

## Article Review: Medical Plants: Their Compounds and the Biotechniques for Identifying and Separation of Them

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www.jrasb.com || Vol. 1 No. 5 (2022): December Issue

Received: 02-11-2022

Revised: 23-11-2022

Accepted: 03-12-2022

### ABSTRACT

It was possible through this study to give a brief overview of the most important pharmaceutical compounds, which included glycosides, alkaloids, terpenes and their plant sources, which encourages the adoption of various separation techniques protocols to obtain multiple types of pharmaceutical compounds of high pharmacological value from medicinal plants compared to its standard compounds and thus the possibility of using it medically to cure many diseases and dispense with medicines and chemotherapy with multiple side effects and interactions.

The study dealt with garlic, ginger and chamomile plants and their pharmaceutical compounds as examples of medicinal plants known since ancient times, research has confirmed its health benefits, as it supports normal body functions and the immune system.

**Keywords-** Medicinal plants, separation technologies, pharmaceutical compounds.

### I. INTRODUCTION

A medicinal plant is defined as a plant that contains one or more of its different organs one or more chemicals with different concentrations, and if it is given to the patient either in its pure form after extracting it from the plant material or if it is used while it is still in its initial form in the form of fresh vegetable herb, or dried or partially extracted which have the physiological ability to treat a specific disease or at least reduce the symptoms of infection, The importance of plants in medicine changed radically in the nineteenth century with the application of chemical analysis techniques. Alkaloids were isolated from strains of medicinal plants beginning with morphine from poppies in 1806 followed by ipecac and styrax in 1817, and quinine was produced from the eucalyptus tree and later from many other plants. New classes of pharmacologically active substances were discovered in medicinal plants with the development of chemistry, and the extraction of alkaloids (including morphine) began commercially in

the Merck Group in 1826. Synthesis of the medicinal substance discovered in medicinal plants from salicylic acid began for the first time in 1853. With the end of the nineteenth century, pharmacology began to oppose the use of medicinal plants because enzymes often modify the activity of medicinal ingredients when dried, and moved toward the use of alkaloids and glycosides extracted from plant matter. Medicines discovered from medicinal plants maintained their importance during the 20th and 21st centuries (1). The scientist Dragendroff defined medicinal plants as everything of plant origin and used medicinally is a medicinal plant. It creates many opportunities for the discovery of many chemical, therapeutic and non-curative substances of plant origin, such as antibiotics, insecticides and herbicides (2). As for the aromatic plant, it can be defined as the plant that contains one of its plant organs or their modifications volatile aromatic oils, whether they are in their free form or in the form that hydrolyse into volatile aromatic oils, and there are no separating boundaries that can be used as a basis for distinguishing between both medicinal and

aromatic plants, as some essential oils have physiological effects and medicinal uses, such as oils extracted from peppermint, *Cinnamomum verum* and others. Also, some plants we classify as aromatic plants contain medicinal chemicals in addition to volatile essential oils, as is the case in the rose plant (3)

Division of medicinal and aromatic plants (4 ; 5).

#### **First: Organic division**

This division depends on the division of medicinal and aromatic plants on the different plant members that contain medically active substances, from which these useful compounds can be obtained in the pharmaceutical industry, and they are summarized as follows:

1-Aerobic vegetative organ: Leaves in the tea plant, stems in sidr plant, terminal tops in cannabis, bark in *Cinnamomum verum* .

2- Sexual organs: Flower buds in flowers as jasmine, stigma of flowers in *Corcus vrenus*, fruits in pomegranate, seeds in *Nigella sativa*.

3- Earth's modified organs: Bulbs in the onion plant, corms in *Corcus vrenus*, tubers in orchid, rhizomes in ginger, true roots in *Glycyrrhiza glabra*.

#### **Secondly: Chemical division:**

It mainly depends on the components of metabolism that are formed automatically in the tissues of medicinal and aromatic plants, which are called primary secretions or natural products, are characterized as being chemically different as well as the botanical difference between them. The most important chemical compounds of therapeutic benefit and economic value are as follows:

**1- Carbohydrates:** These natural materials consist of the following:

**Sucrose:** It is produced from sugar cane juice and is used in the manufacture of candy and drinks and in the installation of some therapeutic medicines.,

**Mucilage:** is used from the roots of the symopsis tetragonoloba and basil plants, and from the roots and leaves of the Alcea plant,

**Gum:** It is produced from the Arab acacia and Senegalese gum trees. It is used in the manufacture of medicinal tablets.

**2- Fixed Oil :** The most important of them are edible for humans and extracted from the seeds of each of cotton, corn and sunflowers, as well as some of which are useful in treating some diseases as a main medicine, such as the extract from castor and flax seeds.

**3- Essential Oils:** The green grass plants of sage, mint and basil are used in this field to distill the aromatic volatile oils. It is possible to use organic solvents to obtain the so-called aromatic paste, as in the flowers of chamomile, chrysanthemum and jasmine, and from the seeds of caraway, coriander and cuminum.

**4- Resins:** It is separated from pine trees and its types and from the pistacia and balsam.

**5- Glycosides:** These active substances are extracted from the leaves of cactus and from the fruits of citrullus, myrrh, oleander, mustard and salix. Examples of these glycosides are routine from ruta, silane from onion, oleandrin from oleander, salicin from salix, and vanillin from vanilla .

**6- Glycol-alkaloids:** Sourced from the solanum herb, agave leaves and fenugreek seeds.

**7- Alkaloids:** These alkaloids are extracted, such as cocaine from coca, morphine from opium, hyoscine from Datura, and nicotine from nicotiana.

**8- Bitter Substances:** These materials are extracted from the artemisia herb, the flowers of the *Crocus sativus* plant, viola, and the seeds of the *Ammi visnaga*, Examples of these materials are Khalin from *Ammi visnaga* and alsantonin from artemisia.

**9- Antibiotics:** Which separates from some microorganisms such as bacteria as Streptomycin, Bacillus, and from some fungi, including Penicillium.

## **II. THE MOST IMPORTANT PHARMACEUTICAL SUBSTANCES: THEIR PROPERTIES, METHODS OF EXTRACTION AND SEPARATION**

### **1- Glycosides**

Glycosides are widespread in the plant kingdom and are closely related to monosaccharides ,The glycosides are active and important substances in medicinal plants, and these organic substances play an important role in the treatment of many diseases, such as cardiac glycosides, which work to regulate heartbeat, and others are responsible for strengthening the walls of weak blood vessels. They are substances that contain sugars and other non-sugar materials that differ greatly in different plants, which leads to differences in their properties as a result of the difference in the non-sugar fraction and that the effective role of glycosides is due to the non-sugar part, while the sugar part acts as a carrier for the non-sugar part and transporting it to the part to be treated., which is called the glycan moiety, which is due to the therapeutic and chemical properties of glycosides, It can be decomposed either by using hydrolysis with special enzymes or acids that lead to the separation of the two slits, one of them: a type of sugar called (Glycon) such as glucose sugar, rhamnose sugar, samarose and the second part is glycon, which includes organic compounds such as (alcohols, esters, ketones... ) and the process of separation by removing a molecule of water (H<sub>2</sub>O)(6)

### **2- Alkaloids**

They are organic substances that contain nitrogen in their composition and are similar to alkalis in their basic properties, It is widely present as natural products in plants of medicinal use, as it has a great physiological and pharmacological effect on humans and

animals. They are colorless, odorless, crystalline and non-volatile solids. They have outstanding physiological properties, some of which are sedative and analgesic such as codeine or stimulant such as caffeine or narcotic such as malic, citric, succinic, oxalic and tannic, are rarely found in the form of inorganic salts, except in one case in the form of sulfate of sulfuric acid, as in morphine sulfate alkaloid. The different alkaloids present in the same plant always have a close chemical structure, which is an important and useful fact that facilitates the identification of the chemical composition when identifying the main alkaloids that usually belong to the same plant family.

The alkaloid-bearing plant parts of plants:

Leaves: nicotiana, fruits: poppy, seeds: cocoa, vegetative part: datura, ground parts: ipecac, bark: pomegranate.

These compounds are important to plants, as they are useful in resisting insects and toxins attacking plants externally and internally, and are a source of nitrogenous materials when needed. As for its importance to humans, colchicine is used in the treatment of gout and is used in medicine in the form of salts, and it is widely used in medicine, including morphine, the very effective analgesic, nicotine, an insecticide, and quinine, which is a specific medicine for malaria (7)

### 3- Terpenes

Compounds resulting from the fusion of two units of isoprene and its chemical symbol ( $C_{10}H_{16}$ ), and when they are combined, they may produce aliphatic compounds in the form of an open chain, for example, the Ocimene compound found in the volatile oil of the basil plant, or it may produce cyclic aromatic compounds which are either:

1- Compounds with one ring monocyclic terpenes: such as limonene compounds found in orange oil.

2- Compounds with two rings: An example is pinene, which is found in most of the volatile oils of coniferous plants, such as turpentine oil.

3- Sesquiterpenes: An example of these compounds is farnesene, which is found in ginger Oil.

4-Diterpenes: an example of which is camphorene

The methods used to extract turbinates are numerous, but the most important ones are:

1- Steam distillation, and it is considered one of the most widely used methods, especially for extracting monoterpenes and sesquiterpenes, as these primary types of terpenes are the main component.

2- For volatile oils separated from the different procedures of plants, the plant parts are crushed well and then distilled with steam.

3- The petroleum ether method by providing a low pressure and temperature to distill the ether and then separate the mixture of volatile oils by partial distillation.

4- Chromatographic methods to separate the terpenes from each other through Thin-Layer Chromatography

(TLC) or by High-Efficiency Liquid Chromatography Technology (HPLC), Thin layer method on silica gel is considered one of the most appropriate chromatography methods for separating most high-grade terpenes such as binary, triple and quaternary terpenes, after they are extracted from natural sources using moderate polar solvents such as chloroform.

5- Chromatographic diagnosis of phenolic compounds: Identification of phenolic compounds in extracts of pine and oak using thin layer chromatography technique.

Glass plates covered with silica gel were used, as the samples were carried on one end of the plate in the form of a spot on the starting line by means of a capillary tube. The plate loaded with one of the samples was placed in its container vertically so that the end loaded with samples was at the bottom in an upward manner and in contact with the solution system consisting of the solvent system in succession, the container was covered with its lid and left at the laboratory temperature  $25^{\circ}C$  until the rise of the separation solution was completed, after which the plate was lifted from the container and left to dry. The spots were then exposed by spraying them with a solution of artists' reagent - sulfuric acid. Thin layer chromatography technique was adopted to measure the flow rate of the phenolic compounds of the bark tannin extracts of the aforementioned species (8)

It has become possible to obtain many secondary metabolic compounds that can be used in the pharmaceutical industries, such as antibiotics, alkaloids, phytochemicals, phenols, steroids, terpenes and pesticides. As plants produce, during their growth and development, a large number of chemical compounds, and it is believed that one of their most important functions is that they are effective defense methods against animals and insects that attack them, and it is an important medicinal plant. The *Antirrhinum majus* plant, which was cultivated in Iraq as an ornamental plant, and the extracts of this plant are toxic to many living organisms because it contains an alkaloid substance called Vasicine (9)

Medically important materials were also obtained from different plant species, by means of plant tissue culture techniques, for example, the volatile oil camazolin, which has important medicinal and therapeutic benefits, was extracted from the *Matricaria chamomilla* plant (10) Obtaining Menthol from *Mentha piperita* plant and other compounds from many plants, and obtaining these compounds in this technology is by controlling the metabolic pathways of plant cells in tissue cultures to produce these compounds, including pharmaceutical compounds, which is difficult to create in plants growing in their natural environments (11) These special chemicals and compounds are obtained either from the implanted tissues or from the medium in which these tissues grew. It has been found that the production of medical materials, drugs and pharmaceuticals through plant tissue culture is affected

by many factors, including the nature of the plant part (Explant) used in agriculture, its source and production quantity of active substances, components of the nutrient medium used for cultivation, and the conditions of planting preservation such as lighting, ventilation, heat and other growth conditions that directly affect the plant primary products (12). Thus, it affects the various secondary metabolites that are derived from primary metabolites, and one of the most important determinants of drug production and medically important materials in plant tissue culture is the type and concentration of growth regulators added to the food medium used. In particular, auxins and cytokinins affect the growth and differentiation of tissue culture and the construction of secondary products (13).

### III. EXAMPLES OF MEDICINAL PLANTS AND THEIR PHARMACEUTICAL COMPOUNDS

#### *Garlic:*

One of the medicinal plants known since ancient times, and recent research confirms positive results about the health benefits of garlic, as it was found that it supports the normal functions of the body and the immune system, as well as giving vital assistance to maintain health. It is anti-carcinogenic, helps regulate heart rate, prevents many diseases, lowers cholesterol and lowers high blood pressure. It increases blood fluidity, reduces the chances of a blood clot, activates blood circulation, prevents cold extremities, relieves rheumatic pain, cleanses the intestines, and is useful in treating cases of constipation and bloating, as well as preventing symptoms of cold and cough (14).

#### *Ginger:*

It is one of the perennial herbaceous plants belonging to the Zingiberaceae family and is abundant in the countries of East India, the Philippines, China, Sri Lanka and Mexico, as well as in some Arab countries. Its effective compounds have a significant effect on increasing bile secretion, improving bowel movement, and contributing to lowering the concentration of fat and cholesterol in the blood serum. (15).

#### *Active Chemical Components in Ginger*

Ginger rhizomes contain volatile oils at a rate of 2.5-3%, and it contains another group of aryl alkanes, which give it a pungent taste, and it includes two groups :

- 1- Gingerols: which contains the compound gengenol, which is attributed to the hot taste in ginger, and it is an oily resin and is considered an anti-blood clot as well as an anti-inflammatory of all kinds such as asthma, joints, colitis and migraine.
- 2- Shogaols: One of its most important compounds is shogaol, a spicy substance that helps digest fats. Ginger contains 50% of starch, 9% of protein and 7% of fats (fatty acids + glycerides + phospholipids)(16)

#### *Chamomile:*

The inhabitants of Mesopotamia knew the benefits of the chamomile flower since ancient times, and classified it among the medicinal plants in the clay figure, and this classification was arranged according to the effect of the plant on the human body, the chamomile flower has three types, and the difference between each type is in the color of the flowers it bears, it is yellow, white and red, and the best kind is white with yellow flowers (17).

Chamomile, as described by the Europeans in their book on plants, and in particular herbs, as "Alles Zutrant," meaning the cure for all diseases. The dried flowers represent the medicinal part used in the plant. The flowering tops of the two types of German and Roman chamomile are used in herbal medicine (18), The flower heads and volatile oil is used in medicines, where the flowers are dried for use in medicinal purposes or to produce the base oil from them (19), Its therapeutic importance comes from its role in treating many cases. In cases of the respiratory system, it is useful in cases of colds, flu, and bronchitis (20), It was also described as a nasal sterilizer, an anti-cold, and a preventive treatment for colds and influenza (21). Chamomile and its oil are used in treating asthma and relieving its attacks, also that chamomile has a soothing effect on tissues (inside the mouth, nose and throat) and that inhaling its vapor helps to get rid of shortness of breath, nasal and chest congestion and bronchial tubes, and in the treatment of bronchitis (22, 23; 24). Chamomile is very important as a respiratory anti-inflammatory, as it is used to treat infections of the respiratory tract and airways, as well as to treat mucous membrane inflammation and that chamomile has effects against colic and intestinal spasm, it can help or prevent unwanted muscle interference, especially in the intestinal tract. Therefore, it is used to treat nervous spasms that lead to intestinal colic. It is also used as an appetizer in cases of poor appetite, as well as adjuvant or digestive stimulant, antacid, and as a treatment for indigestion (25). Also it is used to treat intestinal and stomach cramps, inflammatory diseases, gastrointestinal spasms, and to relieve pain resulting from these spasms without any side effects, as well as for a nervously convulsive stomach(26). It may be a treatment for stomach ulcers, as chamomile tea and its essential oil are used locally to treat stomach ulcers. It has been found that chamomile is widely and effective as a mouthwash and disinfection To treat mouth ulcers and gums, prevent bad odors resulting from them, relieve pain in the oral cavity, and treat diseases and infections of the mouth. It is a good mouthwash to maintain oral health for example, people with cancer when exposed to UV rays during radiation irradiation and systemic chemotherapy, their use of the German chamomile mouthwash called (Kamillosan Liquidum) will prevent or reduce the severity of infections of their oral mucous membranes (24), It is used in the form of compresses for dental suppurations and to treat toothache and to stop

bleeding or swelling of the teeth or gums, and it is used as a treatment for joint disease and rheumatism (18). This plant has the activity against microbes (bacteria, fungi, viruses) was well tested in the laboratory, and the antibacterial activity of the essential oil prepared from the flower heads (soft or dry) was confirmed by steam refining, they were tested against gram-positive bacteria (*Bacillus subtilis*, *Staphylococcus aureus*) and gram-negative bacteria (*E.coli*, *Pseudomonas aeruginosa*), in addition to the fungi, including *Candida albicans*, it was observed that oil concentrations higher than 0.05% are very effective against Gram-positive bacteria and *Candida albicans*, while the negative ones are relatively less sensitive (27).

One of the medically important therapeutic functions is to rely on chamomile to get rid of mental and nervous disorders of the nervous system, as it is considered sedative, hypnotic and comfortable chamomile extracts, tea and ointments are used as a sedative agent and as an aid to relax muscles and nerves, as it has great hypnotic and sedative effects as it benefits children with mother or intestinal colic, and sends them sleep and comfort. In the United States, oral chamomile is taken in small doses, to give great effects on sleep and rest (28). In the field of tumors, studies have recently confirmed the effective effect of German chamomile in the treatment of cancerous diseases (29). The effective forms of chamomile differ in medical use, as it is used in the form of healing baths, tea, hot compresses, dyes, refreshments or moisturizers, hair lotion or paint (18).

#### IV. ACTIVE COMPOUNDS IN THE CHEMICAL COMPOSITION OF CHAMOMILE

Chamomile contains a high variety of active compounds each of them has a special effect, as a result of this diversity, chamomile possesses a wide list of beneficial medical effects that result from the work of such components together to give very important special activities. From the study of this high diversity of active synthetic components, a large number of them were identified and reach to its medicinal efficacy and their work together to show the activities of the plants of this type, where the active ingredients of the Roman chamomile were identified, *Chamomelum nobilis*, it was found that it contains, like the rest of the members of the Asteraceae family sesquiterpene lactones which make up more than 0.6% of the successive lactones are germacranolide especially nobilin and 3-epinobilin and its derivatives such as hydroxynobilin, which are anti-bacterials, and the active part in Roman chamomile is volatile essential oil as 0.7% W/V. It is a component (oil) of 85% mono and bifunctional esters of aliphatic acids and alcohols with low molecular weights and it itself arises leucine and isoleucine or valine derivatives (29) and of these derivatives are esters of angelic acid including angelates and isobutyl angelate +

isomylmethacrylate at a rate of 30-40 % , isomylangelate 12-22 %,methylallylangelate 6-10% and methylbutyl angelate -2 3-7 % . The same applies to tiglates acid esters, including tiglates, methylacrylates 0.5-1.5 % , Isobutylmethacrylate 1-3% and methylbutylmethacrylate(20)

The effectiveness of Roman chamomile is due to these effective compounds on which its known effective properties depend, for example, its effectiveness against colic can be related to leuteolin, apigenin and leuteolin glycosides, and this was proven in one of the laboratory experiments on mice (30), Also, its effectiveness in lightening the hair is due to the peroxides, and most of the effectiveness of Roman chamomile is due to the part that contains flavonoids (31), TLC and HPLC separation techniques were used to study the components of the volatile oils of chamomile, and it was found that farnesene -  $\beta$  - (E), bisabolol -  $\alpha$ , B bisabolol oxides, A and chamazulene, dicycloether are the main components in chamomile (32). It was also found that the flower heads of German chamomile contain a blue volatile oil that contains azulene, which is known as chamazulene, bisabolol - $\alpha$  and farnesene. These heads also contain anthemidine, tannin, dihydroxycinamic acid, matricin (which is a raw material for azulene), herniarin, palustrine, flavonoidglycosides, apigenine and quercetin which is tryhydroxyflavones (30), these flavonoid and terpene components of chamomile, especially apigenin and chamazulene show anti-inflammatory, anti-microbial, anti-viral, anti-allergic, anti-oxidant effects, Camazolin and Bisabolol are the first two active compounds in German chamomile that many preparations of German chamomile have determined its content of both substances (33) It was found that some of the compounds found in the base oil of German chamomile participate in the effectiveness of smooth muscle relaxation, especially volatile compounds including flavonoids (quercetin, patuletin, leuteolin, apigenin). Also, these compounds have an effect against colic. And chamomile tea has only 10-15 parts of the base oil available in the flowers, but if used for a long time, it has the power to have the therapeutic effect of most of the components of the essential oil (32). The volatile oil of German chamomile (which is a mixture of different single oils) extracted from the flower heads varies from brilliant blue to dark green at the beginning of its extraction, and its color changes over time to become dark yellow, Despite the change in color over time, its effect remains and does not lose its strength, and that this oil was indicated to contain more than 50 % Bisabolol -  $\alpha$  and chamazulene, which reduce inflammation and have direct effects against bacteria (33). It was also indicated that the base oil contains bisabolol oxides, farnesene and ether-spiro which have anti-inflammatory and anti-colic activities and some anti-acid flavonoids such as Chrysoplenin, Jecceidin, Chrysoplenol, have been

diagnosed and acted in the base oil of German chamomile, and they have been shown to have anti-inflammatory and anti-colic activity (33). A recent local study was able to separate and diagnose a number of active compounds from the different plant parts of the chamomile plant after preparing alcoholic extracts of these vegetative parts. Its most important active medicinal compounds, represented by the blue color camazolin, were separated and compared to the flow rate Rf with the same value for the standard compound, which appeared clearly using TLC on plates Silica gel (34), and stains from tissue and cell cultures of chamomile extracts separated on a slide were diagnosed using HPLC technology, the results of which indicated the separation of a number of medicinal compounds by comparing them with their standard compounds (36).

## V. CONCLUSION

Through the study, it was possible to clarify the most important medicinal plants with the most prominent pharmaceutical compounds extracted from them and to highlight the most important components and compositions diagnosed in these compounds, while highlighting some of the methods of their separation and diagnosis in order to use these compounds as alternatives to medicines and pharmaceutical preparations with therapeutic effects without negative aspects.

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