Pharmacological Importance

1. Anthraquinone glycosides possess laxative property which helps in quick evacuation of the bowels. This is achiev by stimulating the smooth muscles of the large intestine and mucous secretion which prevents water reabsorptic thus forming soft stools which can be easily evacuated.
2. Usually reduced forms of the aglycone such as anthrone, anthranol, oxanthrone and dianthranol show enhanc biological activity when compared to oxidized forms.
3. Glycone moiety (sugar) aids in the transportation of glycoside to its site of action.

Senna

The two major varieties of Senna are Indian senna and Alexandrian senna.

Indian Senna	Alexandrian Senna
Synonyms Senna leaf, Tinnevelly senna, Folia sennae **Biological Source** Indian senna comprises of dried leaflets of *Cassia angustifolia* (family-Leguminosae) **Location** Large scale cultivation is carried out in Tinnevelly, Madurai and Ramananthapuram districts of Tamil Nadu. **Cultivation, Collection and Method of Preparation** *Requirements for Cultivation* Temp - Above 10°C. Rainfall - Moderate Soil - Red loamy soil, coarse gravel soil or alluvial loamy soil. Methods such as broadcasting and dribbling are adopted for sowing the seeds. Seeds are sown in the month of February or March. Second sowing is done again after rainy season in October or November. Nitrogenous fertilizers are to be provided. The plant is allowed to grow for a period of five months. Leaves are plucked in three stages. *First Stage* - Plucking is carried out when the leaflets become thick, green in colour and fully grown. *Second Stage* - After one month of first plucking, second plucking is carried out. *Third Stage* - Leaflets are plucked after 4-7 weeks of second plucking, after which the plants are uprooted. Fully grown leaves show maximum content of sennosides. As maturation advances, sennoside content decreases. After collection of the leaflets, drying is carried out for 7-10 days in shades to restore their green colour. Leaflets are spread in thin layers. Dried leaves are placed one above the other in stacks, and hydraulic pressure is applied. They are then packed into bales and stored.	**Synonyms** Folia sennae Alexandrinae, Egyptian senna, Cassia senna. **Biological Source** Alexandrian senna comprises of dried leaflets of *Cassia acutifolia* (family-Leguminosae). **Location** Mainly cultivated in Egypt, Tropical African countries (mainly Sudan). **Cultivation, Collection and Method of Preparation** Alexandrian senna is collected from wild sources in September and dried in sunlight. In order to separate leaves from pods and stalks, coarse sieving is performed. Tossing is done in shallow trays. Due to their light weight, entire and broken leaves get separated from heavy sand. These are again sifted to separate small leaflets, entire leaves and mixed leaves. The entire leaves are stacked on one another and packed into bales.

Extraction Method of Sennosides

(a) *First Method - Solvent Extraction*

This method is useful for the extraction of about 62% of sennosides from the senna leaves.

Drug powder + 90% methanol (or 80% acetone)
↓ Extracted for 6 hrs
Above contents + Cold water
↓ Extracted for another 3 hrs
Extract (17-18% sennosides)

(b) *Second Method - Maceration*

This method is used to obtain calcium salts of sennosides A and B.

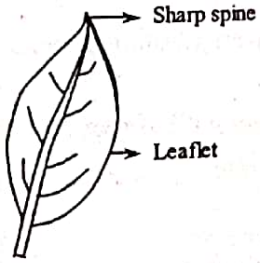
Senna leaf powder + Citric acid in methanol
↓ Maceration
Above contents + Methanol + Toluene + Ammonia
↓ Extraction
Extract + $CaCl_2$
↓
Calcium salts of sennoside A and B.

Indian Senna

Characteristics

1. ***Macroscopy***

Colour : Yellowish-green
Odour : Slight or faint
Taste : Characteristic, bitter and mucilagenous
Size : Width 7 - 8 mm
Length 2.5 - 5 cm.
Shape : Lanceolate



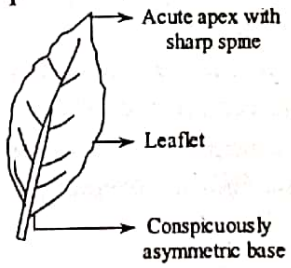
Nature : They are less brittle.
Appearance : Mostly whole leaves
Leaf surface : Shows the presence of transverse and oblique impressions, and is less hairy.
Leaf margin : Entire
Apex : It is less acute with sharp spine
Base : Less asymmetric.

Alexandrian Senna

Characteristics

1. ***Macroscopy***

Colour : Green
Odour : Faint
Taste : Characteristic, bitter and mucilagenous
Size : Width 6 - 12 mm
Length 2 - 4 cm.
Shape : Ovate lanceolate



Nature : They are more brittle.
Appearance : Mostly broken leaves
Leaf surface : Transverse and oblique impressions are absent. The surface is more hairy.
Leaf margin : Entire (continuous) and curled.
Apex : It is more acute with sharp spine.
Base : More asymmetric.

Vein Islet Number - It is defined as the number of vein islets present per mm^2 of leaf surface midway between the midrib and margin. It is constant for a given species of the plant.
19-22.5 25-29.5

Stomatal Index - It can be defined as the percentage of number of stomata to the total number of epidermal cells where every stomata is counted as one cell.
17-20 11.4-13.3

Palisade Ratio - Palisade ratio is the average number of palisade cells present below each epidermal cell.
4-12 4.5-18

Indian Senna	Alexandrian Senna
Standards - (a) Foreign Organic Matter - NMT-2% (b) Acid Insoluble Ash - NMT-2% (c) Moisture - NMT-10% (d) Total Ash - NMT-12% (e) Water Soluble Extractives - NMT-30%. (f) Cadmium - NMT-0.3 ppm (g) Lead - NMT-10 ppm.	

2. ***Microscopy***

The histological features of both Indian and Alexandrian senna are almost similar. The only difference is that Alexandrian senna contains numerous trichomes. The values of leaf constants also differ in both. The senna leaflets can be divided into two symmetrical halves. Hence, they are considered as isobilateral.

The lamina can be categorized into the following,

(a) *Epidermis*: Upper epidermis consists of a single layer of polygonal cells with straight anticlinal walls. Some of the cells possess mucilage. Above the cells, a thin layer of cuticle is present. Each covering trichome is unicellular, thick-walled and conical in shape. Upper epidermis also shows the presence of rubiaceous or paracytic stomata.

(b) *Mesophyll*: It is divided into the following portions.

(i) Upper Palisade Layer : It consists of a single layer of elongated, closely packed cells. They are rectangular in shape, thin walled, parenchymatous and extend to the midrib portion.

(ii) Spongy Parenchymatous Tissue: Cells are thin-walled, parenchymatous with large intracellular spaces. Cells show the presence of spheraphides (cluster crystals of calcium oxalate).

(iii) Lower Palisade Layer: Cells are wavy and are smaller when compared to the upper palisade cells.

(c) *Lower Epidermis*: Lower epidermis is similar to upper epidermis. However, it is less hairy with few trichomes and stomata.

(d) *Crystal Sheath* : It is a sheath consisting of double layer of parenchymatous cells. This sheath is seen both on the dorsal and ventral sides of the midrib.

(e) *Multilayered Collenchyma* : It consists of many layers of thick walled parenchymatous cells. These cells contain cellulose. They are present only towards the ventral side.

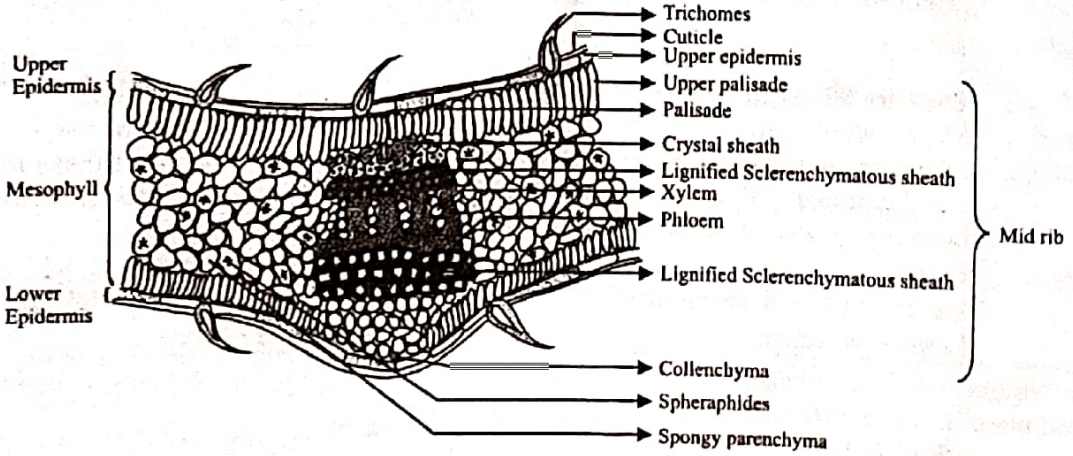
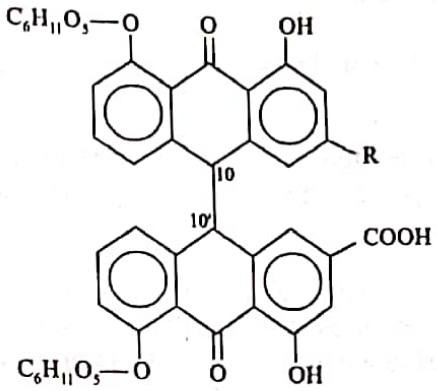


Figure: Transverse Section of Senna Leaflet

Chemical Constituents

1. Sennosides

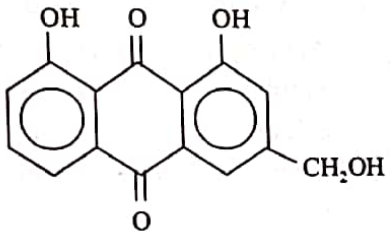
The major constituents of senna leaf are a pair of dimeric crystalline glycosides (2.5%), namely sennoside A and B with rhein as their aglycone moiety. Sennosides C and D are also present in minute quantities.



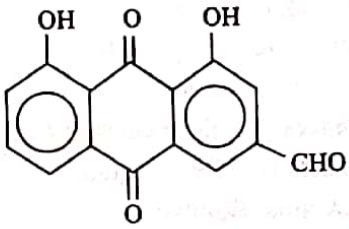
Sennosides

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

Upon hydrolysis, sennosides A and B gets hydrolysed to form sennidin A and B respectively along with two glucose molecules. Chemically, sennidin A and B are dianthrones of rhein.
Sennosides C and D are heterodianthrones of rhein and aloe-emodin



Aloe-emodin



Rhein-anthrone

2. Other anthracene glycosides of senna are,
   (a) Rhein anthrone-8-glycoside
   (b) Rhein-8-diglucoside
   (c) Aloe-emodin
   (d) Aloe emodin-8-glucoside
   (e) Aloe emodin-anthrone-diglucoside
   (f) Rhein-1-glucose
3. Naphthalene glycosides namely, tinnevellin glycoside in Indian senna and 6-hydroxy mucizin glycoside in Alexandrian senna.
4. Other constituents include kaempferol, phytosterol, mucilage, resin, lignin, myricyl alcohol, calcium oxalate crystals and water soluble polysaccharides.

Identifying Tests

1. ***Common Test***
   It gives positive results to the general identifying tests of anthraquinone glycosides.
2. ***Distinguishing Test***
   Senna leaf extract + Acid solution + Methanolic magnesium acetate
   ↓ Acid hydrolysis
   If the solution gives greenish-orange colour in UV light → Alexandrian senna
   If the solution gives yellowish-green colour in UV light → Indian senna

Assay Method

The assay of senna is carried out by two methods.

1. *Chemical Method*

Techniques such as thin layer chromatography (TLC), high pressure liquid chromatography (HPLC) and spectrophotometric or spectrocolorimetric methods are used to carry out the chemical assay of senna leaves.

2. *Biological Method*

In this method, two groups of mice are taken, each group containing five animals. Group-A is designated as blank which is not given any drug while group-B is designated as test to which the senna leaf suspension is given. After 24 hrs, the number of faeces are counted. Group-A (blank) produces less number of well formed faeces when compared to Group-B (test) which produces more number of wet faeces. This shows the purgative property of senna.

Uses

Senna leaves show purgative action, hence are used in habitual constipation. It is also used as a stimulant, cathartic and is used to promote defecation. It acts as a strong purgative which hastens the emptying of bowels. Senna is used along with carminatives, since it irritates the large intestine and promotes griping action.

Substitutes and Adulterants

Biological Source	Characteristic Features
1. *Dog senna/Italian Senna* Source - Dried leaves of *Cassia obovate* (family-Leguminosae) Location: Indigenous to Egypt and Italy	(a) Obovate leaves (b) Apex is tapering and obtuse (c) Lower epidermal cells are papillaceous (d) Anthraquinone glycoside content is less i.e., 1%
2. *Arabian/Bombay/Mecca Senna* Source - Dried leaves of wild species of *Cassia angustifolia* (family - Leguminosae) Location: Saudi Arabia, Bombay	(a) Similar to Indian senna, but is brownish green in colour. (b) Leaflets are narrower and elongated.
3. *Palthe Senna* Source - Dried leaves of *Cassia auriculata*	(a) Trichomes are numerous, long and hair-like (b) No anthracene glycosides (c) *Distinguishing test* Drug + Chloral hydrate ⟶ Crimson colour

Storage

Leaves are packed in bales and stored in well-closed containers protected from light. The potency remains intact for a period of about 5 years.

Powder Characteristics

The following microscopical characters and chemical tests help to identify the given powdered drug.

1. ***Microscopical Characters***

(a) *Epidermal Cells*

These are polygonal, tubular, epidermal parenchymatous cells with thin, straight anticlinal walls.

(b) *Paracytic (Rubiaceous) Stomata*

These are parallel celled or rubiaceous stomata consisting of two subsidiary cells present around the guard cells.

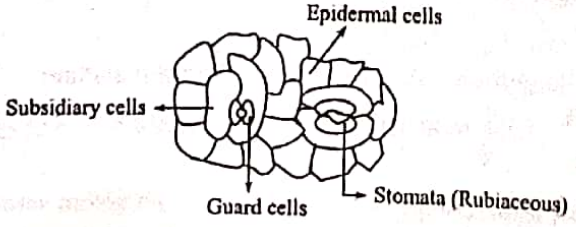


Figure: Paracytic stomata

(c) *Covering Trichomes*

These are unicellular cells, conical in shape with a narrow lumen and thick pitted warty walls. They possess a bulbous base and acute apex. They are 70-260 μ long and 12-18-25 μ wide.

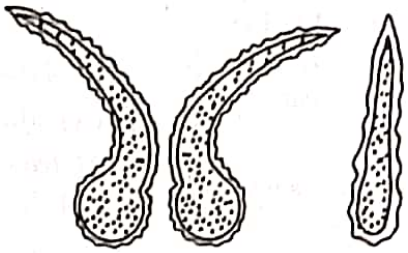


Figure: Covering Trichomes

(d) *Xylem Vessels*

Xylem vessels are lignified with annular thickenings.

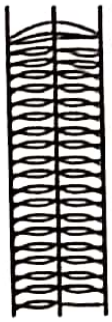


Figure: Xylem Vessels

(e) *Calcium Oxalate*

Calcium oxalate crystals are seen in palisade and spongy tissues. They occur either as isolated or in cluster form. They are abundant in number and in the shape of prisms.

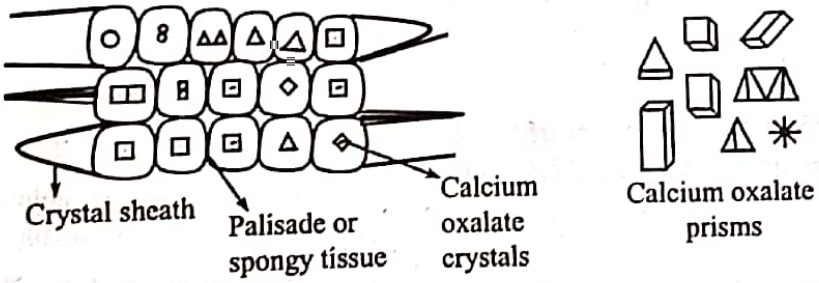


Figure: Calcium Oxalate

2. ***Identification Tests***

(a) Powder + Phloroglucinol + Concentrated HCl (1:1)

↓ Observed under microscope

Red/pink colour appears

(b) Powder + Rhuthenium red

↓ Observed under microscope

Red/pink colour appears

(c) Powder + Sudan red III

↓ Observed under microscope

Pink colour is observed.