PROCEEDINGS

OF THE SECOND SYMPOSIUM

ON THE BOTANY OF THE BAHAMAS

Editor

Robert R. Smith

CCFL Bahamian Field Station

San Salvador, Bahamas

Printed by Don Heuer in the USA

ISBN 0-935909-

MEDICINAL PLANTS OF SAN SALVADOR, THE BAHAMAS

Virginia White
Chemistry Department
Smith College
Northampton, Massachusetts

ABSTRACT

The medicinal use of bush teas prepared from certain plants on San Salvador, The Bahamas, has been correlated, wherever possible, to known physiological activity of specific chemicals extracted from these plants.

INTRODUCTION

Even though modern drugs are available on the island of San Salvador, many of the older inhabitants still prefer to use the traditional bush medicines. The natives prepare the medicinal teas by boiling the plant in water for several minutes and straining the brew. Sometimes citron fruit juice, sugar, or milk is added to the teas to make them more palatable (White, 1987).

It is assumed that the same plant will synthesise the same chemical wherever it is grown, but in varying concentration, depending on the season, the climate, the soil conditions, herbivory, and perhaps genetic variation.

It is commonly believed that about 10% of vascular plants contain alkaloids. This group of compounds contains a basic heterocyclic nitrogen atom and are synthesised in the plant from amino acids and their immediate derivatives. They frequently affect the central nervous system as a toxin and are sought after as sources of drugs. The alkaloids are probably produced in the leaves and then carried in the sap to other parts of the plant, such as the bark or seeds, where they are stored. A plant is screened initially to determine which classes of compound are present. The plant is first pulverised and treated with dilute acid to extract the water soluble components. Any alkaloids present are precipitated with specific reagents that react with the basic nitrogen atom. The extract may also be tested for terpenoids, steroids, glycosides and sugars, and flavonoids. Even if a material is found in trace quantities, it may be physiologically significant, and further extractions with other solvents are needed to extract sufficient pure sample for identification and testing.

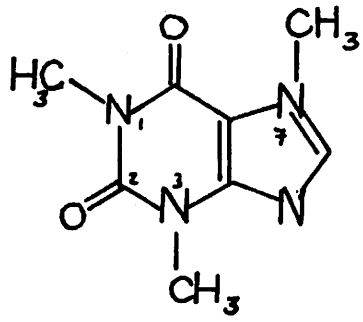
Turnera ulmifolia (Cup and Saucer or Bahama Buttercup): This aromatic shrubby herb or shrub grows to 1m in sandy or gravelly soil in open areas, beach sands, scrublands, coppice-covered hills, and coastal dune areas. It is found throughout the Bahamas, Florida, Bermuda, the West Indies, and continental tropical America. The flowers are dark--yellow, sometimes with a brown spot at the base (Correll & Correll, 1982).

A few leaves are often added to those from other plants to prepare a herbal tea with an added "pick me up".

Caffeine and deidaclin have been extracted from this plant (Tantisewie et al., 1969) with as much as 1% caffeine being extracted from the seeds of the plant (Tarar & Patil, 1979). Caffeine is an alkaloid with a chemical structure of 1:3:7 trimethyl xanthine (Fig.1). Small quantities of caffeine can act as a toxin to the central nervous system and affect one's well being. Deidaclin is a cyanogenic glycoside (a sugar derivative) otherwise known as tetraphyllin A (Fig 1). It can be enzymatically hydrolysed in the body to give hydrogen cyanide and a carbonyl compound by a process called cyanogenesis. Hydrogen cyanide is toxic to the human system as is caffeine in large quantities.

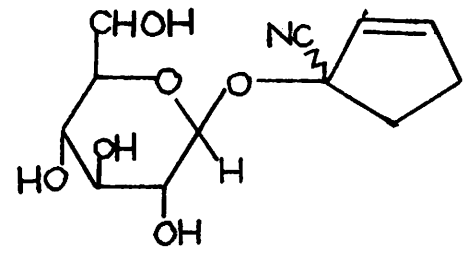
Heliotropium angiospermum (Babybush or Scorpion-tail): This loosely branching coarse weedy annual or short-lived perennial herb grows 3-8dm tall in open coppices, disturbed soil, wastelands, rockflats and pasturelands. It is found throughout the Bahamas (except for Grand Bahamas and the Abacos), southern United States, Mexico, Central America, the West Indies and South America (Correll & Correll, 1982).

The tea prepared from the stalk of this



Caffeine

1:3:7 trimethyl xanthine



Deidaclin

(tetraphyllin A)

Figure 1

plant is taken as a tonic.

Pyrrolizidine alkaloids have been extracted from young plants collected either during the flowering or fruiting season. The main component (97%) is the necine, 1beta; 2beta, -epoxyl -1alpha hydroxymethyl- 8alpha pyrrolizidine, a nonesterified amino alcohol (Birecka et al., 1984) (Fig 2). No physiological testing on this compound has been reported.

Two similar alkaloids have been extracted from *Heliotropium indicum*, a small herb found in S.India; Indicine-N-oxide which has been determined to be an active antitumor agent, and heliotrine 2, one methyl group different, being an established carcinogen (Nakanishi et al.,1978) (Fig.2).

Croton linearis (Granny Bush): This aromatic shrub with narrow linear leaves grows 1-2m tall in dryish habitats such as scrublands, rock formations, gravelly and sandy soils in rather open areas. It is found in Florida, the mid and southern Bahamas, and the West Indies (Correll & Correll, 1982).

A tea prepared from the leaves is given to a woman who has just given birth to help her uterus contract and to reduce the associated pain. The tea is taken for nine mornings following birth.

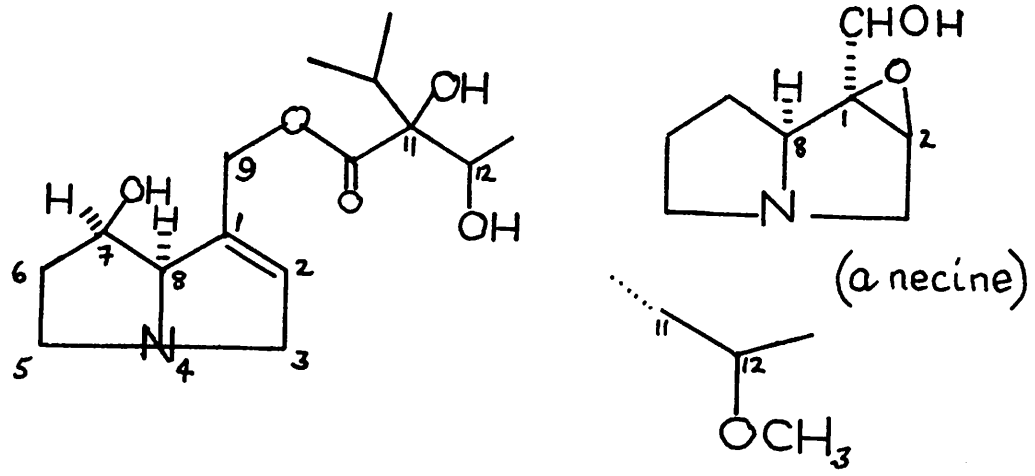
Gamma-aminobutyric acid (GABA) (Fig. 3) has been isolated from the tea extract. Physiological testing on laboratory animals shows that GABA lowers blood pressure if directly injected into the blood stream (Feng, 1962). This amino acid is found in high concentrations in the brain and has been postulated as a possible chemical neurotransmitter. Increasing its concentration in the brain cells inhibits brain cell activity (Julien, 1975). Both of these effects could account for its medical success on the island.

Croton discolor resembles a venose broad-leaved form of *Croton linearis* and is common only on San Salvador and Rum Cay. It is used interchangeably with *C. linearis* as a medicinal plant.

Croton eluteria (Sweetwood bark or Cascarilla): This silver-shining willowy shrub or small tree with its rich spicy odor grows to 4m tall on open rocky slopes, in fields, behind dunes, and on coppice-covered ridges throughout the mid-Bahamas, Mexico, the West Indies, and northern South America (Correll & Correll, 1982).

The bark from this treelike shrub was collected by the women of San Salvador and bartered for flour and sugar during the first half of the twentieth century. Extracts from the bark were used in commercial medicines as an aromatic stomachic tonic. On the island the natives steeped the twigs in boiling water to make a tea that is used to sooth a cough from a cold.

The main ingredient extracted from the bark is cascarillic acid, an eleven carbon cyclopropane carboxylic acid (Wilson & Prodan, 1976) (Fig 4).

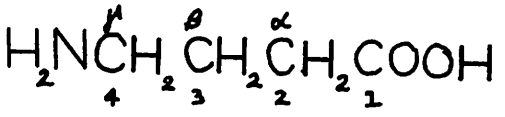


Indicine-N-oxide (antitumor agent)

Heliotrine (carcinogen)

Pyrrolizidine alkaloids

Figure 2



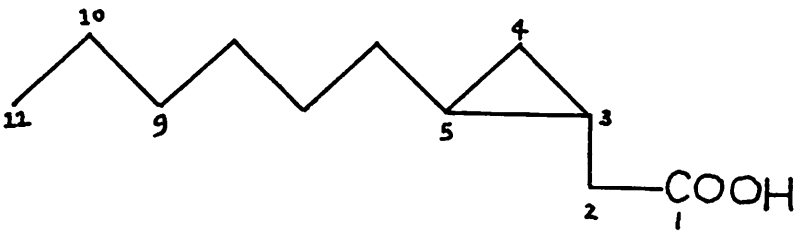
γ-aminobutyric acid

(or 4-aminobutanoic acid)

Figure 3

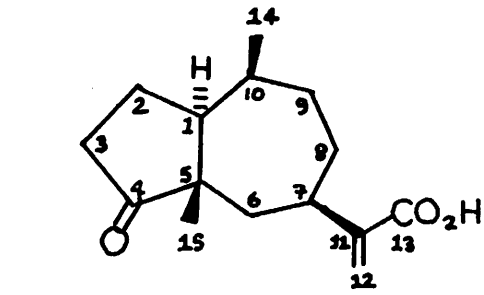
Ambrosia hispida (Bay Geranium): This clump forming perennial has trailing stems up to 80cm long with leaves that are 2 or 3-pinnately divided giving the leaf a lacy appearance. It grows on beach and dune sands along shores or bay areas and can be found throughout the Bahamas (except for Cat Island), Florida, Mexico, Central America, the West Indies and northern South America (Correll & Correll, 1982).

A tea prepared from the leaves is given to a patient tocontrol the high fever or loss of appetite associated with a cold or flu.

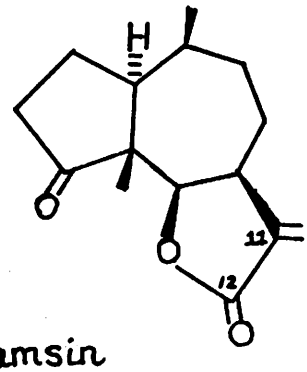


Cascarillic acid

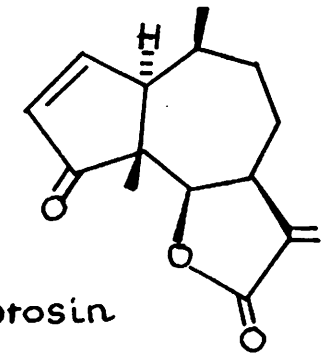
Figure 4



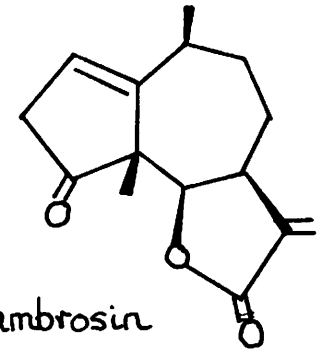
damsinic acid
(sesquiterpene, 15C)



damsin



ambrosin



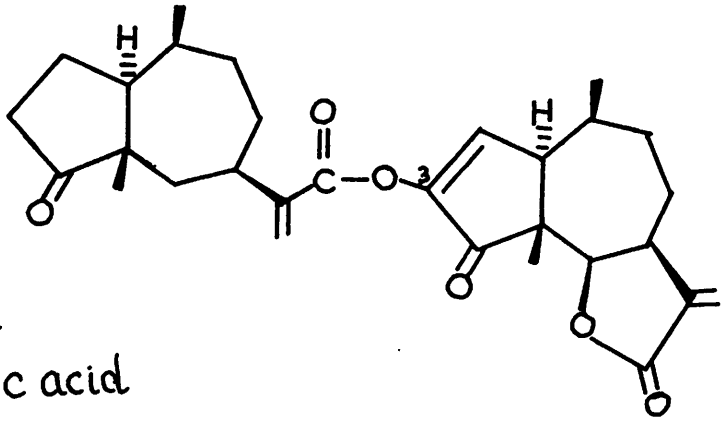
neoambrosin

(sesquiterpene lactones)

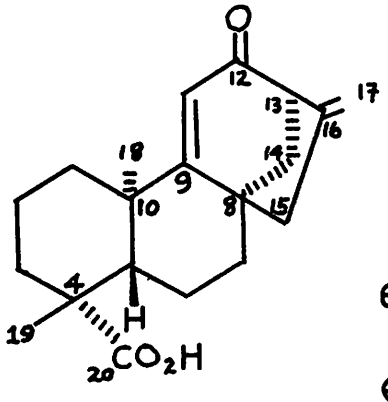
Figure 5

Large quantities of the sesquiterpene, damsinic acid, (a 15 carbon compound) and smaller quantities of the sesquiterpene lactones, ambrosin and damsin, have been extracted from the vegetative state of the plant (Hertz et al., 1981). The mixture contains more damsin when the plant is in flower. Smaller quantities of related products, neoambrosin, 3-hydroxy ambrosin damsinate, ent-12-oxokaura-9(11), 16-dien-19--oic acid and 6-methyoxy-5,7,4'trihydroxy flavone have also been isolated and identified (Figs. 5 & 6).

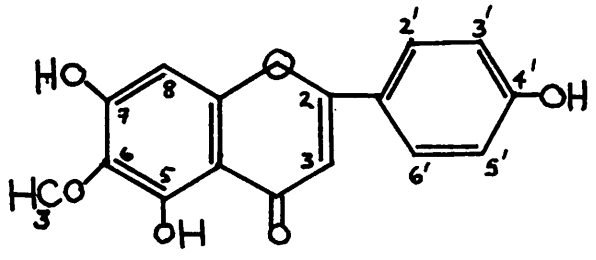
The only known physiologically active ingredient of these sesquiterpenes is ambrosin, a compound known to reduce tumor growths. None of the chemicals isolated have been reported as having any antipyretic (fever reducing) properties that would account for the native use of the plant.



ester of
damsinic acid
and
3 hydroxy ambrosin



ent-kaurenoic acid
or
ent-12-oxokaura-9(11),
16-dien-19-oic acid



hispidulin
or
6-methoxy-5,7,4'
trihydroxy flavone

Figure 6

Aloe barbadensis (Aloe or Snake Plant): This stemless plant has narrow, lanceolate, turgid leaves, 3-6 dm long with toothed leaf margins. It grows naturally on coastal rocks, in thickets, and on the plains and dunes of some of the Bahamian islands, and can be found cultivated throughout the tropics and subtropics (Correll & Correll, 1982).

The jelly from a cut leaf is rubbed directly onto the skin to cure open sores, to alleviate itching from insect bites, and to reduce the redness from sunburn. Thin slivers of the bitter pulp can be swallowed as a purgative.

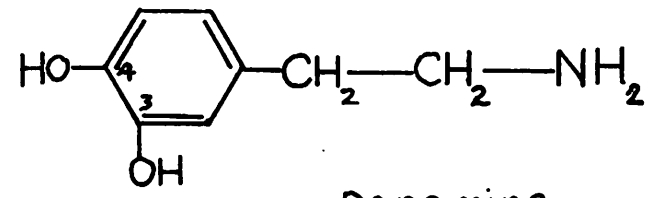
The leaf extracts taken from this plant are separated into several fractions. The gel fraction contains a high concentration of lectin-like substances and the fluid fraction contains material that promotes the growth of human cells and enhances the healing of damaged cell tissue in vitro (Winters et al., 1981). The juice extract from the leaves shows analgesic activity when injected into albino rats (Gupta, 1981). The pulp itself contains a mixture of polysaccharides with a high percentage of pectin acid and several complex sugars (Mandal & Das, 1980). In addition, seventeen amino acids have been identified in the water soluble fraction, and the steroids, cholesterol, campesterol, beta-sitosterol and lupeol have been identified in substantial amounts in the lipid fraction. Only one alkaloid has been detected but has not been identified (Waller et al., 1978). The chemical believed responsible for most of the Aloe plant's healing properties is 7-hydroxy aloin, a polysaccaride (or polysugar) (Rauwald & Voetig, 1982).

Further research carried out by the major drug companies has led to the incorporation of extracts from the natural Aloe plant into commercially sold creams and emollients.

Stachytarpheta jamaicensis (Blueflower): A spiked (1-7dm long) blue flowered erect or spreading herb that grows up to 1m tall, although usually much smaller, in waste areas, on salt flats, palmetto flats, and savannas, in potholes and cleared land. It is found in the Bahamas, Bermuda, Alabama, and Mexico, through Central America and the West Indies to South America (Correll & Correll, 1982).

A tea prepared from the leaves is taken to reduce a fever. A leaf bandaged against a boil helps to bring the pus to the surface and can also be used to clean skin irritations.

The water extract from this plant contains dopamine (Fig 7), a compound that has been found to elevate blood pressure (Feng, 1962).



Dopamine

Figure 7

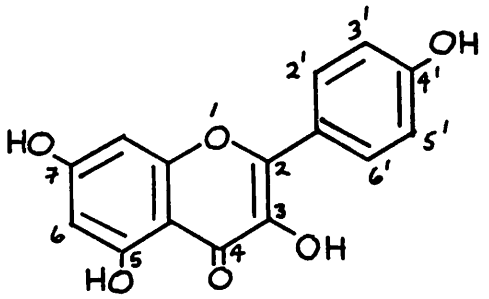
Chenopodium ambrosioides (Jerusalem Bush): This garlic-smelling annual or perennial tap rooted herb grows 2-10dm tall in the waste areas of habitation. It is found in the mid Bahama islands and is established throughout tropical and warm regions of the world (Correll & Correll, 1982).

A tea prepared from young plants is given to small children to clear intestinal worms. Some adults drink the tea as a tonic.

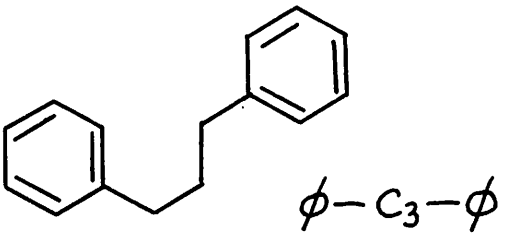
During a study of populations with a high incidence of esophageal carcinoma with their habitual consumption of teas prepared from local plants, this plant was one of twelve medicinal herbs investigated for chemical content. The aqueous extract from *Chenopodium ambrosioides* that was fed to NIH black rats produced tumors in over 50% of the treated animals (Govind, 1978).

Two kaempferol glycosides have been isolated from the plant (Arisawa et al., 1971) (Fig 8). One of the glycosides is kaempferol-7-rhamnoside, the other is kaempferol-7-rhamnoside with one mole of glucose and rhamnose sugars attached. This latter glycoside has been named ambroside.

Solanum erianthum (Salve Bush or Wild Tobacco): This unarmed shrub or small tree, very soft velvety-tomentose throughout with stellate hairs, grows to 3m high, on open rocky hills, opening in coppices, scrublands, disturbed soil, and dump areas throughout the Bahamas (except for the Exumas). It is considered to be a native of tropical Asia, but is now widespread in the American



kaempferol



flavonoid skeleton

Figure 8

tropics and warmer regions (Correll & Correll, 1982).

The tea is taken for a cough from a cold and to raise phlegm from the chest.

The chemical content of many Solanum species has been studied to understand the resistance of certain species to the potato beetle larva. The glycoalkaloid extracted is composed of two parts, an aglycone and a polysaccharide. If the aglycone is of the solasodine type structure (contains a secondary basic nitrogen) the hydroxyl group in the 3Beta position is glycosidically linked to a branched tetrasaccharide, and if of the solanidine structure, then the hydroxyl group is linked to a trisaccharide (Fig.9).

Eight alkaloids have been determined present in extracts from *Solarnum erianthum* and several crystalline materials have been isolated including an alkaloid that gives the aglycone solasodine, and solarmarine, a compound that hydrolyses to give two sugars, galactose glucose and rhamnose (Mola, 1973). This plant evidently synthesises the alkaloids that are not resistant to the potato beetle larvae. There are no reports of any physiological activity from these compounds at this time.

Swietenia mahagoni (Madeira bark)

This deciduous or somewhat evergreen tree with a brown flaking bark can grow to 25m tall with a trunk to about 2m thick, but such large specimens are no longer found on San Salvador. It grows in various coppices, along roadsides and saline flats through the Bahamas (except Cat Island), Florida, Central America and the West Indies to Peru (Correll & Correll, 1982).

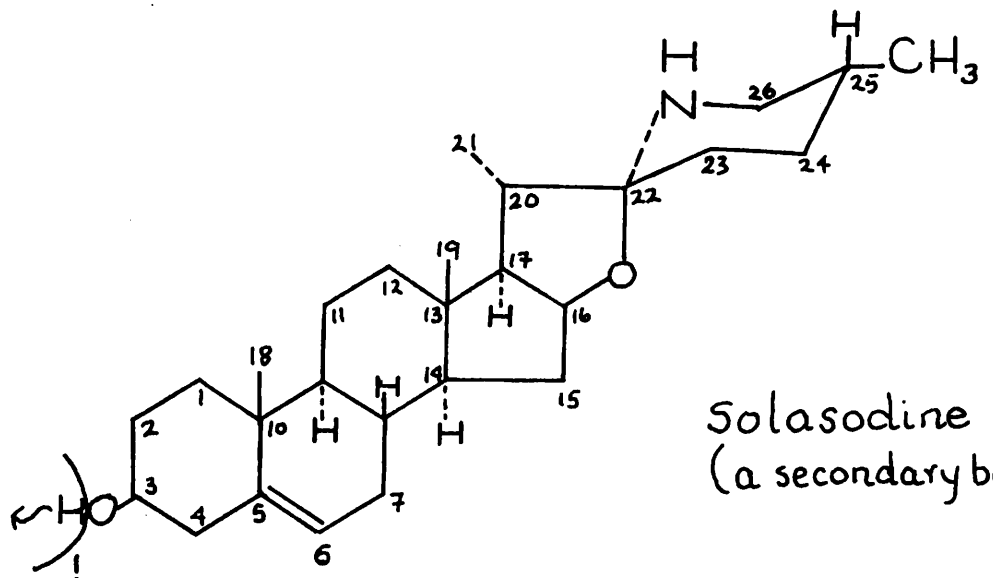
The tea is prepared from the bark of this tree by steeping it in cold water overnight. A woman would take it every morning when she is tired and run down, and feeling "low in iron".

Many chemicals have been isolated from various parts of this tree, but two cyclotriterpenes (31carbons) have been isolated from the bark, cycloartenol (Anjaneyulu et al., 1979) and cycloswietenol (Anjaneyulu et al., 1978) (Fig 10). In addition, cycloswietonol-3--O-beta -D-glucopyranoside has been also extracted (Lakshminarayana et al., 1982). These compounds have not been investigated for physiological activity.

No reports of any chemical analyses of the following plants were found in Bioabstracts, Chemabstracts, and International Pharmaceutical Abstracts from 1976-1986.

1. *Phyllanthus amarus* (Gale of Wind)
2. *Gundlachia corymbosa* (Horsebush)
3. *Capraria-bifloria* (Goatweed)
4. *Bursera simaruba* (Gumbo limbo)
5. *Caesalpinia vesicaria* (Brasiletto)
6. *Salvia serotina* (Catnip)

   (Another plant, *Nepetaria cataria*, is also called catnip and references to studies on catnip refer to this plant and not to *Salvia serotina*.)

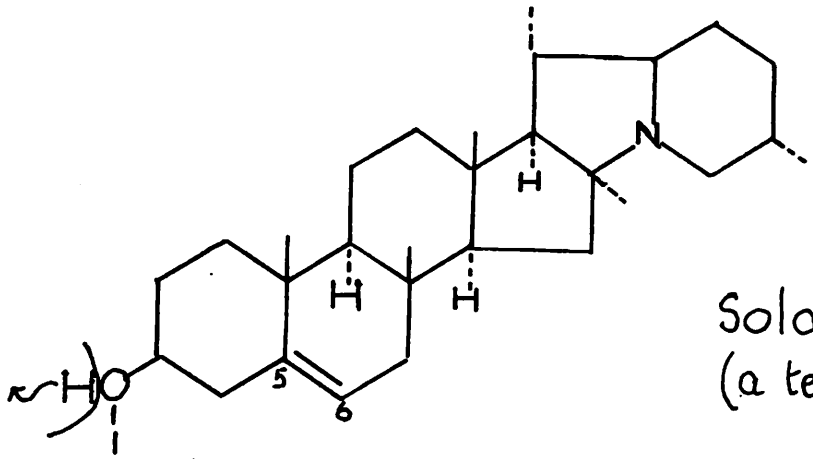


Solasodine
(a secondary base)

glyco
alkaloid

(a branched
tetrasaccharide)

D galactosyl
1↑1
O-D-glucosyl-2-O-D-glucosyl
3↑1
O-D-xylosyl



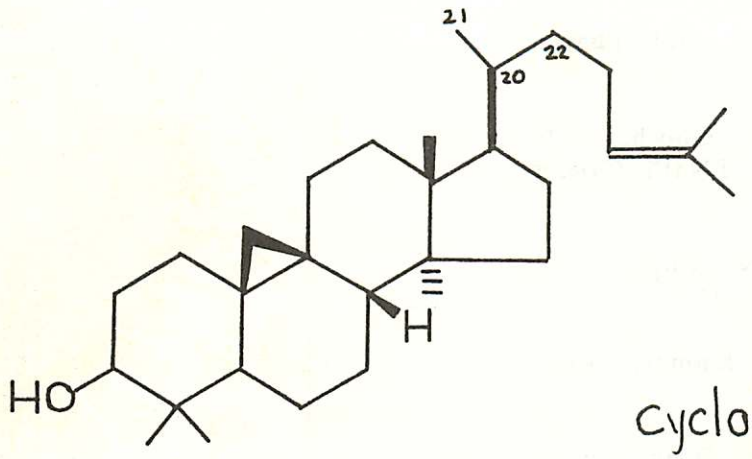
Solanidine
(a tertiary base)

glyco
alkaloid

(a trisaccharide)

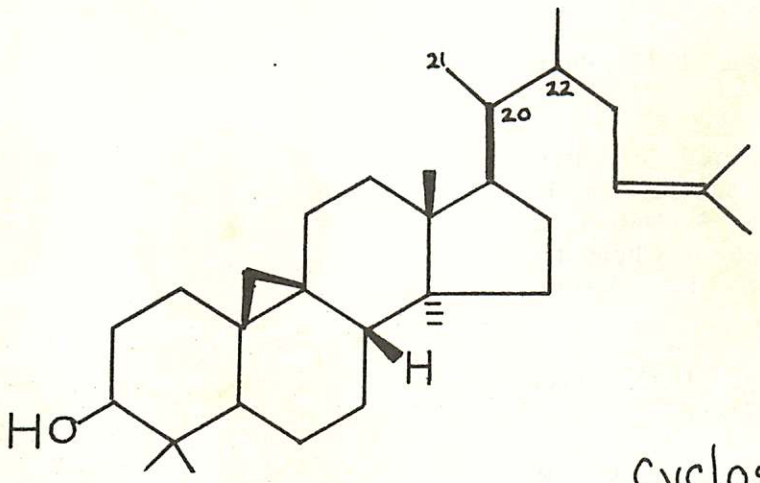
D-glucosyl
6↑1
O-D-galactosyl
4↑1
O-L-rhamnosyl

Figure 9



cycloartenol

2 triterpenoids



cycloswietenol

Figure 10

REFERENCES

Anjaneyulu, A.S.R., Y.L.N. Murty & I.R. Row, 1978, Ind.J.Chem.Sect.B Org.Chem.-incl.med.chem. 16(8): 650-654.

Anjaneyulu, A.S.R., V. Lakshminarayana, Y.L.N. Murty & I.R. Row, 1979, Ind. J.Chem.Sect,B org.chem. incl. med.chem. 17(5): 423-426.

Arisawa, M., N. Minabe, R. Saeki, T. Takakuwa, & T. Nakaoki, 1971, Yakugaku Zasshi 91(5): 522-524.

Birecka, H., T.E. DiNolfo, W.B. Martin & M.W. Frohlich, 1984, Phytochemistry 23: 991-997.

Correll, D.S. & H.B. Correll, 1982, Flora of the Bahama Archipelago. J.Cramer. Vaduz.

Feng, P.C., 1962, Journ. Pharm. and Pharm. 14: 556.

Govind, J.K., E.B. Chung, B. Ghosh, Y.N. Shukla & S.P. Basak, 1978, J.Nat'l Cancer Inst. 60(3): 683-686.

Gupta, R.A., B.N. Singh & R.N. Singh, 1981, J.Sci.Res.Plants Med. 2(4): 110-112.

Hertz, W., D. Gage & N. Kumar, 1981, Phytochemistry 20: 1601-4.

Julien, R.M., 1975, A Primer of Drug Action. W.H. Freeman and Co. San Francisco.

Lakshminarayana, V., Y.L.N. Murty & L.R.Row, 1982, Ind.J.Chem.Sect.B org.-chem.incl.med.chem. 21(3): 179-182.

Mandal, G. & A. Das, 1980, Carbohyd.Res. 87(2): 249-256.

Mola, J.L., U. Hess, W. Doepke, 1973, Pharmazie 28(5): 337.

Nakanishi, K., 1978, Synthesis of Pyrrolizidine Alkaloids. Page 546-549 in K. Nakanishi, T. Goto, S. Ito, S. Natori, S. Nozoe. (eds.) Natural Products Chemistry 3. Univ. Science Books. Mill Valley, Calif.

Rauwald, H.W. & R. Voetig, 1982, Arch Pharm (Weinheim) 315(5): 477-478.

Tantisewie, B., H.W.L. Ruijgrok & R. Hegnaur. 1969. Pharm.Weekbl. 104: 1341.

Tarar, J.L. & K.J. Patil, 1979, Ind.J.Bot. 2(1): 118-119.

Waller, G.R., S. Mangiafico & C.R. Ritchey., 1978, Proc.Okla.Acad.Sci. 58(0): 69-76.

White, V, 1987, Oral History of San Salvador, The Bahamas. CCFL Bahamian Field Station Publication.

Wilson, S.R. & K.A. Prodan, 1976, Tetrahedron Letters. 47: 4231-4234.

Winters, W.D., R. Benavides & W.J. Clouse, 1981, Econ.Bot. 35(1): 89-95.