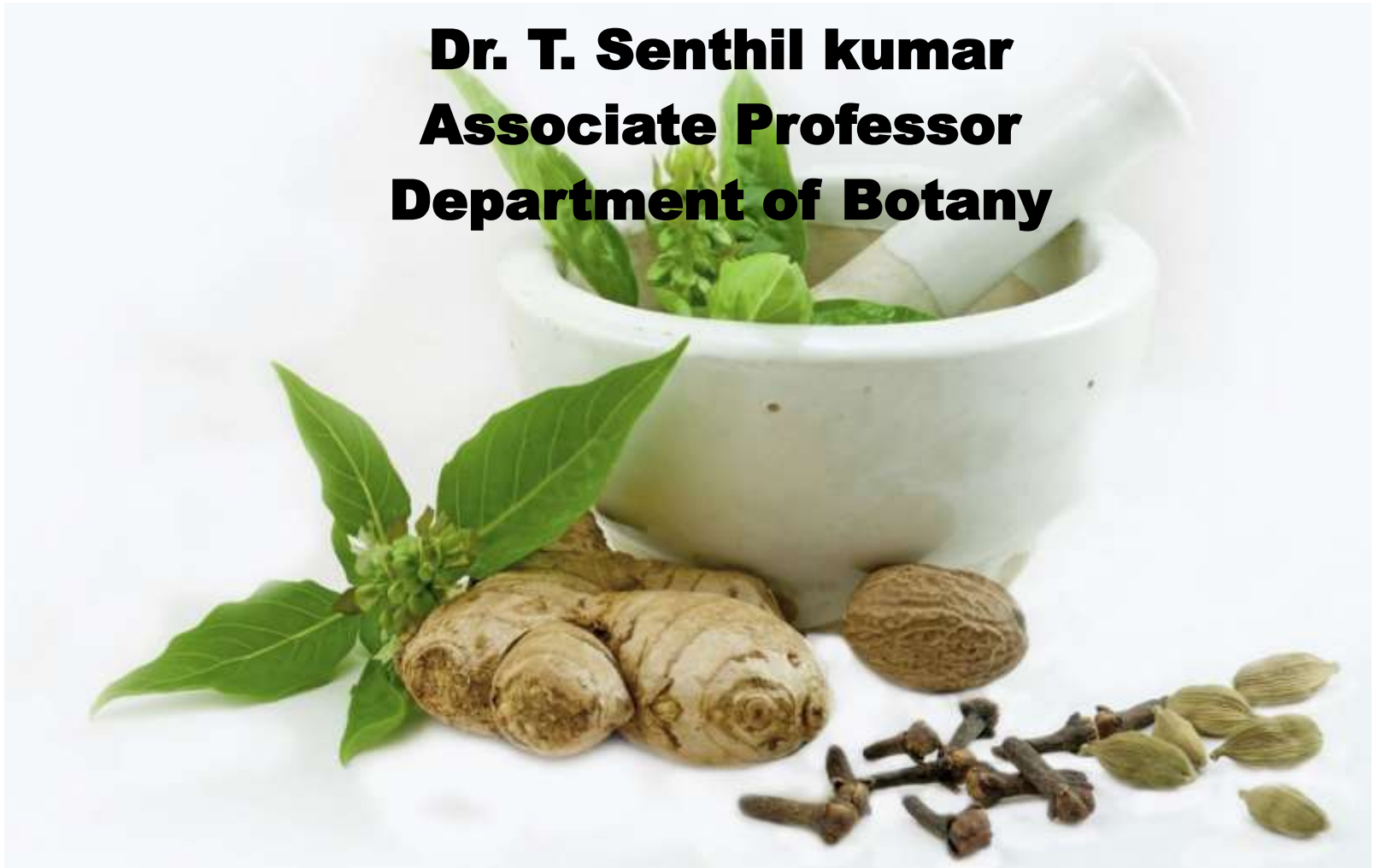


Study of Medicinal Plants

BY

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Urgent need to study medicinal plants

1. To rescue knowledge in imminent danger (likely to occur at any movement) of being lost

Inventory by WHO found 20,000 plant species in use for medicine in 90 countries

Only 250 of those species are commonly used or have been checked for main active chemical compounds

Urgent need to study medicinal plants

2. The utility of plants in current therapy

There has been a rush to develop synthetic medicines based on plant medicines, but often the synthetic medicines doesn't work as the original plant medicines.

For example – quinine and malaria

The medicinal properties of the cinchona tree were originally discovered by the [quechua](#) peoples of [peru](#), [Bolivia](#), and [Ecuador](#), and long cultivated by them as a [muscle relaxant](#) to abate shivering due to low body temperatures, and symptoms of Malaria. The Countess of Chinchon contracted malaria and native people persuaded her to immerse in a small pond beneath a tree; the water was bitter (due to the quinine contents).

Urgent need to study medicinal plants

3.To find new molecular models in plants

Many times we can take a plant chemical and modify it or make synthetic copies of it that are very valuable to us.

Lippia as a sweetener

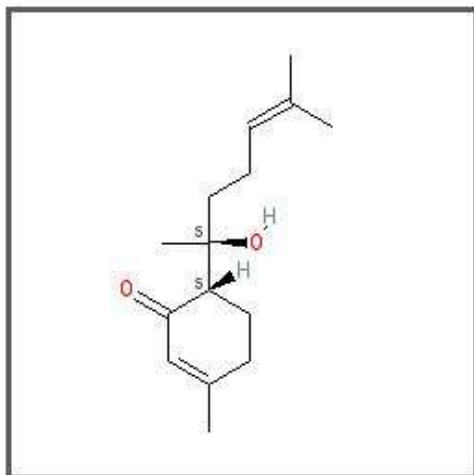
- In Pre-Columbian America, several plants of the genus *Lippia* were used as sweeteners. (Family: Verbenaceae – the verbenas).
- In the 20th century, *Lippia dulcis* was chemically analyzed and a new sweetener was found, hernandulcin, that is 800 to 1000 times sweeter than sucrose.

Lippia dulcis – sweetener from Pre-Columbian America



Hernandulcin

Hernandulcin



CAS No.
95602-94-1

Molecular Weight
236.3534

Chemical Formula
C₁₅H₂₄O₂

IUPAC NAME
(6S) - 6 - [(2S) - 2 -
hydroxy - 6 - methylhept - 5
- en - 2 - yl] - 3 -
methylcyclohex - 2 - en - 1 -
one



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Urgent need to study medicinal plants

4. The wide use of plants in folk medicine

One positive aspect of the use of medicinal plants is their low cost compared to the high price of new synthetic drugs that are totally inaccessible to the vast majority of the world's people.

Another benefit is that most medicinal plants do not have the kinds of harmful side effects seen with synthetic drugs.

Diospyros lycioides – source of chewing sticks in Namibia



Ceanothus americanus – Native American chewing stick



Modern Chewing Sticks



Most chewing stick plants have a wide range of antibacterial activity against a number of odontopathic bacterial species, and many also contained healing and /or analgesic compounds

Bloodroot – *Sanguinaria canadensis*



Rhizome of Bloodroot



Bloodroot extracts to treat dental plaque

- Bloodroot extracts have been identified as potentially valuable in controlling plaque
- Blood root has many alkaloids, known as sanguinaria alkaloids, and sanguinarine in particular, is thought to be a potential problem limiting the usefulness of blood root as a dental medicine
- There is an indication that sanguinarine may provoke glaucoma in predisposed humans and cats.

ETHNOPHARMACOLOGY



ETHNOPHARMACOLOGY

The systematic study of the use of medicinal plants by specific cultural groups.

Ethno (Greek-ethnos) - means race, people or culture

Pharmacology (Latin-pharmacologia)- the science dealing with the preparation, uses, and especially the effects of drugs.

The scientific study of substances used medicinally, especially folk remedies, by different ethnic or cultural groups

The study of the medicinal use of plants by indigenous peoples

The observation and experimental investigation of indigenous drugs and their biological activities

Pharmacological evaluation of ethnomedicinal uses

- Ethnopharmacology is a related study of ethnic groups and their use of drugs. Ethnopharmacology is distinctly linked to plant use, ethnobotany, as this is the main delivery of pharmaceuticals. **Ethnopharmacy** is the interdisciplinary science that investigates the perception and use of pharmaceuticals (especially traditional medicines, but not only), within a given human society.

- When investigating a natural product used by a culture as a medicine, it is important that the methods of collection, extraction and preparation are the same or similar to those used by the ethnic group. This is to ensure consistency and legitimacy of the experimentation

- documentation of indigenous medical knowledge
- scientific study of indigenous medicines in order to contribute in the long-run
- to improve health care in the regions of study, as well as
- search for pharmacologically unique principles from existing indigenous remedies

Ancient archaeological records of medicinal plants

3500 BC - India had an extensive

Pharmacopoeia or **Pharmacopoea** (literally, "drug-making"), in its modern technical sense, is a book containing directions for the identification of compound medicines, and published by the authority of a government or a medical or pharmaceutical society. Descriptions of preparations are called monographs.

Much of that knowledge is still used as part of the Ayurveda medical system

2250 BC – Egypt and Babylon were trading medicinal plants

900 BC - Archaeological records demonstrate the use of medicinal and psychoactive plants in the New World

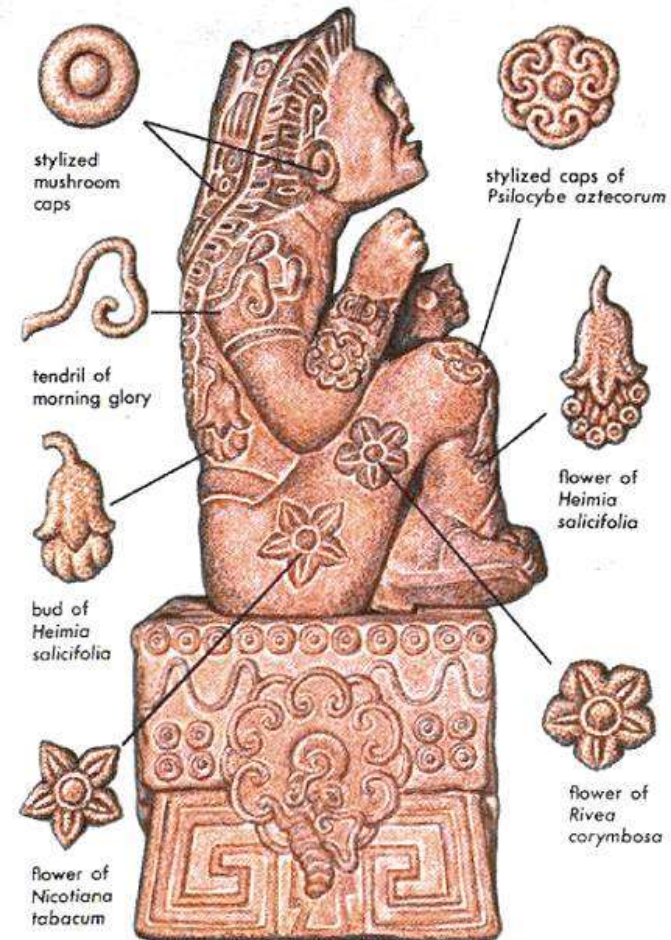
330 BCE - One of Theophrastus's students, Alexander the Great, sent medicinal plants from Asia back to Greece for cultivation

2000 YA - The first written Chinese records although use is probably as ancient as India's

Xochipilli – God of Inebriating Plants



Xochipilli, Prince of Flowers
from *Plants of the Gods*, by Schultes and Hofmann



Mayan Mushroom Stone



Use of Medicinal Plants

- The use of medicinal plants usually was passed down from generation to generation via two separate systems.
- First was the formal system of medicine men and women. They often functioned as shamans, as people with a path to another world, and they used psychoactive plants to make that journey. They used sacred plants with a resident spirit to communicate with the spirit world via visions and other hallucinations. (perception in the absence of external stimulus that has qualities of real perception)

Use of Medicinal Plants

- The second system was more informal and based on a general familiarity with medicinal plants. This knowledge was amassed via experimentation over many generations and was handed down orally from person to person – often woman to woman.

Collecting Medicinal Plants



Strychnos toxifera

– source of D-tubocurarine



Penicillium fungus



Mexican yam – *Dioscorea villosa*

Source of cortisone



Indian snakeroot – *Rauwolfia serpentina* – Source of reserpine



Madagascar periwinkle *Catharanthus roseus* –Source of vincristine



White Hellebore – *Veratrum album*

Source of hypotensive alkaloids



Medicinal Plants

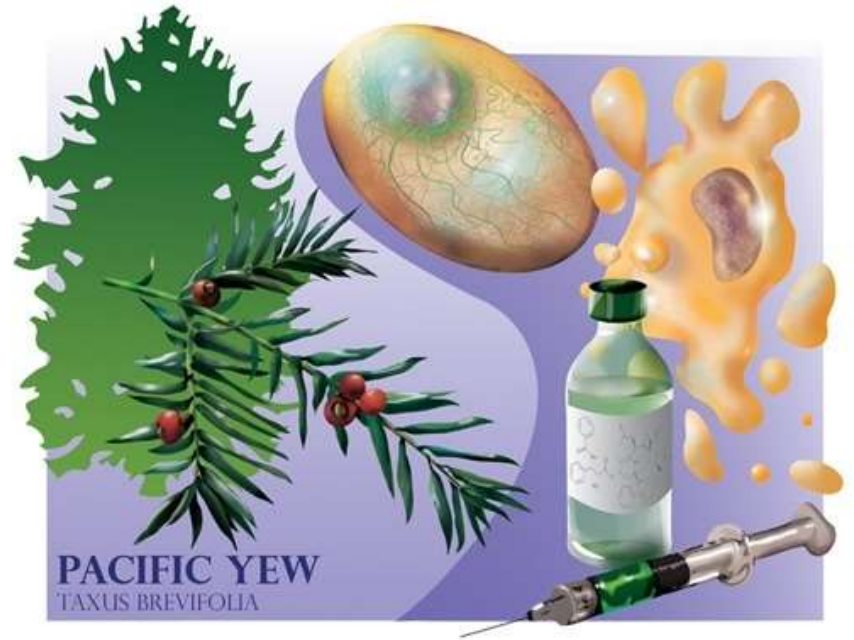
- About 25% of the prescription of drugs used in the western world have active ingredients that are derived from plants – often the only way to acquire these drugs is through growing and harvesting the plants because synthetic substitutes are not as effective.
- 89 plant derived drugs that are currently used in western medicine as prescription medicines were discovered by studying folk knowledge of the plant's properties.

How to find medicinal plants?

- There are typically two approaches used - a random search or a targeted search -
- In a random search, a broad net is cast and plants from a specific region are collected and screened for potential medicinal properties without regard to the taxonomic status, ethnobotanical use or any other quality - random searches have had consistently low success rates, though the National Cancer Institute discovered taxol, produced from the bark of the Pacific yew tree, an important drug used to treat breast and ovarian cancer, during a random screen

Pacific Yew Tree – Taxol

Random Search

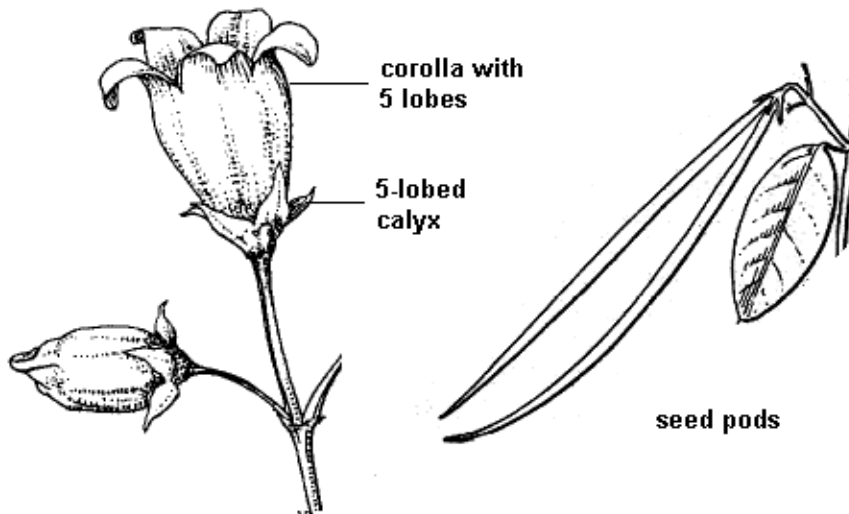


Targeted Search

- Targeted selections can be of several types:
- Phylogenetic surveys - close relatives of plants known to produce useful compounds are collected - such searches are likely to produce positive results
- Ecological surveys - plants that live in particular habitats or which have particular characteristics such as immunity to predation by insects or molluscs, are selected
- Ethnobotanical surveys - plants used by indigenous peoples in traditional medicine are selected for further research and study - this has often resulted in positive results

Phylogenetic Search - Apocynaceae

TYPICAL DOGBANE FLOWER



Vinca minor produces about 50 alkaloids – vincamine, reserpine, etc.



Ecological Search

Bogs – Insectivorous Plants



Ethnobotanical Survey

The success of ethnobotanical surveys stems from two components of the survey -

1. there is a cultural prescreening in which indigenous people experiment with plants in their environment, often over hundreds of generations, and identify those that are bioactive - obviously this greatly increases the chances of finding useful plants
2. the ethnobotanist will employ a screening process to determine which plants warrant further study

Success of Ethnobotanical Surveys

- Ethnobotanical surveys greatly increase the success rate when testing for plant activity in *in vitro* (test-tube) studies - for example, Paul Cox, Rebecca Sperry, Lars Bohlin, and others at the University of Uppsala found 86% of the plants used medicinally in Samoa to show significant levels of pharmacological activity
- Michael Balick tested plants from a sample of “powerful plants” recommended by a healer in a village in Belize, found 4 times as many plants with pharmacological activity as compared to a random screening when searching for anti-HIV plants during a project with the National Cancer Institute

Increasing the success rate of searches

Ethnobotanists tend to focus their surveys on cultures with three main characteristics:

1. A cultural mechanism for the accurate transmission of ethnopharmacological knowledge from generation to generation
2. Live in a floristically diverse environment
3. Continuity of residence in the area over many generations

Not always successful

- Not all plants identified by indigenous people as useful yield in pharmacological activity - this may be because of the plant is used in combination with another plant that has the activity;
- indigenous people sometimes treat diseases not recognized by western medicine (such as fright, wind or envy in Belize);
- and there may be a placebo effect with use of some plant products

What kinds of diseases are treated with plant products?

- A review of published accounts of plant uses in 15 widespread geographical areas - Australia, Fiji, Haiti, India, Kenya, Mexico, Nepal, Nicaragua, North America, Peru, Rotuma, Saudi Arabia, Thailand, Tonga, and West Africa makes it possible to categorize the plants according to the ailments for which they are used - the plants are used to treat - diseases of the nervous system, cardiovascular system, obstetrical and gynecological ailments, treatment of neoplasms (cancers), gastrointestinal ailments, skin diseases, inflammation (including fevers), microbial diseases, renal ailments, parasitic diseases, immunotherapy, blood diseases, and poisons

What kinds of drugs remain or are likely to be discovered?

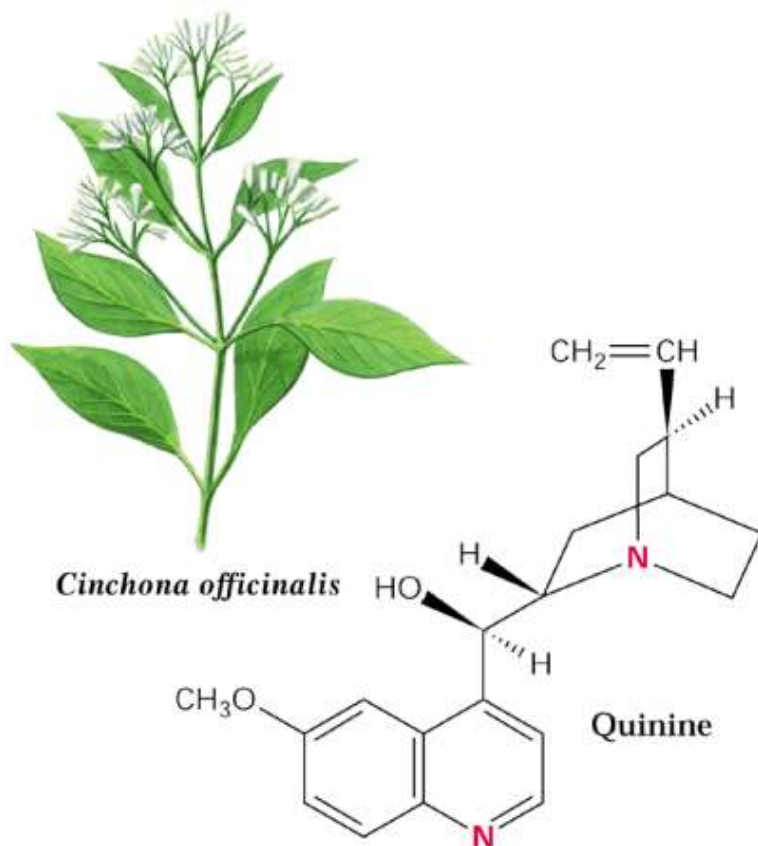
Indigenous therapies focus on GI complaints, inflammation, skin ailments, and ob/gyn disorders, while western medicine focuses on disorders of the cardiovascular and nervous systems, cancers, and microbial ailments - why the differences?

1. Perceived Peril
2. Saliency
3. Toxicity
4. Economic incentives

Ethnobotanists at work in the field

- Usually the ethnobotanist must obtain permits to conduct the research from a national government - certain international protocols must be observed - if the nation in which the research is to be done was a signatory of the Rio Treaty on Biodiversity, then that nation has sovereignty over all the biodiversity within its boundaries - no plant sample that may have pharmacological properties may be removed from the nation without permission of the country

Quinine



Cinchona officinalis – source of quinine



Ethnobotanists at work in the field

- Then the ethnobotanist must obtain permission from a village's elders to carry out the research - because of issues of intellectual property rights, the ethnobotanist should negotiate a fair and equitable return to the local people for any commercial development of a plant used in their traditional medicine
- The ethnobotanist must meet and establish rapport with the village healers - securing and maintaining the healer's trust is the single most important skill the ethnobotanist can have
- Ethnobotanists must develop their own personal ethnography - an understanding of the culture they are studying

Participant Observer



- living with the people under study, observing their daily life and customs, and learning about their lifestyle, foods, disease systems, and myths and legends

Immersion Ethnobotany



The extreme of involvement is immersion ethnobotany in which the researcher becomes a patient of traditional healers – e.g. seeking cure from Ayurvedic medicine

Complexities of Indigenous Healing

Indigenous healing systems can be very complex because they often incorporate at least three basic components:

1. a cosmological view of the universe that can help explain the cause, diagnosis, and treatment of disease
2. a cultural context within which health care is given
3. a performance of pharmaceutical substances