



# Economic & Medicinal Botany

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Introduction: History of Plant Use in Medicine

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# Prehistoric times

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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



# Ebers Papyrus

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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# After Fall of Rome

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- Many herbal remedies had a sound scientific basis
- Some became useful prescription 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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 (*Symphytum officinale*) removed from products due to liver toxicity



# Herbal remedies

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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