Medicinal Botany

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- Introduction: History of Plant Use in Medicine

Prehistoric times

- No one knows where or when plants first began to be used to treat disease
- Accidental discovery of some new plant food that eased pain might have been the beginning of folk knowledge
- Early evidence: the grave of a Neanderthal man buried 60,000 years ago. Pollen analysis indicated that plants buried with the corpse were all of medicinal value

Recorded history

- Earliest record 4,000 year old Sumerian clay tablet recorded numerous plant remedies
- Ancient Egyptian civilization left a wealth of information on medicinal plants and medical practice

Ancient Egypt

- Wealth of knowledge in medicine
- Physicians highly respected and very specialized
- Several important medical papyri
  - Ebers Papyrus
  - Edwin Smith Papyrus
  - Hearst Papyrus
  - Kahun Gynecological Papyrus

Edwin Smith Papyrus

- Purchased by Edwin Smith in Luxor, Egypt in 1862
- Written around 1700 BC but most of the information is based on older records from around 2640 BC - Imhoteps time
  - Imhoteps was physician of 3rd Dynasty
- The papyrus mainly covers wounds, and how to treat them

Ebers Papyrus

- From 1550 B.C. one of the oldest
- Most important and complete medical papyrus recovered
- Hieratic script (similar to hieroglyphics)
- 20.23 m in length and 30 cm. in height
- 110 pages scroll contains 700 magical formulas and folk remedies

Ebers Papyrus

- Purchased in Luxor in 1862 by Edwin Smith
- Said to have been found between the legs of a mummy on the west bank
- Possibly came from tomb of a doctor
- Purchased by Georg Ebers in 1873
- Now in Germany at University Library of Leipzig

Ebers Papyrus

- Contains chapters on
  - intestinal disease
  - ophthalmology
  - dermatology
  - gynecology, obstetrics, pregnancy diagnosis, contraception
  - dentistry
  - surgical treatment of abscesses, tumors, fractures and burns

Ebers Papyrus

- Also includes:
  - Description of the circulatory system
    - existence of blood vessels throughout the body
    - heart's function as a center of the blood supply
  - References to diabetes mellitus, hookworm and filariasis, arthritis
  - Section on psychiatry - describes a condition of severe despondency

Ancient China

- The Pun-tsao, a pharmacopoeia published around 1600
- Contained thousands of herbal cures that are attributed to the works of Shen-nung, China's legendary Emperor who lived 4500 years ago
- Emperor Shen-nung investigated the medicinal value of several hundred herbs
- Knowledge passed on orally for centuries
- Use of *Ephedra* for asthma one of these

Ancient India

- Herbal medicine dates back several thousand years to the Rig-Veda, the collection of Hindu sacred verses
- This is the basis of a health care system known as Ayurvedic medicine
- One useful plant that has come from Ayurvedic tradition is snakeroot, *Rauwolfia serpentina*

Foundations of western medicine

- These ancient records indicate that in all parts of the world native peoples discovered and developed medicinal uses of local plants
- Herbal medicine of ancient Greece laid the foundations of our Western medicine

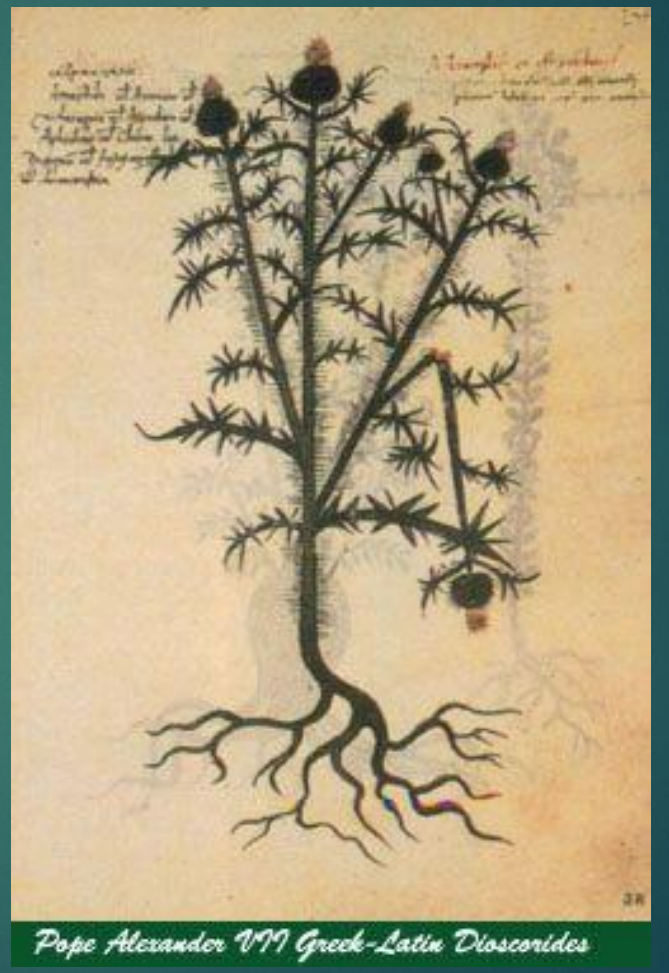
Ancient Greek and Roman medicine

- Greek physician Hippocrates (460-377 B.C.), the Father of Medicine used various herbal remedies in his treatments
- Theophrastus - Father of Botany
- Roman physician Dioscorides (1st century A.D.) wrote *De Materia Medica* which contained an account of over 600 species of plants with medicinal value
- Roman physician Galen (2nd century)

De Materia Medica

- Pharmacopoeia which was universally used in the Greek, Roman and Arab worlds from the 2nd century till 16th
- In *De Materia Medica*, Dioscorides listed 600 plants, 90 minerals and 30 animal products, with a drawing of each one and a note of its therapeutic properties

Illustrations from De Materia Medica



De Materia Medica

- Descriptions of plants, directions on the preparation, uses, and side effects
- Many still in use
  - willow bark tea - precursor to aspirin
- Some have been lost
  - Greek and Roman women used silphium as an effective contraceptive for 1,000 yrs - now extinct
- Standard medical reference for 1500 years

Silphium or Silphion

- A plant in the genus *Ferula* – parsley family
- Related to giant fennel (not the cooking herb)
- Used by ancient women for contraception
- During Greek and Roman Civilization, rare plant growing in a narrow 30 mile band along the dry mountain sides facing the Mediterranean Sea in northern Africa near the city of Cyrene (area is now part of Libya)

Silphium on Ancient Greek Coins

After Fall of Rome

- Little new knowledge was added in Europe during the Dark Ages
- De Materia Medica was copied and recopied
  - New illustrations
  - Translations into other languages
  - Annotations
  - Some of the most famous copies made during this time
- Knowledge added in Arab world

During the Middle Ages

- Western knowledge preserved in monasteries
- Manuscripts were translated or copied for monastery libraries
- The monks gathered herbs in the field, or raised them in their own herb gardens
  - These were prepared for the sick and injured
- Monastery gardens still may be found in many countries

The First Apothecary Shops

- First drug stores established by Moslems in Bagdad late in the 8th century
- Arab physicians not only preserved the Greco-Roman wisdom, but added to it
- When the Moslems swept across Africa, Spain and southern France, some of their practices were introduced to Europe
- Crusades introduced more Islamic plant knowledge and practices back to Europe

Avicenna

- Ibn Sina (about 980-1037 A.D.), a Persian who was called Avicenna by the Western world
- Pharmacist, poet, physician, philosopher and diplomat - considered a genius
- His pharmaceutical and medical teachings were accepted as authority in the West until the 17th century

Age of herbals

- Beginning of Renaissance in the early 15th century saw a renewal of learning in all fields
- Botanically - revival of herbalism for medicinal plants
- Coupled with the invention of the printing press in 1440 ushered in the Age of Herbals

Herbals

- Beautifully illustrated books that described plants
- When to collect, useful parts
- Medicinal and culinary uses
- Also included a lot of misinformation and superstition
- Often advocated the Doctrine of Signatures

Doctrine of Signatures

- Medicinal use recognized by distinct "signatures" visible on the plant which corresponded to human anatomy
  - Red juice of bloodwort to treat blood disorders
  - Lobed appearance of liverworts to aid the liver
- Belief in this concept developed independently among different cultures

Medicine and Botany

- During this time, medical schools were established in Europe
- Study of both medicine and botany
- Medical students knew the herbs
- These were the early botanists

18th Century

- As science progressed, a dichotomy in medicine developed between practitioners of herbal medicine and regular physicians
- About this same time a similar split occurred between herbalism and scientific botany

Path to modern medicine

- Many herbal remedies had a sound scientific basis
- Some became useful prescriptions drugs
- William Withering was the first to scientifically investigate a folk remedy
  - His studies (1775-1785) of foxglove to treat dropsy (congestive heart failure) set standard for pharmaceutical chemistry

19th Century

- Scientists began purifying the active extracts from medicinal plants
- Breakthrough in pharmaceutical chemistry came when Serturner isolated morphine from opium poppy in 1806
- First synthetic drugs were developed in the middle of the 19th century based on natural products

20th Century

- Direct use of plant extracts continued to decrease in the late 19th and 20th centuries
- Today medicinal plants still contribute significantly to prescription drugs
- 25% of prescriptions written in the U.S. contain plant-derived active ingredients
- 50% if fungal products are included
- An even larger percent based on semi-synthetic or wholly synthetic ingredients originally isolated from plants

Late 20th to early 21st centuries

- Renewed interest in investigating plants for medically useful compounds
- Recent success of taxol from the Pacific yew tree has shown this interest is worth pursuing

Growth of Alternative Medicine

- Dramatic increase in the use of alternative medical treatments
  - Complementary and Alternative Medicine - CAM
- Refers to a wide range of therapies outside the mainstream of traditional Western medicine:
  - aromatherapy, acupuncture, biofeedback, chiropractic manipulation, herbal medicine, hypnosis, and massage therapy

CAM

- Plants and plant extracts (often called botanicals) figure prominently in alternative treatments
  - herbal remedies
  - aromatherapy
- Sales of herbal remedies amount to approximately $3 billion per year in the U.S. and constitute close to 30% of the total sales for dietary supplements

Dietary Supplements

- Herbal remedies considered "dietary supplements" by the U.S. FDA
- Traditionally, dietary supplements referred to vitamins, minerals, other essential nutrients
- Dietary Supplement Health Education Act of 1994 expanded the category to include other products such as herbs, other botanicals, amino acids, and metabolites

FDA Regulations

- Dietary supplements are not required to undergo the same type of testing or approval that are required for prescription drugs or over-the-counter drugs
  - FDA requires extensive testing and clinical studies of drugs to determine their safety, proper dosages, effectiveness, possible side effects and interactions with other substances
  - Dietary supplements not subject to these

DSHEA

- Based on the DSHEA, the manufacturer of a dietary supplement is responsible for ensuring that the product is safe
- Prior approval is not required before sale
- FDA has responsibility to take action if a dietary supplement is later shown unsafe
- In 2001 comfrey (*Symphytim officinale*) removed from products due to liver toxicity

Herbal remedies

- Although not considered drugs by FDA, most contain active compounds that may offer health benefits or possibly cause adverse reactions
- 40% of US population using some form of CAM - many do not tell physicians
- Many can react with prescription medication - i.e. *Ginkgo*

Traditional (herbal) medicine today

- 75%-90% of the population in developing nations rely on herbal medicine as their only health care
- Medicinal herbs are sold alongside vegetables in village markets
- Practitioners of herbal medicine undergo extensive training to learn the plants, their uses, and preparation of remedies

People's Republic of China

- Traditional herbal medicine incorporated into a modern health care system
- Blend of herbal medicine, acupuncture, and Western medicine
- Thousands of species of medicinal herbs are available for the Chinese herbalist
- Chinese apothecaries contain an incredible assortment of dried plant specimens
- Prescriptions filled with blends of specific herbs

India

- Traditional systems separate from Western medicine
- At universities medical students are trained in Western medicine
- Most people use traditional systems:
  - Ayurvedic medicine - Hindu origin
  - Unani medicine - Muslim and Greek origin
  - Economics also a factor - manufactured pharmaceuticals too expensive for most

Other areas

- Interest in medicinal plants has focused on indigenous peoples in many parts of the world
- Ethnobotanists are spending time with local tribes and learning their medical lore before they are lost forever
- Especially important among native peoples in the tropical rain forests

Tropical rain forests

- Widespread destruction threatens to eliminate thousands of species that have never been scientifically investigated for medical potential
- Erosion of tribal cultures is also a threat to the knowledge of herbal practices
- As younger members of native groups are drawn away from tribal lifestyles, oral traditions are not passed on

WHO encourages the practice and improvement of traditional medicine

- 75 to 85% of the world's people still rely on traditional medicine to provide basic healthcare
- The native materia medica, derived from locally available medicinal plants, is the mainstay of this grass-roots ethnomedical system
- Documentation of these folk pharmacopoeias can expand the traditional healer's place in world
- Diagnostic criteria and diseases in conventional medicine need to be correlated with those in traditional medicine