THE MEDICAL, PHARMACEUTICAL, AND NUTRITIONAL BIOCHEMISTRY AND USES OF SOME COMMON MEDICINAL PLANTS

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Contents

Summary

This chapter dwells on the commonly used medicinal plants and the active compounds (the phytochemicals) which are often the basis for their medicinal, pharmaceutical, and food applications. Modern and traditional trends in medicine now turn towards using the active compounds in these plants without using whole plants. These active compounds are mainly the phytochemicals which are grouped into alkaloids, terpenes, polyphenols, and glycosides. Understanding the biochemistry of these active compounds is key to having a basic understanding of their role in modern and traditional medicines. Traditional medicine remains in use and accepted as desired primary healthcare system in several communities around the globe, with over 80% in developing countries and about 60% of the global population directly depending on the medicinal plants and herbs for their medical treatment and health purposes. Many parts of plants are applied to return health anomalies to normal, relieve symptoms, and/or avoid illness. The plants contain bioactive phytochemicals. Alkaloids have pharmaceutical properties, including as anticancer, antiasthma, and antimalarial. The characteristics and level of phenol structures in polyphenolic compounds determine the exclusive biological and physicochemical properties of exact polyphenols; for example, tannic acid and ellagitannin. Plants usually have mixtures of polyphenolic compounds and related phytochemicals. Several extracts of polyphenols, including those from olive pulp, grape seeds, grape skin, and maritime pines, have been made available as recipes for functional food, pharmaceutical products, as well as dietetic supplementation. Terpenes were brought to public spotlight by the development and edification of recreational and medical cannabis. Terpene and terpenoid are basic components of essential oil from several flowering plants broadly applied as scents/fragrance in modern and traditional medicines, including aromatherapy. Several glycosides from plants have medicinal and therapeutical effects. Pharmacologically active phytochemicals have useful applications and safety concerns.

1. Introduction

Medicinal plants, or medicinal herbs or just herbs, are plants with therapeutic properties and beneficial pharmacological effects on humans or animals. These therapeutic and pharmacological effects are usually due to the pharmacologically active compounds in these plants. These active compounds are mainly the phytochemicals which are grouped into alkaloids, terpenes, polyphenols, and glycosides. There is a rich history of using medicinal plants to cure diseases. Many parts of plants are applied to return health anomalies to normal, relieve symptoms, and/or avoid illness. The plants contain bioactive phytochemicals; alkaloids, polyphenols, glycosides, and terpenes. As the

practices of herbal medicines do not strictly follow facts accumulated with scientific-based approaches, orthodox medicine perceives herbal medicines as alternative medicines. Majority of the pharmaceutical products presently recommended by physicians, nutritionists, and pharmacists have historical usage as herbal medicines, including digitalis, quinine, aspirin, and opium. Modern medicine uses isolated active compounds from the higher plants, and about 80% of which show positive connection between their traditional uses and current modern therapeutic uses.

The use and quest for dietary supplements and drugs obtained from medicinal plants have increased recently. Scientists and researchers such as botanists, phytochemists, pharmacologists, microbiologists, and food chemists are exploring the ecosystem for active phytochemicals and the clues which can be formed into medicines for the treatment of several conditions. Traditional medicine remains in use and accepted as desired primary healthcare system in several communities around the globe, with over 80% in developing nations and about 60% of the global population directly depending on the medicinal plants and herbs for their medical treatment and health purposes. Most naturally occurring sugar alcohols can be used for medicinal purposes, especially as laxatives.

Currently, billions of people all-over the globe take plant based medications and diets as part of the traditional medicine or health therapy for a wide range of clinical, medical, and/or nutritional reasons. The utilization of traditional medicine in developing and underdeveloped countries directly contributes to the socio-economic status, wellbeing, and needs of the rural communities. People in rural areas generate income from medicinal plants, especially herbalists and traditional healers. The use of medicinal plants particularly in primary healthcare system is prominent, leading to the growing exploration for plants/herbs with medicinal application and uses. The search and quest for plants with medicinal uses have led to many ethnobotanical studies that documented species of traditional medicinal plant, the preparation mode, and uses by local communities in many parts of the world. The identifications of these medicinal plants and the subsequent investigations into their qualities and toxicities are of utmost importance. Moreover, numerous invaluable possibilities from indigenous knowledge on the uses of medicinal plants are often lost from one particular generation to the other. With the growing destruction of habitats and human encroachment into the wild, plant resources such as the medicinal plants are threatened or are getting depleted. Many medicinal plants including teas and herbs provide safe ways for health improvement.

Modern and traditional trends in medicine now turn towards using the active compounds in plants without using all the parts of the plants. Phytochemicals in these plants may be compounded, synthesized, or transformed to produce pharmaceuticals. The typical examples of such phytochemical derivatives are capsaicine from chili; digoxin from digitalis; and aspirin which is known to be chemically similar to salicylic acid in the white willow. Opium poppy remains a key industrial source of the opiates, including morphine. Some traditional medicines, nevertheless, have transformed into modern drugs, though there are ongoing robust studies on efficacies and likely adaptations of treatments with traditional herbs. This chapter dwells on the commonly used medicinal plants worldwide and the active compounds (the phytochemicals) which are often the basis for their medicinal, pharmaceutical, and food applications.

At times, consumption of medicinal plants can have comparatively low risks than consuming concentrated, factory-made supplements, because there are increased risks of product contamination with manufacturing and handling operations. It is a unique way to exploit their medicinal properties and also derive gratification of cultivating them yourself. Medicinal plants can add required nutrients, as they contain nutrients such as carbohydrates, fats, proteins, vitamins and minerals, and water; but phytochemicals are the major substances that give them their medicinal effects. Therefore, this chapter focuses more on these phytochemicals. Some of the groups of phytochemicals are shown in Figure 1. It is important to note that both plants and supplements, which are not regulated by relevant authorities for safety and quality, could be consumed in doubtful doses and may have contamination risks.

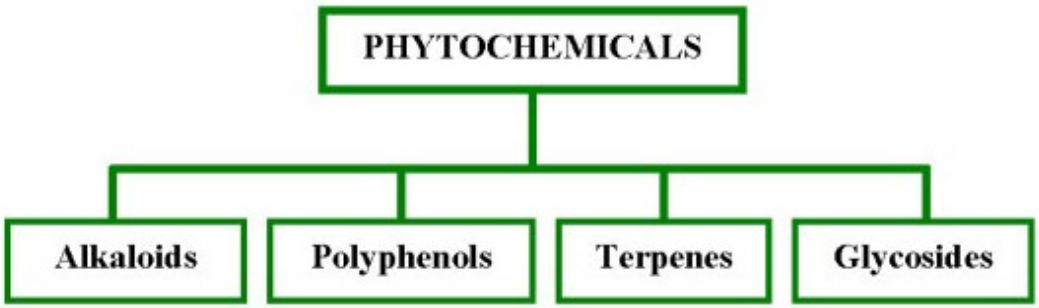

Figure 1. Classification of Phytochemicals

2. Common Medicinal Plants and Extracts used in Modern and Traditional Medicine

Medicinal plant extracts have been widely recognized for being effective in traditional and modern medicine. At the beginning of the 21st century, 11% of the 252 medications considered essential by the WHO were all from flowering plants. Medicines such as morphine, codeine, and quinine have plant-based constituents. Although factory-made medications have unquestionably become significant to humans, it is reassuring to know that nature is with us, and these herbs are often available to complement good health practices. Herbal teas contain polyphenols which are soluble and have astringency believed to possess medicinal characteristics. Ayurveda system makes use of pomegranate and its peel rich in polyphenols for therapeutic applications. Here are some common medicinal herbs currently used worldwide for medicinal and health purposes and they are shown in Appendix 1.

2.1. Grape-seed (*Vitis vinifera*) Extract

For decades, grape-seed extracts which are rich in proanthocyanidins are available as liquid, tablets, or capsules, and have been acknowledged and much-admired for their antioxidant activities. Grape-seed extract has medicinal benefits, such as reducing the symptoms associated with poor circulation within veins in legs and lowering bad cholesterol; low density lipoprotein (LDL). Recent studies have confirmed that steady intake of grape-seed extracts has anticancer/anticarcinogenic outcome and appears to stop the growth of cancer cells. Grape-seed contains similar antioxidant compounds

seen in wines. *Vitis vinifera* extracts may be beneficial for lowering LDL, cancer, edema, blood pressure, etc. However, caution needs to be taken in circumstances such as taking blood thinners, going in for surgery, or taking blood pressure medications. Grape-seed extracts may also reduce iron absorption.

2.2. Garlic (*Allium sativum*)

Garlic has been widely used for lowering blood pressure and reducing cholesterol levels. It contains phytochemicals such as allicin, flavonoids, ajoene, saponins, vinyldithiins, etc., which have various health benefits. Garlic has antimicrobial effects. Some studies indicated that it might cause a little decrease in LDL cholesterol and total cholesterol levels. But results of studies on cholesterol-lowering effects of garlic have been managed to confer positive effects, according to FDA. Currently, studies are looking into possible role of *Allium sativum* in cancer prevention. It is safe, but should never be used along with warfarin (an anticoagulant), as huge quantities of garlic could have effects on clotting. Due to this reason, high quantities are advised never to be taken prior to surgical or dental procedures.

2.3. Ginger (*Zingiber officinale*)

Ginger is popularly used globally; whether as spice in foods, or medicine for modern and traditional purposes, the high demand for the medicinal plant worldwide has been unswerving all through history. Ginger is used for many food or medicine items, including vegetables, pickles, alcoholic beverages, candy, and soda. Research shows that ginger is effective in relieving nausea due to pregnancy or chemotherapy. Some researchers have suggested that ginger can help boost the immune system against viral infection such flu. Ginger contains high amounts of gingerol, a phytochemical with powerful antioxidant and anti-inflammatory properties. About 1 to 1.5 g of ginger alone can help prevent many types of nausea, including chemotherapy-related nausea, sea sickness, morning sickness, and nausea following surgery. Ginger seems very effective against menstrual pain when consumed at the start of menstrual period. Ginger is known to decrease blood sugar level as well as improve many risk factors of heart disease in Type 2 diabetes patients. Some studies indicate ginger is effective at decreasing the osteoarthritis symptoms. Reported side effects usually include heartburn, bloating, gas, etc.

2.4. Holy Basil (Tulsi)

Holy basil (*Ocimum tenuiflorum*), also known as tulsi, is a green leafy plant native to Southeast Asia. Historically, it has been applied in Indian medicines for treating numerous health conditions, including eye diseases and ringworms. Many parts of tulsi plant are used for treating different health conditions: the seeds and leaves, together with black pepper, for treating malaria; its fresh flowers for treating bronchitis; the whole plant for nausea, vomiting, and diarrhea; alcohol extracts for eye diseases and stomach ulcers; essential oils produced from its leaves for insect bites; its ointment and pill forms for eczema treatment. Holy basil has antianxiety and antidepressant properties that are likened to antidepressant drugs. Studies indicated that it may help individuals become more social with less anxiousness. It has been shown that holy basil boosts

health in numerous ways. It helps lower blood sugar, protect against infectious diseases, lower cholesterol, ensure stomach health, and ease joint pain. There are several ways to add holy basil to one's life every day. It can be added to foods while cooking, taken as supplements, or used to make tea. Holy basil can also be available as essential oil.

2.5. Gingko (*Gingko biloba*)

Ginkgo leaf extracts have been used as treatment for numerous health conditions, including fatigue, tinnitus, asthma, and bronchitis. They are also used to prevent dementia, enhance memory health, and prevent other brain disorders and impairments. Although studies have maintained support for its small effectiveness, the exact way gingko works is not fully understood. Only the extracts from its leaves have to be used. Gingko seed contains ginkgo toxin, which can result in seizures and even death in large amounts. As some information submits that ginkgo may add to bleeding risk, never use it together with none steroidal anti-inflammatory medications, anticonvulsant drugs, tricyclic antidepressants, or anticoagulants.

2.6. Saint John's Wort (*Hypericum perforatum*)

Hypericum perforatum has been in usage as antidepressant for years. Current studies and reviews have not proven that there is more than the small effects on depression. More studies are required to establish doses. One side effect is light sensitivity, which is only reported in individuals consuming large doses of Saint John's wort. *Hypericum perforatum* can result in harmful interactions with many regularly used medications.

2.7. Chamomile

Chamomile is a group of plants that belong to the family Asteraceae, which include *Matricaria chamomila, Chamaemelum nobile, Chamomilla recutita*, among others. Considered to be cure-all by many, chamomile is used as an anxiolytic and sedative to manage relaxation and anxiety. It has been in use for healing wounds and reducing swelling or inflammation, although results on its effectiveness for any health conditions are insufficient. It often serves as tea and can also be applied as compress. Many authorities such as the FDA consider it as safe. It might increase drowsiness resulting from medicines or supplements, or from other herbs. Chamomile may affect the way human body makes use of several medicines, resulting in very high level of the medicine in many individuals.

2.8. Echinacea

Species in Echinacea include *Echinacea purpurea, E. laevigata, E. tennesseensis*, etc. Echinacea is usually used for the treatment or prevention of colds, infections, and flu, as well as for the healing of wounds. More than two dozen published studies examined how good echinacea worked to shorten or prevent cold development, however no one was conclusive. Study in 2014 compared echinacea to a placebo for cold treatment. The results indicated echinacea had no effects on common cold. Prolonged use may have effect on immune system. Echinacea ought not to be used along with medications which

impair liver functions, including hepatic necrosis. Individuals allergic to the plants of daisy family could be more likely allergic to echinacea. Daisy family includes plants such as chrysanthemums, daisies, marigolds, as well as ragweed.

2.9. Feverfew (*Tanacetum parthenium*)

Feverfew has been used as traditional treatment for fevers. Currently, it is generally used to treat arthritis and to prevent migraines. Some studies have indicated that some preparations of feverfew can prevent migraines. Side effects of feverfew often include digestive irritation and mouth ulcers. Individuals who abruptly stop feverfew intakes for migraines might have the headaches coming back again. Feverfew ought not to be taken with nonsteroidal anti-inflammatory medications, as these medications could change the efficacy of feverfew. Feverfew should never be used together with warfarin or any anticoagulant medications.

2.10. Valerian (*Valeriana officinalis*)

Valerian is used for treatment of sleeplessness and for reducing anxiety. Studies suggest that valerian could be helpful for sleeping; however, some experts argue that there are no reliable studies to prove these results. In the United States, valerian is widely used as flavoring (food additive) for foods such as root beer.

2.11. Ginseng

Ginseng is root obtained from plants of *Panax*, including *P. ginseng, P. notoginseng*, etc. Ginseng is used as aphrodisiac and as tonic, as well as cure-all. Studies are not certain about effectiveness of ginseng, in part due to challenge in defining quality of life and vitality. Side effects of ginseng include tachycardia and high blood pressure (HBP). Ginseng is believed to be safe by many regulatory authorities; however, it should not be used along with heparin, digoxin, warfarin, estrogens, corticosteroids, or nonsteroidal anti-inflammatory medications. Diabetic patients should avoid ginseng usage.

2.12. Lavender

Lavender, a genus species in Lamiaceae, is an aromatic, purple flower with anti-anxiety properties. It has been shown to have soothing effect in one study involving those with dental problems, whereas a different study established it directly impact cognitive performance and mood. Lavender also has commendable sedative functions, which help individuals get the desired sleep. Recently, it was reported that lavender has anti-inflammatory benefits. It is effective even when diluted and used on skin or in aromatherapy. Lavender may be beneficial for: anxiety, migraine, stress, and blood pressure. It can cause skin irritation. Lavender has limited side effects. It is poisonous when taken orally, and may also disrupt hormones when used without dilution.

2.13. Goldenseal (*Hydrastis canadensis*)

Goldenseal is usually used for the treatment of diarrhea, skin irritations, eye irritation, as an antiseptic, and as an unproven cold treatment. Goldenseal has berberine, an alkaloid

with deep-rooted historical medicinal applications in Chinese and Ayurvedic medicine. Studies indicated the effectiveness of goldenseal for diarrhea treatment. However, it is not recommended as it is poisonous in very high dosages. Goldenseal can cause throat, gastric, skin, and mouth irritations. Currently, it is an endangered species, and thus also not recommended for this reason.

2.14. Milk Thistle (*Silybum marianum*)

Milk thistle is used in modern and traditional medicines to treat high cholesterol, liver conditions, and to reduce cancer cell growth. Milk thistle originated from the Mediterranean region. Over the past many thousand years, milk thistle has been used for treating different illnesses particularly liver complications. Though study results are often undefined, promising and reliable knowledge exists.

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