

# History of Plants in Medicine; Active Principles in Plants

## History of Plants in Medicine

The earliest known medical document is a 4000-year-old Sumerian clay tablet that recorded plant remedies for various illnesses

The ancient Egyptian Ebers papyrus from 3500 year ago lists hundreds of remedies

The Pun-tsao contains thousands of herbal cures attributed to Shen-nung, China's legendary emperor who lived 4500 years ago

In India, herbal medicine dates back several thousand years to the Rig-Veda, the collection of Hindu sacred verses

The Badianus Manuscript is an illustrated document that reports the traditional medical knowledge of the Aztecs

## Early Greeks and Romans

Western medicine can be traced back to the Greek physician Hippocrates, who believed that disease had natural causes and used various herbal remedies in his treatments

Early Roman writings also influenced the development of western medicine, especially the works of Dioscorides, who compiled information on more than 600 species of plants with medicinal value in *De Materia Medica*

Many of the herbal remedies used by the Greeks and Romans were effective treatments that have become incorporated into modern medicine (e.g., willow bark tea, the precursor to aspirin)

Dioscorides' work remained the standard medical reference in most of Europe for the next 1500 years

## Age of herbals

The beginning of the Renaissance saw a revival of herbalism, the identification of medicinally useful plants

This coupled with the invention of the printing press in 1450 ushered in the Age of Herbals (see fig. 19.2)

Many of the herbals were richly illustrated; all of them focused on the medicinal uses of plants, but also included much misinformation and superstition

The Doctrine of Signatures, for example, held that the medicinal use of plants could be ascertained by recognizing features of the plant that corresponded to human anatomy

For example, the red juice of bloodwort suggests that it should be used for blood disorders; the lobed appearance of liverworts suggests that it should be used to treat liver complaints; the “humanoid” form of mandrake root suggests that it should be used to promote male virility and ensure conception (see fig. 19.2)

### Modern prescription drugs

Many of the remedies employed by the herbalists provided effective treatments

Studies of foxglove for the treatment of dropsy (congestive heart failure) set the standard for pharmaceutical chemistry

In the 19<sup>th</sup> century, scientists began purifying the active extracts from medicinal plants (e.g., the isolation of morphine from the opium poppy)

Advances in the field of pharmacology led to the formulation of the first purely synthetic drugs based on natural products in the middle of the 19<sup>th</sup> century

In 1839, for example, salicylic acid was identified as the active ingredient in a number of plants known for their pain-relieving qualities; salicylic acid was synthesized in 1853, eventually leading to the development of aspirin

It is estimated that 25% of prescriptions written in the U.S. contain plant-derived ingredients (close to 50% if fungal products are included); an even greater percentage are based on semisynthetic or wholly synthetic ingredients originally isolated from plants

### Herbal medicine today

While Western medicine strayed away from herbalism, 75% to 90% of the rural population of the rest world still relies on herbal medicine as their only health care

In many village marketplaces, medicinal herbs are sold alongside vegetables and other wares

The People’s Republic of China is the leading country for incorporating traditional herbal medicine into a modern health care system; the result is a blend of herbal medicine, acupuncture, and Western medicine

Plantations exist in China for the cultivation of medicinal plants, and thousands of species are thus available for the Chinese herbalist; prescriptions are filled with measured amounts of specific herbs rather than with pills or ointments (see fig. 19.3)

In India, traditional systems have remained quite separate from Western medicine

In addition to Ayurvedic medicine, which has a Hindu origin, Unani medicine, with its Muslim and Greek roots, is another widely practiced herbal tradition in India

The renewed interest in medicinal plants has focused on herbal cures among indigenous populations around the world, especially those in the tropical rain forests (see fig. 19.4)

It is hoped that these investigations will add new medicinal plants to the world's pharmacopoeia before they are lost forever

In addition to the destruction of the forests, the erosion of tribal cultures is also a threat to herbal practices

### Active Principles in Plants

The active principles in medicinal plants are chemical compounds known as secondary plant products

Some secondary products discourage herbivores; others inhibit bacterial or fungal pathogens

Two major categories of these compounds are alkaloids and glycosides

#### Alkaloids

More than 3000 alkaloids have been identified in 4000 plant species; most occur in herbaceous dicots and also in fungi

Alkaloids contain nitrogen, they are usually alkaline (basic), and they have a bitter taste

Their most pronounced actions are on the nervous system, where they can produce physiological and/or psychological results

The difference between a medicinal and a toxic effect of many alkaloids (or any drug) is often a matter of dosage

#### Glycosides

Glycosides are so named because a sugar molecule (*glyco-*) is attached to the active component

Glycosides are generally categorized by the nature of the nonsugar or active component

## Cyanogenic glycosides

Release cyanide (HCN) upon breakdown

The seeds, pits, and bark of many members of the rose family contain amygdalin, the most abundant cyanogenic glycoside

The pits of apricots are a particularly rich source of amygdalin and are ground up in the preparation of laetrile, a controversial cancer treatment; supposedly, HCN is released only in the presence of tumor cells and thus selectively destroys them

## Cardioactive glycosides and saponins

Both contain a steroid molecule as the active component

Cardioactive glycosides have their effect on the contraction of heart muscle and, in proper doses, some can be used to treat various forms of heart failure

On the other hand, some of the deadliest plants, such as milkweed and oleander, contain toxic levels of cardioactive glycosides

One useful saponin is diosgenin from yams, which can be used as a precursor for the synthesis of various hormones such as progesterone and cortisone

This lecture outline was prepared mainly from *Plants and Society*, by Levetin and McMahon, 2003 (3<sup>rd</sup> edition), and may contain phrases or entire sentences taken verbatim from that source.