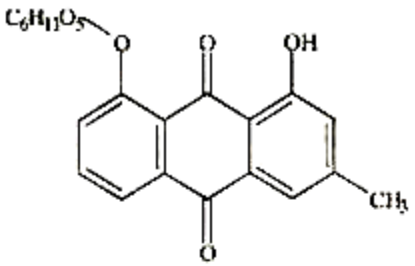
Anthraquinone glycosides

The anthraquinone glycosides are the ones whose aglycone component is a polyhydroxyanthraquinone derivative. The drugs having these glycosides possess cathartic activity. The polyhydroxyanthraquinone derivatives present in these drugs are chrysophanic acid (1, 8-dihydroxy- 3- methylanthraquinone), aloe emodin (1, 8- dihydroxy-3- methyl anthraquinone), Frangula emodin and rhein (1, 8- dihydroxy anthraquinone -3-carboxylic acid).

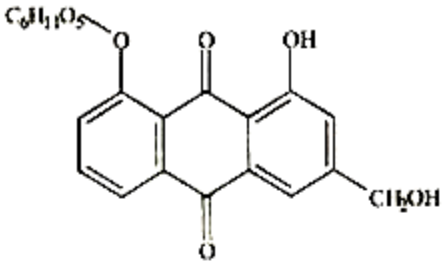
Glycosides of anthranol and anthrones, reduced derivatives of anthraquinones, also occurs in the plant materials, and they make significant contributions to the therapeutic action of these natural products. The free anthraquinone aglycones exhibit little therapeutic activity.

The sugar residue facilitates absorption and translocation of the aglycone to the site of action. The anthraquinone and related glycosides are stimulant cathartics and exert their action by increasing the tone of the smooth muscle in wall of the large intestine.

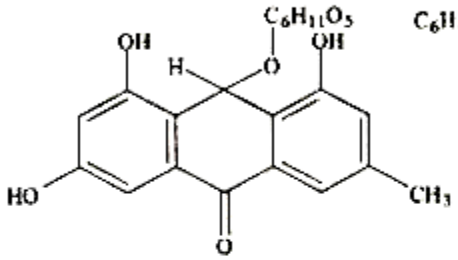
Glycosides of anthranol and anthrones elicit a more drastic action than the corresponding anthraquinone glycosides and a preponderance of the former constituents in the glycosidic mixture can cause discomforting griping action.



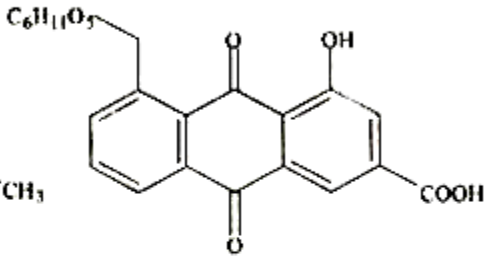
Chrysophanol- 8- glucoside



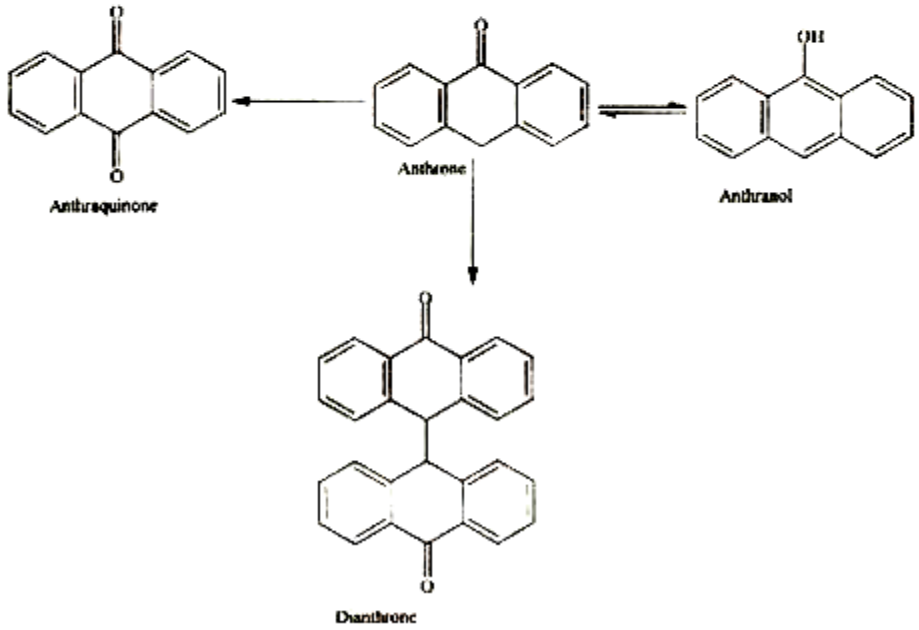
Aloe-emodin- 8- glucoside



Emodin- oxanthrone glucoside



Rhein- 8- glucoside



INTERRELATIONSHIP OF ANTHRAQUINONE DERIVATIVES

Chemical Test:

1. **Borntranger's test:**

Powdered leaves of Senna are boiled with dilute sulphuric acid. Filtered and cooled. The filtrate is extracted with chloroform or benzene and dilute ammonia is added to it. The ammonical layer becomes pink to red due to the presence of anthraquinones derivative.

2. **Modified anthraquinone test-**
   Take 0.1 gm of drug and add 5ml of 5% solution of ferric chloride and 5ml dilute hydrochloric acid and heat on boiling water-bath for 5 minutes, cool the solution and shake gently with an organic solvent like benzene. Separate the organic solvent layer and add an equal volume of dilute ammonia. A pinkish red colour is formed in ammonical layer. This test is of C. glycoside.

Saponin glycosides

Saponin Glycosides are the plant glycosides possessing a distinct property of forming soapy lather in water. Therefore, they are largely used as detergents. Saponins on hydrolysis give sugars (glucose, galactose, rhamnose or xylose, etc.) and aglycones (sapogenin). Chemically, sapogenins are characterized by the presence of a spiroketal side-chain. Saponins have also been used in medicine, foaming agents, in fire extinguishers and fish poisons.

Fishers are killed by introducing sapogenins in water but they are not rendered inedible because the saponins is not toxic to human being when given orally (of course it is poisonous if used intravenously because under such conditions it causes haemolysis).

Properties of saponin glycosides:

Saponins are mostly amorphous in nature, soluble in alcohol and water, but insoluble in non-polar organic solvents like benzene, n-hexane, etc.

Saponins also possess certain special properties:

1. An aqueous solution froths when shaken.

2. An aqueous solution absorbs and retains in solution a volume of gas (e.g. carbon dioxide) several times greater than that absorbed by an equal volume of water.

3. An aqueous solution, shaken with oil and fats, produces emulsion, which stable for a short time, varying from a few minutes to an hour or more. Emulsification is caused by the saponin lowering the surface tension between the oil and the water.

4. An aqueous solution added to red blood corpuscles causes haemolysis, e.g. disintegration and solution of the corpuscles to form a clear red liquid.

Classification of Saponins:

They are classifying in two groups:

I. Tetracyclic triterpenoid spaonins:

(a) Dioscorea bark- Diosgenin

(b) Solanum Berries- Solasodine

(c) Asparagus roots- Sarsapogenin

II. Pentacyclic Triterpenoid saponins

(a) Ginseng- Gingenoside

(b) Licorice- Glycyrrhizin

(c) Senega- Senegin- II

(d) Quillaja – Quillaia

(e) Sarsaparilla- Sarsapogenin

Chemical tests for saponin glycosides:

1. Foam test:

Shake the drug extract or dry powder vigorously with water. Persistent foam observed.

2. Haemolytic test:

Add drug extract or dry powder to one drop of blood placed on glass slide. Haemolytic zone appears.

Resins

These are amorphous products of complex chemical nature. These are amorphous mixtures of essential oils, oxygenated products of terpenes and carboxylic acids. These are found as exudation from the trunk of various trees.

Properties-

1. These are transparent or translucent solids, semisolids or liquid substances containing large number of carbon atoms.
2. On heating they are softened and then melted if in solid form.
3. They are practically insoluble in water but dissolve in organic solvents like alcohol, ether and chloroform. Also soluble in volatile and fixed oils.
4. They are hard, electrically non-conductive and combustible masses.
5. They produce smoky flame on burning.
6. They are usually formed in schizogenous or schizolysogenous cavities of ducts as end products of metabolism.

Classification-

Chemically resins contain organic acids, alcohols, esters and neutral resins. Depending upon the type of constituents present, resins are classified as-

1. **Resin acids**- These are mixture of oxy acids, carboxylic acids and phenolic acids. They are present in free state or as esters. They are soluble in aqueous alkaline solution which form soap like froth on shaking. Ex- Abietic acid in colophony resin, Copaivic acid and Oxycopaivic acid in Copaiba, Guaiconic acid in Guiac resin.
2. **Resin alcohols**- These are complex molecules with high molecular weight. They are present in either free state or as esters of simple aromatic acids ex benzoic acid, Salicylic acid and Cinnamic acid. Resin alcohols are further divided into resinotannols and resinols. **Resinotannols** are tannins and form blue colour with ferric chloride. Ex. Aloe resinotannol from aloe, Suma resinotannol from Benzoin. **Resinols** does not contain tannins. Ex. Benzoresinol from Benzoin, Storesinol from storex.
3. **Resenes**- they are complex neutral compound which do not respond to any chemical reaction. They are insoluble in acids and alcohols and do not form any salt and not get hydrolysed. Ex. Asafoetida, Colophony, Dammar.

Classification on the basis of their occurrence in combination with other compounds-

a. Oleoresin- Resins and oils in homogenous mixtures. Ex. Copaiba capsicum, Canada balsam.
b. Oleogumresin- Homogenous mixture of oil, gum and resin. Ex. Myrrh, Guggul, Asafoetida.

c. Glycoresins- Mixture of resins with sugar. Ex. Jalap, Ipomoea
d. Balsams- If resin contains benzoic acid or cinnamic acid. Ex. Balsam of tolu, Balsam of Peru, Storex

Extraction and isolation-

Pharmaceutical resins are obtained from plants and animals by one of the following methods-

a. By extraction with alcohol and precipitation with water.
b. By distillation for separation of oil.
c. By heating the plant part.
d. As plant exudates by incision.
e. By collecting fossil resins.

Identification tests-

1. The alcoholic solutions of resins are acidic in nature.
2. When treated with concentrate sulphuric acid, bright red colour obtained.
3. With water, emulsion is formed.
4. With concentrate nitric acid, resins give green colour.
5. When resins are heated, cooled and examined under microscope, crystals of cinnamic acids are shown.
6. When treated with ammonia solution and examined under UV- Blue fluorescence observed.

Uses-

- Carminative and stimulant (Ginger, Asafoetida)
- Antiseptic (Benzoin, Tolu balsam)
- Expectorant (Tolu balsam)
- Flavoring species (Ginger, Turmeric)
- Diuretic (Benzoin)
- Industrial uses- as perfumes, chewing gum and confectionary preparation

Tannins

These are complex organic, non-nitrogenous phenolic compounds of high molecular weight and posses the property to tan i. e. convert hide and skin into leather. The term tannin was first applied by Seguin in 1796. These are detected qualitatively by a tanning test (the gold beater's skin test) in determined quantitatively by its absorption on standard hide powder.

Occurrence- these are widely distributed in plant kingdom, in almost every plant family. When tannins occur in appreciable quantity, they are usually localized in specific plant parts such as leaves, fruits, barks and stems. Although often found in immature fruits, tannins usually disappear during the ripening process. In plant metabolism, tannins probably serve as protective during certain stages of growth and finally they are destroyed or deposited as end products of metabolism in certain dead tissues to the mature plant (outer bark, hard wood).

Chemically tannins contain the mixture of complex organic substances in which polyphenols are present, generally with ortho dihydroxy or ortho trihydroxy groups on a phenyl ring.

Classification- On the basis of chemical nature-

1. **Hydrolysable tannins**- These tannins can be readily hydrolysed by acids, alkali or enzymes to yield phenolic acids and sugar. The products of hydrolysis are Gallic acid, Ellagic acid, so also known as gallic acid tannins. These produce dark blue to black colour with ferric chloride solution but are not precipitated with bromine water. Ex. Harde (Myrobalan), Bahera, Amla, Rhubarb, Chestnut, red rose petal, Pomegranate rind and bark.
2. **Condensed/ Non-hydrolysable tannins**- These are resistant to hydrolysis or cleavage. They are related to flavonoid pigments, because they are formed via derivatives of flavones like catichin. When heated with enzymes or mineral acids, they are polymerized or decomposed into red coloured water insoluble compound known as **Phlobaphenes**. These give green colour with Ferric chloride and precipitated with bromine water. Ex. Ashoka bark, Pale catechu, Black catechu, Pterocarpus.
3. **Pseudotannins**- They are phenolic compounds of low molecular weight and they do not show the gold beaters skin test. They occur as gallic acid in rhubarb, catechin on cocoa, chlorogenic acid in coffee and nux vomica.

Properties-

1. They are amorphous in nature and form colloidal solution with water and re noncrystalline.
2. These are mixture of complex organic substances in which polyphenols are present, generally with ortho dihydroxy or ortho trihydroxy groups on a phenyl ring.
3. High molecular weight and not contain nitrogen atom.
4. Show acidic reaction due to phenol in soluble form.

5. Soluble in alcohol, glycerine and dil alkali but practically insoluble in organic solvents except acetone, sparingly soluble in chloroform and ethyl acetate. Phlobaphenes are soluble in alcohol but practically insoluble in water.
6. They precipitate proteins from solution and are able to combine with them rendering them resistant to proteolytic enzymes. This property is known as astringent action and many tannins containing drugs are used as astringent medicinally.
7. Have sharp puckering (Astringent/ acidic) taste.

Chemical tests-

Small quantity of alcoholic or aqueous extracts are taken nd following tests are performed-

1. Gelatin test:

To a solution of tannin, aqueous solution of gelatin and sodium chloride are added. A white buff coloured precipitate is formed.

2. Goldbeater's skin test:

A small piece of goldbeater skin (membrane prepared from the intestine of an ox) is soaked in 20% hydrochloric acid, ringed with distilled water and placed in a solution of tannin for 5 minutes. The skin piece is washed with distilled water and kept in a solution of ferrous sulphate. A brown or black colour is produced on the skin due presence of tannins.

3. Phenazone test:

A mixture of aqueous extract of a drug and sodium acid phosphate is heated and cooled and filtered. A solution of phenazone is added to the filtrate. A bulky coloured precipitate is formed.

4. Match stick test (Catechin test):

A match stick is dipped in aqueous plant extract, dried near burner and moistened with concentrated hydrochloric acid. On warming near flame, the matchstick wood turns pink or red due to formation of phloroglucinol.

5. Chlorogenic acid test:

An extract of chlorogenic acid containing drug is treated with aqueous ammonia. A green colour is formed on exposure to air.

6. Vanillin-hydrochloric acid test:

Sample solution and added vanillin- hydrochloric acid reagent (Vanillin 1 gm, alcohol 10 ml, concentrated hydrochloric acid 10 ml). A pink or red colour is formed due to formation of phloroglucinol.

7. Solution of tannin precipitates gelatin and alkaloid.
8. They form dark blue or green blac soluble compound with ferric chloride solution.

Extraction and isolation-

Hydrolysable tannins- Plant twigs are extracted with a mixture of ether and alcohol (4:1). To the extract water is added. Alcoholic aq extract separated from ether layer. Ether layer on evaporation gives gallic acid and aq alcoholic layer on evaporation gives tannic acid. Both are isolated by fractional distillation or chromatography.

Condensed tannins- Leaves and twigs are put into a large pan with full of boiling water. Boiled for 3 hours and stirred well. Then leaves and twigs are separated from extract by decantation. Marc is pressed and the expressed extract is combined with above decanted extract. It was evaporated till it become thick mass, then cool with stirring. Semisolid mass produced which is further purified by fractional distillation or chromatography.

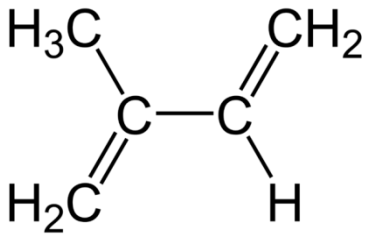
Uses-

- Used in the tanning process of animal hides to convert them into leather.
- Aqueous solution is used to precipitate gelatin, protein and alkaloids in laboratory.
- As healing agents in inflammation, leucorrhoea, gonorrhea, burns, piles and diarrhea.
- Used as antidote in treatment of alkaloid poisoning.
- These form deep red coloured complex with iron salts that is used in manufacturing of inks.
- Antiseptic effect on mucous membrane and skin due to phenolic compounds.
- As astringent

Terpenoids

It represents hydrocarbons as well as their oxygenated derivatives and also regarded as derivatives of polymer of Isoprene $(C_5H_8)_n$.

Isoprene unit-



2-methyl-1,3-butadiene

These units are joined by Head to tail, it is called as Isoprene rule. These are widely distributed in plant kingdom.

Occurrence- These are mainly found in essential oils which have pleasant odour and present in almost all parts of a plant.

Classification-

1. **Depending on the number of Isoprene unit**-

S. No.	Name of class	Number of units	Formula	Example
1.	Hemiterpene/ Isoprene	1	C5H8	Not found in nature
2.	Monoterpene	2	C10H16	Geraniol, Menthol
3.	Sesquiterpene	3	C15H24	Zingiberene
4.	Diterpene	4	C20H32	Phytol, Vitamin A
5.	Sesterpenes	5	C25H40	Cybastacines A, B
6.	Triterpenes	6	C30H48	Squalene
7.	Tetraperpenes/ Carotenoids	8	C40H56	Alpha and Beta carotene
8.	Polyterpene/ Rubber	n	$(C_5H_8)_n$	Rubber

2. **On the basis of number of rings present in structure**
   A. Acyclic terpene- No ring in structure- Myrcene
   B. Monocyclic- one ring- Limonene
   C. Bicyclic- Two ring- Abietic acid
   D. Tri…, tetra…, pentacyclic..

Volatile oils-

The odorous volatile principle of plants and animals sources are known as volatile oils. They evaporate when exposed to air at ordinary room temperature, so also called as ethereal oils. They represent essence or active constituents of plant so called as essential oils. Chemically they are derived from terpenes and their oxygenated derivatives and generally made up of mono, sesqui and diterpenes.

Properties-

1. Soluble in alcohol, ether, and lipid solvents and insoluble in water.
2. Generally lighter than water.
3. They have characteristic odour and high refractive index
4. Optically active compounds.
5. They are secreted in special structures such as ducts, cells, trichomes and Lysigenous glands.
6. Commonly found in dicot plant families such as Umbelliferae, Labiatae, Zingiberaceae etc and present in entire plant or any part of plant.

Isolation-

1. **By Hydrodistillation**- It includes water distillation, water and steam distillation & steam distillation used for extraction of volatile oil from herbal drugs. The fresh crude drug is subjected to hydrodistillation for volatile oil isolation. The apparatus used is Clevenger apparatus.
2. **Enfluerage method**- It is used for extraction of delicate perfumes. For this fresh flower petals are mechanically spread on fatty material layer. It was allowed to imbibe and the exhausted petals are replaced with fresh petals. The process is continued till the fatty material layer is saturated with volatile oil which is further extracted with lipid solvents.
3. **Ecuelle method**- it is used for extraction of citrus oils. In this the oil cells are ruptured mechanically using pointed projections by twisting raw material over them in clockwise direction either mechanically or manually.
4. **By using liquid Carbondioxide**- CO_2 is liquefied under pressure and it act as solvent for extraction of essential oils. It reverse back to gaseous nature when pressure is reduced and leaving no any residue of solvent.
5. **Sfumatrice method**- It is a cold expression method of volatile oil isolation from Citrus fruits. The equipment consist of a metallic chain that is drawn by two horizontal ribbed rollers. The peels are passed through these rollers and pressed and bent to release their oil. This oil is then washed, separated, centrifuged and purified.
6. **Cohobation method**- It is a procedure that can only be used during water distillation or water & steam distillation. In this, the distilled water returns to the distillation flask after

the oil has been separated from it, so that it can be re-boiled. The principal behind it is to minimize the loss of oxygenated compounds which dissolve in the distilled water.

Types of volatile oils- On the basis of chemical nature-

1. Aldehyde volatile oil- Cinnamon, Lemon peel
2. Alcohol V. O.- Cardamom, Coriander
3. Ester VO- Mustard
4. Hydrocarbon VO- Turpentine
5. Ketone VO- Camphor, Musk
6. Phenolic VO- Clove

Chemical tests-

A. A thin section of drug treated with alcoholic solution of Sudan-III- gives red colour.
B. A thin section of drug treated with a drop of tincture alkane- gives red colour.

Storage- Volatile oils should be stored properly in well closed well filled amber colour containers away from light and in cool place.

Uses-

1. As flavouring and perfuming agents.
2. For medicinal uses like- Carminative (Cardamom), anthelmintic (Chenopodium), Local anaesthetic (Clove), Antiseptic (Eucalyptus) etc.
3. Citral is obtained from Lemon grass oil and Citral is used for synthesis of vitamin A.
4. Terpeneless volatile oils are used for high priced perfumes because of their specificity and stability. These are prepared by removing hydrocarbons and undesired components by fractional distillation.