Drugs Containing Saponin glycosides (LIQUORICE, BRAHMI GINSENG & DIOSCOREA)

By

Vijetha Pendyala,

Associate professor, Dept. of Pharmacognosy &Phytochemistry

Chebrolu Hanumaiah Institute of Pharmaceutical Sciences

General Characters of Saponins

1.Widely distributed in higher plants.

2.Bitter, acrid taste & sternutatory(irritant to mucousmembranes).

3.Form colloidal solutions in H_2O→ foam on shaking→ lowers surfacetension in aqueous solution.

4.Destroy RBCs→blood haemolysis.

6.Toxic by i.v.injection & harmless by oralroute.

Chemical Characters

- 1.O-glycosides on hydrolysis aglycone(sapogenin)+sugarmoiety.
- 2.Aglycone:
- –triterpenoidal(C-30)[mainly in Dicotyledons]
- –steroidal(C-27)[mainly in Monocotyledons]
- 3.Sugarmoiety:
- –Often contain uronicacids or acylresidues.
- –Usually glycosylation is at C-3.

Physical Characters

1.Rarely crystalline & generally amorphous powder with high MPs

2. Soluble in water and form colloidal solutions

3. Soluble in ethyl & methyl alcohol

4. Insoluble in organic solvents like petroleum ether, chloroform and acetone etc.

5. Bitter in taste

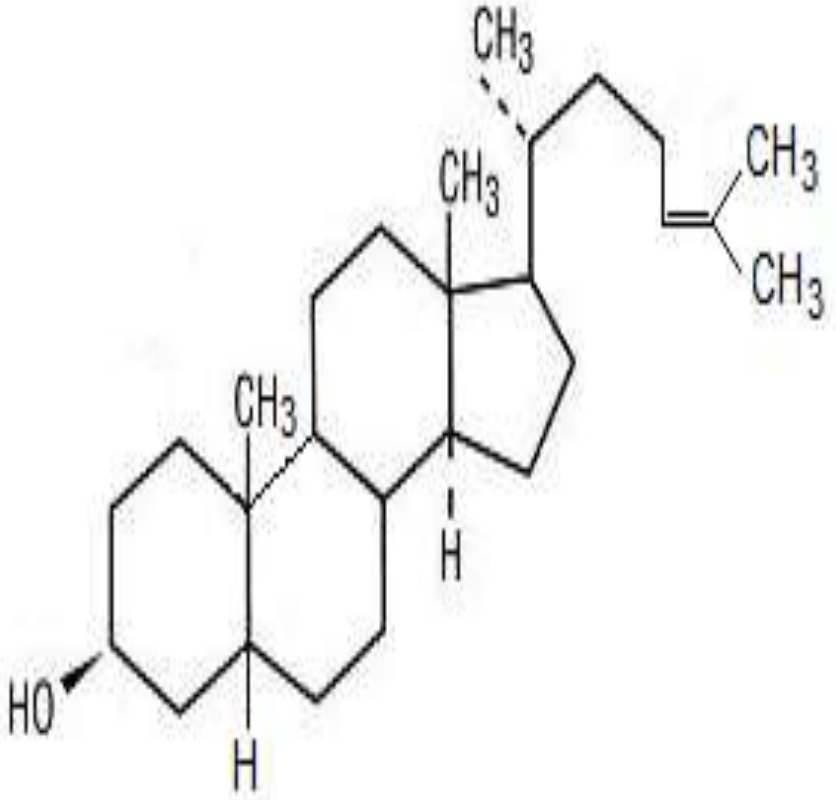
6. Non-alkaline in nature

7. Produce sneezing and have property of lowering surface tension

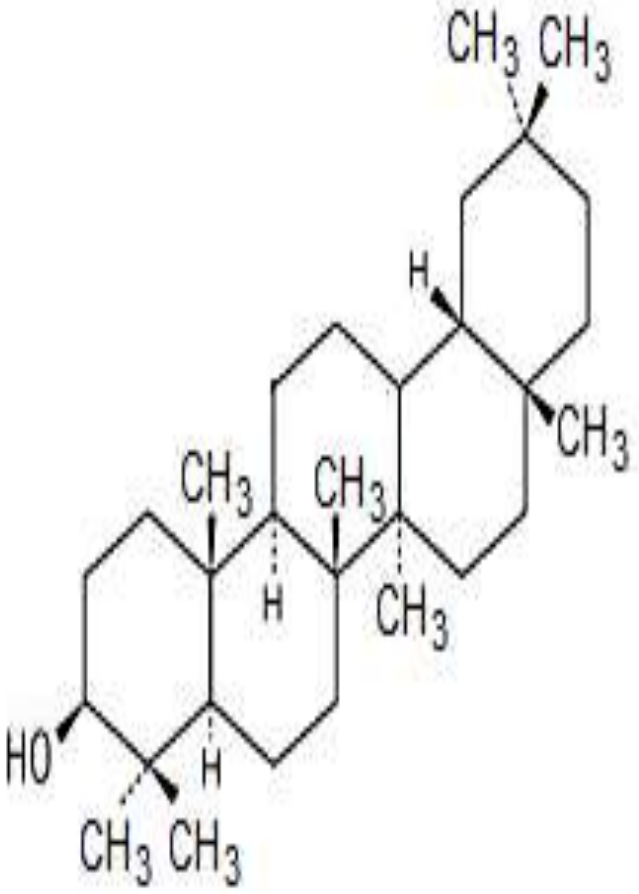
8. Hydrolysed by acids, alkalies to yield aglycone called sapogenin

Physiological Properties:

1. Extremely toxic to fishes but not poisonous to man when taken orally 2. Very dilute solution of saponins hemolyses RBC (hemolysis takes place due to the formation of complex with the cholesterol or erythrocyte membrane causing its destruction (chief property of saponin, very rarely shown by any other plant product. 3. Accelerate the germination and growth of the seeds. 4. Shows fungicidal, antifertility, molluscidal, blood purifying, abortifacient, anthelmintic, sedative & antispasmodic effects. Occurrence: 1. In whole, 75% of the families showed the presence of saponins 2. Function in the plant is as storage in form of carbohydrate and acts as immune system.



Steroidal skeleton



Tri-terpenoidal skeleton

Economical & Medicinal Importance

- **Economical uses**
- **1.Cleaning industrial equipment & finefabrics.**
- **2.Powerful emulsifier.**
- **3.Steroidal sapogenins used in semisynthesis of cortisone & sexhormones.**
- **Medicinal uses**
- **1.Expectorant**
- **2.Immunostimulant**
- **3.Controlofschistosomiasissnails(molluscicides)**
- **4.Hypoglycemic.**

Tests for Identification

- **1.Froth test:**

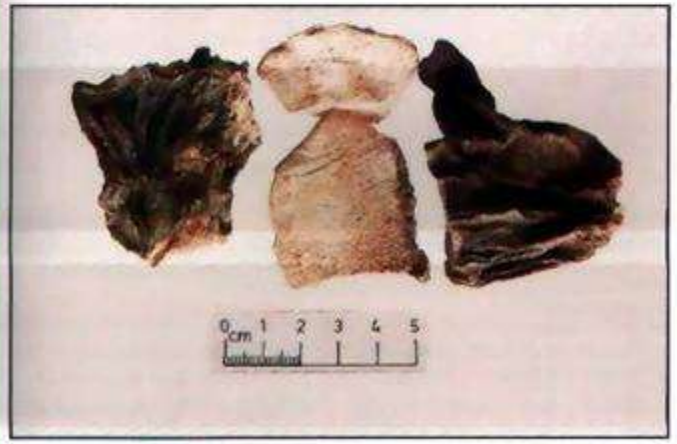
1 ml of aqueous solution of saponin or plant extract + shake →persistent & voluminous froth.

- **2.Haemolysis test:**

Suspension of RBCs in normal saline + equal volume of plant extract in normalsaline+ Shake gently →clear red solution indicating heamolysis of RBCs(compared with blank).

DIOSCOREA

DIOSCOREA COMPOSITA



DIOSCOREA COMPOSITA : TUBERS

Synonym: Yam, Rheumatism root

Biological Source:- Dried tubers of plant *Dioscorea deltoidea, D. composita* and other species of Dioscorea

Family: Discoreaceae

Organoleptic Characters:

Colour: Slightly brown.

Odour: - Odourless.

Taste: - Bitter.

Size: varies depending upon age of rhizomes. Rhizomes are soft.

Chemical Constituents

1. It contains 75% of starch which is non edible because it is bitter in taste.
2. Chief active constituent is a steroidal sapogenin known as diosgenin.

Uses

1. It is used in treatment of rheumatic arthritis.
2. Used for extraction of diosgenin.
3. Diosgenin is steroidal in nature and used as precursor for synthesis of several corticosteroids, sex-hormones and oral contraceptives.

A.R.CHAUDHARY

- **DIOSCOREA (STEROIDAL SAPONIN) Dried tubers of Dioscorea deltoidea, D. composita & other species of Source Dioscorea Family Dioscoreaceae Syn. Yam, Rheumatism root**

- **G.S. North western Himalaya, USA, Mexico Non-edible as very bitter.**
- **ChemicalConstituents : Rhizome: 75% starch & phenol; Roots: Diosgenin (4-6%) steroidal sapogenin, glycoside: smilagenin, epismilagenin, B-isomer of yammogenin, Enzyme: sapogenase;**
- **The group contains the sapogenins with pentacyclic triterpenoids nucleus which is linked with sugars and uronic acids. The sapogenins are further divided in to α-amyrin, β-amyrin & Lupeol.**
-

- Important derivative of this group is triterpenoid acid formed via substitution of carboxylic acid group at C4, C17 & C20 positions
- USES:

Diosgenin is hydrolytic product of saponin dioscin. Source of STEROIDS (in manufacturing progesterone, steroidal drugs, contraceptive) & in treatment of arthritis

Licorice Root(RADIX GLYCYRRHIZAE)

- **Botanical origin : The dried peeled or unpeeled roots and stolons of Glycyrrhizaglabra L.and its varieties (Family Leguminosae).**
- **Geographical Source:Licoriceisnative to the Mideterranean region, as Spain,Italy, England, France Germany,U.S.A.,Russia and Egypt.**

- **Deep well cultivated fertile moistened retentive soil for good root production -prefers a sandy soil with abundant moisture and does not flourish in clay. -slightly alkaline condition gives best production**
- **Cultivation -thrives in maritime climate -propagated using seeds and roots -seeds are presoaked for 24 h in warm water and then sown in spring or autumn in a green house -The roots are usually harvested after 3 to 4 years from its plantation when they mostly display enough growth.**
- **The rhizomes and roots are normally harvested in the month of October, particularly from all such plants that have not yet borne the fruits, thereby ascertaining maximum sweetness of the sap.**
- **The rootlets and buds are removed manually and**

- **Preparation -The drug is first dried under the sun and subsequently under the shade till it loses almost 50% of its initial weight. -The large thick roots of the Russian Liquorice are usually peeled before drying. - It is an usual practice in Turkey, Spain and Israel to extract a substantial quantity of the drug with water, the resulting liquid is filtered and evaporated under vacuo and the concentrated extract is molded either into sticks or other suitable forms.**
- **MORPHOLOGY: Color Unpeeled Liquorice-Externally, yellowish brown or dark brown; and internally, yellowish colour Odour Faint and characteristic**
- **Shape Unpeeled drug—Straight and nearly cylindrical Peeled drug— Mostly angular Size Length 20 to 50 cm; Diameter 2 cm, Taste Sweet**
- **Fracture Fibrous in bark; and splintery in the wood**

CHEMICAL CONSTITUENTS

Glycyrrhizin (6-8%) is found to be 50 times as sweet as sugar. - Glycyrrhizin upon hydrolysis loses its sweet taste and gives rise to the aglycone glycyrrhetinic acid (glycyrrhetic acid) together with two moles of glucuronic acid.

-Color of drug is due to Chalcone glycoside-isoliquiritin -A host of other chemical constituents essentially include are namely: coumarin derivatives e.g., umbelliferone and herniarin;

flavonoid glycoside e.g., liquiritoside; isoliquiritoside, liquiritin; isoliquiritin, rhanoliquiritin, and rhamnoisoliquiritin;

Usparagines; 22-33-dihyrostigmasterol; glucose; mannitol and about 20% of starch.

Interestingly, carbenoxolone, which is an oleandane Chemicalderivative

Section/Powder + 80% H_2SO_4 orange yellow color Test (transformation of flavones glycoside liquiritin to chalcone glycoside isoliquiritin

USES -demulscent and expectorant; -as a masking agent for bitter drugs in pharmaceutical formulations, such as: Uses quinine, aloe, ammonium chloride etc. -Ammoniated glycyrrhiza: as a flavouring agent in beverages, pharmaceuticalsand confectionary.

- **The presence of glycyrrhetinic acid exert mineralocorticoid activity and hence it is used in the treatment of inflamations, rhematoid arthritis and Addison's disease.**
- **- liquid extract: as a foam stabilizer in the foam type-fire-extinguisher**
- **in the treatment of peptic ulcer.**
- **- In Europe the glycyrrhetic acid: in dermatological formulations;**
- **anti- iinflammatory properties.**
- **Substitutes/Adulterants**

1. **Glycyrrhiza uralansis, also known as Manchurian Liquorice, which is pale chocholate brown in appearance having wavy medullary rays and & exfoliated cork**
2. **Russian Liquorice is also used as an adulterant, because the drug is purplish in appreance, has long roots but having no stolons.**

GINSENG

Ginseng, *Panax ginseng* (Araliaceae). Left : Plants with green stems and leaves supported on bamboos showing clusters of bright red berries. Right : Fresh white ginseng roots. (See page 254)

Synonym: Five fingers, Ninjin, Schinset

Biological Source:- Dried roots of *Panax ginseng* (Asian ginseng) or *P.quinquefolium*(American ginseng)

Family: Araliaceae

Organoleptic Characters: White, yellowish brown or red, fleshy

Chemical Constituents

It contains mixture of saponine glycosides, they can be grouped as

1. Ginsenosides.
2. Panaxosides.
3. Chikusetsusaponin.

Gynsenosides are -Ro,-Rb,-Rb2,-Rc,-Rd,-Re,-Rf, -Rg2,-Rg3 and -Rh.

Uses

1. Used as tonic, stimulant and aphrodisiac,
2. It regulates catabolic and anabolic processes of cells.
3. It stimulates immunological function
4. It lowers blood pressure, blood sugar
5. It stimulates pituitary and adrenal glands
6. Inhibits tumor growth

Ginseng Root

- RootsofPanaxquinquefolius(Americanginseng)&P.ginseng(Asianginseng),Araliaceae.
- Containsacomplexmixtureoftriterpenoidalsaponinswithatetracyclic(steroids)orpentacyclicstructure(in its cork).

- Classification
- Classified into 2 types:
- 1.Ginsenosides,
- 2.Panaxosides (differ from ginsenosides in the sugar moiety).
- Aerial parts
- Roots

- **GINSENG (TRI TERPENOID SAPONIN) Dried roots of Panax ginseng (Korea) and other species of Panax Source P. japonicas (Japan), P. pseudoginseng (Himalaya), P. quinquefolius (American), P. trifolius (Dwarf), P. vietnamensis (Vietnamese), P. notoginseng (Chinese) Family Araliaceae Syn. Ninjin, Pannag, Energofit Image G.S. Korea, China, Russia now cultivated in Japan, Canada & US The term panax (derived from greek) panaceae = cure all History The term ginseng (derived from chinese) shen sang = man root Shape of human body - Ginsenosides, Panaxosides and Chikusetsu Saponins. Chemical - Ginsenoside consists of aglycone dammarolConstituents - Panaxoside have aglycone as oleanolic acid**
- **- Starch, Gum, Resin, volatile oil, flavonoids, sesqui terpenoids**
- **USES-important immunomodulatory drug, increase natural resistance and overcome illness -both stimulant & sedative property Uses -aphordiasic & adrenal & thyroid disfuntioning -blood sugar, anaemia, gastritis etc [toxic on prolonged usage**

Ginseng -Therapeutic uses

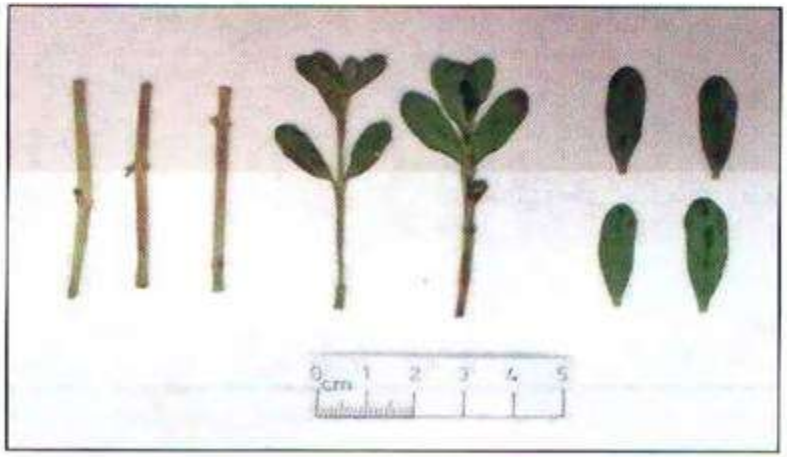
- **Adaptogenic(antistress):enhancesbodynonspecificresistancetoexternalstress(physical,chemicalorbiological).**

- **Improvesphysical&mentalperformancee.g.learning,memory&physicalcapabilities.**
- **Tonic,stimulant,diuretic & carminative.**
- **Improves immunefunction &metabolism.**
- **Used in anemia, Hepatoprotective(ginsenosides), diabetes(saponinsandpolysaccharides), insomnia, gastritis, Antitumor(polyacetylenes and polysaccharides) & sexual impotence.**

- **Contraindicatedincaseofhypertension&duringpregnancy.**

BRAHMI

BACOPA MONNIERI



BACOPA MONNIERI: LEAVES AND STEMS

- Synonym: Jalbrahmi
- Biological Source:- Fresh & dried leaves and stems of plant *Bacopa moniera (Herpestis moniera)*
- Family: Scrophulariaceae
- Organoleptic Characters:
- Colour: Green.
- Odour: - None.
- Taste: - Bitter.
- Shape: Leaves are obovate, entire, sessile with dotted lower surface, flowers are small with bluish white colour, five sepals.
- Chemical Constituents
- 1. It contains alkaloids important are brahmine, herpestine, bacosides A and B.
- Uses
- It is used as nervine tonic.
- In treatment of asthma, epilepsy and insanity.
- Alcoholic extract of plant is anti-cancer.

A.R.CHAUDHARY

BACOPA

- Source: Fresh leaves and stem of Bacopa monnieri (Herpestis monnieri) Family Scrophulariaceae Syn. Jalbrahmi, Neerbrahmi
- G.S. Throughout India in wet, damp & marshy places up to 1200 m elevation –
- ChemicalConstituents: saponin glycosides known as bacoside A and bacoside B - on acid hydrolysis triterpenoid aglycone bacogenin A and bacogenin B - asiatic acid and brahmic acid ChemicalConstituents

- treatment of insanity and epilepsy, asthma Uses - potent nervetonic, cardiotonic and diuretic - mild laxative.

HYDROCOTYL

Source: dried aerial parts of Centella asiatica (Hydrocotyl asiatica) Family Umbelliferae Syn. Indian pennywort, Mangosteen,Mandukparni

G.S.: India, Pakistan, Srilanka, Madagaskar

ChemicalConstituents: Tri terpenoid saponin glycoside in form of α-amyrin derivative: asiaticoside,madecassoside - Asiaticoside hydrolysis asiatic acid + 2 glucose + rhamnose -Madecassoside hydrolysis madecassic acid + 2 glucose + rhamnose Chennai & Lucknow variety Brahmoside, Brahminoside hydrolysis brahmic acid & iso brahmic acid , arabinose, glucose, rhamnose

USES -nervine tonic, spasmolytic, anti anxiety, anti-stress, sedative Uses -skin diseases, leprosy, syphilis

SQUILL (CARDIAC GLYCOSIDE)

- **Dried slices of the bulb of white variety Urginea maritima Source Red variety: Urginea maritima Family Liliaceae Syn. Scillae bulbus, Urginea scilla, Drimia maritime, European Scilla**
- **G.S. Spain, Portugal, Morocco, Algeria, Southern France, Italy, Dalmatia, Greece, Syria White variety**
- **Cardiac glycoside: Bufadienolide: Scillaren A (2/3rd of total glycoside content, responsible for activity) & Scillaren B.**
- **Scillaren A on acid hydrolysis Scillarenin + Scillabiose (Glucose + Rhamnose) Scillaren A enzyme hydrolysis Proscillaridin A + Glucose Glucoscillaren A: Scillarenin + Rhamnose + Glucose + Glucose**
- **Proscillaridin A acid hydrolysis Scillarenin A + Rhamnose ; Xanthoscillide, flavonoids, mucilage, Calcium oxalate, sinistrin (carbohydrate similar to inulin), volatile substances (causing irritation) Red variety Anthocyanin (red color), Scilliroside (glycoside which is toxic to rat) White & Red variety is chemical races.**

Chemical Test -NOT POSITIVE Baljet Test & Legal Test: Liberman's sterol Test: Squill glycoside

Squill mesophyll region: mucilage, calcium oxalate and yellow coloring matter xanthoscillide is present. Mucilage not pink color with ruthenium red but stains red with corallin soda & pale yellow with iodine

Due to mucilage, it is very much susceptible for moisture & with moisture it forms clumpy mass. Moisture hydrolyses glycoside content aglycone become less active Calcium oxalate, as a bundle of long acicular crystal, which easily penetrate skin when bulbs are handled, cause intense irritation, sometimes eruptions Stimulating, expectorant, diuretic property, cardiac tonic, same like Uses digitalis (but more irritating to GI mucus membrane), chronic bronchitis, catarrhal affection, asthma

INDIAN SQUILL

Source: Dried slices of the bulb of Urginea indica Family Liliaceae Syn. Sea onion, jungali pyaj Image G.S. Westernal Himalaya, Konkan, Coramandal coast, Bihar Chemical Cardiac glycoside similar to European squill, Mucilage in mesophyll cellConstituents Mesophyll Colarin solution red.

Chemical Test Mucilage reddish purple with iodine water while European squill does not

- **Cardiotonic, Expectorant, Stimulant, Diuretic, Cathartic, Bronchodilator & Uses anti cancer**