

SOME CHEMICAL CONSTITUENTS OF MEDICINAL PLANTS

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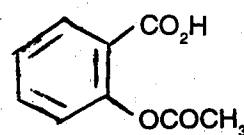
The use of plants and parts of plants such as leaves, root, bark seeds etc., as remedies for various ailments and diseases that afflict man, is almost as old as mankind. Man's curiosity to examine his environment by trial and error led him to discover which materials provided food and nourishment, which substances were toxic and which ones gave him relief from pain.

The use of plants as curative agents has over the years established distinct systems of medicine. The allopathic or Western system of medicine has developed through the advancement of science while some of the ancient practices remained in the hands of traditional healers. The ancient, methods of treatment developed into Ayurveda, Sidda, Unani, Chinese and other traditional systems of medicines.

Plants by far were the main source of all drugs until the development of synthetic drugs during the last century. Chemists have investigated plant extracts in their search for active compounds, leading to the development of new drugs.

It is interesting how scientists in the early days, explored nature and unravelled its secrets by discovering the medicinal value of plants. It is believed that Hippocrates, who is considered the father of modern medicine used medicinal plants. The white willow (salix) is one such plant. As far back as 1700 salix has been used in the form of a decoction as a remedy for fever. However, it was more than a century later that a French chemist by the name of Leroux extracted the active substance from the bark of salix. This substance was

called "salicin" and was used a pain relieving agent (analgesic). Many derivatives of salicin were prepared and much later in the 1890's Bayer, a German Company launched a new product - acetylsalicylic acid. This product was marketed as "Aspirin", which is today a household name and the world's most widely known medication.



Aspirin (Acetylsalicylic acid)

Chemists have characterized and identified many active substances from plant extracts, some of which have led to the development of valuable drugs. Most of the active substances belong to the following chemical classes of compounds:

1. Alkaloids,
2. Terpenes,
3. Steroids,
4. Phenolic substances,
5. Cardiac glycosides.

The Alkaloids

These are substances containing nitrogen, and widely distributed in plants. Their physiological effects were discovered by many ancient peoples much before Organic chemistry developed.

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Quinine, which is an alkaloid, is one of the major active constituents of the bark of the cinchona tree. As far back as 1639 it was known developed much later. To serve as a commercial source of the drug, cinchona trees were cultivated in the Dutch East Indies. Examples of other alkaloids obtained from plants are:

Nicotine - (a stimulant, increases blood pressure); from the tobacco plant

Cocaine - (a powerful anaesthetic and stimulant); from coca leaves

Berberine - (paralytic effect, increases blood pressure); from barberry root

Morphine, codeine - (pain killers, toxic unless taken in small doses, habit forming); from poppy seeds

Piperidine - from black pepper

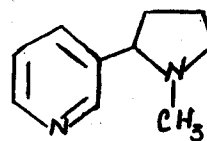
Reserpine - (for hypertension, nervous and mental disorders); from *Rauvolfia serpentina*

Vincristine, Vinblastine - (used in the treatment of leukaemia); from *Catheranthus*

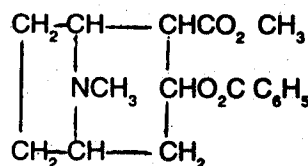
Many valuable drugs have been developed in the West from Sri Lankan medicinal plants such as *Rauvolfia serpentina* (Ekaweriya) and *Catheranthus roseus* (Minimal). *Catheranthus* is also known as the rose periwinkle. It grows wild on waste land and is often found growing in cemeteries; hence the Sinhalese name Minimal. Unknown to many,

much research has been carried out on the properties of its alkaloids, two of which are used in the treatment of leukaemia - vincristine and vinblastine. Most of the medicinal plants used in Ayurveda contain alkaloids eg. *Adathoda vasica*, *Solanum xanthocarpum* (Katuwelbatu).

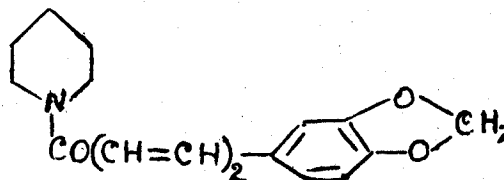
All alkaloids are bases containing nitrogen, but they exhibit a wide variety of structural features:



Nicotine



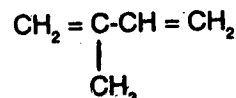
Cocaine



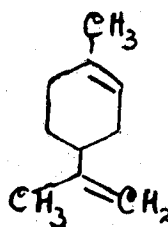
Piperidine

Terpenes

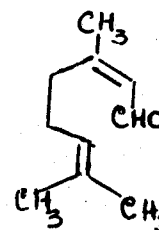
These compounds present in plants are based on the C5 unit, isoprene:



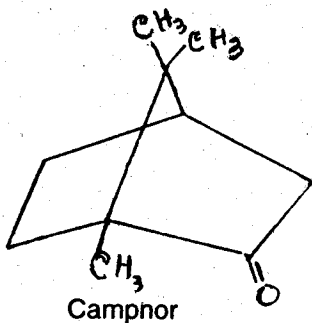
Mono terpenes contain two of these units, sesquiterpenes three, diterpenes four, triterpenes six and tetraterpenes eight units. Camphor, a monoterpene has medicinal properties. *Vernonia cinerea* (Monarakudumbiya) and *Azadirachta indica* (Kohomba) are two other plants that contain these compounds.



Limonene (lemon, orange)

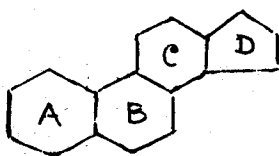


Citral (oil of lemon grass)

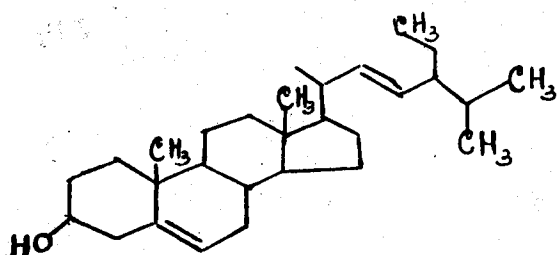


Steroids

Steroids have the following ring system in their chemical structure:



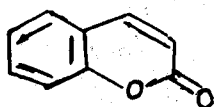
They bear a close structural relationship to the triterpenes. Many plant constituents are sterols. eg. stigmasterol, setoserol, cholesterol etc. Diosgenin from the plant *Dioscorea deltoidea* is the main raw material for the production of steroid hormones.



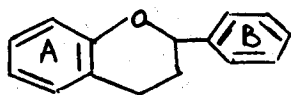
Stigmasterol

Phenolic compounds

A large number of phenolic substances occur in plants: Eg. phenolic acids, flavonoids, coumarins, anthocyanins. These have been identified in plant-extracts showing biological activity.



Coumarin



Ring system in Flavanoids

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for the youth of
our country to realize the
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and improve the
quality of life.**

**Preserving and protecting
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achieving this goal.**

Cardiac glycosides

These compounds possess the property of causing the heart muscles to contract. In small doses these are used in the treatment of cardiac problems. These occur as glycosides in purple foxglove- eg. digitoxigenin, digoxigenin.

Also present in plants are nutrients such as carbohydrates, vitamins, minerals, aminoacids, proteins, fattyacids, and lipids.

Chemists have isolated and identified many of the constituents of medicinal plants through phytochemical studies and advanced analytical techniques. The activity of these substances have been determined by various bioassay methods. Some of which are specific to the activity eg. antiulcer, antidiabetic.

New compounds identified from plants have been usually named after the plant source as seen in Table 1, which lists some of the chemical constituents of Sri Lankan medicinal plants.

Scientists have investigated the chemical constituents and the activity of several medicinal plants used in Ayurveda. Some plants used in Ayurveda and the indigenous system of medicine in Sri Lanka and their chemical constituents are listed below.

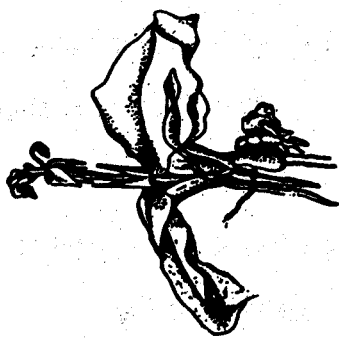
TABLE 1: SOME CHEMICAL CONSTITUENTS PRESENT IN MEDICINAL PLANTS.

Name of the Plant	Some Important Chemicals Constituents
1. <i>Adathoda vasica</i> (Adathoda)	vansicine, vasicinone
2. <i>Hemidesmurs indicus</i> (Iramusu)	hemidesmine
3. <i>Solanum virgintanum</i> (Katuwelbatu)	solasodine
4. <i>Solanum nigrum</i> (Kalukammeriya)	solanidine, solasodine
5. <i>Abraus precatorius</i> (Olinda)	glycyrrhizin, abrin
6. <i>Terminalia chebula</i> (Aralu)	garlic acid, phenolic substances (tannins)
7. <i>Vernonia cinerea</i> (Monarakudumbiya)	sitosterol, stigmasterol, amyirin, flavanoids
8. <i>Gloriosa superba</i> (Niyagala)	colchicine, gloriosine, lumicolchicine
9. <i>Azadirachta indica</i> (Kohomba)	azadirone, nimbidin, diterpenes, sterols, flavanoids
10. <i>Centella asiatica</i> (Gotukola)	asiaticosides
11. <i>Datura metel</i> (Attana)	atropine, hyoscyne, hyocyamine, scopolamine
12. <i>Withania somnifera</i> (Amukkara)	withanine, somniferine, nicotine
13. <i>Trachyspermum roxburghianum</i> (Asamodagam)	thymol
14. <i>Kaemferia galanga</i> (Hinguru piyali)	cinnamic acid, borneol, camphene, cineol, conmarines
15. <i>Zingiber officinale</i> (Inguru)	zingiberine, camphene, phillandrene "ginger oleoresin"
16. <i>Coscinum fenestratum</i> (Barwelgeta)	berberine
17. <i>Rauvolfia serpentina</i> (Ekaweriya)	ajmalicine, thebaine, yohimbine, serpentine reserpine....
18. <i>Catheranthus roseus</i> (Minimal)	vindoline, catheranthine vincaloeoblastine, vincristine yohimbine ajmalicine...
19. <i>Coleus amboinicus</i> (Kapparawalliya)	carvacrol
20. <i>Sida rhombifolia</i> (Kotikan bevila) <i>Sida cordifolia</i> (Wel bevila)	ephedrine

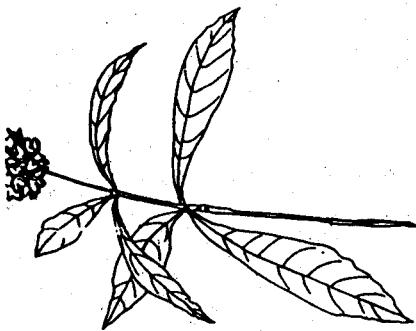
Unlike in the allopathic system of medicine, in Ayurveda it is not possible to say which single chemical compound or compounds are responsible for the therapeutic effects of a particular treatment. The part of the plant used in the preparation, the method of preparation the manner in which the drug is administered - all these play a role in achieving the desired effect from the treatment. Infact, Ayurveda is described as a way of life. The scientific approach to Ayurveda therefore has to be confined to the correct identification of plant material, standardization of the drug and standardization and quality control of the final product.

Among the medicinal plants of Sri Lanka are endangered species threatened with extinction, due to the unlimited exploitation of these by foreign nationals. Many a villager would oblige them by going into the jungles and collecting the plants - just for a few dollars. It is important for the youth of our country to realize the vast potential of our natural resources, to safe guard our heritage and improve the quality of life. Preserving and protecting our flora is one step towards achieving this goal.

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Kaempferia galanga



Rauvolfia serpentina (L)



Solanum nigrum L.



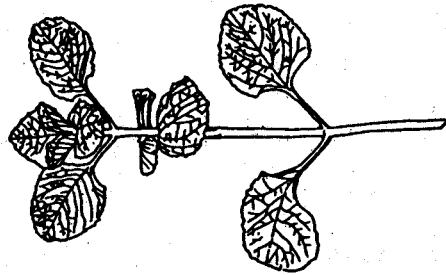
Datura metel L.



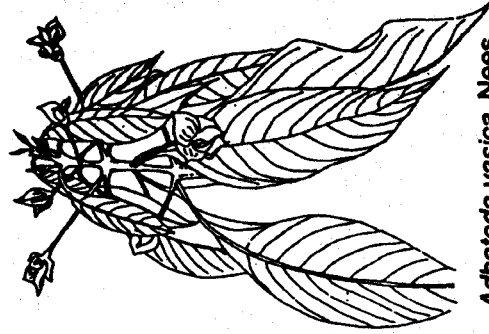
Hemidesmus indicus L.



Solanum virginianum L.



Coleus amboinicus



Adhatoda vasica Nees

Some Medicinal Plants of Sri Lanka