

Pharmacognosy, Phytotherapy and Modern Medicine

Review Article

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Abstract

Pharmacognosy has been developed from ancient civilization who used parts of plants and animals for healing, eliminate pain, control suffering and to treat diseases. It is a science devoted to the study of medicines of natural origin of animal, mineral or vegetable origin. Pharmacognosy deals, among other things, with the history, distribution, identification and methods of use of natural medicines. Nowadays, research carried out in the field of pharmacognosy is mainly focused on the study of the therapeutic properties of plants and their derivatives. Indeed, the plant kingdom is a huge source of natural medicines. More than 400,000 plant species have been scientifically identified. Despite the evolution of modern medicine, herbal medicine occupies a prominent place in the management of human diseases. Scientific research carried out on medicinal plants has enabled the isolation of more than 170,000 bioactive molecules from which almost 70% of our current pharmaceutical products originate. The topics covered in this review have been selected to provide the reader with a general overview of pharmacognosy, herbal medicine and the importance of plants in modern medicine.

Keywords: Pharmacognosy, Phytotherapy, Modern medicine

Introduction

The word "Pharmacognosy" was first introduced by the Austrian physician Schmidt in 1811 and then in 1815 by Seydler in a work titled *Analecta Pharmacognostica*. Pharmacognosy derives from the Latin words *Pharmakon* which means «a drug» and *Gignoso* which means «to acquire knowledge of [1]. It may be defined as an important branch of pharmacy which deals with the study of structural, physical, chemical, biochemical and sensory characters of crude drugs obtained from medicinal plants, animals, fungi, and other natural sources. It also includes a study of their history, collection, identification, distribution, preparation, cultivation, evaluation, preservation, use and commerce [2]. Pharmacognosy has been developed from ancient civilization who used parts of plants and animals for healing, eliminate pain, control suffering and to treat diseases. The primitive man tried to understand the rationale behind use of the crude drugs and transfer his knowledge by mouth and later on by carving on to stones and clays and then writing on parchment or paper [3]. Nowadays, Pharmacognosy is mainly focused on phytotherapy which is the use of plants or herbs to manage health conditions.

In fact, plants are the most widespread and accessible natural source of medicines for humans. According to WHO, around 21,000 plant species have the potential for being used as medicinal plants. Medicinal plants, also called medicinal herbs, have been discovered and used in traditional medicine practices since prehistoric times. Ancient Unani manuscripts Egyptian papyrus and Chinese writings described the use of herbs. Evidence exist that Unani Hakims, Indian Vaid and European and Mediterranean cultures were using herbs for over 4000 years as medicine. Indigenous cultures such as Rome, Egypt, Iran, Africa and America used herbs in their healing rituals, while other developed traditional medical systems such as Unani, Ayurveda and Chinese Medicine in which herbal therapies were used systematically. Recently, WHO (World Health Organization) estimated that 80 percent of people worldwide rely on herbal medicines for some aspect of their primary health care needs. The global market value of medicinal plant products exceeds \$100 billion per annum [4].

Ethnobotanical research is receiving particular attention, with growing interest in medicinal plants and their extracts as a potential source of medicine. Indeed, the treatment of human diseases by plants



is a common practice in traditional settings and several plant species are known for their therapeutic effects. Several curative potions made from medicinal plants have been listed in the traditional pharmacopoeia. An aqueous decoction of the leaves of *Chromolaena odorata*, for example, is consumed to treat diarrhea caused by *Escherichia coli*. The leaves of *Saxifraga jacquemontiana* are crushed and applied on wounds. *Capparis sepiaria* bark is pounded and drunk with hot water to treat stomachache. Medicinal plants are vital sources of easily accessible remedy used in the countryside healthcare system. Many sick people in the developing regions combine the conventional medicine with traditional medicine [5]. Traditional medicines are usually cheaper than modern medicines, and probably the only natural remedies available and accessible in the remote rural communities in developing countries [6]. To date, traditional medicine and medicinal plants in particular remain an important source for the discovery of new drugs.

Drug discovery involves the identification of new chemical entities of potential therapeutic value, which can be obtained through isolation from natural sources. In the last few decades, the Phytoterapy has become the interest of many scientists as a tool to improve the global health issues. In fact, plants produce chemical compounds as part of their normal metabolic activities. These phytochemicals are divided into primary metabolites such as sugars and fats, which are found in all plants; and secondary metabolites compounds which are found in a smaller range of plants, serving more specific functions [7]. The secondary metabolites produced by plants have various pharmacological properties in humans. They can act at several levels in the body, which makes it possible to restore physiological balances and overcome diseases [8]. Drug use from medicinal plants has advanced from the formulation of crude drugs to the isolation, identification, and assessment of bioactivity of active compounds in drug discovery. Plants provide an important source of drugs against various pharmacological targets including cancer, alzheimer's, malaria, pain, wounds, and so on [1]. They are considered as rich resources of ingredients which can be used in drug development [4]. This review first highlights the place of herbal medicine in pharmacognosy and then describes the importance of medicinal plants in modern medicine [9].

Objectives of Pharmacognosy

Pharmacognosy is a scientific discipline whose objectives are, among others, to:

- i. Search for new natural substances of therapeutic interest.
- ii. Make an in-depth study of the natural substances (medicinal plants) already introduced in therapy.
- iii. Provide natural therapeutic substances in sufficient quality and quantity.
- iv. Find new ways to use natural substances.

Sources of Natural Drugs

Microbial Metabolites

Historically, microorganisms have played an important role in providing new structures, like antibiotics for drug discovery and development [10]. Several microbial species secreting natural antibiotics have been identified. This is the case of *Penicillium notatum* which secretes penicillin, *Actinobacteria* which secrete Streptomycin, or even *Bacillus* which produce polymyxin B and bacitracin. Several other molecules derived from microbial metabolism are now used in pharmacy. The best known are among others chloramphenicol, erythromycin, kanamycin, amphotericin, gentamicin, actinomycin, streptomycin and tetracycline [11].

Animal Derivatives

Many drugs are derived from the animal's body secretions, fluid or glands [12]. For example, the use of horse serum as an antibody sup-

plement in diphtheria vaccine is more than 100 years old. Horses used to be injected with small doses of bacteria that caused diphtheria so that they could develop antibodies. Later, the blood of the infected animal was used to extract the antibodies and used in the vaccine. Similarly, the pancreas is a source of insulin, used in treatment of diabetes. Sheep thyroid is a source of thyroxin, used in hypertension. Cod liver is used as a source of vitamin A and D. Blood of animals is used in preparation of vaccines. Cochineal (dried full grown female insects) consists of carminic acid used as colouring agent for foods, drugs and for cosmetic products [3].

Marine Sources

Bioactive compounds from marine flora and fauna have extensive past and present use in the prevention, treatment or cure of many diseases. Coral, sponges, fish, and marine microorganisms produce biologically potent chemicals with interesting anti-inflammatory, anti-viral, and anticancer activity. For example curacin A from marine cyanobacterium *Lyngbya majuscula*, eleutherobin from coral *Eleutherobia* sp., discodermolide from marine sponge *Discodermia dissoluta*, etc. show potent anti-tumour activity [13]. Macroalgae have been used as crude drugs in the treatment of iodine deficiency states such as goiter, etc [3]. Halichondrin B is a complex polyether macrolide isolated from the marine sponge *Halichondria okadae*, with an extraordinarily high potency as an antitumor agent [14].

Mineral/Earth Sources

Minerals (both metallic and non-metallic minerals) have been used as drugs since ancient times. Our body requires trace elements of minerals in order to maintain homeostasis. Patients lacking an adequate level of these materials may take specific mineral-based drugs to raise the level of minerals. Some minerals can also be used in the treatment of human diseases. As examples include ferrous sulfate in iron deficiency anemia; magnesium sulfate as purgative; magnesium trisilicate, aluminum hydroxide and sodium bicarbonate as antacids for hyperacidity and peptic ulcer; zinc oxide ointment as skin protectant, in wounds and eczema; gold salts (solganal, auranofin) as anti-inflammatory and in rheumatoid arthritis; selenium as anti-dandruff [13]. Iodine is used for the treatment of goiter. Gold is used for the treatment of arthritis. Sulfur is used externally in skin diseases. Several silicates such as Kaolin, Bentonite, Diatomite and compounds of Na, K, Al, Ca, Mg etc. are obtained from mineral sources including Sulphur and Iodine [11].

Plant Products

Plants are the oldest source of drugs. Most of the drugs in ancient times were derived from plants. Almost all parts of the plants are used i.e. leaves, stem, bark, fruits and roots [3]. A number of plants have medicinal qualities and have been used for centuries as drugs or drug sources. Although the earliest plant source for drugs was the leaf, other parts of plants (e.g., barks, fruits, roots, stem, wood, seeds, blossoms, bulb etc.) were also later exploited for drug extraction. Where the product is used without further processing e.g., ground leaves or bark, boiled concoctions or powdered sap, the substance is called crude drug [14]. Natural compounds isolated from medicinal plants are the source of many of our pharmaceutical drugs. For example, vincristine and vinblastine have been isolated from *Vinca rosea* flowers; anti-malarial compounds such as quinine and quinidine have been isolated from *Cinchona* bark [3].

Phytotherapy

Indigenous use of Medicinal Plants

Medicinal plants have been a vital source of both curative and preventive medical therapy preparations for human beings. Several plant species such as *Papaver somniferum* and *Glycyrrhiza glabra* have been mentioned on the clay tablets from Mesopotamia in 2600BC; these plants are still used either alone or as one of the ingredients of herbal formulations for the treatment of various diseases [15]. Plant medi-



cine has continuously been practiced for a long period, especially in some African tribes (Table 1) [16]. In traditional settings, several plant species are known for their curative effects on human diseases. These medicinal plants are consumed in the form of teas, decoctions, herbal powders and other formulations [17]. Diseases commonly treated can be headache, stomach disorder, ulcers, sprains, bone fractures, measles, bodyache, fevers, coughs, etc. In the last decade traditional medicine has become very popular in Africa, partly due to the long unsustainable economic situation in the country. However, multiple factors such as gender, age, ethnicity, education and social class are shown to have association with prevalence of herbal remedies use. The World Health Organization (WHO) defines traditional medicine as “the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness” [18]. Medicinal plants have been a vital source of both curative and preventive medical therapy preparations for human beings since ancient times. Nowadays ethnobotanical research is of great significance for the conservation of ancient medicinal cultures, as well as for understanding changes in history and culture. It is also important for the conservation of traditional medicinal plant resources [19]. The (Table 1) below illustrates some therapeutic preparations used in traditional settings.

Phytotherapy in Modern Medicine

Complementary and Alternative Medicine

Complementary Medicine is used in addition to standard treatments; Alternative Medicine is used instead of standard treatments, and Integrative Medicine is an approach to medical care that combines conventional medicine with Complementary and Alternative Medicine practices that have shown through science to be safe and effective. Complementary and Alternative Medicine (CAM) is a group of diverse medical and health care systems, practices, and products that are not generally considered to be part of conventional or orthodox medicine. Towards the end of last century, the practice of different forms of CAM gained enormous popularity. Natural medicines, including herbs, vitamins, minerals and various other supplements, became an important and widely used stream worldwide. They have three main categories [27]:

- i. Physical therapies, e.g. exercise, yoga, bright light, acupuncture;
- ii. Nutraceuticals (vitamins and minerals), e.g. Vitamin D, folic acid, magnesium, omega-3 fatty acids;
- iii. Herbal remedies, e.g. St. John's wort, roseroot and saffron.

Herbal medicine is also called phytomedicine or phytotherapy. Despite the evolution of modern medicine, herbal products continue to meet therapeutic requirements in both traditional and clinical settings. The types of phytotherapy observed in CAM include aromatherapy, herbalism, gemmotherapy, herbal medicine in pharmacy, Chinese herbal medicine, and so on.

Aromatherapy

Aromatherapy has been used for thousands of years. Ancient cultures in China, India, Egypt, and elsewhere incorporated aromatic plant components in resins, balms, and oils [28]. Aromatherapy is based on the usage of aromatic materials including essential oils and other aroma compounds [29]. Sometimes it's called essential oil therapy. Aromatherapy uses aromatic essential oils medicinally to improve the health of the body, mind, and spirit. It enhances both physical and emotional health [28]. It is offered as a complementary therapy or as a form of alternative medicine [30]. It works through the sense of smell and skin absorption using products such as diffusers, aromatic spritzers, inhalers, bathing salts, body oils, creams, or lotions for massage or topical application, facial steamers, hot and cold compresses, clay

masks [28]. There is no good medical evidence that aromatherapy can either prevent, treat or cure any disease [31]. Placebo-controlled trials are difficult to design as the point of aromatherapy is the smell of the products. There is disputed evidence that it may be effective in combating postoperative nausea and vomiting [32].

Herbalism

Herbalism consists of the preparation and marketing of medicinal plants or derivative preparations. Common forms of treatment include teas, tinctures, capsules containing liquids or powdered herbs, bath salts, oils, skin creams, ointments expressed juices, plant exudates, etc [33]. These therapeutic formulations consist of extracts of one or more medicinal plants [34]. All parts of the plant can be used; roots, seeds, leave, etc. They are used fresh or dry. An herbalist is someone who uses plants for healing. These practitioners are not medical doctors, though some practitioners are also referred to as medical herbalists. Herbalist generally chooses plants based on the symptoms or conditions that the patient describes during the consultation. They might also perform an additional clinical examination. Taking an herbal preparation may not be suitable for people taking other medicines, including hormonal contraceptives, such as the combined pill; people with serious health conditions, such as liver or kidney disease; people who are going to have surgery pregnant or breastfeeding women; the elderly; children. It is necessary to consult a doctor or pharmacist for advice [35].

Gemmotherapy

Historically, buds first began to be used for therapeutic purposes in the middle ages as a result of the influence of alchemical philosophy. The old pharmacopoeias mention more specifically the use of poplar buds for making poplar ointment and fir buds for making herbal teas and pectoral syrup [36]. The gemmotherapy is a field of the phytotherapy which uses the buds and the starts-up of trees and shrubs. They are collected in spring, one key time of their natural development cycle, and are prepared fresh in a mixture of water, alcohol and glycerin. The buds and starts-up are composed of embryonic fabrics under development full which contain all the power of the future plant; this is why they constitute true a concentrated of energy and vitality. They also contain active ingredients which will not be present any more in the adult plant. This explains the broad range of applications and the effectiveness of the macérats-mother or macérats glycerol-coated concentrates [37].

Herbal Medicine in Pharmacy

Phytopharmaceutical drugs use products of plant origin obtained by extraction and which are diluted in ethyl alcohol or another solvent. These extracts are dosed in sufficient quantities to have a sustained and rapid action. They are presented like any other pharmaceutical specialty in the form of syrup, drops, suppositories, capsules, lyophilisates, nebulisates, etc. The concentrations are quite high and the non-toxicity of these drugs is sometimes relative [38].

Chinese Herbal Medicine

Chinese herbal medicine is the largest organized herbal system in the world. In China, it is considered to be a very powerful form of therapy that is used to treat most conditions [39]. Chinese herbal medicine is based around the principles of Yin and Yang. This is the idea that every living thing is balanced by two opposing forces of energy, Yin and Yang, which make up Qi, or the 'life energy' that flows through the body. Chinese herbal medicines are mainly plant-based, but some preparations include minerals or animal products [40]. There are over 300 herbs in common use. Herbal formulas may contain more different ingredients. Herbal formulas are taken in the form of teas, powders, pills, tinctures, or syrups. Ingredients are primarily of plant origin, and may include roots, bark, seeds, flowers, and leaves. Each ingredient has unique characteristics, that when combined, offers a therapeutic effect. A practitioner makes a recommendation based on their idea of the patient's Yin and Yang, and which elements the affect-



ed body parts are made up of. Chinese herbs may help in the treatment of digestive disorders, mental-emotional state (stress, anxiety, and depression), pain, autoimmune disorders, menopausal symptoms, menstrual issues, infertility (male and female), etc [40].

Advantages, Precautions and Disadvantages of Phytotherapy

Phytotherapy nowadays occupies a place of choice in both traditional and modern medicine. Its advantages can be the following:

- i. Phytotherapy is used to prevent or relieve a number of health concerns, from aging skin and acne, to diabetes, high blood pressure and even cancer.
- ii. Medicines made from plant extracts are generally harmless and well tolerated by the body; They have a favorable benefit/risk ratio.
- iii. Phytomedicines are less expensive than pharmaceutical drugs.
- iv. Phytotherapy is a resource for treatments. The majority of active ingredients used in modern medicine are derived from medicinal plants. Today, researchers place particular emphasis on herbal medicine as a source of new drugs.
- v. Satisfactory results are obtained in the strengthening of immune defenses, for diseases of the respiratory tract, rheumatic pains, gastrointestinal problems, osteoarthritis, urinary tract infections, etc. As an accompanying therapy to stimulate the patient's immune defences, herbal remedies prove to be relevant in cases of serious illness such as cancer [41].
- vi. Phytotherapy can be used as a first aid treatment in remote areas.

However, the use of phytomedicines must take into account a certain number of precautions. Patients should pay attention to the following points:

- i. Although in general few side effects occur during herbal medicine, in some isolated cases adverse effects and interactions with other remedies may occur. It is necessary to take into account the contraindications.
- ii. Phytomedicines are not always suitable for pregnant women. During pregnancy, no preparation should be taken without consulting a doctor or pharmacist.
- iii. For a number of indications (eg AIDS, cancer, headaches, prevention of miscarriages etc.), there is no herbal remedy;
- iv. Due to the drying method, the plants not only lose their precious essential oils, but also changes appear in the overall structure, which can negatively influence the content of active principles and sometimes the stability.
- v. Risks of allergy because phytomedicines contain a multitude of chemical elements. It may happen that the organism presents an allergy to some.
- vi. Phytomedicines contain active substances whose excessive use (overdose, prolonged use) can cause adverse effects.
- vii. It is customary to exclude phytotherapy in the treatment of diseases such as cancer, AIDS, diabetes; herbal medicine is better suited to mild pathologies and symptomatic treatment.
- viii. There are few good practitioners in traditional medicine and herbal medicine in particular; this increases the risk of falling on a bad practitioner and being badly treated [41].

Phytotherapy and Drug Discovery

By their richness in bioactive principles, plant extracts can act at several levels in the body, which makes it possible to restore physiological balances and overcome many diseases [42]. For many years, plants have been recognized as a vital source of therapeutic agents by the pharmaceutical and biotechnology industry. A wide range of modern drugs are of plant origin (Table 2). Nearly 170,000 bioactive molecules have been isolated from medicinal plants and have led to the development of around 70% of our current drugs [43]. Current research in drug discovery from medicinal plants involves a multifaceted approach combining botanical, phytochemical, biological, and molecular techniques. Medicinal plant drug discovery continues to provide new and important leads against various pharmacological targets including cancer, HIV/AIDS, Alzheimer's, malaria, and pain. Several natural product drugs of plant origin have either recently been introduced to the market, including arteether, galantamine, nitisinone, and tiotropium, or are currently involved in late-phase clinical trials [44].

Conclusion

The concept of pharmacognosy is primarily based on the study of medicinal plants as potential sources of drugs. Since antiquity, medicines made from plants have been used to meet health needs. Nowadays, herbal medicine continues to occupy a place of choice both in traditional settings and in modern health systems. Pending a complete transition from empirical phytotherapy to "second generation" phytotherapy, phytomedicines are commonly used as alternatives to "classic" treatment methods, despite the lack of well-defined legislation. With the advance of biotechnologies, traditional medicines have been improved and medicinal plants are nowadays used as the main sources for the discovery of new pharmaceutical molecules. This work aimed to describe in a time a general view on the concept of pharmacognosy and to put a particular emphasis on phytotherapy as an effective therapeutic means. This work is an essential prerequisite for the extension of phytotherapy. It could be used in the training of students, researchers and health professionals.

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