

## Medicinal Plants

Medicinal Plants (see table 19.1)

Foxglove and the control of heart disease (see fig. 19.5)

Today in the U.S., several million heart patients rely on digitalis as the primary treatment for their condition

Dropsy is an old name for a condition characterized by severe bloating due to fluid accumulation in the lungs, abdomen, and extremities

Today, we know that the fluid retention is due to congestive heart failure, a failure of the heart to pump sufficiently

William Withering was an English country doctor who began treating dropsy patients with digitalis tea prepared from ground leaves of the purple foxglove, a member of the snapdragon family

It is now known that the leaves contain more than 30 glycosides, with digoxin and digotoxin the most medically significant

The cardioactive glycosides in digitalis slow the heart rate while increasing the strength of each heartbeat so that more blood is pumped with each contraction

The resulting improvement in circulation decreases edema in the lungs and extremities and increases kidney output

Aspirin and the willow tree (see fig. 19.6)

The bark of willow trees has long been known among many cultures as an effective treatment for reducing fever and relieving pain

In the 18<sup>th</sup> century in England, use of willow bark tea was found to be beneficial for the treatment of fever and chills

In the early 19<sup>th</sup> century, in the search for the active compound in willow bark, salicin (a glycoside of salicylic acid) was isolated

In the mid 19<sup>th</sup> century, salicylic acid was synthesized in the laboratory; it was used for rheumatic fever, gout, rheumatoid arthritis, and osteoarthritis

In 1898 it was discovered that acetylsalicylic acid was more palatable and caused less gastric distress than salicylic acid; it was soon given the name aspirin

Aspirin is valued for its three classic properties as an anti-inflammatory, antipyretic (fever reducer), and analgesic (pain reliever)

Newer uses of aspirin include the prevention of heart attacks, strokes, and colon, ovarian, and esophageal cancer

Aspirin may also delay the development of cataracts in the elderly and enhance the immune system in protecting the body against bacteria and viruses

The greatest attention has been given to the beneficial effects of an aspirin a day in the prevention of heart attacks

Administration of aspirin after a heart attack or stroke reduces the risk of a second heart attack or stroke

Also, aspirin given to healthy middle-aged men reduces the incidence of a first heart attack by 44%

One drawback of aspirin is that it can irritate the stomach

Also, it has been found that children who take aspirin while recovering from chicken pox or influenza can develop a condition known as Reye's syndrome (symptoms include vomiting and change in mental alertness)

Malaria and the fever bark tree (see fig. 19.7)

Malaria is still the world's most prevalent disease; 2-3 million people die each year from malaria, and at least 1 million are young children

Records of malaria date back more than 3500 years to ancient Egypt

The Greeks noted the higher incidence of the disease among people living near swamps or marshes

Later, Italians believed that breathing bad air (*mal aria*) near swamps caused the disease; eventually it was learned that mosquitoes near swamps, not the air, were causing the disease

Four species of protozoan parasites (carried by the mosquitoes) cause malaria in humans; symptoms include recurring bouts of fever and chills, anemia, and enlargement of the spleen due to destruction of red blood cells

The mosquito carries a stage of the parasite in its salivary glands and injects the parasite into the bloodstream with its bite

The parasite multiplies in the liver and eventually releases merozoites (the asexual stage in its life cycle) into the bloodstream

The merozoites invade red blood cells and multiply; later the red blood cells rupture, releasing a new generation of merozoites that infect other red blood cells

Until the application of the fever bark tree, there was no effective treatment for malaria

The fever bark tree, called *quina-quina* (bark of barks) by the Incas, is native to the eastern slopes of the Andes

This small evergreen tree is a member of the coffee family; its fever-reducing powers were well known to the Incas of Peru, who shared this knowledge with Jesuit missionaries

By the end of the 17<sup>th</sup> century, the powdered bark of the quina-quina tree was the standard treatment for malaria

In 1820, two French scientists isolated the alkaloid quinine from the bark; within a few years the purified alkaloid was available commercially and replaced whole bark preparations

During the 19<sup>th</sup> century, the British and Dutch established plantations in India and Java, respectively

High-yielding strains, whose bark contains up to 13% quinine, were first developed in Bolivia

The Dutch dominated the world quinine trade until sources were cut off during World War II and synthetics filled the void

Today, the most widely used drug is chloroquine, which is less toxic and more effective than quinine

Quinine acts on the merozoite stage, killing the parasite in the bloodstream; it is also effective as a prophylactic

Development of tonic water by the British for use in India was for prophylaxis; the British colonists made the quinine water more palatable by adding gin – thus the gin and tonic as a favorite drink in the tropics

*Artemisia annua*, wormwood, contains the terpene artemisinin, which has shown promising antimalarial results in animal trials; it shows fewer side effects than quinine or synthetics and is effective against chloroquine-resistant strains

## Snakeroot, schizophrenia, and hypertension

For more than 4000 years, Hindu healer in India used snakeroot *Rauwolfia serpentina* (see fig. 19.8), to treat snakebites (because of the coiled shape of the root), insect bites, and mental illness

The first active principle isolated from the root was reserpine; today, dozens of alkaloids are known with rescinnamine and deserpidine also important pharmaceuticals

The sedative effect of reserpine made it valuable as one of the first tranquilizers prescribed for schizophrenia; a side effect was a reduction in blood pressure

Today, reserpine is used primarily to treat hypertension; the majority of drugs prescribed for controlling high blood pressure contain *Rauwolfia* alkaloids

## The burn plant (see fig. 19.9)

*Aloe* has been used for thousands of years to treat various skin ailments including rashes, sunburns, direct burns, scalds, and minor wounds; medicinal use dates back to the ancient cultures in Africa and the Mediterranean area

When cut, the succulent leaves yield a thick mucilaginous sap that can be soothing when applied to injured skin

Aloe sap promotes faster healing with less scarring by stimulating cell growth and inhibiting bacterial and fungal infection

Compounds in the sap inhibit pain, itching, and inflammation; the sap is also useful in treating skin and mouth ulcers, eczema, psoriasis, ringworm, athlete's foot, and poison ivy rashes

In a recent investigation, dried aloe sap showed some promise for treating diabetes by lowering blood glucose levels

It can be found in a variety of skin creams, shampoos, sunscreen lotions, and bath oils

## Ephedrine

Various species of *Ephedra* have a long history of use in herbal medicine as a decongestant for asthma, bronchitis, and other respiratory ailments

The active principle is an alkaloid, ephedrine, which has been used in over-the-counter and prescription decongestants and asthma medications

The FDA has issued warnings that ephedrine can be a dangerous drug, and in February of 2004 issued a final rule prohibiting the sale of dietary supplements containing ephedrine alkaloids (the rule takes effect April 2004)

Herbal teas with ephedrine can cause irregular heartbeats, dizziness, headaches, heart attacks, strokes, seizures, and psychotic episodes

### Cancer therapy

Vincristine and vinblastine from the Madagascar periwinkle (see fig. 19.10a) are used to treat various forms of leukemia and lymphoma

Vincristine is especially effective for treating acute childhood leukemia, and vinblastine is used to treat Hodgkin's disease

Taxol, a terpene from the bark of the Pacific yew (see fig. 19.10b), has great promise for treating ovarian and breast cancer

The trees were in danger of being destroyed, but a promising development is taxol-producing tissue cultures of bark cells that yield seven times more taxol than is produced naturally in the bark of the tree

Also, semisynthetic taxol can now be prepared in the laboratory

### Herbal remedies: promise and problems (see table 19.2)

Plants and plant extracts figure prominently in alternative treatments in both herbal medicine and aromatherapy

Herbal remedies are considered dietary supplements by the FDA; sales are about \$3 billion per year in the U.S. and constitute almost 30% of the total sales for dietary supplements

Like many medicinal plants, herbal remedies contain secondary compounds that can have powerful physiological effects; although not considered drugs by the FDA, they may offer health benefits or cause adverse reactions

#### St. John's wort

St. John's wort is the latest treatment for sufferers of depression; it has a long history of use in herbal medicine and is cited in the classic works of Hippocrates, Pliny, and Dioscorides

In Germany, St. John's wort is the leading treatment for mild and moderate depression; clinical trials in Great Britain showed that patients treated with the herb showed significant improvement

As do many antidepressants, St. John's wort apparently lifts spirits by raising levels of certain mood-enhancing neurotransmitters in the brain, particularly serotonin

There is also interest in developing St. John's wort as a weight-loss aid

On the negative side, St. John's wort may induce photosensitivity in certain individuals

Also, it has been recently reported that patients who take St. John's wort supplements experience a drop in blood concentration of certain prescribed medications they are taking

## Ginkgo

*Ginkgo biloba* is offering hope for Alzheimer's patients

A daily regimen of ginkgo extract results in stabilization or even improvement of brain function in elderly people who suffer from mild dementia

Ginkgo extracts may halt the progression of Alzheimer's; concentration and short-term memory are enhanced while absent-mindedness and anxiety are reduced

There is also evidence that ginkgo extracts can counteract destructive free radicals

Conversely, ginkgo extracts can magnify the effects of anticoagulants such as aspirin and warfarin (coumadin) and thus induce bleeding

## Saw Palmetto

Benign prostate enlargement (BPE) is a noncancerous condition in which the prostate gland increases in size

Once the gland enlarges, urination becomes difficult

In BPE, dihydrotestosterone (DHT) induces the cells of the prostate to replicate, causing enlargement

Saw palmetto contains a substance that inhibits the enzyme alpha reductase, which converts testosterone to DHT; it also prevents DHT from binding to receptors on the membrane of prostate cells

Saw palmetto extract is effective for more sufferers, works faster in relieving symptoms, and has fewer side effects than the commonly prescribed drug finasteride