CHAPTER I

INTRODUCTION AND LITERATURES REVIEW

From earliest times, mankind has used plants in an attempt to cure diseases and relieve physical suffering. Primitive people in all ages have had some knowledge of medicinal plants derived as a result of trial and error. In all the early civilizations, there was much interest in drug plants. Biological studies have started as early as with the Greeks. The work of Aristotle (380 B.C.) on living and non-living things is well known. Theophrastus, a favourite pupil of Aristotle is well known (370 - 287 B.C.) for his botanical work. Pliny's work known as Natural History (23 - 79 A.D.) on medicinal plants was then reported. In China, as early as 5000 to 4000 B.C., many drugs were in use. There are Sanskrit writings in existence which tell of the methods of gathering and preparing drugs. The Assyrians, Babylonians and ancient Hebrews were all familiar with their use. Some of the Egyptian papyri written as early as 1600 B.C., record the news of many of the medicinal plants used today such as myrrh, cannabis, opium, aloes, hemlock and cassia. The Greeks were familiar with many of the present day drugs, as evidenced by the works of Aristotle, Hippocrates, Pythagoras and Theophrastus. King Assurbanipal of Assyria, living in the seventh century B.C. ordered that copies be made of Sumerian, Akkadian and Babylonian documents available to him. Among the 30,000 plates of cuneiform script unearthed from his library, a couple of hundred describe the use of drugs. Some of the original documents are known to have been written in about 4000 B.C. The oldest known herbal is Pen-tsao written by the Emperor Shen Nung (about 2700 B.C.) and contained 365 drugs. The famous medicinal papyrus
of Ebers written about 1700 B.C. described hundreds of drugs used by the ancient Egyptians. In 77 B.C., Dioscorides wrote his great treatise, "De Materia Medica," which dealt with the medicinal plants known at that time.


After the Dark Ages were over, there came the period of the herbalists and encyclopedists and the monasteries of Northern Europe produced vast compendiums of true and false information regarding plants, stressing in particular the medicinal value and folklore. Kao (1973) described the Chinese indigenous therapies and procedures for the advancement of new anti-inflammatory drugs, the bold theory of using purgative in appendicitis in conjunction with herbs and acupuncture, delicate limb and digital connection surgery, the employment of ancient Chinese herbs for the substitution of skin in treating burns and new experimental techniques and concepts that treat man as a whole entity. Alland (1970) described the widespread and long-standing practice of using plants in medicine in Curasaki, especially around the Mediterranean, the sub-continent and China. Stern (1974) explained the system of the Egyptians, the Babylonians and the Vedic Sanskrit. Following the contributions to medicine of Hippocrates (460 - 377 B.C.), Dioscorides (first century A.D.) and Galen (A.D. 31 - 200), together with the early Arabian physicians, there was essentially a period of 1000 years during which little, if any, progress was achieved either in the medicinal sciences or in botany. As far as the classification of plants was concerned, it was Cesalpino (1583) who classified plants according to their flowers and fruits. Bauhin (1596, 1623) described 6000 plants for the first time into definite genera. John Ray (1686 - 1688) categorised plants into dicot and monocot plants with further groupings as families. Linnaeus (1730, 1735, 1737, 1742, 1753) described the
plants in a sequence like class, order, genus and species and introduced the binomial system which is still followed.

Chopra (1958) has described the history of medicine in India from the remote past. The earliest mention of medicinal age of plants is to be found in Rigveda, which is one of the oldest repositories of human knowledge having been written between 4500 and 1600 B.C. In this work, mention has been made of the Soma plant and its effect on man. In the Atharvaveda, which is the later production, the use of drugs is more varied. It is in the Ayurveda which is considered as an Upaveda, that definite properties of drugs and their uses have been given in some detail. Ayurveda in fact is the very foundation stone of the ancient medical science of India. It has eight divisions which deals with different aspects of the science of life and the art of healing.

The age of Ayurveda is fixed by various Western scholars at somewhere about 2500 to 600 B.C. The eight divisions of Ayurveda were followed by two works written later i.e. Susruta and Charaka. About the date of Susruta, there is a great deal of uncertainty but it could not have been written later than 1000 B.C. In this work surgery is dealt with in detail but there is a comprehensive chapter on therapeutics. Charaka written about the same period, deals more with medicine and its seventh chapter is taken up entirely with purgatives and emetics. In the twelfth chapter, there is to be found a remarkable description of materia medica as it was known to the ancient Hindus. From this period down to the Mohammedan invasion of India, Hindu medicine flourished. Its progress may briefly be traced through four distinct stages, namely: (1) Vedic period, (2) Period of original research and classical authors, (3) Period of compilers and also of Tantras and Siddhas and (4) the period of decay and recompilation. During the second and third periods, the progress was remarkable in every respect and Ayurveda then attained its highest development. The nations of the civilised world of that time eagerly sought to obtain information regarding the healing
art from the Hindus of those times, the influence of Hindu medicine permeated far and wide into Egypt, Greece and Rome. The work of the great Physician, Dioscorides definitely shows to what an extent the ancient were indebted to India and the East for their medicine. Many Indian plants are mentioned in his first work, particularly the aromatic group of drugs for which India has always been famed. The smoking of Datura in cases of asthma, the use of Nux vomica in paralysis and use of Croton as purgative can be definitely traced to have originated from India. Some old Sanskrit works dealing with the classification of vegetable drugs and the utilisation of their parts in medicine as practiced by the Hindu physicians of fourteenth or fifteenth centuries ago, provides a most interesting reading. In books like Kalpstanum, elaborate classifications of drugs and medicinal plants are given. Divisions are made under such headings as roots, barks, leaves, flowers, fruits, seeds, acrid and stringent vegetables, milky plants, those containing gums and resins, etc. In the same work, the earliest references occur respecting botanical geography, the sites and climates of different plants, the soils and seasons for collecting medicinal plants, the duration of their efficiency, the method of storage and the weights and measures to be used in pharmacy. There is evidence to show that even in the early Buddhistic period, pharmaceutical gardens were established for growing drugs and herbs for supply to the physician. Detailed instructions are given on every point such as a gathering time, parts to be collected, making of preparations from them, etc.

The study of Indian indigenous drugs was first begun in the early part of the last century and it was then confined to the collection of available information about various medicinal plants. The earliest contribution was in 1810 by John Fleming’s "Catalogue of Indian Medicinal Plants & Drugs, Ainslie’s Materia Medica of Hindoostan, in 1813 and Roxburg’s Flora Indica in 1824. This was followed in 1841 by O'Shanglinessy's "The Bengal Dispensatory and Pharmacopoeia"
which was the first book of its kind which dealt with properties and uses of medicinal plants used in Bengal. In 1868 a *Pharmacopoeia of India* was published under the able editorship of Waring and it signalled a new epoch in establishing and recording the value of indigenous medicinal products. The most elaborate work of all is *A Dictionary of the Economic Products of India* published in 1889 - 1893 by Sir George Watt - the Reporter on the Economic products to the Government of India. This monumental work not only gives a summary of all the previous works on the medicinal plants but every page of it teems with information regarding the use of different barks, roots, flowers, leaves and woods for different medicinal purposes. Work published still later such as Kanny Lal Dey's *Indigenous Drugs of India* (1896) and Kirtikar & Basu's *Indian Medicinal Plants* (1935) are largely summaries and compilations from the above mentioned literature.

Apart from the present volume, another recent work on the subject is *The Wealth of India* 1949 - 53, a very comprehensive treatise which is being published under the auspices of the Council of Scientific and Industrial Research New Delhi.

There are a number of drugs used by the medical profession but which do not naturally grow in this country; they thrive when they are cultivated in our country. Examples: Digitalis, Ipecac, Cinchona, etc. India possesses most wonderful variability so far as the temperature and general climatic conditions are concerned and every drug ranging from those growing in the hottest tropical and damp climates to those growing in dry, temperate and very cold climates can be grown and acclimatised in some part or the other.

During three decades that have followed, the research work on indigenous drugs has received considerable encouragement and has made satisfactory progress. Such semi-Government organisations as the Indian Council of Medical
Research, the Indian Council of Agricultural Research and the last but not the least, the Council of Scientific and Industrial Research, have given very generous grants to various medical institutions and other research bodies for this work. In fact, the last named, the Council of Scientific and Industrial Research established in 1950, the Central Drug Research Institute at Lucknow, is one of the eleven major national laboratories in India. One whole division of this Great Institution is devoted entirely to the study of Indian indigenous plants.

Plants have been studied in India from times immemorial, particularly with reference to their medicinal properties. The Botany of Vrikshyurveda as it was called in ancient India, was a part of the curriculum in seats of learning, comprising collection and study in relation to environment and their efficacy as a medicine and classification was based on such studies. Sanskrit nomenclature has been quite clear and consistent which was adopted by Heinrich van Rheede (1678 - 1703) in his book, "Hortus Malabaricus" which is in fact the main source of inspiration for Linnaeus (1753) in naming Indian plants in his "Species Plantarum". Goa region which is rich in Indian culture and study of Ayurveda, would have been another center for the preparation of useful floristic treatise similar to Hortus Malabaricus with the cooperation of Konkan scholars and Ayurvedic Vaidyas, had the Portuguese administrators who governed the region since 1510, expressed their interest on such projects.

Goa is a small coastal district, roughly in the middle of the Western sea face of the Peninsular India. It forms a part of Southern Konkan with several ingressing arms of Arabian Sea, especially at the confluence of many fast moving short rivers and streams arising in the Western Ghats, e.g. Zuari, Mandovi, Talpona, etc. It is located between 14° 53' 54" - 15° 48' 00" N. and 73° 40' 33" - 74° 20' 13" E. with an area of about 3701 sq.kilometres. The average rainfall is about 110 inches. The mountain ranges running across the main lines of the
Western Ghats or the Sahyadris provide many shady pockets for luxuriant growth of rich vegetation of the semi-evergreen or evergreen types and they form a green belt throughout Goa. Its territorial individuality is entirely related to its political past as a Portuguese Colony from 1488 A.D. to its merger with the rest of India in 1961. For the last 450 years, Goa despite its rich vegetation and scenic beauty, was cut off from the influence of the main land due to alien rule. At the same time, Portuguese explorers brought many plants from their possessions in other parts of the world, the Far East, Africa, Mozambique, South America, etc. and tried to grow them in Goa. Goa therefore is not only rich in indigenous plants but also in exotics.

Garcia da Orta (1563), the personal physician to the Viceroy of the Portuguese Colonies in India, with his vast experience of 30 years contact with the local Ayurvedic Vaidyas and the use of Indian medicine, published *Coloquios dos Simples e drogas he cousas medicinais da India, e essi dalgumas frutas achadas nella tocantes amedica, practica e outras cousas bons para Saber copostos*, an interesting pre-Linnean publication, presenting a detailed account of fifty-seven more commonly used Indian medicinal plants from Goa. This became known to Europe mainly from its Latin translation by Clusius (1567), "Aromatum et Simplicium a Ligno Medicamentorum apud Indos Nascentium Historia". This Latin translation became so popular that it ran into six editions between 1567 and 1595. Conde de Ficalho (1886) an accomplished botanist published a standard annotated edition of this Coloquios with full and admirable notes with botanical names to each colloquy, evidently after consulting all books and research papers. To English readers, Sir Clements Markham's translation (1913) of Ficalho's edition at London was a welcome edition but Soares (1923) in his Article as "Garcia d'Orta, a little known owner of Bombay" indicated that Markham's translation was full of errors. However, 250 copies of this translation were printed and the Copy No. 178 is available in Blatter Herbarium of St. Xavier's College, Bombay.
The Spanish work of Acosta (1578) "Tratado das Drogas e Medicinas das Indias Orientaes" is another book appearing after Orta's colloquios. Though in the preface of this book, it is mentioned that it is the original work of Acosta, Markham indicated that out of 448 pages of text, giving 69 plants, the greater part of it was mostly copied from Orta. However, Acosta's drawings of the plants collected at Cochin and Goa, are found to be useful to illustrate the Colloquios. During the following decades it went through and was translated by the following botanists — Roxburg (1824) published, Flora Indica, occasionally referring to plants of this region as belonging to Konkan, Graham (1839) in his catalogue of Bombay plants has often referred to Lush, who had earlier collected plants from Goa forests. Dalzell & Gibson (1861), Nairne (1894) have also referred to plants from this region in their work. Hooker (1872-97) in his "Flora of British India" often quoted the earlier botanists in the context of plants occurring in Konkan and Goa in particular. Except for this, there is practically no record of any plant material or herbarium specimen from the Portuguese territories of India in the Indian publications on botany of that period. The only half-hearted attempt made by the Portuguese Government to study the natural history of Goa was to commission Manoel Galvao da Silva (1862) to prepare the work "Observacoes sobre a Historia Natural de Goa". This work consisted of 46 pages with 163 species of indigenous and exotic, covering more than half the book and the remaining pages with a brief outline of the Linnean System of classification. D.G. Dalgado says that D'Silva spent hardly two months in Goa and completed the work. D.G. Dalgado (1894) published "Classificacao Botanica das Plantas e Drogas descritas nos Colloquios da India" in Bombay, classifying the plants described by Garcia D'Orta in his Colloquios, with their botanical names and fine drawings of the plants; but later, probably with the publication of Hooker's (1872) Flora of British India, the Portuguese authorities might have encouraged Dalgado (1898) to prepare his "Flora de Goa e Savantvadi", Lisbon to commemorate their rule of 400 years on Indian territory. Dalgado in his introduction to his Flora indicates that
he planned for seven years to complete his work and due to his stay for about
22 years as a Medical Officer in Savantwadi State, he included the States besides
Vengurla and Malwan talukas along with Goa region. This publication of Dalgado,
presented a list of 731 wild species under 478 genera classified into 134 families
and 279 cultivated exotic species under 206 genera representing 69 families. The
vernacular names in Konkani were adopted from Diccionario-Konkani-Portuguez by
S.R. Dalgado (1893) and other local workers and the Portuguese names from
"Compendio de Botanica" by Felix Avellar Brotero and also Coloquiões by Garcia
d'Orta. English and French names were from Indian and other various works. Thus
his book as compared with others then published in British India, turned out to
be only an improved list of plants with brief notes.

In the later period, several botanists of the then Science College,
Pune, under the leadership of Theodore Cooke had made extensive plant collec-
tions in various parts of the then Bombay Presidency. It appears from records
that these botanical visits were often extended to adjacent parts of Goa. This
collection was kept in the Herbarium of the Economic Botanists Agricultural
College, Pune. It is now kept in the Botanical Survey of India, Western Circle,
Pune. "The Flora of Presidency of Bombay" by Cooke (1901 - 1908) and "Forest
Flora of the Bombay Presidency" by Talbot (1909 - 1911) are the records of some
of the medicinal plants from Goa.

Botanists at the St.Xavier's College, Bombay also made substantial
contributions by collecting and reporting plants from Goa. Blatter and De
Almeida (1922) reported 42 species of ferns. Blatter and McCann (1935) reported
over 50 species of grasses. Souza (1944) published a paper entitled "Catalogo
Botanico das Plantas de Goa e Terras Vizinhas"

With such advancement of botanical knowledge in Western India, some
workers from Goa also published papers, a few of which are noted here:


Subsequently with the reorganisation of the Botanical Survey of India and setting up of the Western Circle of the Department in December 1955, a new line of activity in the exploration of various unexplored as well as under-explored regions along the Western parts of India has begun. Rao (1985, 1986) took comprehensive study of *Flora of Goa, Daman, Diu, Dadra & Nagarhaveli as a part-time project in the end of 1962 and published "Flora of Goa, Daman, Diu, Dadra and Nagaraveli".

What lends the district of Goa its scenic charm must be principally attributed to its vegetal cover consisting of three main categories; the typical
tropical monsoonal forests of the Sahadrian Ghats and their extensions along
the projecting hill ranges towards the coastlands, the poor cover of grass and
scrub on its lateritic plateaus and the fringing belts of vegetation along the
estuaries and shoreline.

The tropical wet evergreen forests occur in strands in the deeper
valleys of the Ghats. This is a rich vegetation of evergreen type with a vari-
ety of species. They have an area of 250 sq. kilometers but are dispersed in
patches. Tall trees, dense canopy, sparse middle layer, climbing creepers and
dense humus matting are characteristic. The tropical moist deciduous forests
occupy a large area of the Sahayadrian Goa. High tree species with close cano-
pies are common. Many evergreen types occupy the lower layer and the undergrowth
has bamboo and cane in many places. Laterite thorn forest is the third main type
occurring in Goa. The hard, dry and shallow soils of the lateritic plateaus main-
ly the result of indiscriminate destruction of the earlier cover support only
scrub of 'Acacia sundra' type with coarse grasses occupying the major areas; in
places these are laced with fringes of Karwand ("Carissa carandas") thickets.

The mangrove forests are extensive in the estuaries of the Mandovi and
Zuari rivers, particularly in the silted up fringes of the Cumberjua canal; they
are also to be found in the minor estuaries towards north and south. Above the
tidal limits, wherever the relief allows formation of beaches, typical beach
flora tends to occur with shrubs and maritime grasses.

Climatology

The average annual rainfall which is continuous from June to October
is 2500 mm. The monsoon bursts over the territory in the beginning of June &
withdraws from it by early October. As a result of the orographic influence, rainfall increases rapidly towards the western ghats from 2500 – 3300 mm along the coast to over 4000 mm nearer the ghats. Over 90 percent of the annual rainfall occurs during the monsoon months of June to September. July is the rainiest month when about 36 percent of the annual rainfall is recorded.

This territory gets rainfall of 10 mm or more on 70 to 100 days in a year on an average, the number of rainy days (i.e. days with rainfall 2.5 mm or more) being 100 to 125. As in the case of rainfall, the average number of rainy days is more in the eastern portion of the Territory, nearer the ghats, than near the coast. Occasionally, rainfall over the territory becomes heavy and vigorous in association with cyclonic disturbances which form in the Arabian Sea or those which form in the Bay of Bengal and emerge into the Arabian Sea, after crossing the Peninsula. Due to the maritime influence the diurnal range of temperature during the day is not large. The diurnal range is the least, being 4-6°C during the monsoon season and increased to the maximum of 10-12°C during December to February. Temperature variation through the seasons are also slight. May is relatively the warmest month when the mean daily temperature at a slightly lower value of about 25°C. It is interesting to note that the day temperatures are lowest in the monsoon months of July and August and not in the 'cool weather' months of December and January. Maximum temperatures are at their highest (around 33°C in the mean) in the pre-monsoon months of April and May and again in the post-monsoon months of November and December. On the other hand, lowest night temperatures of the order of 20°C are experienced in December and January. During the winter season, cold and dry continental air from the North is prevented by the Western Ghats from exerting its full influence over the territory with the result that temperatures do not fall appreciably in the same way as they do inland to the east of the ghats or even along the coast in the north. Along the coast, the maximum temperature rarely goes beyond 37°C. Due to the proximity of the sea, the territory is generally humid, with a further rise in humidity during the monsoon period. Even during the
summer months the relative humidity is generally above 60 percent.

Skies are clear to lightly clouded from November to March, with gradual increases thereafter till May after which there is a sharp increase in cloudiness with the onset and advance of the monsoon; skies remain mostly clouded to overcast till September. Cloudiness decreases sharply after October. Winds in the morning are easterly to north-easterly during October to April backing to north-east in May, while in the afternoon they tend towards west or north-west, due to the sea breeze effect. During the monsoon months the winds are generally westerly throughout the day. Winds are fairly strong during the monsoon period. Otherwise they are generally moderate in strength.

**Geomorphology, geology & geo-chemistry**

The physiography of the Goa District chiefly comprises of undulating terrain of western Ghats in a series of hills with several off-shoots and spurs gradually merging in the West. In the East bordering Karnataka State, the hill ranges are precipitous upto an elevation of 1022.50 metres. The Western Ghat is the source of two prominent rivers in Goa, viz: Mandovi and Zuari that flow off into the Arabian Sea near Panaji and Vasco-da-Gama.

**Vegetation:**

The vegetation can be broadly classified into following types:

(1) Coastal Vegetation: (i) Estuarine vegetation consisting of mangrove species along the narrow muddy banks of rivers; (ii) Strand vegetation along the few coastal belts; (iii) Plateau vegetation comprising of low deciduous as well as moist deciduous species confined especially to the lower elevations of the ghats; (iv) Semi-evergreen and evergreen forests limited to patches along the
upper elevation of the Ghats. Altitudinally, the estuarine and strand vegetation range from sea level to 50 m., the low deciduous and moist deciduous species fall within 50 - 500 m. and the semi-evergreen and evergreen forests occur from about 500 m. upwards. Besides, the area abounds in many hydrophytes and grass lands which occur at all elevations. The composition of the various types of vegetation has been briefly analysed below: -

(1) **Coastal Vegetation : Sea-weeds, sea-grasses**

(i) **Estuarine vegetation of mangrove along swampy river banks**

Botanically this zone is characterised by the presence of halophytes with their peculiar root formations (still roots of *Rhizophora* spp., pneumatophores in *Avicennia* spp., knee roots in *Bruguiera* spp. etc.) and Viviparous fruits for seed disposal in all genera. Thickets of species of *Rhizophora*, *Bruguiera*, *Kandelia*, *Lumnitzera*, *Sonneratia* and *Avicennia* readily strike the eye. Often *Acanthus ilicifolius* represents pure formations and near the high tide mark.

(ii) **Strand and Creek vegetation along coastal belt**

The vegetation along the south bank of River Mandovi near Panaji comprises tree species such as Karanji (*Pongamia glabra*), Bhendi (*Thespesia populnea*), Undi (*Calophyllum inophyllum*) and Keura (*Pandanus odoratissimum*) some of which are exotics but naturalised, growing wild, whereas Mad (*Cocos nucifera*) and Saro (*Casuarina equisetifolia*) are extensively cultivated in Goa. Along the rocky creeks and projecting ridges facing the coast, could be seen many herbaceous species of *Neanotia*, *Iphigenia*, *Scilla*, *Cyperus*, *Naregamia* and *Begonia*.

(iii) **Plateau vegetation along undulating terrain and foot hills**

A major portion of Goa belongs to this category with the
scrub jungles extending from 50 - 200 m. and the deciduous forests confined to 200 - 500 m. altitude.

(a) Open scrub jungle - Undulating rocky plateaus with scant vegetation are met with along Panaji to Cortalim, Panaji to Colvale, Cortalim to Margao and from Bicholim to Sanquelim, to mention a few, which are due to manganese ore mining, "Kumei" cultivation, overgrazing and other biotic factors. Kaju (Anacardium occidentale) is cultivated on an extensive scale. Severely eroded wastelands sustain patchy vegetation composed of dry deciduous species such as Karvandi (Carissa caranda), Kindo (Holarrhena antidysenterica), Ghaneri (Lantana camara), Dhawri (Woodfordia floribunda), Ansali (Crewig microcos), Nigad (Vitex negundo) etc. The majority of climbers are confined to families like Menispermaceae, Vitaceae, Aslepiadaceae and Liliaceae.

(b) Moist deciduous forests - Forests around Tudal, Ordofond, Butpal, Molem, Codal, Ambiche Gol near Valpoi and Anmode Ghat are essentially moist deciduous and much of the forest area in Goa falls under the above type. The important components of the deciduous forests belong to species of Rubiaceae, Bignoniaceae, Anacardiaceae, Sapindaceae, Fabaceae, Caesalpiniaceae and Mimosaceae. The ground flora in forest clearings and exposed situations comprise members of Fabaceae, Acanthaceae, Rubiaceae, Euphorbiaceae, Asteraceae, Lamiaeae. Also fern species such as Pteris aquilina, Selaginella imbricata and Ophioglossum nudicaule are seen on the moist forest floor.
Moist Deciduous Forests (Commercially Potential)

Along the foot-hill slopes of hill tract traversing from North to South and spurs leading towards West, in the talukas of Ponda, Canacona, Quepem, Sanguem and Satari, there are commercially potential forests categorized as "B" class for exploitation of the forest produce by the State to earn maximum profits and for regeneration of the crop on perpetual basis. This type of forest is distributed in about 385 sq. kms., providing the timber and fuel wood requirements of the district. Natural teak is of sporadic occurrence in these forests, yet the tract has rich potential for bearing teak. The prominent tree species in this zone are Asan (Terminilia crenulata), Arjuna (Terminalia arjuna), Kindal (Terminilia paniculata), Zambo (Xylica xylocarpa), Nano (Lagerstroemia lanceolata), Ghoting (Terminalia bellerica), Siso (Dalbergia latifolia), Edu (Adina cordifolia), Kadam (Mitragyna parvifolia), Kermal (Dillenia pentagyna), Tambdo Assan (Pterocarpus marsupium) and Kosimb (Schleichera oleosa).

In the understorey, common tree species found are Dhaman (Grewia tiliifolia), Shiras (Albizzia lebbec), Kinnai (Albizzia procera), Phatarphod (Bridelia retusa), Shivan (Gmelina arborea), Moi (Lannea coromandelica), Bel (Aegle marmelos) Kastel (Hydnocarpus vichtiana), Sendri (Mallotus philippensis), Charoli (Buchanania latifolia), Kalo Kudo (Wrightia tinctoria) and Kumbyo (Careya arborea).

The ground vegetation consists mostly of Gelphal (Randia dumetorum), Alataya (Helicteres isora), Karvi (Strobilanthes callosus), Dimdo (Lear sambucina), Menki (Glycosmis pentaphylla), Dikna (Ardisia solanacea), Ranbhendi (Urena lobata), Karvandi (Carissa carandas), Damdarlo (Flemmingia congesta), Saykilo (Clerodendron infortunatum), Kudo (Holorrhena antisyenterica), Karbel (Murraya koenigii), Adki (Rauwolfia serpentina), and Vadli namdit (Tabernaemontana coronaria). The common climbers of these forests are Ukshi (Calypcopteris floribunda), Kante-bhonvri
(Ichnocarpus frutescens), Chhotivel (Smilax zeylanica), Chilhar (Caesalpinia sepria), Vagati (Wagatea spicata), Wakeri (Caesalpinia nuga) and Churan (Zizyphus rugosa).

(iv) Semi—evergreen vegetation: The tallest trees are composed of species of Ud Champo (Michelia champaca), Gulmara (Cryptocarya wightiana), Disa (Actinodaphne hookeri), Wad (Ficus bengalensis), Naraun (Lagerstroemia lanceolata), Kanak Champo (Pterospermum acerifolium) mixed with smaller tree species such as Bhoma (Glochidion hohenackeri), Dhavi Pitkoli (Ixora parviflora), Bok (Bischofia javanica), Chandivado (Macaranga peltata) and Londa (Hopea racemosa).

Evergreen forests: The evergreen forests never reach the climax in Goa region as they do in North Kanara district of Karnataka and the Amboli—Ramghat belt of the South Ratnagiri. The transition from the semi—evergreen forests to the evergreen is gradual and almost imperceptible. The tree components are selected and few limited to such families as Clusiaceae, Ebenaceae, Lauraceae, Moraceae, Euphorbiaceae and Burseraceae. The lofty trees belong to species of Calophylium, Carcinia, Canaxia, Lophopetalum, Chrysophyllum, Artocarpus and Diospyros whereas the medium sized tree species are composed of Litsea, Ficus, Aporosa, Antidesma, Carallia, Evodia and Mallotus.

As compared to the evergreen forests of North Kanara, the epiphytes are comparatively poor, limited mostly to members of Orchidaceae, Asclepiadaceae and Araceae. A few species of Utricularia, Habenaria and Begonia are seen in the crevices of tree bark wherever there is a little soil and moisture, thus superficially appearing as epiphytes. The root parasites belong to members of Scrophulariaceae, Santalaceae and Orobanchaceae. The stem parasites are predominantly composed of members of Loranthaceae. The terrestrial orchids include species of Platanthera, Malaxis together with species of Habenaria and Peristylus.
Evergreen and semi-evergreen forests

Along the north-eastern and south-eastern portions bordering Karnataka State, few evergreen and semi-evergreen vegetation occurs in the deep gorges and ravines of Sanguem, Satari and Canacona talukas. On the precipitous aspect the tree growth is mostly stunted having low timber value. In this zone of forests the annual rainfall varies from 5,100 millimetres to 7,600 millimetres. The trees of common occurrence are Bobbi (Calopbyllum wightianum), Jambul (Eugenia jambolana), Ambo (Mangifera indica), Onval (Mimusops elengi), Otamb (Artocarpus lakoocha), Ranpanas (Artocarpus hirusta), Nag Champa (Mesua ferrea), Kavsi (Hopea wightiana), Bhirand (Garcia indica), Olam (Machilus macrantha), Dalchini (Cinnamomum zeylanicum), Chandivado (Macaranga peltata), Kuhimdar (Steroulia guttata), Kalezad (Diospyros embroyopteris), Bibo (Semecarpus anacardium), Ranbibo (Holigarna amrottiana), Bhoma (Glochidion hohennackeri), Peddhaliki (Olea dioica), Tusal (Heynea trijuga) and Arola (Mallotus philippinensis). The undergrowth is comprised of Dosari (Colebrookea oppositifolia), Thinpudi (Triumfetta rhomboidea), Ayamsar (Callicarpa janata), Dhavi-pitkoli (Ixora barbata), Dhavru (Woodfordia fruticosa), Bakhnel (Lobelia nicotianefolia) and Nakeri (Melastoma malabathricum). The common bamboos occurring in these forests are Man (Bambusa vulgaris) and Kanaki (Dendrocalamus strictus). Vet, Rotam (Calamus rotang) is the important oame of evergreen belt. Kombal (Gnetum scandens), Chilhar (Acacia intaia), Garyel (Entada pusaetha), Amrutvel (Tinospora cordifolia), Ajravel (Goculus macrocarpus), Padvel (Stephania hermandifolia), and Bhatvel (Cissampelos pareira) are the common climbers of these dense forests. In the ravines, the tree growth is luxuriant with clear boles attaining a height of 10 to 15 metres. Both evergreen and semi-evergreen forests are distributed over an area of 256 square kilomets. of which 50 percent of the area is inaccessible. The zone of evergreen forests has been classified as 'A' class forests under the Portuguese regulation of forests, set apart for preservation of climate, regulation of workflow and conservation of soils in the hilly tracts.
**TALUKA-WISE GEOGRAPHICAL AREA VIS-A-VIS FOREST AREA (UNDER GOVT. CONTROL)**

<table>
<thead>
<tr>
<th></th>
<th>Geographical area in Ha.</th>
<th>Forest area in Ha.</th>
<th>Percentage forest area to geo-area</th>
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<tbody>
<tr>
<td>1</td>
<td>Tiswadi</td>
<td>16,612</td>
<td>16,612</td>
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<tr>
<td>2</td>
<td>Salcete</td>
<td>27,719</td>
<td>27,719</td>
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<tr>
<td>3</td>
<td>Bardez</td>
<td>26,480</td>
<td>26,480</td>
</tr>
<tr>
<td>4</td>
<td>Mormugao</td>
<td>7,831</td>
<td>7,831</td>
</tr>
<tr>
<td>5</td>
<td>Ponda</td>
<td>25,228</td>
<td>2,931</td>
</tr>
<tr>
<td>6</td>
<td>Bicholim</td>
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<td>7</td>
<td>Pernem</td>
<td>24,200</td>
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<td>Quepem</td>
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<tr>
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<td>Sanguem</td>
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<td>Canacona</td>
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</tr>
<tr>
<td>11</td>
<td>Satari</td>
<td>51,284</td>
<td>24,252</td>
</tr>
</tbody>
</table>

**Economic and Medicinal Plants** - Species of *Cocos, Anacardium, Mangifera, Ananas, Areca, Piper, Artocarpus, Musa, Citrus* and *Psidium* and their cultivation and further development on commercial basis are quite well known. Species of *Garcinia, Cinnamomum, Myristica, Murraya* as condiments deserve a mention for their utility. A few other plants like species of *Flacourtia, Averrhoa, Litchi, Phyllanthus* are also grown for their edible fruits.

As for the timber, variety of woods are in demand with the developing industrialisation and some of the species suggested here are known for their quality of wood. With proper management of deciduous and semi-evergreen forests, most of the species can be brought into the approved range of species required for
wood-based industries. Besides the well-known timber species of Terminalia, Tectona, Lannea, Dalbergia, Xylia and Lagerstroemia, tree species of Saccopetalum Hopea, Sterculia, Pterocarpus, Pongamia, Bridelia, Dillenia, Holigarna, Syzygium Mitragyna and Madhuca, also deserve special attention. Though Tectona grandis the teak does not occur wild it was possible to successfully introduce and cultivate on selected plots as seen from the forty-year old teak plantations at Valpoi which present satisfactory growth.

For extraction of fibre, oils, gums, etc. several species are known to yield suitable material. Species of Sarcostigma, Blumea, Guizotia, Carthamus, Mimosops, Origanum, Thymus, Sontalam, Croton, Hitchenia, Vetiveria and Cymbopogon, are quite important as oil producing plants. Corchorus, Crotalaria, Calamus, Caryota are some of the fibre yielding plants whereas Sterculia is a good source of Karaya gum used as a food preservative.

The grasslands of Goa harbour many economic fodder grasses which could be profitably utilised through proper farm management. The highly palatable fodder grasses, include species of Centotheca, Cynodon, Eohinochloa, Hygroryza, Isachne, Digitaria, Setaria and Themeda. The common legumes that occur in this region are species of Desmodium, Geissaspis, Alysicarpus, Indigofera, Phaseolus, Sesbania, Smithia, Cassia, Vigna, Zornia and Tephrosia, which are well known for their forage value but in nature these do not occur in proper proportion. By selecting much of the indigenous rich legumes that are common in Goa and broadcasting the seeds during the early monsoon, the nutritive value of the fodder grass can be considerably enhanced.

The area is quite rich in medicinal plants. There is good possibility of introduction and cultivation of several useful species required by the pharmaceutical firms of Bombay who have already been planning for cultivation and pro-
pagation of specific medicinal plants. To mention a few, species like Nisalbombdi (Salacia chinensis), Itari (Rubia cordifolia), Akalkada (Spilanthes acmella), Tambdichtitrak (Plumbago indica), Kudo (Holarrhena antidysenterica), Adki (Rauwolfia serpentina), Kawli (Gymnema sylvestre), Pitvel (Tylophora indica), Upas (Hemidesmus indicus), Kajro (Strychnos nux-vomica), Kanchi (Solomon nigrum), Dondalki (Withania somnifera), Adoso (Adhatoda vasica), Kolasa (Hygrophila auriculata), Bhumi tulas (Ocimum basilicum), Carmalo (Coleus amboinicus), Alem (Zingiber officinale), Masalkanda (Curculigro orchoides), Sabro (Asparagus racemosus) and Vaghachyodavlyo (Gloriosa superba) well-known for their medicinal value, grow under natural conditions in Goa forests.

The flora of the region abounds in interesting species of botanical value both from the taxonomic as well as academic point of view especially for the student community. Quite a few species have been found to be new to the science like Manisuris goaensis, Arthrason lancifolius var. hindustanicus and species of Fimbristolvis, Ceropogia fantastica, a rare plant has been collected again after a lapse of over 50 years. Members of Podostemaceae like Polypleurum stylosum Griffithella hookerianna, Hydrobryopsis sessile, Terniola zeylanica and parasites like Aeginetia indica and species of Dendrophthe, Helixantha, Helicanthe, Loranthus, Macrosolen and Viscum are quite interesting enough. Orchids species, both terrestrial and epiphytic, like Plantanthera, Habenaria, Liparia, Eulopia, Pholidota, Cymbidium, Dendrophthe and Vanda, deserves special mention.

The Pteridophyte flora is equally rich with species of Selaginella, Ophioglossum, Fibresum, Angiopteris evecta, Acrostichum aureum, Schizoloma heterophyllum and several others.

Goa coast also abounds in the seaweed species belonging to various phyla. Although these marine algae species have been reported to have several interesting bioactive compounds and other chemical elements, these have not been used so far any medicinal use, inspite of their properties.
PHARMACOLOGICAL REVIEW.
As in the past, to-day there has been greater emphasis on a search for plants with medicinal activity. Screening of plants for their pharmacological effect using animal models is continued from the past. However, the situation regarding well-planned clinical studies of plant products is not much satisfactory. Major laboratories like CDRI have resorted to a more broad based screening of plants. In spite of all these efforts however, the ultimate goal of providing potent, inexpensive and safer drug for most diseases encountered in our country still remains to be achieved. Certain important and useful leads, however, have certainly have been obtained during the years under review. Such examples are coleonol - a diterpenoid from *Coleus forskohlii* with hypotensive activity, spasmolytic sesquiterpenes from *Cedrus deodara* and spermicidal saponins from several plants. With the Alma Ata declaration of "Health for all by 2000 A.D." research in traditional medicine and ethno-pharmacology all over the world has received more attention from the Government of various countries as well as the World Health Organisation (WHO 1978). In this literature review, plants have been placed according to their pharmacological activities such as anti-inflammatory, anti-protozoal, anti-cancer, anti-fertility, anti-fungal, anti-hypertension, insecticidal, expectorant, uterine stimulant, anti-pyretic, oxytocic, anti-viral, cardiovascular, diuretic, purgative, anti-spasmodic, spasmodic, anthelmintic, hypoglycaemic, anti-bacterial, and CNS acting.

**Plants having anti-inflammatory activity:**

ICMR Bulletin (1972) described that the saponins from *Hemidesmus indicus* were found to be anti-inflammatory against formalin induced oedema. Dutta *et al* (1982) reported that ethyl acetate extract of this Plant exhibited significant anti-inflammatory activity in both acute and sub-acute methods of inflammation as
revealed by significant inhibition of inflammation induced by carrageenin, bradykinin, 5 hydroxy tryptamine, granuloma pouch and cotton pellet implantation method in rats. Singh et al (1978) reported that the ethanolic extract of the leaves of Hibiscus rosa-sinensis revealed anti-inflammatory activity against carrageenin induced rat paw oedema. Thirugmanasambantham et al (1982) reported that the aqueous and alcoholic extracts of Leucas aspera showed good activity in chronic antiinflammatory model. In acute model, however, the aqueous extract was more potent. Singh et al (1972) reported that alcoholic extract of the bark of Moringa pterygosperma showed activity against formalin induced rat paw oedema, cotton pellet implantation and granuloma pouch in doses of 500, 750 and 1000 mg per kg oral doses respectively in albino rats. Saxena et al (1984) reported that water soluble portion of alcoholic extract of leaves of Nyctanthes arbor-tristis showed significant activity against acute, subacute and chronic models of inflammation in rats. It inhibited acute oedema induced by different phylogistic agents such as carrageenin, formalin, histamine, 5-Ht and hyaluronidase in rat hind paw. It also induced inflammation swelling in the knee joint of rats induced by the intrasynovial injection of turpentine oil. The extractive significantly reduced the granulation tissue formation in the cotton pellet test. The formaldehyde induced arthritis was also significantly inhibited in acute as well as chronic phase of inflammation. Chaturvedi & Singh (1965) reported that decoction of Paederia foetida given orally in a daily dose of 1.5 ml. (representing 0.75 gms of dry powder of drug) for 10 days showed significant activity against formaldehyde induced arthritis in non adrenalectomized albino rats. Sharma & Singh (1980) reported that decoction of whole plant of the above drug showed a mild degree of activity against carrageenin induced rat paw oedema. Bhalla et al (1968) & (1971) reported the activity of the Boerhavia diffusa in albino rats. Bhalla et al (1971) also reported bio-chemical studies of this Plant. Mudgal (1974) also reported the same activity. Rai & Gupta (1966) reported the anti-inflammatory activity of Tinospora cordifolia in albino rats.
Plants having antiprotozoal activity:

Chopra et al (1927) and (1933) studied the antiprotozoal activity of total alkaloids of Holarrhena antidysenterica. Dutta & Iyer (1966) studied that various fractions of the above plant showed promising activity against experimental amoebiasis in rats & hamsters. Basu & Jayaswal (1966) reported that conessine from above plant was more active as an amoebicidal agent in vitro in comparison to other alkaloids of this plant as tested against the 'C' strain of Entamoeba histolytica. Bhakuni et al (1969) reported that the ethanolic extract (50%) of the whole plant of Murraya koenigii excluding roots has the activity against Entamoeba histolytica. Mishra & Sharma (1973) reported in uncontrolled clinical studies on 21 confirmed patients of intestinal amoebiasis for the drug of Oroxylum indicum that the oral administration of concentrated aqueous extract of powder drug led to symptomatic improvement as well as absence of Entamoeba histolytica cysts in stools in 19 patients.

Plants having anti-cancer activity:

Dhar et al (1966) reported that fruit extract (50%) ethanolic of Holarrhena antidysenterica is having anticancer effect against human epidermoid carcinoma of the nasopharynx in tissue culture. Dhawan et al (1980) reported that 50% ethanolic extract of Moringa pterygosperma excluding roots showed anti-cancer activity against human carcinoma and P 388 lymphocytic leukaemia in mice. Dhar et al (1968) reported that 50% ethanolic extract of leaves of Paederia foetida showed the above activity.

Plants having anti-fertility activity:

Batta & Santhakumari (1971) reported that benzene extract of Hibiscus rosa-sinensis flowers (100 mg per Kg.) revealed post-coital antifertility effect in female albino rats, leading to 80% reduction in the implantation site on the 10th day of pregnancy. The foetal loss in the rats was within the normal
range indicating the absence of any early abortifacient effect in the benzene extract. The petroleum ether extract was devoid of anti-fertility effect whereas the ether & ethanolic extracts of flowers did not show any significant activity. The benzene extract of flowers was found to be most active when administered as a dose of 250 mg/kg from day 1 to day 10 of pregnancy in rats. The petroleum ether and aqueous extracts failed to prevent pregnancy. The alcoholic extract however showed 50 to 70% activity in female rats in a dose of 250 mg/kg as reported by Kholkute & Udupa (1974 & 1976a). Further studies with the total benzene extract of the flowers of *Hibiscus rosa-sinensis* revealed to show anti-estrogenic activity in bilaterally ovariectomized immature albino rats, as reported by Kholkute & Udupa (1976a). Kholkute & Udupa (1976b) reported that benzene extract of the above drug disrupted estrous cycle in rats depending on the dose and duration of treatment. The extract led to the reduction in the weights of ovary, uterus & pituitary. Ovaries showed follicular atresia & uterine atrophic changes. These effects could be reversed 30 days after withdrawal of plant extract. In an attempt to find the mechanism of action of its antifertility potential, Kholkute & Udupa (1976b) used various experimental models like administration of drugs during various embryonic stages of pregnancy, pontamine blue reaction and delayed implantation technique and showed that though the maximum anti-fertility activity is mediated via inhibition of implantation, invoking anti-implantation alone was not adequate to achieve full contraception & the drug also caused absorption of foetus. Prakash (1979a) studied the effect of 50% ethanolic and benzene extracts of flowers of *Hibiscus rosa-sinensis* on the estrogen dependent enzyme (acid & alkaline phosphatase) activity of rat uterus. He reported that a significant increase in acid phosphatase & decrease in alkaline phosphatase in both extracts was related to both enzymes. Prakash (1979b,c) also further reported the antiestrogenic property of the ethanolic & benzene extracts in rats. Kholkute et al (1977) reported that flowers of *Hibiscus rosa-sinensis* collected in winter season showed the
maximum post-coital antifertility activity in female rat followed by those collected during rainy season. The activity was minimum in the flowers collected during summer. Sethy et al (1977) reported that extract of *Maesa indica* whole plant excluding roots had a spermicidal activity in rats at 2% concentration but had no such effects on human semen at the same concentration. Banerji et al (1978) studied that saponin from *Mimusops elengi* seeds has spermicidal activity at a dilution of 0.06% in human semen. Prakash & Mathur (1976) reported that *Moringa pterygosperma* root extract (50% ethonolic) at a dose of 200 mg /kg led to foetal resorption in 60% female pregnant rats.

**Plants having anti-fungal activity:**

Bhatnagar et al (1961) studies that the roots of *Hibiscus rosa-sinensis* has anti-fungal activity against phyto-pathogen, *Helminthosporium sativum*. Deshmukh & Jain (1981) reported that the seed oil of *Holarrhena antidysenterica* showed an inhibitory effect against pathogenic keratinophillic fungi like *Chryso-sporium indicum*, *C. pannicola*, *Malbranchea aurentiaca*, *Keratinomyces ajelloi*, *Microsporum gypseum*. Maximum inhibition was noted against *K.ajelloi* & *M. gypseum*. Rao Narsimha & Rao (1972) reported that oil from *Leucaena aspera* completely inhibited the growth of *Epidermophyton floccosum* even at concentration of 1:250. Thakur et al (1982) reported that chloroform extract of (0.5%) of the above plant was found to bring about the disappearance of clinical lesions in *Trichophyton mentagrophytes*, *T. verrucosum*, *T. rubium* & *Microsporum gypseum* dermatomycosis in mice and Thakur et al (1983) reported the above work against *T. mentagrophytes* in calves. Bhatnagar et al (1961) reported that bark extract of *Moringa pterygosperma* showed anti-fungal activity against *Microsporum gypseum* *Trichophyton mentagrophytes*, *Candida albicans* & *Helminthosporium sativum*. Dhir et al (1982) reported in case of *Pterogarpsus marsupium* that efficacy of this drug in the form of ointment as an anti-fungal agent was evaluated in a clinical trial on 50 patients suffering from dermatophyte infection i.e. *Tinea cruris*
(22 patients) *T. corporis* (14 patients) and mixed infection (14 patients). The ointment was locally applied for 7 to 10 days. The ointment made from alcoholic extract of wood was more effective than that prepared from aqueous extract of wood. Gupta & Bannerjee (1972) reported anti-fungal activity of *Curcuma zedoaria*. Satyaprakaash *et al* (1972) reported anti-fungal activity of *Eucalyptus globulus*.

**Plants showing anti-hypertension activity:**

Dwivedi *et al* (1977) reported that the ethanolic extract of flowers of *Hibiscus rosa-sinensis* showed hypotensive effect in dogs. Agarwal & Shinde (1967) reported that glycosidic material isolated from leaves of *Hibiscus rosa-sinensis* showed hypotensive action in intact as well as spinal dogs. Jayshankar *et al* (1961) reported that in higher doses the alkaloid conkurchine hydrochloride of *Holarrhena anti-dysenterica* lowered the dog blood pressure and dilated the rat blood vessels. It lowered the blood pressure of the atropinised dogs. Sharma *et al* (1978) reported that ethanolic extract (90%) of the fruit and the leaves of *Mimusops elengi* showed hypotensive effect in dogs. Singh *et al* (1976) reported that alcoholic extract of *Moringa pterygosperma* leaves caused an initial rise in blood pressure in mongrel dogs and cates followed by a gradual fall lasting for a considerable duration. Its action on blood pressure suggested the presence of a potent adrenergic neurone blocking substances in the alcoholic extract. Sabir *et al* (1974) reported that the alcoholic extract of leaves of *Nyctanthes arbor-tritiae* showed hypotensive action in dogs. Bhakuni *et al* (1971) also reported the action of 50% ethanolic extract of *Pterocarpus marsupium* bark in cats and dogs. Iswarish *et al* (1954) reported this action in *Rawfelia serpentina*. There are many scientists who have reported hypotensive action in *Rawfelia serpentina*. They are Hamied *et al* (1956), Chakravarty *et al* (1951), Chakravarti (1953), Vakil (1953), Chowhan & Ghosh (1954), Gaitonde & Lewis (1955) and Dhawan & Bhargava (1959). Patel & Dessai (1960) recorded that alcoholic extract of bark of *Zanthoxylum rhetsa* showed hypotensive effect.
Lahiri & Pradhan (1964) reported vasicinol alkaloid from *Adhatoda vasica* produced hypotension in cats.

**Plants showing Insecticidal activity:**


**Plants having Expectorant activity:**

Amin (1961) reported expectorant action of Alkaloid vasicinon from *Adhatoda vasica*. Lahiri & Pradhan (1964) also reported the same. Sabir (1974) reported that the alcoholic extract of leaves of *Nyctanthes arbor-tristis* had respiratory stimulant action in dogs.

**Plants having Uterine activity:**

Dhawan & Saxena (1958) reported the aqueous extract of pods of *Helicteres isora* showed a mild stimulant effect on spontaneous activity of isolated non gravid rat uterus. Misra *et al* (1966) studied *Annona squamosa* as uterotonic drug. Jethmalani & Gaitonde (1966) reported the uterine contraction action of ethyl acetate & alcoholic extracts of roots of *Asparagus racemosus*. Yoginder Nath (1962) studied the oxytocic principles from the seeds of *Cassia tora*.

**Plants showing anti-pyretic activity:**

Singh *et al* (1978) reported ethanolic extract of leaves of *Hibiscus rosa-sinensis* at a dose of 100 mg/kg. i.e. *Hibiscus rosa-sinensis* revealed a significant antipyretic effect against pyrexia induced by Brewer's yeast in the rat.
Plants showing antiviral activity:

Dhar et al (1968) reported the aqueous ethanolic extract of whole plant of *Hemidesmus indicus* (0.05 mg/ml) showed antiviral activity against Raniket disease (RDV) but was inactive against vaccinia virus. Babbar et al (1970) reported for the above plant in a dose of 75 mg/ml the extract was effective against both the viruses. Stem extract of *Hemidesmus indicus* and *Cassia fistula* inhibited the replication as well as cytopathic activity of both RDV & Vaccinia virus. Babbar et al (1982) studied both the above extracts for minimum concentration required for 100% viral inhibition and *Hemidesmus indicus* in concentration of 0.0125 mg/ml was effective against only RDV & not against Vaccinia virus. Singh & Singh (1972) reported the bark extract of *Hibiscus rosasinensis* having antiviral activity against potato virus X (PVX) inhibiting the viral multiplication by 60 - 79.9%. Tripathi & Tripathi (1982) reported that extract of *Leucas aspera* showed some anti-viral activity against bean common mosaic virus. Bhakuni et al (1969) reported that extract of whole plant of *Moesa indica* excluding roots revealed antiviral activity against Vaccinia virus. Bhakuni et al (1969) reported that 50% ethanolic extract of whole plant of *Moesa indica* exerted antiviral activity against vaccinia virus but was inactive against Ranikhet disease virus. Dhar et al (1968) reported 50% ethanolic extract of bark of *Moringa pterygosperma* showed activity against vaccinia virus but inactive against Ranikhet disease virus. Singh & Singh (1972) reported that bark extract of *Nyctanthes arbor-tristis* showed inhibition against potato virus X.

Plants showing Cardiovascular activity:

Dashputra et al (1977) reported that leaf extract of *Moringa pterygosperma* depressed action of the heart. Lohiri & Pradhan (1964) reported depression action of heart in guinea pig by vaccinol alkaloid from *Adhatoda vasica*. Neogi & Ahuja (1960) reported that bark extract of *Nyctanthes arbor-tristis* in higher doses had depression action on frogs' heart. Satoskar et al (1962) repor-
ted the aqueous extract of roots of *Hemidesmus indicus* showed an increase in cardiac rate in rabbits. Roy et al (1968) reported that extracts of roots of *Asparagus racemosus* in low doses increase heart rate and higher doses cause cardiac arrest. Pandey & Sharma (1978) reported that decoction of bark of *Pterocarpus marsupium* showed hypocholesterolemic effect in rabbits.

**Plants showing Diuretic activity:**

Satoskar et al (1962) reported the aqueous extract of *Hemidesmus indicus* caused a light increase in urinary flow in rats but not in dogs. Dhawan et al (1977) reported that 50% ethanolic extract of whole plant of *Leucas aspera* had diuretic effect in rats. Pillai et al (1978) reported that decoction of leaf of *Mimosa pudica* showed moderate diuretic response in albino rats. Aswal et al (1984) reported that 40% ethanolic extract of whole plants excluding roots of *Mimusops elengi* showed diuretic action in rats. Gujral et al (1955) reported that decoction of bark of *Oroxylum indicum* showed good diuretic action in rats.

**Plants having Antispasmodic activity:**

Bhakuni et al (1969) reported 50% ethanolic extract of whole plant of *Hibiscus rosa-sinensis* excluding roots having antispasmodic action on guinea pig ileum. Dhar et al (1968) reported same action in fruit extract of *Holarrhena antidysenterica*. Bannerji et al (1982) reported that saponins from seeds of *Mimusops elengi* had spasomolytic action on isolated guinea pig ileum against acetylcholine, histamine and barium chloride. It was most active against histamine. Banerjee et al (1982) reported antispasmodic activity in 50% ethanolic extract of whole plant of *Mimusops elengi*, and in *Nyctanthes arbor-tristis*. Bose et al (1968) reported that alkaloid akmadine and aknadinine from roots of *Stephania herndonifolia* showed antispasmodic effect on uterine spasm brought about by pituitary lobe extract. Dhar et al (1968) reported 50% ethanolic extract of leaves of *Paederia foetida* having the above effect.
Plants having Spasmodic activity:

Bhakuni et al. (1969) reported that 50% ethanolic extract of whole plant of *Helicteres isora* excluding roots had a spasmogenic action on isolated guinea pig ileum. They also further reported the same action in *Mimosa pudica*. Dhar et al. (1968) reported the same action in *Moringa pterygosperma* and also in fruits extract of *Oroxylum indicum*.

Plants having Anthelmintic activity:

Vijayalakshmi et al. (1979) reported that the aqueous extract of seeds of *Mimosa pudica* showed nematicidal activity against the second stage juveniles of *Meloidogyne incognita* chitwood. They also reported the same action in plant of *Mimusops elengi*. Dhanwar et al. (1980) reported that the aqueous extract of *Momordica dioica* tuber showed anthelmintic activity against *Hymenolepis nana*. The extract did not show any activity against *Nippostrongylus brasiliensis*. Sabir et al. (1974) reported that alcoholic extract of leaves of *Nyctanthes arbor-tristis* produced paralysis in intact Ascaridia galli worms. Roychowdhury et al. (1970) reported that the juice of the leaf of *Paederia foetida* showed potent anthelmintic effect against bovine helminthis viz. *Strongyloides* sp., *Trichstrongylus* sp., *Haemonchus* sp. (100%), * Bunostomum* sp. & *Moniezia* sp. (50 - 70%) in young calves.

Plants having Hypoglycaemic activity:

Dhar et al. (1968) reported the fruit extract (50% ethanolic) of *Holarrhena antidysenterica* showed hypoglycaemic activity in rats. Narayana & Sastry (1975) reported that aqueous extract of leaves of *Murraya koenigii* showed hypoglycaemic activity in normal & alloxan diabetic dogs. Joglekar et al. (1959) studied glucose absorption from the gastro-intestinal tract in mice which were administered *Pterocarpus marsupium* aqueous extract for 15 days. Reduced glucose absorption observed in *Pterocarpus marsupium* extract treated mice was attributed
to non-specific action of tannates. This finding was confirmed by Gupta (1963a,b) who studied the effect of *Pterocarpus marsupium* wood (aqueous infusion) on glucose tolerance in albino rats. Khandare *et al.* (1983) in a preliminary study found that chronic administration of wood powder of the above drug for 5 days claimed to check blood sugar level in rats after a glucose load. Haranath *et al.* (1958) reported that Pterostilbine derived from the wood of above drug (10 mg/kg) administered intravenously to dogs produced a fall in blood sugar. Higher doses of (20, 30, & 50 mg/kg) led to an initial hyperglycaemia followed by hypoglycaemia lasting for nearly 5 hours. Pandey & Sharma (1976) reported that the decoction of the bark of above drug administered orally 4 gm/100 g body wt/day for 10 day showed a hypoglycaemic action in rats which were rendered diabetic by alloxan. Gupta *et al.* (1963b) reported aqueous infusion of bark of above drug to inhibit in the third hours the acute hyperglycaemic response induced by the anterior pituitary extract in glucose fed albino rats. Trivedi (1963) reported the aqueous extract of bark of above drug to have hypoglycaemic effect in both in acute and chronic experiments on normal rabbits. The aqueous extract was more potent than alcoholic fraction. Shah (1967) and Saifi *et al.* (1971) reported the hypoglycaemic action of the above drug in normal rabbits. Chakravorthy *et al.* (1980) reported in a series of studies carried out in rats that this drug has a novel antidiabetic mechanism as revealed by pancreatic B-Cell regeneration by flavonoid fraction. Dharmadhikari *et al.* (1984) while confirming the hypoglycaemic action of the above drug thought that the action may be partly due stimulation of insulin secretion from B-Cells of pancreas and partly due to decreased absorption from the gastro intestinal tract. Gupta *et al.* (1967d) studied antidiabetic effect of *Casearia esculenta*. Nantiyal (1968) also studied *Casearia esculenta* in the treatment of diabetic mellitus. Kashyap & Ahuja (1968) did the clinical work on hypoglycaemic activity of the above drug. Brahmachari & Augusti (1964) reported isolation of orally effecting hypoglycaemic compounds from *Ficus Bengalenisi*. Brahmachari & Augusti (1961) reported hypoglycaemic effect of seeds of *Eugenia Jambolana*.

**Plants having antibacterial activity:**

ICMR Bulletin 1972 reported petroleum ether, chloroform & alcoholic extracts of roots of *Hemidesmus indicus* having antibacterial activity against *Staph. aureus*, *S. albus*, *Sal. typhosa*, *Vib cholerae*, *E. coli*, *Sh. shigae*, *Sh. flexneri* & *Sh. sonnei*. Prasad et al (1983) reported the essential oil obtained from the above plant exhibited marked antibacterial activity against *E. proteus*, *Pa. aeruginosa*, *Staph. pyogenes* & *E. Coli* at a concentration of 0.2%. Bhatnagar et al (1961) reported bark extract of *Leucas aspera* having antibacterial activity against *E. coli*, *Sal. typhosa*, *Vib. comma* & *Sh. dysenterica*. Gaind & Bappa (1967) reported antibacterial effect of roots of *Thespesea populnea*. Satyanarayana et al (1977) reported the leaf extract of *Mimusops elengi* having antibacterial activity in vitro against *E. antracis*, *B. mycodes*, *B. pumilus*, *E. subtilis*, *Sal. paratyphi*, *Staph. albus*, *Vib. cholerae*, *Xanth. campestris* & *Xanth. malvaevarum*. The inhibition being significant against *Zanth. campestris* and *B. antracis*. Bhavsar et al (1965) reported that the juice of leaf & bark of *Moringa pterygosperma* inhibited *Staph. aureus* but not *E. coli*. Vhora

Plants acting on Central Nervous system:

Bhakuni et al (1969) reported that the ethanolic extract of *Hibiscus rosa-sinensis* (50%) showed depressant effect on CNS. It produced hypothermia and potentiated barbiturate induced hypnosis in mice. Dhawan et al (1977) reported that (50%) ethanolic extract of whole plant of *Leucas aspera* revealed CNS depressent action in mice. Bhakuni et al (1969) reported the same action in *Nyctanthes arbor-tristis*. Dhar et al (1968) reported the work in *Paederia foetida*. Neogi & Ahuja (1960) reported that glycoside isolated from the bark of *Nyctanthes arbor-tristis* having CNS depressent action. Gaitonde & Lewis (1955) reported that alkaloids from roots of *Rawolfia serpeinga* had vasodialatory & central sedatory effect.
LITERATURE REVIEW (PHYTOCHEMICAL REVIEW)

The living organism may be considered a bio-synthetic laboratory not only for chemical compounds (carbohydrates, proteins & fats) that are utilised as food by men and animals but also for multitude of compounds (glycosides, alkaloids, volatile oils) that exert a physiologic effect. These chemical compounds give plant and animal drugs their therapeutic properties. Drugs are either used as such in their crude form or they may be extracted, the resulting principles being employed as medicinal agents. The usual term for these principles or chemical entities is constituents. But since plant or animal is composed of many chemical compounds it is common practice to single out those compounds that are responsible for therapeutic effect and call them active constituents. These active constituents are differentiated from inert constituents which also occur in plant and animal drugs. Cellulose, lignin, suberin & cutin are regarded as inert matters in plant drugs, in addition starch, colouring matter and other substances which have no definite pharmacologic activity are also considered as inert substances. In animal drugs, Keratin, chitin, muscle fibre and connective tissue are regarded as inert substances. This chapter is devoted to these active constituents and accordingly the plants containing such active constituents have been exemplified viz. alkaloids, flavonoids, steroids, glycosides, isoprenoids, saponins, tannins, esters, organic acids & amino acids and other organic compounds.

Alkaloids

the above drug. Roy et al. (1976) isolated new steroidal alkaloid 20 \( S \)-acetamide
\(-5\alpha\)-pregnan-3-\( \beta \)-ol, in addition to conessine in bark of the above
drug. Gupta et al. (1976) identified alkaloids in leaves of *Mimosa pudica*.
Chakraborty et al. (1964, 1965 & 1966) reported that stem bark of *Murraya koen-
gigii* on extraction of petroleum ether gave carbazole alkaloid, girinimbine,
murrayanine (1-methoxy-3-formylcarbazole) and mahanimbine respectively.
Roy and Chakraborty (1974) isolated optically inactive mahanimbine from extract
of *Murraya koenigii*. Chakraborty & Das (1968) and Chakraborty et al. (1971)
isolated murrayacine alkaloid from *Murraya koenigii*. Spectroscopic, degradative
& synthetic evidences have been documented for girinimbine as published by
Dutta & Quasim (1969), Narasimhan et al. (1970a), Kureel et al. (1970a), Chakrab-
orty & Islam (1971), Joshi et al. (1970); for murrayanine as published by
Chakraborty et al. (1965), Chakraborty & Chowdhury (1968); for mahanimbine as
published by Joshi et al. (1970), Narasimhan et al. (1968), Chakraborty et al.
(1969), Narasimhan et al. (1970a, 1975 and 1976); for murrayacine as published
by Chakraborty & Das (1968), Chakraborty et al. (1971) & (1973), Anwar et al
(1973), Joshi et al. (1970) and for mukanol as published by Bhattacharyya &

The other carbazole alkaloids isolated from the stem bark were murraya-
zolidine as reported by Chakraborty et al. (1970); murrayacinine as published by
Chakraborty et al. (1974); iso-murrayazoline published by Bhattacharya et al.
(1982); currayanine, currayangin as published by Dutta et al. (1969), Narasimhan
& Kelkar (1976), & murrayazoline published by Bordner et al. (1972). Narasimhan
et al. (1968 & 1975) recorded that *Murraya koenigii* fruits yielded a new alka-
loid koenimbine. Kureel et al. (1969) reported that leaves of *Murraya koenigii*
yielded a number of alkaloids including a new alkaloid koenigicine apart from
koenimbine, cyclomahanimbine, biyolomahanimbine & mahanimbidine. Joshi et al
(1970) reported that the hexane extract of the above drug yielded mahanimbine,

Flavonoids

Subramanian & Nair (1968) reported flavonoid glycosides in flowers of Hemidesmus indicus as hyperoside, isoquercitin, & rutin and in leaves only hyperoside and rutin. Subramanian & Nair (1972d) reported quercetin - 3 diglucooside & cyanidin - 3' - sophoroside - 5' - glucooside in flowers of Hibiscus rosa-sinensis. Subramanian & Nair (1971) reported two flavonoids rutin and kaempferol -
3 - rutinoside in leaves & flowers of *Ixora parviflora*. Misra & Mitra (1967b) reported in ethanolic extract of *Mimusops elengi* seeds, quercitol, dihydro-quercetin, quercetin and in flowers quercitol. Singh et al (1965) reported that ethanolic extract of leaves of *Nyctanthes arbor-tristis* contained astragelin (kaempferol - 3 - glucoside) and micotiflorin (kaempferol - 3- rhamno-glucoside). Mitra & Joshi (1983) reported isoflavonoid from heart-wood of *Pterocarpus marsupium*. Parthasarathy et al (1979) reported NMR studies of flavono-lignans from *Hydnocarpus wightiana*. Subramanian & Nair (1972a) reported that ethanolic extract of *Oroxylum indicum* leaves gave baicalein & scutellarein from its ether fraction; a flavone glycoside identified as baicalein - 6 - glucuronide from its ethyl acetate fraction & two glucuronides and scutellarein - 7 - glucuronide (scutellarein) & baicalein - 7 - glucuronide (baicalein) from aqueous mother liquor. Subramanian & Nair (1972b) reported that ethanolic extract of bark of *Oroxylum indicum* yielded oroxylin, baicalein & scutellarein from ether fraction and scutellarein - 7 - rutinoside, from ethyl acetate fraction. Chrysin & baicalein - 7 - glucuronide, occurred in mother liquor of ether & ethyl acetate fractions. Joshi et al (1977) reported that flavone is present in benzene extract of heartwood of *Oroxylum indicum*. Mehta & Mehta (1959) reported that baicalein-6-glucoside was present in ethanolic extract of defatted seeds of *Oroxylum indicum*. Nair & Joshi (1979) reported new flavone oxindine flavone from ethanolic extract of seeds of *Oroxylum indicum*. Adinarayana et al (1982) reported that *Pterocarpus marsupium* roots yielded a new C - glycosyl - P - hydroxydihydrochalcone, pterosupin, apart from pseudobaptigenin, liquiritigenin, isoliquiritigenin, garbanzol, 5 deoxykaempferol. Sawhney & Seshadri (1956) reported that alkali soluble portion of *Pterocarpus marsupium* heartwood yielded isoliquiritigenin & liquiritigenin. Subbarao & Mathew (1982) isolated from ether extract of the above drug a novel isoflavonoid glycoside, marsupol. Mathew & Subbarao (1983) isolated from the above drug a novel 2 - hydroxy - 2 - benzyl coumaranone

**Steroids**

Chatterjee & Bhattacharyya (1955) reported β-sitosterol in roots of

**Glycosides**


**Isporenoids**

Narayanan & Naik (1981) reported a new triterpene, lupadien 3-β-ol

**Saponins**


**Tannins**

Atal *et al* (1978) reported absence of tannins in whole plant of *Helecteres isora*. Daniel *et al* (1978) reported 2.5% of tannins in leaves of *Hemidesmus indicus*. Atal *et al* (1978) reported presence of tannins in 50% alcoholic extract of whole plant excluding roots of *Ixora parviflora*. They also reported presence of tannins in whole plant excluding roots of *Maesa indica*. Sawhney & Seshadri (1956) reported epicatechin in bark of *Pterocarpus marrupium*. Datta *et al* (1971) isolated a phenolic substance populnecol from flowers of *Thepsia populnea*.
Esters


Organic Acids & Amino Acids

thionine, in leaves of *Moringa pterygosperma*. Ramiah & Nair (1977) identified 9 amino acids in flowers, 8 in fruits and 7 each in protein hydrolysate of flowers and fruits of above drug. Alanine, arginine, glutamic acid, glycine, serine, threonine & valine were common in all parts tested, whereas aspartic acid was present in flowers as well as in fruits and lycine in flowers of the above drug. Subba Rao et al (1953 a, b) reported that seed oil of *Moringa pterygosperma* contained palmitic, stearic, behenic and oleic acids. Chowdhury & Chakraborty (1971 a) that alcoholic extract of *Murraya koenigii* stem yielded mukoeic acid i.e. 1-methoxy carbazole - 3 carboxylic acid. Chakraborty et al (1978) reported methyl ester of mukoeic acid from petrol extract of bark of above drug. Khastgir et al (1960) reported that *Oldenlandia corymbosa* yielded oleanolic acid and ursolic acid. Sunderaramaiah & Vimalabai (1973) reported oleanolic acid from the roots of *Lantana camara*. Gupta & Bihari (1973) reported that alcoholic extract of seeds of *Vitex negundo* gave carboxylic acid.

**Other Organic Compounds**