

5.2. CARDIOTONICS

5.2.1 ⁷ Introduction

Cardiotonics have a positive inotropic action, as a result of which the heart beats stronger and slower. Cardiac glycosides (sugar-containing substances made from plants), phosphodiesterase inhibitors, and dobutamine (sometimes used in end-stage heart failure to increase myocardial contractility in a dose-dependent manner) are some **examples** of cardiotonics. Digoxin (a preparation of digitalis) is the major cardiac glycoside.

5.2.2. Digitalis

The genus *Digitalis* has around twenty species of herbaceous, perennial, or biennial shrubs. The digitalis plant is also known as foxgloves.

Synonyms

Digitalis leaves and Foxglove leaves.

Biological Source

Digitalis is dried leaves of *Digitalis purpurea*, dried at a temperature below 60°C, immediately after collecting the leaves. The leaves should not contain more than 5% of moisture.

Family

Scrophulariaceae

5.2.2.1. Occurrence and Distribution

Digitalis is cultivated in European countries like England, France, Germany, North America, and India. In India, it is grown in Kashmir and Nilgiri Hills.

5.2.2.2. Organoleptic Evaluation

The organoleptic features of digitalis are (figure 5.6):

- 1) **Colour:** Dorsal surface is deep green and greyish, but ventral surface is pale green and more greyish.

- 2) **Odour:** Slight characteristic.
- 3) **Taste:** Bitter.
- 4) **Size:** Length 10-40cm and width 4-20cm.
- 5) **Shape:** Ovate (egg-shaped), lanceolate (like a lance much longer than broad, widest in the middle, and tapering); apex is pointed; margin is serrated or crenate (broad rounded teeth); tips are obtuse (rounded with narrow spaces); petiole is small and winged.

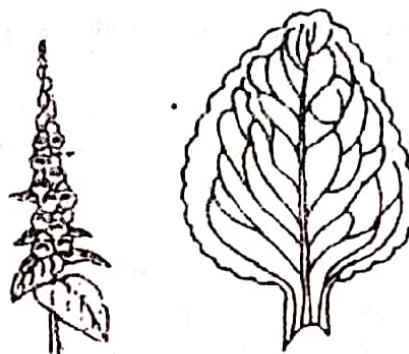
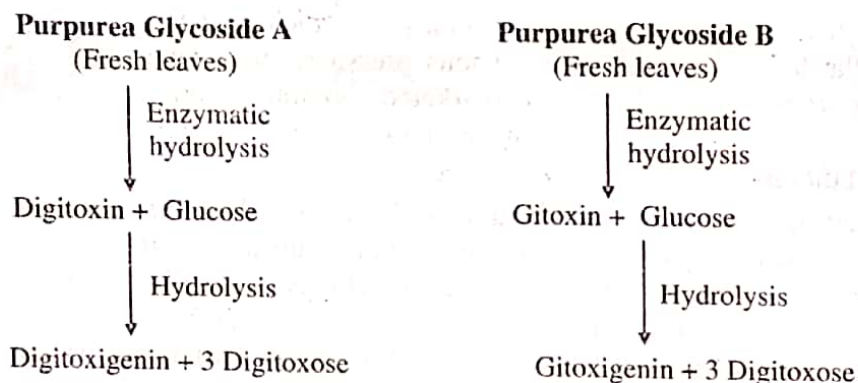


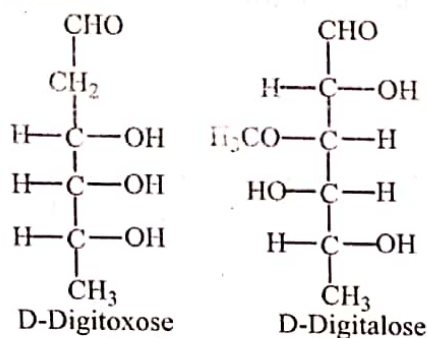
Figure 5.6: Herb and Leaf of *Digitalis Purpurea*

5.2.2.3. Chemical Constituents

Digitalis contains 0.2-0.45% mixtures of both **primary and secondary cardiac glycosides** (cardenolides). **Purpurea glycosides A and B** and **glucogitaloxin** are primary glycosides possessing at C-3 of the aglycone, a linear chain of 3 digitoxose moieties terminated by glucose. Digitalis also contains several other glycosides such as odoroside H, gitaloxin, verodoxin, and glucoverodoxin.



Additionally, it contains 2 **saponin glycosides**, viz. digitonin and gitonin. The total number of glycosides reported in the drug is about 30. Apart from the glycosides, leaves also contain hydrolytic enzymes.



5.2.2.4. Chemical Tests

There are 6 tests for digitalis:

- 1) **Keller-Kiliani Test for Digitoxose:** The test involves boiling about 1gm finely powdered digitalis with 10ml 70% alcohol for 2-3 minutes. The extract is filtered and the filtrate is added to 5ml water and 0.5ml strong solution of lead acetate. The mixture is shaken well and the filtrate is separated. The clear filtrate is treated with equal volume of chloroform and evaporated to yield the extractive. The extractive is dissolved in glacial acetic acid and after cooling, 2 drops ferric chloride solution is

added. These contents are transferred to a test tube containing 2ml concentrated sulphuric acid. A reddish brown layer acquiring bluish-green colour after standing develops due to the presence of digitoxose.

- 2) **Legal Test:** The extract is dissolved in pyridine, sodium nitroprusside solution is added to it, and made alkaline. A pink or red colour develops.
- 3) **Baljet Test:** To a section of digitalis, sodium picrate solution is added. It shows yellow to orange colour.
- 4) **Kedd's Reagent:** Cardenolides react with this reagent to develop blue or violet colour.
- 5) **Raymonds Test:** Digitalis is dissolved in 1ml of 50% ethanol and 0.1ml of 1% solution of dinitrobenzene in ethanol or methanol is added. Further 2-3 drops of 20% NaOH is added. The solution develops violet colour which changes to blue.
- 6) **Tollen's Test:** Glycoside when dissolved in pyridine and ammoniacal silver nitrate solution forms a precipitate of silver.

5.2.2.5. Therapeutic Efficacy

Digitalis has the following therapeutic properties:

- 1) It enhances the contraction force of heart muscles which increases the cardiac output, decreases the heart size, decreases venous pressure, and decreases blood volume. Due to these reasons, digitalis and its marketed preparations are used as cardiotonics in different kinds of congestive heart failure, atrial flutter, atrial fibrillation, supraventricular tachycardia, and premature extra systoles.
- 2) It exerts an overall cumulative effect in the body, thus undergoes gradual elimination. It is important to monitor the dosage regimen by a physician who relies on either branded products or on natural drug preparations, e.g., Digitoxin injection, Lanoxin, Prepared digitalis, and Digitalis tincture.

5.2.3. Arjuna

Arjuna is a tree bark used in Ayurveda medicinal system for maintaining cardiovascular health pertaining to the heart itself.

Synonyms

Arjun bark and Arjun

Biological Source

Arjuna is the dried stem bark of *Terminalia arjuna* Rob.

Family

Combretaceae

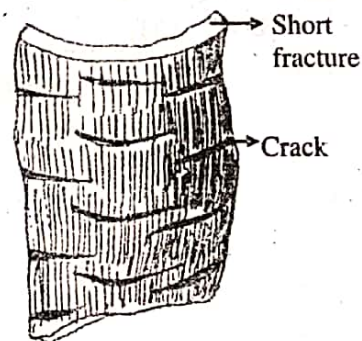


Figure 5.7: Arjuna Bark

5.2.3.1. Occurrence and Distribution

Arjuna is found throughout India, especially in the sub-Himalayan tracts and Eastern India. It is widely grown in Bandhavgarh National Park, Pench Tiger Reserve, and Kanha National Park in India. It is grown on the banks of rivers and streams.

5.2.3.2. Organoleptic Evaluation

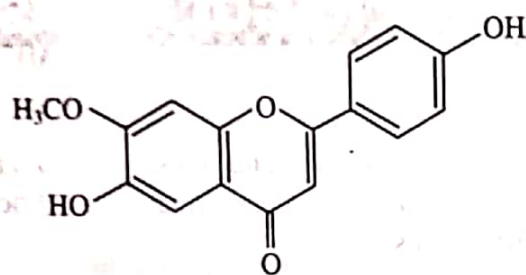
Arjuna bark has the following organoleptic properties (figure 5.7):

- 1) **Colour:** Greyish-brown from the outer as well as the inner side.
- 2) **Size:** Pieces of various-sizes, about $15 \times 10 \times 1$ cm are available.

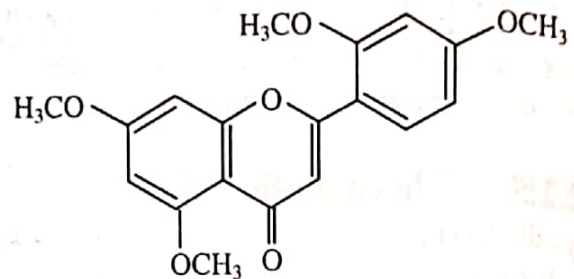
- 3) **Surface:** The transversely cut surface is dark brown and has characteristic greyish shining patches.
- 4) **Extra Features:** Presence of cork is not reported in the commercial drug. Arjuna bark is collected from old trees, thus the cork gets removed due to exfoliation.

5.2.3.3. Chemical Constituents

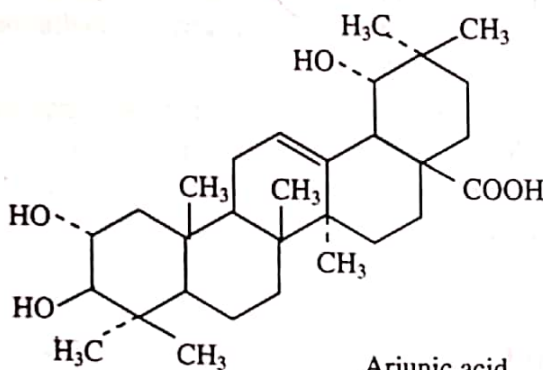
Arjuna bark contains hydrolysable tannins (about 15%), triterpenoid saponin, arjunolic acid, arjunic acid, and arjunogenin. It also contains β -sitosterol, ellagic acid, and arjunic acid. Arjunine and arjunetine are its crystallisable compounds. Arjunetin, arjunolone, and arjunone are the flavonoids present. Some other constituents are calcium, aluminium, and magnesium salts, along with colouring matter and sugar.



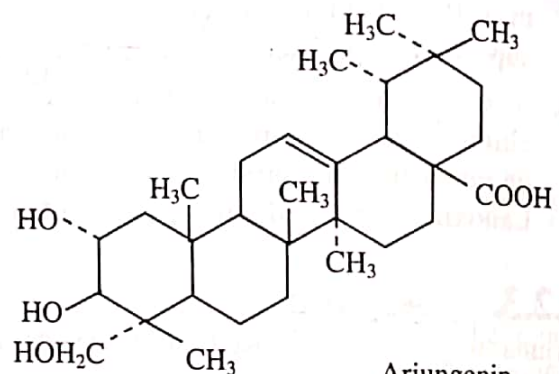
Arjunolone



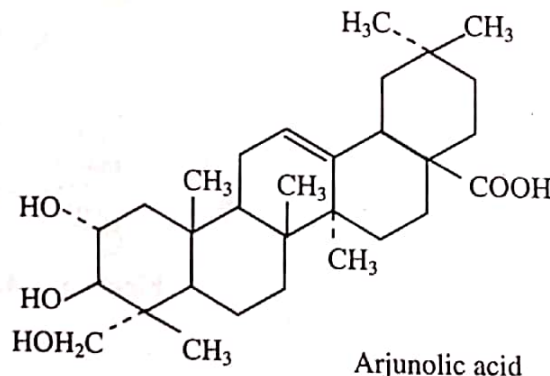
Arjunone



Arjunic acid



Arjunenin



Arjunolic acid

5.2.3.4. Chemical Test

Arjuna is extracted with ether and the product obtained shows pinkish fluorescence under UV light.

5.2.3.5. Therapeutic Efficacy

Arjuna has the following therapeutic properties:

- 1) The juice of its leaf has been used in traditional Ayurvedic medicine system for treating dysentery and ear ache.

- 2) It helps in maintaining normal cholesterol levels, as it possesses antioxidant properties.
 - 3) It strengthens the heart muscles and maintains the normal functioning of heart.
 - 4) It improves the functioning of cardiac muscles.
 - 5) It is used for treating coronary artery disease, heart failure, oedema, angina, and hypercholesterolemia.
 - 6) Its bark possesses diuretic, prostaglandin enhancing, and coronary risk factor modulating properties.
 - 7) It is also used for treating asthmatic conditions.
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