Drugs Containing Glycosides

CHAPTER 16

16.1. INTRODUCTION

A glycoside is any molecule in which a sugar group is bonded through its anomeric carbon to another group via glycosidic bond. A glycosidic bond is a certain type of chemical bond that joins a sugar molecule to another molecule. Specifically, a glycosidic bond is formed between the hemiacetal group of a saccharide (or a molecule derived from a saccharide) and the hydroxyl group of an alcohol. A substance containing a glycosidic bond is a glycoside. The glycone and aglycone portions can be chemically separated by hydrolysis in the presence of acid. There are also numerous enzymes that can form and break glycosidic bonds.

The sugar group is known as the glycone and the nonsugar group as the aglycone or genin part of the glycoside. The glycone can consist of a single sugar group (monosaccharide) or several sugar groups (oligosaccharide). The sugars found in glycosides may be glucose and rhamnose (monosaccharides) or, more rarely, deoxysugars such as the cymarose found in cardiac glycosides.

In plants glycosides are both synthesized and hydrolysed under the influence of more or less specific enzymes. They are crystalline or amorphous substances that are soluble in water or alcohols and insoluble in organic solvents like benzene and ether. The aglycone part is soluble in organic solvents like benzene or ether. They are hydrolysed by water, enzymes and mineral acids. They are optically active. While glycosides do not themselves reduce Fehling's solution, the simple sugars which they produce on hydrolysis will do so with precipitation of red cuprous oxide. The sugars present in glycoside are of two isomeric forms, that is, α form and β form, but all the natural glycosides contain β-type of sugar.

The term 'glycoside' is a very general one which embraces all the many and varied combinations of sugars and aglycones.

16.2. CLASSIFICATION

The glycosides can be classified by the glycone, by the type of glycosidal linkage, and by the aglycone.

On the Basis of Glycone

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, etc.

On the Basis of Glycosidic Linkage

1. **O-glycosides:** Sugar molecule is combined with phenol or –OH group of aglycon, for example, Amygdaline, Indesine, Arbutin, Salicin, cardiac glycosides, anthraxquinone glycosides like sennosides etc.
2. **N-glycosides:** Sugar molecule is combined with N of the –NH (amino group) of aglycon, for example, nucleosides
3. **S-glycosides:** Sugar molecule is combined with the S or SH (thiol group) of aglycon, for example, Sinigrin.
4. **C-glycosides:** Sugar molecule is directly attached with C—atom of aglycon, for example, Anthraquinone glycosides like Aloin, Barbaloin, Cascaroside and Flavan glycosides, etc.

On the Basis of Aglycone

The various classes according to aglycone moiety are given below:

S. No.	Class	Examples
1.	Anthraquinone glycosides	Senna, Aloe, Rhubarb, etc.
2.	Sterol or Cardiac glycosides	Digitalis, Thevetia, Squill, etc.
3.	Saponin glycosides	Dioscorea, Liquorice, Ginseng, etc.
4.	Cyanogenetic and Cyanophoric glycosides	Bitter almond, Wild cherry bark, etc.
5.	Thiocynate and Isothiocynate glycosides	Black mustard
6.	Flavone glycosides	Ginkgo
7.	Aldehyde glycosides	Vanilla
8.	Phenol glycosides	Bearberry
9.	Steroidal glycosides	Solanum
10.	Bitter and Miscellaneous glycosides	Gentian, Picrrohiza, Chirata, etc.

16.3. DISTRIBUTION OF GLYCOSIDES

Glycosides are the class of compounds abundant in nature. Some plant families containing important glycosides are listed bellow:

1. Scrophulareaceae (*Digitalis purpurea* and *Digitalis lanata*, *Picrorhiza kurroa*).
2. Apocyanaceae (*Nerium oliander* and *Thevetia peruviana*).
3. Liliacea (*Urgenea indica* and *U. maritima*, *Aloe vera*)
4. Leguminocae (*Cassia acutefolia* and *C. angustefolia*, *Glycyrrhiza glabra, Psoralea corylifolia*)
5. Dioscoreaceae (*Dioscorea floribunda*)
6. Rosaceae (*Prunus amygdalus, Carategus oxycantha*)
7. Cruciferae (*Brassica* sp.)
8. Gentianaceae (Gentian and Chirata)
9. Acanthaceae (Kalmegh)
10. Simarubaceae (Quassia)
11. Umbelliferae (*Ammi majus, Ammi visnaga*)
12. Rutaceae: Citrus sp. (*Ruta graveolens*)
13. Polygonaceae (Fagopyrum sp.)
14. Myrtaceae (Eucalyptus sp.)

16.4. CHEMICAL TESTS OF GLYCOSIDES

Glycosides are the compounds with organic molecules having attached glucose or any mono-oligo sacchrid unit. Usually, these are crystalline or amorphous solids; optically active, soluble in water and alcohol but insoluble in organic solvents like ether, chloroform and benzene etc. Generally, aqueous or alcoholic extracts of crude drugs are tested with specific reagents for presence of various types of glycosides.

Chemical Tests for Anthraquinone Glycosides

Borntrager's test

To 1 gm of drug add 5–10 ml of dilute HCl boil on water bath for 10 min and filter. Filtrate was extracted with CCl_4/benzene and add equal amount of ammonia solution to filtrate and shake. Formation of pink or red colour in ammonical layer due to presence of anthraquinone moiety.

Modified borntrager's test

To 1 gm of drug, add 5 ml dilute HCl followed by 5 ml ferric Chloride (5% w/v). Boil for 10 min on water bath, cool and filter, filtrate was extracted with carbon tetrachloride or benzene and add equal volume of ammonia solution, formation of pink to red colour due to presence of anthraquinone moiety. This is used C-type of anthraquinone glycosides.

Chemical Tests for Saponin Glycosides

Haemolysis test

A drop blood on slide was mixed with few drops of aq. Saponin solution, RBC's becomes ruptured in presence of saponins.

Foam test

To 1 gm of drug add 10–20 ml of water, shake for few minutes, formation frothing which persists for 60–120 s in presence of saponins.

Chemical Tests for Steroid and Triterpenoid Glycosides

Libermann burchard test

Alcoholic extract of drug was evaporated to dryness and extracted with $CHCl_3$, add few drops of acetic anhydride followed by conc. H_2SO_4 from side wall of test tube to the $CHCl_3$ extract. Formation of violet to blue coloured ring at the junction of two liquid, indicate the presence of steroid moiety.

Salkowaski test

Alcoholic extract of drug was evaporated to dryness and extracted with $CHCl_3$, add conc. H_2SO_4 from sidewall of test tube to the $CHCl_3$ extract. Formation of yellow coloured ring at the junction of two liquid, which turns red after 2 min, indicate the presence of steroid moiety.

Antimony trichloride test

Alcoholic extract of drug was evaporated to dryness and extracted with $CHCl_3$, add saturated solution of $SbCl_3$ in $CHCl_3$ containing 20% acetic anhydride. Formation of pink colour on heating indicates presence of steroids and triterpenoids.

Trichloro acetic acid test

Triterpenes on addition of saturated solution of trichloro acetic acid forms coloured precipitate.

Tetranitro methane test

It forms yellow colour with unsaturated steroids and triterpenes.

Zimmermann test

Meta dinitrobenzene solution was added to the alcoholic solution of drug containing alkali, on heating it forms violet colour in presence of keto steroid.

Chemical Tests for Cardiac Glycosides

Keller-kiliani test

To the alcoholic extract of drug equal volume of water and 0.5 ml of strong lead acetate solution was added, shaked and filtered. Filtrate was extracted with equal volume of chloroform. Chloroform extract was evaporated to dryness and residue was dissolved in 3 ml of glacial acetic acid followed by addition of few drops of $FeCl_3$ solution. The resultant solution was transferred to a test tube containing 2 ml of conc. H_2SO_4. Reddish brown layer is formed, which turns bluish green after standing due to presence of digitoxose.

Legal test

To the alcoholic extract of drug equal volume of water and 0.5 ml of strong lead acetate solution was added, shaked and filtered. Filtrate was extracted with equal volume of chloroform and the chloroform extract was evaporated to dryness. The residue was dissolved in 2 ml of pyridine and sodium nitropruside 2 ml was added followed by addition of NaOH solution to make alkaline. Formation of pink colour in presence of glycosides or aglycon moiety.

Baljet test

Thick section of leaf of digitalis or the part of drug containing cardiac glycoside, when dipped in sodium picrate solution, it forms yellow to orange colour in presence of aglycones or glycosides.

3,5-dinitro benzoic acid test

To the alcoholic solution of drug few drops of NaOH followed by 2% solution of 3,5-dinitro benzoic acid was added. Formation of pink colour indicates presence of cardiac glycosides.

Chemical Tests for Coumarin Glycosides

$FeCl_3$ test

To the concentrated alcoholic extract of drug few drops of alcoholic $FeCl_3$ solution was added. Formation of deep green colour, which turned yellow on addition of conc. HNO_3, indicates presence of coumarins.

Fluorescence test

The alcoholic extract of drug was mixed with 1N NaOH solution (one ml each). Development of blue-green fluorescence indicates presence of coumarins.

Chemical Tests for Cynophoric Glycoside

Sodium picrate test

Powdered drug was moistened with water in a conical flask and few drops of conc. Sulphuric acid was added. Filter paper impregnated with sodium picrate solution followed by sodium carbonate solution was trapped on the neck of flask using cork. Formation of brick red colour due to volatile HCN in presence of cynophoric glycosides takes place.

Chemical Tests for Flavonoid Glycosides

Ammonia test

Filter paper dipped in alcoholic solution of drug was exposed to ammonia vapor. Formation of yellow spot on filter paper.

Shinoda test

To the alcoholic extract of drug magnesium turning and dil. HCl was added, formation of red colour indicates the presence of flavonoids. To the alcoholic extract of drug zinc turning and dil. HCl was added, formation of deep red to magenta colour indicates the presence of dihydro flavonoids.

Vanillin HCl test

Vanillin HCl was added to the alcoholic solution of drug, formation of pink colour due to presence of flavonoids.

16.5. ISOLATION

Stas-Otto Method

The general method of extraction of glycosides is outlined here. The drug containing glycoside is finely powdered and the powder is extracted by continuous hot percolation using soxhlet apparatus with alcohol as solvent. During this process, various enzymes present in plant parts are also deactivated due to heating. The thermolabile glycosides, however, should be extracted at temperature preferably below 45°C. The extract is treated with lead acetate to precipitate tannins and thus eliminate nonglycosidal impurities. The excess of lead acetate is precipitated as lead sulphide by passing hydrogen sulphide gas through solution. The extract is filtered, concentrated to get crude glycosides. From the crude extract, the glycosides are obtained in pure form by making use of processes like fractional solubility, fractional crystallization and chromatographic techniques such as preparative thin layer and column chromatography.

The characterization of isolated purified compounds is done by IR, UV, visible, NMR and mass spectrometry and elemental analysis.

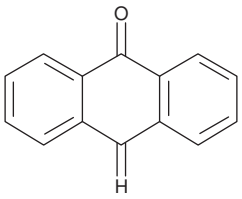
16.6. ANTHRACENE GLYCOSIDES

Anthracene glycosides are chiefly found in dicot plants but to some extent it is also found in monocot and lower plants. It consists of glycosides formed from aglycone moieties like anthraquinones, anthranols, anthrones or dimers of anthrones or their derivatives. Anthrones are insoluble in alkali and do not show strong fluorescence with them, while anthronols which are soluble in alkali show strong fluorescence. The reduced anthraquinones are biologically more active. Anthroquinones that are present in fresh drugs are in reduced form, which on long storage get oxidized and hydrolysed, Glycosides of reduced derivatives are more active than oxidized aglycones. This is due to the fact that sugars take the glycosides to the site of action and thus are more active.

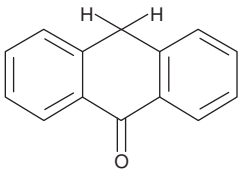
Anthraquinone is an aromatic organic compound and a derivative of anthracene. It has the appearance of yellow or light grey to grey-green solid crystalline powder. Its chemical formula is $C_{14}H_8O_2$. It melts at 286°C, boils at 379.8°C. It is insoluble in water or alcohol, but dissolves in nitrobenzene and aniline. It is chemically fairly stable under normal conditions.

Anthraquinone naturally occurs in some plants (e.g. aloe, senna, rhubarb and cascara), fungi, lichens and insects, where it serves as a basic skeleton for their pigments. Natural anthraquinone derivates tend to have laxative effects.

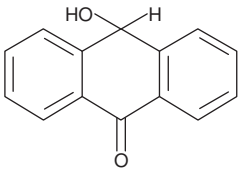
These glycosides are characterized by a chemical test, known as Borntrager test and show the property of microsublimation. Most of the glycosides are O-glycosides and S-glycosides, by their hydrolysis derivatives of 1,8-dihydroxy anthraquinone, anthranol, anthrone, or dianthrone are obtained.



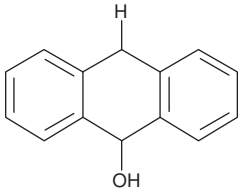
Anthraquinone



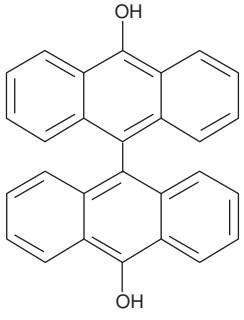
Anthrone



Oxanthrone



Anthranol



Dianthranol

The common aglycones are aloe-emodin, emodin, rhein, chrysophanol and physcion which may exist as anthraquinones, anthranols or anthrones. The sugars presents are usually arabinose, rhamnose and glucose.

In the drug originally glycosides of reduced derivatives or their dimers are present. During drying and storage by hydrolysis and oxidation free anthraquinones are produced.

SENNA LEAF

Synonyms

Alexandrian senna, Tinnevelly senna, Folia senna.

Biological Source

Senna leaf consists of the dried leaflets of *Cassia acutifolia* Delile (*C. senna* L.) known as Alexandrian senna and of *C. angustifolia* Vahl., which is commercially known as Tinnevelly senna. It belong family Leguminosae.

Geographical Source

Alexandrian senna is indigenous to South Africa. It widely grows and sometimes is cultivated in Egypt and in the middle upper territories of Nile river. It is also cultivated in Kordofan and Sennar regions of Sudan. Indian or Tinnevelly senna is indigenous to southern Arabia and cultivated largely in Tinnevelly and Ramnathpuram districts of Tamilnadu. It also grows in Somaliland, Sindh and Punjab region.

Cultivation and Collection

Senna plant is a small shrub of 1–1.5 m height with paripinnate compound leaves. Tinnevelly senna is mostly cultivated in well-ploughed, levelled, rich clayed semiirrigated land sometimes after paddy crop in South India. Propagation is done by seeds which are rubbed with coarse sand and sown thinly by broadcasting or in rows 30 cm apart, first during February–March and second after rain in July. Seeds germinate on the third day. The crop becomes ready for harvesting after about 2 months but first plucking of leaflets is done after 3 months of sowing when the leaves appears mature, thick and bluish in colour. Second plucking is followed after a month and subsequent pluckings after 4–6 weeks. The plant can survive for two to three years, but it is grown as an annual. After third plucking the plants are uprooted. Plant shows great tolerance for salinity. It sometimes shows die-back symptoms in which the branches or shoots die from the tip inward, which is caused by parasites or environmental conditions. Leaflets of Tinnevelly senna are collected by careful plucking from luxuriantly grown plants and compressed into bales.

Alexandrian senna is obtained almost entirely from the wild and sometimes from the cultivated plants. At the stage of fully formed fruits, branches are cut off and rapidly dried in the sun. Pods and large stalks are first separated by using sieves. Leaves separated from stalks are graded into whole leaves, whole and half leaves and shiftings. Whole leaves and shiftings are generally used for making galenical preparations. The leaves are packed loosely in bales for marketing.

Characteristics

Senna leaflets are 3–5 cm long, 2 cm wide and about 0.5 mm thick. It shows acute apex, entire margin and asymmetric base. Outline is lanceolate to ovate lanceolate. Pubescent lamina is found on both the surfaces. Leaves show greyish green colour for Alexandrian senna and yellowish green for Tinnevelly senna. Leaves of Tinnevelly senna are somewhat larger, less broken and firmer in texture than that of Alexandrian senna. Odour of leaves is slight but characteristic and the taste is bitter, mucilagenous. Both the types of leaflets show impression or transverse markings due to the pressing of midrib. Distingushing characters of Alexandrian and Indian senna are given in Table 16.1.

Table 16.1 Distinguishing characters of Alexandrian and Indian senna

Character	Indian Senna	Alexandrian senna
Appearance	Generally entire and less broken in good condition	Broken and brittle in nature
Size	2.5–5.0 cm long and 7–9 mm wide	2.4 cm long and 6–12 mm wide.
Shape	Lanceolate	Ovate lanceolate
Apex	Less acute with a sharp spine	Acute with a sharp spine
Margin	Entire, flat	Entire curled
Base	Less asymmetrical	Conspicuously asymmetrical
Veins	Pinnate, distinct towards the under surface and anastomosing towards margin	Pinnate, distinct towards the under surface and anastomosing towards margin
Surface	Transverse and oblique impressions, less pubescent (hairy)	Without transverse and oblique impressions and more pubescent
Texture	Flexible and less brittle	Thin more brittle
Odour	Faint	Faint
Colour	Light green	Light greyish green
Test	Bitter mucilaginous	Bitter mucilaginous
Vein Islet Number	19–22.5	25–29.5
Stomatal index	14–20	10–15
Palisade ratio	4–12	4.5–18

Fig. 16.1 Leaflets and legumes of *Cassia angustifolia*

Microscopy

Being isobilateral leaf, senna shows more or less similar features at both the surfaces of leaf with few differences. Transverse section of leaf shows upper and lower epidermis with straight wall cells, few of which contain mucilage. Paracytic stomata and nonlignified unicellular trichomes are found on both the surfaces. A single layer of palisade parenchyma is observed at both the sides but it is discontinued in the midrib region of lower epidermis due to the zone of collenchymatous tissues. Palisade is followed by spongy mesophyll which contains cluster crystals of calcium oxalate and vascular strands. Midrib shows the vascular bundle containing xylem and phloem, almost surrounded by lignified pericyclic fibres and a sheath of parenchyma which contains prismatic crystals of calcium oxalate.

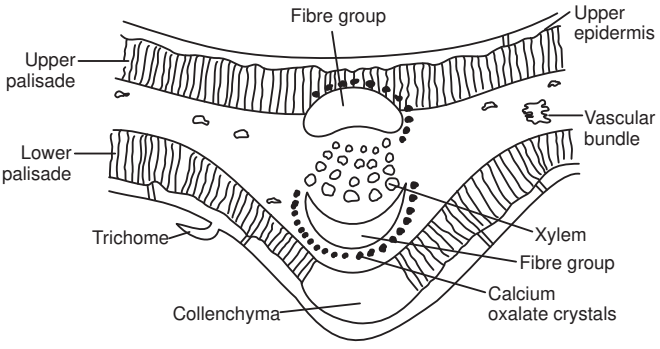


Fig. 16.2 Transverse section of senna leaf (schematic)

Chemical Constituents

Senna contains sennosides A and B (2.5%) based on the aglycones sennidin A and B, sennosides C and D which are glycosides of heterodianthrones of aloe-emodin and rhein are present. Others include palmidin A, rhein anthrone and aloe-emodin glycosides. Senna also contains free chryso-

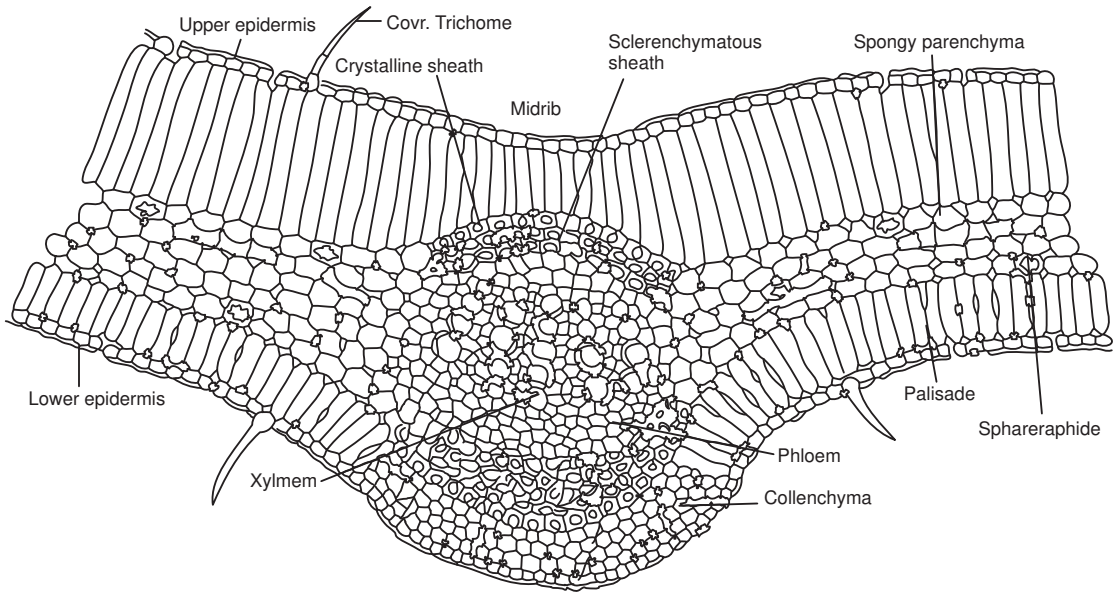
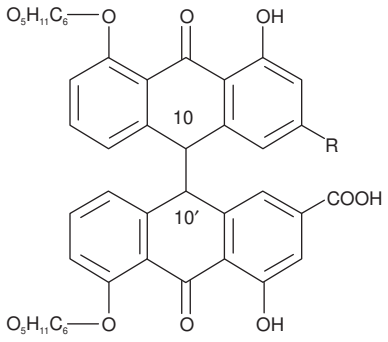


Fig. 16.3 Transverse section of senna leaflet

phanol, emodin and their glycosides and free aloe-emodin, rhein, their monoanthrones, dianthrones and their glycosides. Mucilage is present in the epidermis of the leaf and gives red colour with ruthenium red.



Glycoside	10 - 10′	R
Sennoside A	trans	COOH
Sennoside B	meso	COOH
Sennoside C	trans	CH_2OH
Sennoside D	meso	CH_2OH

Chemical Test

1. *Borntrager test for anthraquinones:* The leaves are boiled with dilute sulphuric acid and filtered. To the filtrate organic solvent like benzene, ether or chloroform is added and shaken. The organic layer is separated, and to it add ammonia solution. The ammoniacal layer produces pink to red colour indicating the presence of anthraquinone glycoside.

Uses

Senna leaves are used as laxative. It causes irritation of large intestine and have some griping effect. Thus they are prescribed along with carminatives. Senna is stimulant cathartic and exerts its action by increasing the tone of the smooth muscles in large intestine.

Adulterants

Cassia obovata (Dog Senna): They occur as small pieces with Alexandrian senna but can be easily identified by its obovata shape and obtuse and tapering apex. It has only 1% anthraquinone derivatives. The presence of *Cassia auriculata* (Palthe senna) can be identified by treating it with 80% sulphuric acid. It gives red colour.

Cassia angustifolia (Bombay or Mecca or Arabian senna) a mild variety of Indian senna have the morphology similar to that of Tinnevelly senna but the leaflets are narrow, more elongated and brownish green in colour. *C. marilandica* or American Senna, Wild Senna, *Poinciana pulcherima,* formerly *Maryland Senna,* is a common perennial from New England to Northern Carolina. Its leaves are compressed into oblong cakes like other herbal preparations of the Shakers. It acts like Senna, but is weaker, and should be combined with aromatics. These leaves are also found mixed with or substituted for Alexandrian Senna. *Coriaria myrtifolia* is a Mediterranean shrub and highly poisonous, so that it should be recognized when present. The leaves are green, very thin and soft, three veined, ovate-lanceolate, and equal at the base. It is also used to adulterate sweet

marjoram. *Cassia montana* yields a false Senna from Madras, partly resembling the Tinnevelly Senna, though the colour of the upper surface of the leaves is browner.

Marketed Products

It is one of the ingredients of the preparations known as Constivac, Softovac (Lupin Herbal Laboratory) and Isova powder, Kultab tablet (Vasu Healthcare).

ALOE

Biological Source

Aloe is the dried juice collected by incision, from the bases of the leaves of various species of Aloe. *Aloe perryi* Baker, *Aloe vera* Linn or *Aloe barbadensis* Mil and *Aloe ferox* Miller., belonging to family Liliaceae.

Aloe perryi Baker is found in Socotra and Zanzibar islands and in their neighbouring areas and so the aloes obtained from this species is known as Socotrine or Zanzibar aloe. *Aloe vera* Linn is also known as *Aloe vulgairis* Lamarek, or *Aloe barbadensis* Mil. or *Aloe officinalis* Forskal. It was formerly produced on the island of Barbados, where it was largely cultivated, having been introduced at the beginning of the sixteenth century. It is now almost entirely made on the Dutch islands of Curacoa, Aruba and Bonaire. The aloes obtained from this species is known as Curacao or Barbados aloe. *Aloe ferox* Miller and hybrids of this species with *Aloe africana* and *Aloe spicata, A. platylepia* and other species of Aloe grows in Cape Colony and so is known as Cape aloe.

Geographical Source

Aloes are indigenous to East and South Africa, but have been introduced into the West Indies and into tropical countries, and will even flourish in the countries bordering on the Mediterranean.

Cultivation and Collection

It is an evergreen perennial growing to 0.8 m by 1 m at a slow rate. The plant prefers light (sandy) and medium (loamy) soils, requires well-drained soil and can grow in nutritionally poor soil. The plant prefers acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It requires dry or moist soil and can tolerate drought. They are xerophytic plant. It can be propagated by seeds. Seeds are sown in the spring in a warm green house. The seed usually germinates in 1–6 months at 16°C. The seedlings are transferred to the pots containing well-drained soil. They are allowed to grow in sunny part for at least their first two winters. The offsets will be available, usually in spring. The plants produce offsets quite freely and they can be divided at any time of the year as long as it is warm enough to encourage fresh root growth to allow reestablishment of the plants. Young offsets are planted in the soil after the rainy season in rows situated at a distance of 60 cm.

In the second year leaves are collected by the natives by protecting their hands because of the spiny nature of leaves. The leaves are cut near the base, kept inside of kerosene tins and taken them to a central place for the preparation of aloe. Juice of aloe is present in parenchymatous cells of pericycle that are mucilage cells. In a single incision mucilage cells exert pressure on pericycle cells and the entire juice from the leaves is drained out.

Preparation of Aloe

Curacao or barbados aloe

In West Indies the cut leaves are arranged with their cut surface on the inner side, on the sides of V shaped vessel of about 1–2 m long and the flowing juice is collected in a tin vessel that is placed below the V-shaped vessel This juice thus collected is concentrated either by spontaneous evaporation, or more generally by boiling until it becomes of the consistency of thick honey. These conditions favours the crystallization of barbaloin and this aloe contains crystals of barbaloin because of the presence of which it becomes opaque and so also known as hepatic or livery aloe. On cooling, it is then poured into gourds, boxes, or other convenient receptacles and solidifies.

Socotrine aloe

When it is prepared, it is commonly poured into goat skins, and spontaneous evaporation is allowed for about a month when it becomes viscous pasty mass which are then packed into cases. In European countries it is dried in wooden pans with hot air till moisture is about 10%.

Zanzibar aloe

This aloe is prepared similar to Socotrine aloe. It is packed in skins, of carnivorous animals. This aloe is also known as monkey skin aloe.

Cape aloe

The leaves of the plants from which Cape aloe is obtained are cut off near the stem and arranged around a hole in the ground, in which a sheep skin is spread, with smooth side upwards. When a sufficient quantity of juice has drained from the leaves it is concentrated by heat in iron cauldrons and subsequently poured into boxes or skins in which it solidifies on cooling. Large quantities of the drug are .exported from Cape Town and Mossel Bay.

Characteristics

Curacao aloe

It is usually opaque and varies in colour from bright yellowish or rich reddish brown to black. Sometimes it is vitreous and small fragments are then of a deep garnet-red colour

and transparent. It is then known as 'Capey Barbados' and is less valuable, but may become opaque and more valuable by keeping. Curacoa Aloes possesses the nauseous and bitter taste that is characteristic of all Aloes and a disagreeable, penetrating odour. It is almost entirely soluble in 60% alcohol and contains not more than 30% of substances insoluble in water and 12% of moisture. It should not yield more than 3% of ash. The fracture is waxy.

Fig. 16.4 *Aloe vera*

Socotrine aloes

It may be distinguished principally from Curacoa Aloes by its different odour. Much of the dry drug is characterized by the presence of small cavities in the fractured surface; it is yellow-brown to dark-brown in colour and opaque. Fracture is irregular and porous and taste is bitter.

Zanziber aloes

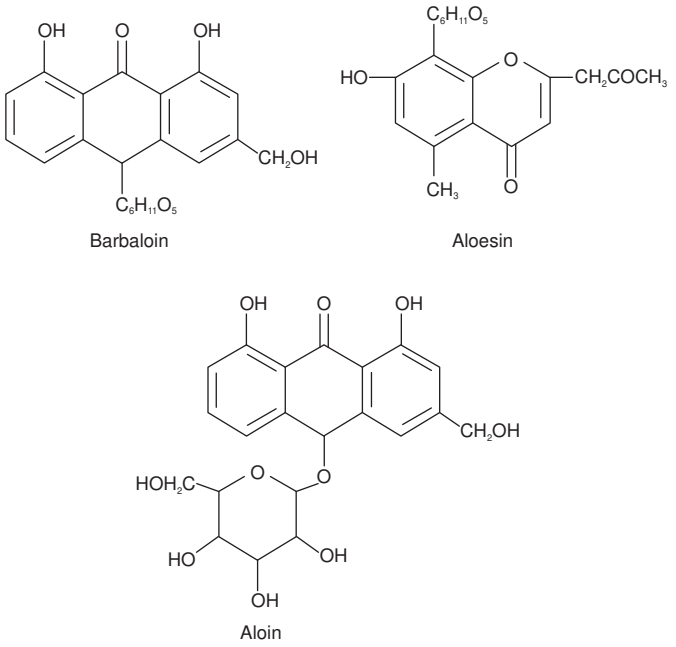
Zanzibar Aloes often very closely resembles Curacoa in appearance and is usually imported in liver-brown masses which break with a dull, waxy fracture, differing from that of Socotrine Aloes in being nearly smooth and even. It has a pleasant odour and bitter taste.

Cape aloes

It forms dark coloured masses which break with a clean glassy fracture and exhibit in their splinters a yellowish, reddish-brown or greenish tinge. Its translucent and glossy appearance are very characteristic and red-currant like odour sufficiently distinguish it from all other varieties of Aloes.

Chemical Constituents

The most important constituents of Aloes are the three isomers of Aloins, Barbaloin, β-barboloin and Isobarbaloin, which constitute the so-called 'crystalline' Aloin, present in the drug at from 10 to 30%. Other constituents are amorphous Aloin, resin, emodin and Aloe-emodin. Barbaloin is present in all the varieties; it is slightly yellow coloured, bitter, water soluble, crystalline glycoside. Isobarbaloin is a crystalline substance, present in Curacao aloe and in trace amount in Cape aloe and absent in Socotrine and Zanzibar aloe. The chief constituents of Socotrine and Zanzibar aloe are Barbaloin and β-Barbaloin.



Chemical Tests

Boil 1 gm of drug with 100 ml water, allow it to cool; add 1 gm kieselguhr, stir it well and filter through filter paper.

1. *Borax Test:* Take 10 ml of aloe solution and to it add 0.5 gm of borax and heat; a green coloured fluorescence is produced indicating the presence of aloe-emodin anthranol.
2. *Modified Anthraquinone Test:* To 0.1 gm of drug, 5 ml of 5% solution of ferric chloride is added followed by the addition of 5 ml dilute hydrochloric acid. The mixture is heated on water bath for 5–6 min and cooled. An organic solvent (benzene or chloroform) is added and shaken. Separate the organic solvent layer and add an equal volume of dilute ammonia. The ammoniacal layer produces pinkish red colour.
3. *Bromine Test:* To 5 ml of aloe solution, add equal volume of bromine solution; bulky yellow precipitate is formed due to the presence of tetrabromaloin.
4. *Nitrous Acid Test:* To 5 ml of aloe solution, add little of sodium nitrite and few drops of dilute acetic acid; it produces Pink or purplish colour. Zanzibar and Socotrine aloes give negative test.
5. *Nitric Acid Test:* 2 ml of concentrated nitric acid is added to 5 ml of aloe solution; Curacao aloe gives

deep reddish-brown colour, Socotrine aloe gives pale yellowish-brown colour, Zanzibar aloe gives yellowish-brown colour and Cape aloe first produces brown colour which on standing changes to green.

6. *Cupraloin Test:* 1 ml of the aloe solution is diluted to 5 ml with water and to it 1 drop of copper sulphate solution is added. Bright yellow colour is produced which on addition of 10 drops of saturated solution of sodium chloride changes to purple and the colour persist if 15–20 drops of 90% alcohol is added. This test is positive for Curocao aloe, faint for Cape aloe and negative for Zanzibar and Socotrine aloes.

Uses

The drug Aloes is one of the safest and stimulating purgatives, in higher doses may act as abortifacient. Its action is exerted mainly on the large intestine; also it is useful as a vermifuge. The plant is emmenagogue, emollient, stimulant, stomachic, tonic and vulnerary. Extracts of the plant have antibacterial activity. The clear gel of the leaf makes an excellent treatment for wounds, burns and other skin disorders, placing a protective coat over the affected area, speeding up the rate of healing and reducing the risk of infection. To obtain this gel, the leaves can be cut in half along their length and the inner pulp rubbed over the affected area of skin. This has an immediate soothing effect on all sorts of burns and other skin problems.

Substituents and Adulterants

A. candelsbmm (Natal aloes) is dull greenish black to dull brown in colour, opaque. When scraped it gives a pale greyish green or a yellow powder. It can be distinguished as it gives negative test to borax test and produces a deep blue colour. Jafferabad aloes and the Mocha aloes are the other two type of aloe which is used as adulterant.

Marketed Products

It is one of the ingredients of the preparations known as Diabecon, Evecare (Himalaya Drug Company), Mensonorm (Chirayu Pharma) and Kumari Asava (Baidyanath).

RHUBARB

Synonyms

East Indian Rhubarb, China Rhubarb, Turkey Rhubarb.

Biological Source

Rhubarb consists of the peeled dried rhizomes and roots of *Rheum palmatum* Linn., belonging to family Polygonaceae.

Geographical Source

It is mainly found in E. Asia, N.W. China in Yunnan, W. Sichuan, E. Xizang and Gansu, Thibet and India.

Cultivation and Collection

The plant is perennial growing to 3 m by 2 m. The plant prefers medium (loamy) and heavy (clay) soils, requires well-drained soil and can grow in heavy clay soil. The plant prefers acid, neutral and basic soils. Drug is collected from wild plants but is also cultivated to some extent. The plant grows at an altitude of 2,500–4,000 m. It can grow in semishade or no shade. It requires moist soil. Plants can be grown in quite coarse grass, which can be cut annually in the autumn. Seeds are sown in autumn in a shaded cold frame. The seed can also be sown in spring in a cold frame. When large enough to handle, seedlings are pricked out and transferred into individual pots and allowed to grow them on in the green house or cold frame for their first winter, then they are transplanted out in the spring.

The rootstocks are divided in early spring with a sharp knife, making sure that there is at least one growth bud on each division and the required amount of drugs is collected and the remaining are planted.

Rhizomes are large and roots are thick branched, Drug is collected in autumn in September or October from 6 to 15 years old plants. Rhizomes are dug out, crown and lateral roots are removed and the outer bark is separated by peeling. The rhizomes that are small in size are kept as such or cut into transverse slices and so they are round.

Large rhizomes are made flats by making cut into longitudinal slices. These slices are dried by boring holes in the flat pieces and passing thread through the holes and hanging between shades of trees. In absence of the required climatic conditions the drugs are dried artificially heated stones, which are previously heated by woodfire. Drug dried in this way is called high dried. The drugs that are dried in above said manner exerts an unpleasant odour and darker in colour and is considered inferior. The remaining bark is peeled off and graded according to size, shape and quality.

Characteristics

The leaves of the Turkey Rhubarb are palmate and somewhat rough. The root is thick, of an oval shape, sending off long, tapering branches; externally it is brown, internally a deep yellow colour. The stem is erect, round, hollow, jointed, branched towards the top, from 6 to 10 feet high.

This species is distinguished from other Rhubarbs by its much larger size, the shape of its leaves, with their oblong, sharpish segments, and the graceful looseness of its little panicles of greenish-white flowers. The first buds which appear in spring are yellow, not red.

Chinese or Turkey Rhubarb occurs in commerce in brownish-yellow pieces of various sizes, usually perforated, the holes often containing a portion of the cord used to hang