

## 30.1. CARDIAC GLYCOSIDES

### 30.1.1. Introduction

Cardiac glycosides are derived from the foxglove plant (*Digitalis purpurea*). William Withering in 1785, described the therapeutic benefits of digitalis. Primarily, digitalis was used for treating dropsy, an old word for oedema. Further investigations established that digitalis was most helpful for oedema caused by weakened heart (i.e., heart failure).

### 30.1.2. Sources

The natural sources of cardiotoxic agents are foxgloves (*Digitalis* spp.) and related plants. Foxgloves contain several cardiac glycosides with similar actions. The cardiac glycosides and their sources are as follows:

Table 30.1: Sources of Cardiac Glycosides

Sources	Glycosides
<i>Digitalis purpurea</i> (leaf)	Digitoxin, Gitoxin, and Gitalin
<i>Digitalis lanata</i> (leaf)	Digitoxin, Gitoxin, and Digoxin
<i>Strophanthus gratus</i> (seed)	Strophanthin-G (quabain)
<i>Thevetia nerifolia</i> (nut)	Thevetin
<i>Bufo vulgaris</i> (toad skin)	Bufotoxin
<i>Convallaria majalis</i>	Convallotoxin
<i>Urginea</i> (scilla), <i>maritima</i> (bulb)	Proscillaridin-A

### 30.1.3. Individual Compounds

The following drugs are studied in detail:

- 1) Digoxin, and
- 2) Digitoxin.

#### 30.1.3.1. Digoxin

Digoxin is a purified cardiac glycoside, derived from the leaves of digitalis plant. It works by affecting certain minerals (sodium and potassium) inside heart cells. This reduces strain on the heart and helps it maintain a normal, steady, and strong heartbeat.

**Molecular Formula:**  $C_{41}H_{64}O_{14}$

**IUPAC Nomenclature:** 4-[(1S,2S,5S,7R,10R,11S,14R,15S,16R)-5-[[[(2R,4S,5S,6R)-5-[[[(2S,4S,5S,6R)-5-[[[(2S,4S,5S,6R)-4,5-dihydroxy-6-methyloxan-2-yl]oxy]-4-hydroxy-6-methyloxan-2-yl]oxy]-4-hydroxy-6-methyloxan-2-yl]oxy]-11,16-dihydroxy-2,15-dimethyltetracyclo[8.7.0.0<sup>2,7</sup>.0<sup>11,15</sup>]heptadecan-14-yl]-2,5-dihydrofuran-2-one.



**Properties:** Digoxin occurs as clear to white coloured crystals or white coloured powder with a bitter taste and no odour. It is soluble in dilute alcohol, pyridine, or a mixture of chloroform and alcohol; and practically insoluble in acetone, ethyl acetate, acetone, water, and chloroform.

**Uses:** Digoxin is used for treating and managing congestive cardiac insufficiency, heart failure, and arrhythmias. It is also used to treat a certain type of irregular heartbeat (chronic atrial fibrillation).

**Stability and Storage Conditions:** Digoxin preparations should be stored at 15-25°C temperature and should also be protected from light.

**Types of Pharmaceutical Formulations:** Tablet, injection, capsule, and oral solution.

**Brand Names:** Cardioxin, Digitran, Digoxin, and Lanoxin.

### 30.1.3.2. Digitoxin

Digitoxin is a cardiac glycoside which is occasionally used in place of digoxin. Its half-life is longer than digoxin, and toxic effects similar to digoxin lasts longer.

**Molecular Formula:**  $C_{41}H_{64}O_{13}$

**IUPAC Nomenclature:** 3-[(3S,5R,8R,9S,10S,13R,14S,17R)-3-[(2R,4S,5S,6R)-5-[(2S,4S,5S,6R)-5-[(2S,4S,5S,6R)-4,5-dihydroxy-6-methyloxan-2-yl]oxy-4-hydroxy-6-methyloxan-2-yl]oxy-4-hydroxy-6-methyloxan-2-yl]oxy-14-hydroxy-10,13-dimethyl-1,2,3,4,5,6,7,8,9,11,12,15,16,17-tetradecahydrocyclopenta[a]phenanthren-17-yl]-2H-furan-5-one

**Properties:** Digitoxin occurs as a white or pale buff coloured microcrystalline powder with a bitter taste and no odour. It is almost insoluble in water; soluble in acetate, amyl alcohol, and pyridine; and mildly soluble in ether, alcohol, and petroleum ether.

**Uses:** Digitoxin is used for treating and managing congestive cardiac insufficiency, heart failure, and arrhythmias.

**Stability and Storage Conditions:** Digitoxin tablets should be stored at 15-30°C temperature in well-closed containers.

**Type of Pharmaceutical Formulation:** Tablets.