

# A Review of Medicinal Plants, their Definition, Uses, Active Ingredients and Prevalence in the Kingdom of Saudi Arabia

Samiha H. Al Shehri<sup>1</sup>, Rasha A. Alhadlaq<sup>2</sup>, Khuzama I. Bin Muhanna<sup>3</sup>, Noura S. Aldosri<sup>4</sup>,  
Mai A. Alghamdi<sup>5</sup>

<sup>1, 2, 3, 4, 5</sup>Department of Botany and Microbiology, College of Science, King Saud University, P. O. Box 2455, Riyadh 11451, Saudi Arabia

<sup>1</sup>Corresponding author: [salshihri@ksu.edu.sa](mailto:salshihri@ksu.edu.sa)

**Abstract:** *Arabian Peninsula is an arid region with deserts and poor biodiversity. However, the Kingdom of Saudi Arabia has a wide range of plants, consisting of different types of trees, herbs, and shrubs, and contains many edible and medicinal plants. Medicinal plants occupy an important source of effective drugs in the treatment of various diseases, so these medicinal plants have become a global topic that has an impact on the health of the world. In this paper, we will refer to identifying the nature of medicinal plants, clarifying the components of some medicinal plants, and their various effects and medicinal benefits. List of various medicinal plants in the Kingdom of Saudi Arabia and their used parts and medicinal uses.*

**Keywords:** Medicinal plants, Saudi Arabia, Alkaloids, Flavonoids

## 1. Interdiction

Some of the plants caused illness, the second caused nausea, and others caused diarrhea or constipation, relieved stomach pain, or calmed the nerves. The ancients used them to treat diseases by taking wild plants or parts of them in their natural state and putting them on the sick part or member of the person (Petrovska, 2012). There is no disease without medicine. Man has sought to search for plants that reduce this or that pain since ancient times, as historical sources tell us that the history of herbal medicine has played an important role in maintaining the health care system for a large number of the population all over the world (Karunamoorthi et al., 2013). In the world, medicinal herbs formed the basis of alternative medicine and led to it being the main path for the conception of new medicines, and until the early nineteenth century (Pan et al., 2014). more than 80% of medicines were formulated from plants (World Health Organization, 2013). Especially after the scientific revolution, the field of herbal medicine led to the development of industry (Ullah et al., 2020).

The greater use of medicinal plants in the treatment of diseases is due to the fact that plants or their derivatives are safe and effective drugs, in addition to having fewer secondary effects and a low cost (Sofowora et al., 2013). The knowledge of alternative medicine based on the use of plants in treatment represents an inheritance passed from one generation to another over the centuries, whether orally or in writing, bearing in mind that the traditional inheritance may face extinction if it is not passed on to the next generation and is still limited to the previous one using only different plant species (Al Akeel et al., 2018). In medicine since ancient times, folk medicine is still a major reference in the Arabian Peninsula, and many medicinal plants are still used today, including garlic, pomegranate, black seed, costus, miswak, henna, ginger, and fenugreek (Aati et al., 2019). These are all It can be effective in treating human diseases.

These plants have been used on a large scale in the form of low - cost products with almost zero side effects that have been manufactured and marketed pharmaceutically. It must be noted here that there are many important medicinal plants, but they are very poisonous plants, as they are toxic and medicinal at the same time. The difference is only in the quantity of the dose given, as the plant may be curative in a small dose and fatal in a larger dose. Here, we must take care, caution, and accuracy in determining the doses when using these plants (Ekor, 2014).

Medicinal plants are those that have therapeutic capabilities and can be obtained from nature or agriculture. These medicinal plants can also be used "soft" or dried, or the raw material can be used in the manufacture of various liquid and solid extracts (Mahomoodally, 2013).

Its importance increases with the progress of civilization, the increase in the need for medicine, and the expansion of its uses. And some medicinal plants are also used for other purposes, such as spices, food oils, and essential oils that are used in the manufacture of cosmetics, perfumes, and pesticides, which has increased interest in these plants in many countries of the world (Otunola, 2021).

### Definition of medicinal plants

A medicinal plant is defined as any plant species that contain secondary metabolites that can be used for medicinal uses or can be used as precursors for the manufacture of novel therapeutics (Penso, 1980). It is a plant that contains one or more of its organs, materials that can be used for treatment purposes or primary materials to form useful drugs. This description makes it possible to distinguish between medicinal plants whose therapeutic properties and their components are known scientifically. Another definition of cabinets, as they are biologically active vegetable compounds found naturally in plants. These plant materials are often divided into primary and secondary receptors (Balandrin et al., 1985), Sofowora et al. (2013) were also aware that a medical plant is defined as a plant that has one

or more of its different organs or mutations on one or more chemicals with a low or high concentration and the physiological ability to treat a specific disease. The term "medicinal plant" refers to many different plant species utilized in herbalism ("herbology" or "herbal medicine"). It involves both the study of and use of plants for therapeutic purposes (Khan, 2016). With this comprehensive definition, the plant kingdom enters by 99% or more of the medical encyclopedia, because it is rarely a specific plant that is medically unparalleled. This comprehensive concept of the medicinal plant creates many opportunities to discover more and the new treatment of therapeutic and non-therapeutic chemicals of vegetarian origin, such as antibiotics, insecticides, or grass. The science of medicinal plants is called a pharmacy, which is a science that is concerned with studying the sources or plant assets of the drugs in their natural or raw form in the appearance, classification, formal and chemical aspects and how to extract effective components and identify them and show their impact on man and other organisms.

Medical plants are referred to as Herbs in most scientific sources, which are (small green plants with a strong perfume); However, this concept is far from reality, as the word herbs in the medical and economic conventions indicate an amazing diversity of plants ranging from algae, ears, fungi and prolonged tropical trees. The correct concept of herbs is every plant that evaluates its medicinal and aromatic properties; it is cultivated because of its treatment or general medical properties. Medicinal plants have become an additional material in some food industries' products, and they are used, especially those plants that contain aromatic substances, vitamins, important amino acids, and enzymes that help digest and take their functions. Medicinal plants are also an important source of effective drugs in the treatment of various diseases, especially in traditional medicine (Bako et al., 2005; Borokini and Omotayo, 2012). Various parts of the plant are used in traditional medicine, including bark, flowers, fruits, leaves, resins, roots, seeds, and stems (scattered et al., 2017). The medicinal value of these plants is in some effective chemical compounds in different parts of the plants that produce a specific physiological effect on the human body (Kumar and Satapathy 2011).

The medicinal plant is any prophecies that have an emotional influence on the body of the human or the animal and is used in the treatment, that is, it affects the performance of members in the body of a human or lively, whether it is influenced by an activist or inhibitor, or has an impact on the human being Inside, either by activation, confusion, killing, or expulsion, such as plants used elimination of bacteria, fungi, worms, Insects, Amoeba, or otherwise. (Daniel, 2006).

#### The importance of medicinal plants and their uses

Medicinal plants and drugs extracted from them are of great economic value, of special importance, for several reasons, the most important of which is medicinal plants represent the main part of the raw materials on which the drug industry is based, and the drug industry is one of the strategic industries, as there is a need to impose their Public health safety and continued preparation for providing the largest possible amount of the mouth, especially in cases of

epidemic and natural disasters, in which import and export cannot, as well as cultivate medicinal plants and the industries based on them in order to achieve self-sufficiency, and export the surplus from them to bring a source of reassurance in the currencies Difficult and from here comes the importance and care of medicinal plants.

The uses of medicinal plants are as follows:

- 1) Medicine for the treatment of many diseases, is the main and distinctive characteristic of medicinal plants, as the medicinal plant is a drug to treat diseases, whether it is taken directly from nature, such as cumin, anise, chamomile, and black seed, or a laboratory making with extraction such Eye pupils, ovens extracted from the poppy plant, and glycosides extracted from the mustard and used to strengthen the heart muscles and improve its strikes.
- 2) Direct food for humans: medicinal plants, like other plants, enter into the daily human food directly, such as pimples rich in carbohydrates and vitamins such as beans, lentils, chickpeas, beans, and other grains rich in proteins, as well as vegetables that are eaten directly such as basil and mint Coast, parsley, spinach, as well as figs, olives, pomegranate and apples, all of these medicinal plants are entered as a direct food for humans.
- 3) Flacks, spices, and spices: There are many medicinal plants today used as flavors and spices such as cloves, saffron, ginger, turmeric, students, black and red pepper, and vanilla, which are parts of medicinal plants used as flavors and fibers.
- 4) Interfer to prepare stimulant drinks: Many medicinal plants are used to prepare and prepare some known daily drinks such as tea, coffee, and cocoa.
- 5) Interfering in the industry, Medicinal plants are interfering in many industrial fields other than pharmaceutical industries, the most important of which are, Manufacturing pesticides, especially insects from them, because some of them contain toxic substances in some parts of it and are influencing insects or dark such as some Chrysanthemum species from which the substance of Pyrethrum with the pesticide effect of insects (Wandahwa et al., 1996), as well as tobacco, henna, onions, etc. that are used in pesticides Wild and bacterial.
- 6) The manufacture of vegetable oils such as castor oil, sunflower oil, corn, linen, and sesame, as these oils are included in the pharmaceutical and food industries. In addition to the perfume industry, as some medicinal plants are included in the industry of scents and perfumes, such as the types of rose, especially gori, jasmine, jasmine, and basil.
- 7) Medicinal plants play an important role in decorating public and home parks, some of which are in the form of seasonal herbs such as poppy with red or colored flowers, chrysanthemum plants with yellow or orange flowers, and some in the form of shrubs such as the stove, cloves, jasmine, pine and Sidr, It may be used to decorate gardens and water basis, and animal feed: Many medicinal plants are planted to provide animal feed such as alfalfa, barley, and white corn, and some are planted to provide concentrated feed for poultry such as soybeans and yellow corn, and animals feed on

many natural medicinal plants that make up natural pastures.

- 8) Some medicinal plants play a role in improving the environment such as improving the physical and chemical properties of the soil and increasing their fertility, and their fallen leaves and roots help improve the strength of soil and signal from nitrogen loss, and there are some types of ideals that work as winds and soil and volatile vapor in The weather, especially the flying carbon from oil wells and factories.

### Ingredients for medicinal plants

The medicinal value of these plants lies in some effective chemical compounds in different parts of the plant that produce a specific physiological effect in the human body. Vegetable compounds are biologically active compounds that are naturally found in plants. These plant materials are often divided into primary and secondary receptors. The initial fluctuations are essential for plants and are involved in the primary metabolism for planting plant cells. They are often found between the top plants inside the seeds and vegetative storage organs as well. For example, fatty acids and vegetable oils are used in the production of soap and detergents.

The most important vegetable chemical groups in this regard are alkalis, glycosides, flavonoids, tannins, soaps, and resins that have medical properties. Alqethami and Aldhebani (2021) examined 85 medical plants found that contain alkaloids, glycosides, flavonoids, tannin, soap, and resin using standard methods. The most common plant chemical compounds distributed among the medicinal plants used were glycosides (82 %, 70 species), tannins (68 %, 58 species), alkaloids (56 %, 48 species), soap (52 %, 44 species) and flavonoids (35 %, 30 species), and on the other hand, the least prevalent compounds were resin (31 %, 26 species).

**Glucoside** has wide medical effectiveness because they are present in almost all medicinal plants. It has been shown that glycosides have sedative, digestive properties, sputum, and anti - cancer. Also, tannins help heal wounds and mucous membranes. Plant extracts containing tannins are used as holding drugs, against diarrhea, such as diuretics, As anti - inflammatory drugs. Also, alkaline, soaps and flavonoids are also known as sedative properties and have a strong effect on the nervous system.

**Tannins** are polyphenols, which have antiseptic and antibacterial effects (Anderson et al., 2012). It was found in 15 species and was the most common distributed compound in most plants in Wadi Yalmlam, one of the important Wadies in Saudi Arabia. Examples of plants that contain tannins such as *Aerva javanica*, *Spergula fallax*, *Cleome hanburyana* and others (Aldhebani and Mufarah, 2017).

**Resins** are by - products of plants that are not soluble in water, harden when exposed to air, typically generated by woody plants, such as *Commiphora myrrh* whose aqueous extract can antimicrobial activities against several pathogenic microbes (Alwhibi et al., 2020), *Alpinia galanga* and *Zingiber officinale* (Andila et al., 2021).

**Terpenoids**, The largest and most diverse class of naturally occurring compounds is the terpene family. They are divided into the categories of mono, di, tri, tetra, and sesquiterpenes based on the quantity of isoprene units they contain. They are primarily present in plants and make up the bulk of essential oils made from plants, the common plant sources of terpenes are tea, thyme, cannabis, Spanish sage, and citrus fruits e. g., lemon, orange, mandarin (Cox - Georgian et al., 2019). Essential plant scents like eucalyptus, lavender, thyme, and mint, as well as tastes like cinnamon, clove, and ginger, and colors like yellow from sunflowers and red from tomatoes, are all influenced by terpenoids. They defend the plant from predators and pests (e. g., from herbivores, insects, fungi, microorganisms, etc.) (Alamgir, 2018).

**Alkaloids**, are organic compounds with at least one nitrogen atom in a heterocyclic ring (Hussein and El - Anssary, 2019). Important secondary metabolites are recognized to provide medicinal benefits. Alkaloids have been divided into many groups based on their biosynthetic precursor and heterocyclic ring system, including indole, piperidine, tropane, purine, pyrrolizidine, imidazole, quinolizidine, isoquinoline, and pyrrolidine alkaloids (Roy, 2017). Wild Syrian rue (*Peganum harmala*) It is a type of plant that contains alkaloids in all its parts (Moloudizargari et al., 2013), and beta - carboline alkaloids derived from particularly harmine shows ability to fight cancer by focusing on apoptosis, autophagy, aberrant cell proliferation, angiogenesis, metastasis, and cytotoxicity (Jalali et al., 2021).

**Flavonoids**, are low molecular weight polyphenolic secondary metabolic compounds, distributed in the plant kingdom, they gather in the cellular vacuoles of plants, and they are responsible for the color and aroma of flowers and fruits. Detoxifying, antimicrobial defense compounds (Samanta et al., 2011), and it's found in re also abundantly found in foods and beverages of plant origin, such as fruits, vegetables, tea, cocoa and wine; hence they are termed as dietary flavonoids (Panche et al., 2016). Onions contain several compounds, most important of them quercetin and its derivatives, a group of flavonoids, which contribute much to the useful bioactive qualities of onions and their related products (Ren et al., 2020). Broccoli (*Brassica oleracea* L. var. *italica*) is a vegetable species that promotes health, flower's who's the primary edible part, which features abundance in secondary metabolites including flavonoids and glucosinolates (Li et al., 2017).

**Saponosins**, are heterosides formed of a water - soluble carbohydrate chain and a triterpene or steroid liposoluble structure (Betina - Bencharif, 2014), they abound in some plant families like Fabaceae (*Glycyrrhizia glabra*) (Zhang and Ye, 2009), and Caryophyllaceae (*Saponaria officinalis*), the whole plant contains resinous substances, mucilaginous matters, flavonoids and saponins (Kunkele and Lobmeyer, 2007). Saponin - containing plant materials, i. e., *Yucca schidigera*, alfafa, were used as feed additives to increase growth, milk, or wool in ruminant production (Wina et al., 2005).

**Volatile oils**, are variable mixtures of principal terpenoids, and a variety of low molecular weight aliphatic

hydrocarbons, acids, alcohols, aldehydes, acyclic esters or lactones, and exceptionally nitrogen - and sulfur - containing compounds, coumarins, and homologs of phenylpropanoids. Terpenes are among the chemicals responsible for the medicinal, culinary, and fragrant uses of aromatic and medicinal plants (Dorman and Deans, 2000). Essential oils are found in all parts of the plant in various plants such as *Cinnamomum verum*, bark, leaves, and flowers, which are used for essential oil production (Narayanankutty et al., 2021); seeds in *Nigella sativa* (Nickavar et al., 2003); loaves in *Salvia officinalis* (Perry et al., 1999); stems in *Caryocarpus villosus* (Magid et al., 2006); and in stems, adult leaves, immature flowers, and fruits of *Eucalyptus oleosa*. The use of volatile, aromatic oils is not limited to food flavorings, toiletries, and perfumes; they can also be used as insecticides or herbicides. Volatile oils extracted by steam distillation from four plant species—turmeric (*Curcuma longa*), kaffir lime (*Citrus hystrix*), and citronella grass (*Cymbopogon winterianus*), and hairy basil (*Ocimum americanum*), were effective against three mosquito vectors: *Aedes aegypti*, *Anopheles dirus*, and *Culex quinquefasciatus* (Tawatsin et al., 2001).

**Fats and Lipids**, Fats and lipids, a large group that includes triglycerides and high fatty acids, these substances are found in plants in the form of fatty droplets, and these substances do not evaporate or volatilize, and they cannot be distilled without decomposition, unlike volatile oils. Scientific studies have shown that saturated fats favorably increase blood HDL - Cholesterol levels without significant changes in the total cholesterol/HDL - Cholesterol ratio. Palmitic acid, the major component of the oil extracted from palm trees, has special structural and functional roles in utero and in infancy to prevent the risk of cardiovascular disease. And indeed, it is being delivered in a unique form in human milk (Agostoni et al., 2016). And castor oil extracted from the seeds of *Ricinus communis* has numerous industrial and medicinal applications (Kaur and Bhaskar, 2020).

#### Medicinal plants in Saudi Arabia

Geographical and climatic diversity in the Kingdom led to diversity in plants, which was examined for the first time in 1974, following two volumes of medicinal plants in the Kingdom of Saudi Arabia that were published in 1987 and 2000 by Musa and others. It is confirmed that the Kingdom of Saudi Arabia produces about 837 genera that appear in 2253 species distributed in 132 families. Approximately 20% of these families represent completely new and uncommon plants, and now current studies indicate that there are 309 genera covering 471 species out of a total of 2253 known species belonging to 89 families. The most dominant families are *Asteraceae*, *Fabaceae*, *Lamiaceae*, *Euphorbiaceae*, *Solanaceae*, *Apiaceae*, *Brassicaceae*, *Chenopodiaceae*, *Poaceae*, *Amaranthaceae*, *Boraginaceae*, *Apocynaceae*, *Convolvulaceae*, *Asclepiadaceae*, *Capparaceae*, *Polygonaceae*, and *Zygophyllaceae* (Aati et al., 2019). An overview of the ethnic medicinal plants used in traditional medicine in the Kingdom of Saudi Arabia. The researchers concluded that the medicinal ethnic plants used in traditional medicine in the Kingdom are some of the epiphytic families that include the largest number of medicinal plant species, which are *Amaranthaceae*, followed by *Asteraceae*, *Apocynaceae*, and *Fabaceae*. Many plant species are abundantly used to treat various diseases

associated with skin and stomach diseases, respiratory infections, tuberculosis, infections, anasarca, cancer, astringents, spasms, coughs, convulsions, diarrhea, dysentery, headaches, high blood pressure, snakebites, Reduce Thirst Ulcers Improve Hunger Control Negative Results Pharmacological Safety Diuretic Alternative: Anti - cyclic and Laxative (Ullah et al., 2020). Medicinal plants in the Riyadh region of Saudi Arabia were also evaluated in comparison with the total medicinal plants in the Kingdom of Saudi Arabia, which may be useful in developing strategies for the sustainable use of one of the threatened natural resources in Saudi Arabia by Shawky et al. (2020). The result revealed that 108 species belonging to 36 families and 94 genera were recorded. The most common families were *Asteraceae*, *Poaceae*, *Fabaceae*, *Chenopodiaceae*, *Boraginaceae*, *Brassicaceae*, *Charyophyllaceae*, and *Zygophyllaceae*. Approximately 97% of all species recorded have at least one aspect of potential or actual economic value, with 165 species having medicinal value. This means that this area has a large number of medicinal plants that need to be discovered and surveyed. This study emphasizes the importance of protecting medicinal plants because most of them are rare or endangered species.

The components of the plants in Saudi Arabia are a mixture of elements from Asia, Africa, and the Mediterranean region. A total of 2250 species, including creeping plants and gymnosperms, in 142 families are represented in the flora of Saudi Arabia. Of these, 242 are endemic, and 600 are rare and endangered (Shawky et al., 2020); Emphasis has been placed on these species to determine conservation priorities for them. Sustainable management of medicinal plants in Saudi flora a complete inventory of rare and threatened medicinal plants and their inclusion in national policy should be prioritized, along with documentation of folk medicinal uses through various development projects. A medicinal plant conservation strategy for sustainable management and sustainable use of folk medicinal knowledge will be framed and implemented. Indigenous knowledge of medicinal plants is ancient in Saudi Arabia and still exists among tribes, village people, and traditional practitioners. There are a large number of medicinal plant species present in the flora of Saudi Arabia, which is expected to be more than 1200 (more than 50%) of the plants. It is known from previous reports that about 24% of medicinal plants are in 15 families, of which 30.1% are rare or threatened. Including the current report, the diversity of medicinal species in plants was found to be 18.45%. Documentation of this medicinal knowledge is sparse, and an inventory of rare and threatened plants has not yet been made for the Red Data Book of Saudi Arabia. As civilization advances and modern medicine becomes more widely available, and more and more medicinal plants disappear from plants, it is critical to prioritize the documentation of indigenous knowledge and the conservation of medicinal plants both in situ and ex situ through the National Conservation Strategy before endangered species become extinct. The current study focuses on conducting further research on the flora of Saudi Arabia to identify and inventory medicinal and endangered plants and document folk medicinal uses for appropriate conservation measures (Yusuf et al., 2014).

## 2. Conclusion and Recommendations

Since ancient times, plants have been resorted to in the treatment of various diseases until the present time, and due to their effectiveness, these medicinal plants are still used to this day in the treatment of some diseases, alleviating the symptoms associated with diseases, or prevention and increasing immunity from exposure to some diseases, as we have noted the circulation of This was among people in the days of the Corona pandemic (Covid - 19) and other diseases, and the use of medicinal plants is considered one of the habits inherited through generations. The Kingdom of Saudi Arabia is characterized by the availability of many types of medicinal plants spread throughout its lands due to its uniqueness in a distinct geography. And because the forms of many medicinal plants are similar, or because the public lacks sufficient information about their benefits and harms, as well as how to use them, it is always recommended to consult specialists in this field to obtain the desired benefit and benefit, and since it has been observed that the world has clearly returned to treatment with natural medicinal plants and interest in alternative medicine, This prompts us to increase interest and research more in this field, to benefit from medicinal plants and natural resources, and to be careful to preserve them so they do not become extinct.

## References

- [1] Aati, H., El - Gamal, A., Shaheen, H., and Kayser, O. (2019). Traditional use of ethnomedicinal native plants in the Kingdom of Saudi Arabia. *Journal of ethnobiology and ethnomedicine*, 15 (1), 1 - 9.
- [2] Agostoni, C., Moreno, L., and Shamir, R. (2016). Palmitic acid and health: Introduction. *Critical reviews in food science and nutrition*, 56 (12), 1941 - 1942.
- [3] Al Akeel, M. M., Al Ghamdi, W. M., Al Habib, S., Koshm, M., and Al Otaibi, F. (2018). Herbal medicines: Saudi population knowledge, attitude, and practice at a glance. *Journal of Family Medicine and Primary Care*, 7 (5), 865.
- [4] Alamgir, A. N. M. (2018). Secondary metabolites: secondary metabolic products consisting of C and H; C, H, and O; N, S, and P elements; and O/N heterocycles. In *Therapeutic Use of Medicinal Plants and their Extracts: Volume 2* (pp.165 - 309). Springer, Cham.
- [5] Aldhebani, A. Y., and Mufarah, N. (2017). Phytochemical screening of some wild plants from Wadi Yalmlam, Saudi Arabia. *J. Pharm. Biol. Sci*, 12 (4), 25 - 27.
- [6] Alqethami, A., and Aldhebani, A. Y. (2021). Medicinal plants used in Jeddah, Saudi Arabia: phytochemical screening. *Saudi Journal of Biological Sciences*, 28 (1), 805 - 812.
- [7] Alwhibi, M. S., Soliman, D. A., Alonazan, A., Marraiki, N. A., El - Zaidy, M., and AlSubeie, M. S. (2020). Green biosynthesis of silver nanoparticle using *Commiphora myrrh* extract and evaluation of their antimicrobial activity and colon cancer cells viability. *Journal of King Saud University - Science*, 32 (8), 3372 - 3379.
- [8] Anderson, R. C., Vodovnik, M., Min, B. R., Pinchak, W. E., Krueger, N. A., Harvey, R. B., and Nisbet, D. J. (2012). Bactericidal effect of hydrolysable and condensed tannin extracts on *Campylobacter jejuni* in vitro. *Folia microbiologica*, 57 (4), 253 - 258.
- [9] Andila, M., Sribudiani, E., and Somadona, S. (2021). Upaya peningkatan produktivitas getah pinus (*Pinus merkusii*) menggunakan stimulan ekstrak lengkuas (*Alpinia galanga*) dan jahe (*Zingiber officinale*).
- [10] Bako, S. P., Bakfur, M. J., John, I., and Bala, E. I. (2005). Ethnomedicinal and phytochemical profile of some savanna plant species in Nigeria. *International Journal of Botany*.
- [11] Balandrin, M. F., Klocke, J. A., Wurtele, E. S., and Bollinger, W. H. (1985). Natural plant chemicals: sources of industrial and medicinal materials. *Science*, 228 (4704), 1154 - 1160.
- [12] Betina - Bencharif, S. B. (2014). Isolement et caractérisation de saponosides extraits de deux plantes médicinales: *Cyclamen africanum*, *Zygophyllum cornutum* et évaluation de leur activité anti - inflammatoire (Doctoral dissertation, Université de Bourgogne; Université Mentouri - Constantine).
- [13] Borokini, T. I., and Omotayo, F. O. (2012). Comparative phytochemical analysis of selected medicinal plants in Nigeria. *Inter J Adv Chem Res*, 1, 011 - 018.
- [14] Cox - Georgian, D., Ramadoss, N., Dona, C., and Basu, C. (2019). Therapeutic and medicinal uses of terpenes. In *Medicinal Plants* (pp.333 - 359). Springer, Cham.
- [15] Daniel, M. (2006). Medicinal plants: chemistry and properties. Science publishers.
- [16] Dorman, H. D., and Deans, S. G. (2000). Antimicrobial agents from plants: antibacterial activity of plant volatile oils. *Journal of applied microbiology*, 88 (2), 308 - 316.
- [17] Ekor, M. (2014). The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in pharmacology*, 4, 177.
- [18] Hussein, R. A., and El - Anssary, A. A. (2019). Plants secondary metabolites: the key drivers of the pharmacological actions of medicinal plants. *Herb. Med*, 1 (3).
- [19] Jalali, A., Dabaghian, F., and Zarshenas, M. M. (2021). Alkaloids of *Peganum harmala*: Anticancer biomarkers with promising outcomes. *Current pharmaceutical design*, 27 (2), 185 - 196.
- [20] Kaur, R., and Bhaskar, T. (2020). Potential of castor plant (*Ricinus communis*) for production of biofuels, chemicals, and value - added products. In *Waste biorefinery* (pp.269 - 310). Elsevier.
- [21] Khan, M. A. (2016). Introduction and importance of medicinal plants and herbs. Unani. Zahid, India.
- [22] Kumar, S., and Satapathy, M. K. (2011). Medicinal plants in an Urban environment; herbaceous medicinal flora from the campus of Regional Institute of Education, Bhubaneswar, Odisha. *International Journal of Pharmacy and Life Sciences*, 2 (10).
- [23] Kunkele, U., and Lobmeyer, T. R. (2007). *Plantes médicinales, Identification, Récolte, Propriétés et emplois*. Edition Parragon.319p.

- [24] Li, D., Li, L., Ge, Z., Limwachiranon, J., Ban, Z., Yang, D., and Luo, Z. (2017). Effects of hydrogen sulfide on yellowing and energy metabolism in broccoli. *Postharvest Biology and Technology*, 129, 136 - 142.
- [25] Magid, A. A., Voutquenne - Nazabadioko, L., Renimel, I., Harakat, D., Moretti, C., and Lavaud, C. (2006). Triterpenoid saponins from the stem bark of *Caryocar villosum*. *Phytochemistry*, 67 (19), 2096 - 2102.
- [26] Mahomoodally, M. F. (2013). *Traditional medicines in Africa: an appraisal of ten potent African medicinal plants. Evidence - Based Complementary and Alternative Medicine*, 2013.
- [27] Marzoug, H. N. B., Romdhane, M., Lebrihi, A., Mathieu, F., Couderc, F., Abderraba, M., and Bouajila, J. (2011). *Eucalyptus oleosa* essential oils: chemical composition and antimicrobial and antioxidant activities of the oils from different plant parts (stems, leaves, flowers and fruits). *Molecules*, 16 (2), 1695 - 1709.
- [28] Moloudizargari, M., Mikaili, P., Aghajanshakeri, S., Asghari, M. H., and Shayegh, J. (2013). Pharmacological and therapeutic effects of *Peganum harmala* and its main alkaloids. *Pharmacognosy reviews*, 7 (14), 199.
- [29] Narayanankutty, A., Kunnath, K., Alfarhan, A., Rajagopal, R., and Ramesh, V. (2021). Chemical composition of *Cinnamomum verum* leaf and flower essential oils and analysis of their antibacterial, insecticidal, and larvicidal properties. *Molecules*, 26 (20), 6303.
- [30] Nickavar, B., Mojab, F., Javidnia, K., and Amoli, M. A. R. (2003). Chemical composition of the fixed and volatile oils of *Nigella sativa* L. from Iran. *Zeitschrift für Naturforschung C*, 58 (9 - 10), 629 - 631.
- [31] Otunola, G. A. (2021). Culinary spices in food and medicine: an overview of *Syzygium aromaticum* (L.) Merr. and LM Perry [Myrtaceae]. *Frontiers in Pharmacology*, 12.
- [32] Pan, S. Y., Litscher, G., Gao, S. H., Zhou, S. F., Yu, Z. L., Chen, H. Q., . . . and Ko, K. M. (2014). Historical perspective of traditional indigenous medical practices: the current renaissance and conservation of herbal resources. *Evidence - based complementary and alternative medicine*, 2014.
- [33] Panche, A. N., Diwan, A. D., and Chandra, S. R. (2016). Flavonoids: an overview. *Journal of nutritional science*, 5.
- [34] Penso, G. (1980). The role of WHO in the selection and characterization of medicinal plants (vegetable drugs). *Journal of ethnopharmacology*, 2 (2), 183 - 188.
- [35] Perry, N. B., Anderson, R. E., Brennan, N. J., Douglas, M. H., Heaney, A. J., McGimpsey, J. A., and Smallfield, B. M. (1999). Essential oils from Dalmatian sage (*Salvia officinalis* L.): variations among individuals, plant parts, seasons, and sites. *Journal of agricultural and food chemistry*, 47 (5), 2048 - 2054.
- [36] Petrovska, B. B. (2012). Historical review of medicinal plants' usage. *Pharmacognosy reviews*, 6 (11), 1.
- [37] Ren, F., Nian, Y., and Perussello, C. A. (2020). Effect of storage, food processing and novel extraction technologies on onions flavonoid content: A review. *Food Research International*, 132, 108953.
- [38] Roy, A. (2017). A review on the alkaloids an important therapeutic compound from plants. *IJPB*, 3 (2), 1 - 9.
- [39] Samanta, A., Das, G., and Das, S. K. (2011). Roles of flavonoids in plants. *Carbon*, 100 (6), 12 - 35.
- [40] Shawky, R. A., and Alzamel, N. M. (2020). Survey on medicinal plants in the flora of Al Riyadh Region, Saudi Arabia. *EurAsian Journal of BioSciences*, 14 (2).
- [41] Sofowora, A., Ogunbodede, E., and Onayade, A. (2013). The role and place of medicinal plants in the strategies for disease prevention. *African journal of traditional, complementary and alternative medicines*, 10 (5), 210 - 229.
- [42] Tawatsin, A., Wratten, S. D., Scott, R. R., Thavara, U., and Techadamrongsin, Y. (2001). Repellency of volatile oils from plants against three mosquito vectors. *Journal of vector ecology*, 26, 76 - 82.
- [43] Ullah, R., Alqahtani, A. S., Noman, O. M., Alqahtani, A. M., Ibenmoussa, S., and Bourhia, M. (2020). A review on ethno - medicinal plants used in traditional medicine in the Kingdom of Saudi Arabia. *Saudi Journal of Biological Sciences*, 27 (10), 2706 - 2718.
- [44] Wandahwa, P., Van Ranst, E., and Van Damme, P. (1996). *Pyrethrum* (*Chrysanthemum cinerariaefolium* Vis.) cultivation in West Kenya: origin, ecological conditions and management. *Industrial Crops and Products*, 5 (4), 307 - 322.
- [45] Wina, E., Muetzel, S., and Becker, K. (2005). The impact of saponins or saponin - containing plant materials on ruminant production A Review. *Journal of agricultural and food chemistry*, 53 (21), 8093 - 8105.
- [46] World Health Organization. (2013). WHO traditional medicine strategy: 2014 - 2023. World Health Organization.
- [47] Yusuf, M., Al - Oqail, M. M., Al - Sheddar, E. S., Al - Rehaily, A. J., and Rahman, M. A. (2014). Diversity of medicinal plants in the flora of Saudi Arabia 3: An inventory of 15 plant families and their conservation management. *International Journal of Environment*, 3 (3), 312 - 320.
- [48] Zhang, Q., and Ye, M. (2009). Chemical analysis of the Chinese herbal medicine Gan - Cao (licorice). *Journal of Chromatography A*, 1216 (11), 1954 - 1969.