



Phytochemical and Pharmacological Studies of Traditionally Used Herbal Plants and their Potential Applications in Nutraceutical Formulations

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Review Article

Volume 7 Issue 2

Received Date: August 09, 2023

Published Date: December 14, 2023

DOI: 10.23880/ipcm-16000262

Abstract

Herbal plants are being used for therapeutic purposes to cure diverse forms of diseases since centuries ago. Many medicinal therapists across the world utilize these herbs for the treatment of diseases, such as ayurveda and traditional Chinese medicine. The use of herbal based medicines considered as safe with no side effects have increased at an alarming pace as compared to synthetic drugs globally. Medicinal herbs have been validated to eradicate the core of diseased ailments irrespective of age group and are having lesser chances of developing adverse effects due to chemical interactions and microbial resistance as induced by most of the synthetic drugs.

Considering the multiple biological activities, which are beneficial for healthy functioning of human body including prevention of cancers, inflammations, infections, antiseptics, antimicrobial, antidiarrheal, antioxidants and innumerable healing characteristics. In this study, we assessed the potential benefits and bioactive compounds present in diverse ranges of medicinal herbs, so that it could provide a valid source for practitioners and those interested in formulation of health promoting supplements and nutraceuticals. The chemical composition of medicinal herbs not only enables a researcher to enhance health by curing a specific disease but also to preserve a formulated food product with natural based remedies. Products developed from herbal combinations have been found to reduce toxicity in human body along with improving efficacy.

Keywords: Medicinal Herbs; Bioactive Composition; Pharamlogical Properties

Abbreviations: WHO: World Health Organization; VN: Vitex Negundo; SM: Silybum Marianum; JNK: N-Terminal Kinase.

Introduction

As man began to explore and expand his knowledge of plants, he discovered the healing properties of plants. He

also discovered how they could be utilized to treat a variety of ailments. That has led to the development of herbal and unani medicines, which has been used to treat a variety of illnesses from thousands of years. Using the ancient wisdom of Ayurveda and the advancement of modern medical science, these novel plant-derived drugs have the potential to revolutionize the healthcare industry. Folk or traditional medicine consists of medical aspects developed

over generations within a variety of societies before modern medicine took hold. According to the World Health Organization (WHO), traditional medicine is defined as a set of knowledge, skills, and practices that are derived from the theories, beliefs, and experiences of various cultures, regardless of whether they can be explained.

They are used to maintain health as well as to prevent, diagnose, improve or treat physical or mental illnesses. WHO has explored about 20,000 medicinal plants all over the world to utilise these for pharmacological screening and therapeutic purposes. As per the reports of WHO, 80% population in less developed and some developing countries, still rely on the medicinal herbs for treatments of ailments due to adverse economic conditions and lack of synthetic medicines. In Chile, 71% of the population consumes herbal medicine, while in Colombia, the number is 40%. In India, 65% of those living in rural areas use Ayurveda and medicinal plants for primary health care needs. Mahatma Gandhi once wrote: "Homeopathy cures a larger percentage of cases than any other form of treatment and is beyond doubt safer and more economical.

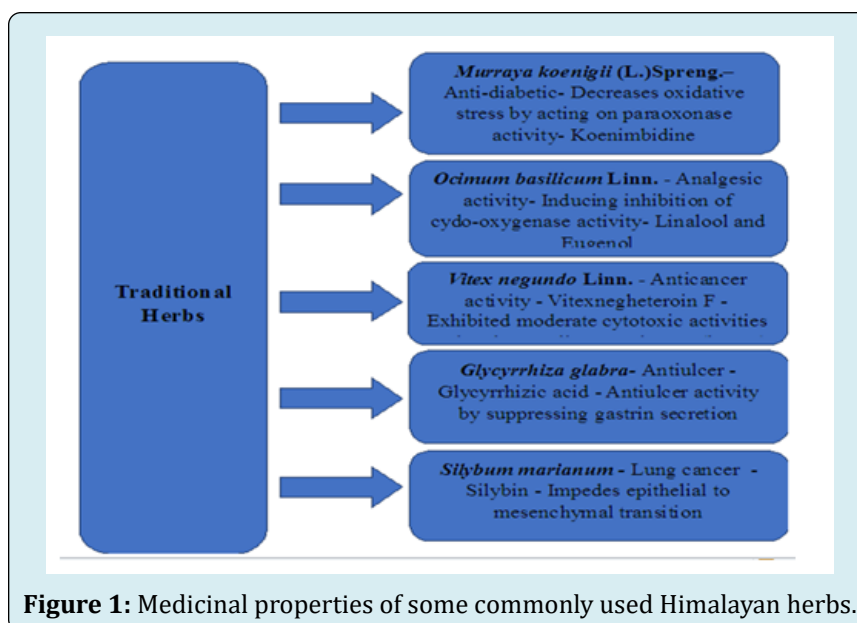
Herbal medicines are generally considered to be safe, effective and are having negligible side effects than synthetic drugs, and are particularly beneficial for treatment of chronic conditions. Additionally, plants often contain a variety of compounds that work together to produce therapeutic effects. This can provide a more holistic approach to healing, rather than just targeting a single cause. The use of medicinal plants dates back at least 5,000 years to the Sumerians, but the practice of herbal medicine is thought to date back as far as 60,000 years ago. Phytochemicals have been found to reduce inflammation, improve metabolic processes, and

inhibit the growth of cancer cells.

They are also known to protect the body from free radical damage, which is associated with aging and chronic disease. Additionally, they can boost the immune system, reduce cholesterol, and improve overall health. The plethora of benefits from phytochemicals is similar to a multivitamin, providing the body with a variety of nutrients and health benefits essential for maintaining health and vitality. This shows the significant role that these plants play in traditional medicine in industrialized and developing nations. The global market for traditional medicine is expected to continue growing. This paper will discuss several major herbs, including Kadipatta (*Murrayakoenigii*), Bhavadi (*Ocimumbasilicum*), Bana (*Vitex negundo*) and Mulathi (*Glycyrrhiza glabra*). As you may know, these herbs have been used in herbal medicine for ages for their medicinal uses and are known to have numerous health benefits, including reducing inflammation, boosting immunity, lowering blood sugar levels, and aiding digestion. Additionally, these herbs are also believed to help protect against certain types of cancer, support liver health, and act as natural detoxifiers. But don't forget the one benefit that everyone knows and loves - they make excellent seasoning for your cooking.

Description

Murrayakoenigii (*M. koenigii*) (L) Spreng (Family: Rutaceae) referred to as curry leaves [1,2]. In tropical and subtropical regions around the world, *M.koenigii* is widely distributed. *Murraya* has 14 species worldwide, but only two, *M. koenigii* and *M. paniculate*, are available in India. *Murraya* species has a wide range of medicinal properties that make it more important than other species [3] (Figure 1).



In Indian Ayurvedic medicine, this plant has been used in a variety of ways for centuries, and is referred to as “krishnanimba”. Different parts of *M. koenigiare* shown to promote a wide range of biological activities, including its leaves, roots, bark, and fruit [4]. Despite drying, *M. koenigii* leaves retain their aromatic bioactive constituents. *M. koenigii*

leaves have a flavor that is faintly bitter, a pungent odor, and a weak acidity. It is used in Indian cuisine as an antihelminthic, analgesic, digestion aid, and appetizer [5]. The green leaves of *M. koeigii* have anti-inflammatory, itching, and anti-bruise properties, and can be used for piles, inflammation, itching, and fresh cuts (Table 1).

| Taxonomy | <i>Murrayakoenigii</i> | <i>Ocimumbasilicum</i> | <i>Vitex Negundo</i> | <i>Glycyrrhiza Glabra</i> | <i>Silybum Marianum</i> |
|----------------|-------------------------------------|------------------------------|----------------------------|---------------------------|-------------------------|
| Kingdom | Plantae | Plantae | Plantae | Plantae | Plantae |
| Subkingdom | Tracheobionta | Tracheobionta | Tracheobionta | Tracheobionta | Tracheobionta |
| Super division | Spermatophyta | Spermatophyta | Spermatophyte | Spermatophyte | Spermatophyte |
| Division | Magnoliophyta | Magnoliophyta | Magnoliophyta | Magnoliophyta | Magnoliophyta |
| Class | Magnoliopsida | Magnoliopsida | Magnoliopsida | Magnoliopsida | Magnoliopsida |
| Subclass | Rosidae | Asteridae | Asteridae | Rosidae | Asteridae |
| Family | Rutaceae | Lamiaceae | Verbenaceae | Fabaceae | Asteraceae |
| Genus | <i>Murraya</i> J. Koenig ex L. | <i>Ocimum</i> | <i>Vitex</i> Linn. | <i>Glycyrrhiza</i> | <i>Silybum</i> |
| Species | <i>Murrayakoenigii</i> (L.) Spreng. | <i>Ocimumbasilicum</i> Linn. | <i>Vitex negundo</i> Linn. | <i>Glycyrrhiza glabra</i> | <i>Silybum marianum</i> |

Table 1: Taxonomy classification of herbs.

A certain amount of purgative properties can be found in the roots. A common body ache can be alleviated by using them because they are stimulating. It has been found that the bark of this tree is beneficial for treating snakebites. The essential oil derived from *M. koenigii* leaves exhibits antioxidative, antimicrobial, antifungal, anti-inflammatory, and nephroprotective effects in animals Bhandari [6]. It has been hypothesized that the medicinal properties of different carbazole alkaloids are due to several chemical constituents, including terpenoids, flavonoids, and dihydropyridines, carbohydrates, carotenoids, vitamins, and nicotinic acid were obtained through multiple parts of the *M. koenigii* plant [7,8].

There are many types of plants within the plant family Lamiaceae called *Ocimum*, most of them aromatic herbs and shrubs, such as, *Ocimumbasilicum* (sweet basil), *O. tenuiflorum* (Tulsi/holy basil), *O. gratissimum* (African basil), *O. campechianum* (Amazonian basil), etc. A number of therapeutic applications, pharmacological applications, and biomedical properties of *O. basilicum* have been reported. Several hundred years have passed since it was used as a medicinal plant, which is cost-effective and easy to obtain. Plants of this species are found throughout the globe, including in tropical, subtropical and temperate climate zones. They grow in India, Pakistan, Nepal (in the Himalayan tract), Sri Lanka, Southeast Asia, and other locations [9]. Since this herb is widely distributed throughout the world, it can be easily found and used in everyday life for its many benefits.

Ayurvedic and Unani medicine treat the disease by

using it as part of their treatment of various afflictions, both physiological and lifestyle-related. The “God of Spices” (*Ocimumbasilicum*) is regarded as a valuable spice in mythology, particularly for its culinary use. A number of health supplements contain basil, including those that promote and maintain health. In addition to its ornamental properties, this herb is also useful for therapeutic purposes, as a result of its wide range of pharmacological activities [10]. A plant with enormous medicinal properties, *Vitex negundo* (VN) is often called “chaste tree”. Different *Vitex* species produce different phytochemicals due to their varying chemical compositions. In addition to volatile oils, flavonoids, lignans, iridoids, terpenes, and steroids, a number of bioactive compounds have been extracted from leaves, seeds, and roots [11]. There are antiinflammatory, antioxidant, antidiabetic, anticancer, and antimicrobial properties of these bioactive compounds.

In most cases, VN modulates processes such as apoptosis, cell cycle, motility of sperms, polycystic ovary disease, and menstruation. It has been reported that VN perturbs many cancer-signaling pathways involving p38, p-ERK1/2, and p-JNK in cells stimulated by LPS, as well as N-terminal kinase (JNK), COX-1 pathways, MAPK, tumornecrosis factor, vascular endothelial growth factor, and hypoxia-inducible factor [12].

A perennial herb native to Eurasia, northern Africa, and western Asia, *Glycyrrhiza glabra* L is in the Fabaceae family. The herb is also known as licorice, sweet wood, or mulaithi. More than 30 species are found in the *Glycyrrhiza* genus globally. The Latin word *glaber*, meaning bare or slick, is derived from the Greek words *glykys*, which means sweet, and

rhiza, meaning root. *Glabra* refers to the smooth husks and is derived from the Latin word *glaber*. A licorice plant grows in fertile, clay, or sandy soil near a river or stream where water is readily available [13]. The medicinal benefits of licorice can be obtained from its roots and roots, which have been reported to be effective in treating digestive system disorders, respiratory tract disorders (e.g., cough and colic). As well as being used in food and beverage flavoring, it can be added to tobacco products to enhance their flavour [14].

Silybum marianum (SM) is a famous medicinal plant in the family *Leucanthemum* that is classified as a tree. It belongs to the genus *Silybum*, and its leaves are characterized by white veins. Due to its hepatoprotective properties, its seeds and fruits have been used as a natural remedy for more than 2000 years. It disperses stagnated liver qi and promotes bile flow in traditional Chinese medicine. *Silymarin*, a chemical compound found in the seeds of SM, has a variety of pharmacological effects, including hepatoprotective, anti-inflammatory, and antioxidant effects [15].

Chemical Constituents and Pharmacological Effects

Murrayakoenigii (L.) Spreng. contains substantial amounts of proximate composition, including moisture at 63.2%, protein at 8.8%, carbohydrates at 39.4%, nitrogen at 1.15 %, fat at 6.15%, sugars at 18.92%, starch at 14.6%, and crude fiber at 6.8%. Many vitamins can be found in the leaves, including vitamin A (B-carotene), which is found in 6.04 mg/100 grams, vitamin B3, (niacin), which is found in 2.73 mg/100 grams, vitamin B1 (thiamin), which contains 0.89 mg/100 g of 0.89 mg with a level of calcium is found in 19.73 milligrams per 100 g, magnesium in 49.06 milligrams per 100 g, and sodium in 16.50 milligrams per 100 g. The alcohol-soluble extract has a value of 1.82%, ash has a value of 13.06% acid-insoluble ash has a value of 1.35%, cold water (20 °C) extractive has a value of 27.33%, and maximum of hot-water-soluble extractive has a value of 33.45% [16].

Ocimum basilicum Linn. herb is extremely nutritious - apart from fats, proteins, vitamins, such as C, E, K, A, 3-carotene, vitamins B1 (thiamine), B2 (riboflavin), B3 (niacin), B5 (pantothenic acid), B6, B9, and choline, it contains many secondary metabolites, including essential oils, phenols, flavonoids, anthocyanins, tannins, and steroids, along with minerals such as Fe, Ca, Mg, P, Mn, Na, K, and Zn. It was found that the plant contains terpenoids, alkaloids, phenolics, flavonoids, tannins, saponin, reducing sugars, cardiac glycosides, steroids, and glycosides according to a preliminary phytochemical analysis. The nutritive elements content/ 100g fresh weight were carbohydrate: 28.84, fat: 0.64 g, protein: 3.15 g, water: 92.06 g, vitamins (vitamin A:

264 µg, β-carotene: 3142 µg, thiamin: 34 µg, riboflavin: 76 µg, niacin: 902 µg, panthotenic acid: 209 µg, vitamin B6: 155 µg, vitamin B9: 68 µg, choline 11.4 mg, vitamin C 18.0 mg, vitamin E: 0.80 mg and vitamin K: 414.8 µg), and minerals (Ca: 177 mg, Fe: 3.17 mg, Mg: 64 mg, Mn: 1.148 mg, P: 56 mg, K: 295 mg, Na: 4 mg and Zn: 0.81 mg) [17,18].

The most common flavonoid glycosides from an ethanolic extract of the leaves of *Vitex negundo* are 5-hydroxy-3, 6, 7-trimethoxy-2-(3, 4-dimethoxyphenyl)-4H-chrome-4-on and 5, 7-dihydroxy-2-(3, 4-dihydroxyphenyl)-4H-chromen-4-one. *Negundoside*, *Agnuside*, and *Vitegnoside* are also present in the methanolic extract. *Phytosterol* and *p-hydroxybenzoic acid* have been isolated from the bark of *Vitex negundo* Linn., and identified from methanol and hexane extracts. In the acetoacetate fraction of the seeds, two phenyl-naphthalene-type lignans have been obtained and identified as 6-hydroxy-4-(4-hydroxy-3-methoxy-phenyl)-3-hydroxy-methyl-7-methoxy-3, 4-dihydro-2-naphthaldehyde and *vitedoamine A*. Leprosy, dyspepsia, colic, rheumatism, worms, boils, and rheumatism are all treated with it. The roots contain a *furanoteremophilane*. Methanol extracts of *Vitex negundo* Linn roots contain lignins that inhibit tyrosinase [19,20].

Physicochemical analysis of *Glycyrrhiza glabra* roots revealed that extractive values were (petroleum ether $4.67 \pm 0.23\%$, chloroform $10.56 \pm 1.53\%$, n-butanol, $6.54 \pm 0.84\%$ and methanol $13.89 \pm 2.42\%$); ash values were (total ash $4.67 \pm 0.35\%$, acid insoluble ash $0.56 \pm 0.34\%$ and water soluble ash $6.54 \pm 0.22\%$); loss on drying $5.87 \pm 0.65\%$, moisture contents $0.56 \pm 0.054\%$, pH of the extract (1% solution) 5.04 ± 0.65 , pH of the extract (10% solution) 6.26 ± 0.54 [19]. Among the main compounds of *Silybum marianum*, flavonoids and fatty oils make up two major groups. Flavonolignans, including *silybin*, *isosilybin*, and *silychristin*, are the main active ingredients of SM. *Silybin* should constitute 0.6% of standardized SM herbs, according to the Chinese Pharmacopoeia. *Taxifolin*, *dihydrokaempferol*, and *quercetin* are also flavonoid compounds in SM.

There are a lot of unsaturated fatty acids in SM's fatty oil, including oleic, linoleic, and palmitic acid [20]. SM seeds are commonly extracted with *silymarin*, a standardized extract. It is composed of 40-65% *silybin*, 20-45% *silychristin*, and 10-20% *isosilybin*, constituting 70-80% of the plant's hydro-alcoholic extract. *Silymarin* accounts for 70-80% of the plant's hydro-alcoholic extract. SM dry extracts with a nominal *silymarin* content of 30 to 65% are listed in the European Pharmacopoeia. According to the European Pharmacopoeia and the United States National Formulary, mature fruits of SM yield no less than 1.5-2% *silymarin* [21]. Table 2 and Table 3 summaries the major chemical constituents and pharmacological activities of different herbs.

| S.No | Compound | Supplied Synonyms | Formula | Molecular Weight(g/mol) | PubChem CID |
|-------------------------------------|---|---|-----------|-------------------------|-------------|
| Murrayakoenigii (L.) Spreng. | | | | | |
| 1. | Mahanine [22] 2. (3R)-3,5-dimethyl-3-(4-methylpent-3-enyl)-11H-pyrano[3,2-a]carbazol-9-ol | 1. (R)-3,5-Dimethyl-3-(4-methylpent-3-en-1-yl)-3,11-dihydropyrano[3,2-a]carbazol-9-ol | C23H25NO2 | 347.4 | 36689305 |
| 2. | Mahanimbine [23] 2. 3,5-dimethyl-3-(4-methylpent-3-en-1-yl)-3,11-dihydropyrano[3,2-a]carbazole | 1. 3,5-dimethyl-3-(4-methylpent-3-enyl)-11H-pyrano[3,2-a]carbazole | C23H25NO | 331.4 | 167963 |
| | | 2. 3,5-dimethyl-3-(4-methylpent-3-en-1-yl)-3,11-dihydropyrano[3,2-a]carbazole | | | |
| 3. | Isomahanine [24] | 3,8-dimethyl-3-(4-methylpent-3-enyl)-11H-pyrano[3,2-a]carbazol-9-ol | C23H25NO2 | 347.4 | 375148 |
| 4. | Koenimbine [25] | 8-Methoxy-3,3,5-trimethyl-3,11-dihydropyrano[3,2-a]carbazole | C19H19NO2 | 293.4 | 97487 |
| 5. | Girinimbine [26] | 3,3,5-trimethyl-11H-pyrano[3,2-a]carbazole | C18H17NO | 263.3 | 96943 |
| 6. | Isolongifolene [27] | (2S)-1,3,4,5,6,7-Hexahydro-1,1,5,5-tetramethyl-2H-2,4a-methanonaphthalene | C15H24 | 204.35 | 11127402 |
| 7. | Pyrayafoline D [28] | 3,8-dimethyl-3-(4-methylpent-3-enyl)-11H-pyrano[3,2-a]carbazol-9-ol | C23H25NO2 | 347.4 | 375148 |
| 8. | Murrayafoline [29] | | | | |
| 9. | Murrayazoline [30] | (14R,17S,19S)-3,13,13,17-tetramethyl-21-oxa-12-azahexacyclo[10.7.1.12,17.05,20.06,11.014,19]henicosane-1,3,5(20),6,8,10-hexaene | C23H25NO | 331.4 | 21770913 |
| 10. | Koenoline [31] | 1-me-thoxy-3-hydroxymethylcarbazole | C14H13NO2 | 227.26 | 375152 |
| 11. | 9-formyl-3-methylcarbazole [32,33] | | | | |
| 12. | O-Methylmurrayamine [34-36] | 9-Methoxy-3,3,5-trimethyl-11H-pyrano[3,2-a]carbazole | C19H19NO2 | 293.4 | 14892681 |
| 13. | Koenine [37-40] | 3,11-Dihydro-3,3,5-trimethylpyrano[3,2-a]carbazol-8-ol | C18H17NO2 | 279.3 | 5318827 |

Table 2: Phytochemical compounds identified in different herbs.

| Ocimumbasilicum Linn. | | | | | |
|------------------------------|----------------------|--|----------|---------|---------|
| 1 | Linalool [41,42] | Linalol Phantol 3,7-dlmethyl-1,6-octadien-3-ol | C10H18O | 154.25 | 6549 |
| 2 | Linalyl acetate [43] | Linalool acetate BergamiolPhanteine | C12H20O2 | 196.29 | 8294 |
| 3 | Estragole [44] | 4-allylanisole p-allylanisole methyl chavicol | C10H12O | 148.2 | 8815 |
| 4 | Geraniol [45] | Geranyl alcohol trans-Geraniol | C10H18O | 154.25 | 637566 |
| 5 | 1,8—cineole [46-48] | Eucalyptol, Cineole, Cajeputol, Zineol, 1,8-Epoxy-p-menthane | C10H18O | 154.249 | 2758 |
| 6 | Neryl acetate [49] | Neryl ethanoate | C12H20O2 | 196.29 | 1549025 |
| 7 | Bergamotene [50] | trans- α -becgamotene | C15H24 | 204.35 | 6429302 |

| | | | | | |
|----|--------------------------|---|----------|--------|---------|
| 8 | Eugenol [51] | Engenol Eugenol acid | C10H12O2 | 164.2 | 3314 |
| 9 | Methyl eugenol [52] | Methyl eugenol ether | C11H14O2 | 178.23 | 7127 |
| 10 | Nerol [53] | cis-Geraniol Neryl alcohol | C10H18O | 154.25 | 643820 |
| 11 | a-Cadinol [54] | alpha-Cadinol | C15H26O | 222.37 | 6431302 |
| 12 | Cyclohexanemethanol [55] | Cyclohexylcarbinol | C7H14O | 114.19 | 7507 |
| 13 | a- Terpineol [56] | Terpineol 1 -Menthene-8-ol | C10H18O | 154.25 | 17100 |
| 14 | Elemol [57] | Alpha-Elemol | C15H26O | 222.37 | 92138 |
| 15 | Methyl cinnamale [58-60] | Methyl 3-phenylpropenoate trans-Cinnamic acid methyl ester (E)-Methyl cinnamate | C10H10O2 | 162.18 | 637520 |

Vitex Negundo Linn.

| | | | | | |
|---|-------------------------|---|----------|--------|---------|
| 1 | Linalool [61] | 3,7-Dimethyl-1,6-octadien-3-ol | C10H18O | 154.25 | 6549 |
| 2 | Vanillic acid [62] | 3-Methoxy-4-hydroxybenzoic acid | C8H8O4 | 168.15 | 8468 |
| 3 | Casticin [63] | 5-hydroxy-2-(3-hydroxy-4-methoxyphenyl)-3,6,7-trimethoxychromen-4-one | C19H18O8 | 374.3 | 5315263 |
| 4 | Luteolin [64] | 2-(3,4-Dihydroxyphenyl)-5,7-dihydroxy-4H-chromen-4-one | C15H10O6 | 286.24 | 5280445 |
| 5 | Leucoanthocyanidin [65] | 2-(3,4,5-Trihydroxyphenyl)chromane-3,4,5,7-tetraol | C15H14O8 | 322.27 | 3081374 |
| 6 | Betulinic acid [66-70] | 3beta-Hydroxy-20(29)-lupaene-28-oic acid | C30H48O3 | 456.7 | 64971 |
| 7 | Friedelin [71] | (4R,4aS,6aS,6bR,8aR,12aR,14aS,14bS)-4,4a,6a,6b,8a,11,11,14a-octamethyl-2,4,5,6,6a,7,8,9,10,12,12a,13,14,14b-tetradecahydro-1H-picen-3-one | C30H50O | 426.7 | 91472 |
| 8 | Squalene [72] | 2,6,10,15,19,23-Hexamethyltetracosane-2,6,10,14,18,22-hexaene | C30H50 | 410.7 | 638072 |
| 9 | Epifriedelinol [73] | 4,4a,6b,8a,11,11,12b,14a-Octamethyldocosahydropicen-3-ol | C30H52O | 428.7 | 119242 |

Glycyrrhiza glabra

| | | | | | |
|---|-----------------------------|---|-----------|-------|----------|
| 1 | Glycyrrhizin [74] | (3β,20β)-20-carboxy-11-oxo-30-norolean-12-en-3-yl 2-O-β-D-glucopyranuronosyl-α-D-glucopyranosiduronic acid | C42H62O16 | 822.9 | 14982 |
| 2 | Glycyrrhizic acid [75] | (2S,3S,4S,5R,6R)-6-[(2S,3R,4S,5S,6S)-2-[[[(3S,4aR,6aR,6bS,8aS,11S,12aR,14aR,14bS)-11-carboxy-4,4,6a,6b,8a,11,14b-heptamethyl-14-oxo-2,3,4a,5,6,7,8,9,10,12,12a,14a-decahydro-1H-picen-3-yl]oxy]-6-carboxy-4,5-dihydroxyoxan-3-yl]oxy]-3,4,5-trihydroxyoxane-2-carboxylic acid | C42H62O16 | 822.9 | 14982 |
| 3 | Isoliquiritigenin [76] | (E)-1-(2,4-Dihydroxyphenyl)-3-(4-hydroxyphenyl)prop-2-en-1-one | C15H12O4 | 256.3 | 638278 |
| 4 | Licochalcone A [77] | (E)-3-[4-Hydroxy-2-methoxy-5-(2-methylbut-3-en-2-yl)phenyl]-1-(4-hydroxyphenyl)prop-2-en-1-one | C21H22O | 338.4 | 5318998 |
| 5 | Liquiritigenin [78] | (2S)-7-Hydroxy-2-(4-hydroxyphenyl)-2,3-dihydro-4H-chromen-4-one | C15H12O4 | 256.3 | 114829 |
| 6 | Prenyllicoflavone A [79,80] | 7-Hydroxy-2-[4-hydroxy-3-(3-methyl-2-buten-1-yl)phenyl]-6-(3-methyl-2-buten-1-yl)-4H-1-benzopyran-4-one | C25H26O4 | 390.5 | 11349817 |
| 7 | Glabridin [81] | 4-[(3R)-8,8-Dimethyl-3,4-dihydro-2H,8H-pyrano[2,3-f]chromen-3-yl]-1,3-benzenediol | C20H20O4 | 324.4 | 124052 |

| | | | | | |
|----|-----------------------------|---|----------|-------|----------|
| 8 | Glabrene [82] | 8-(7-hydroxy-2H-chromen3-yl)-2,2-dimethylchromen5-ol | C20H1804 | 322.4 | 480774 |
| 9 | Licocoumarin A [83] | 3-[2,4-dihydroxy-3-(3-methylbut-2-enyl)phenyl]-7-hydroxy-8-(3-methylbut-2-enyl)chromen-2-one | C25H2605 | 406.5 | 5324358 |
| 10 | 18-β-Glycyrrhetic acid [84] | (2R,4aS,6aS,6bR,8aR,10S,12aS,14bR)-10-hydroxy-2,4a,6a,6b,9,9,12a-heptamethyl-13-oxo3,4,5,6,6a,7,8,8a,10,11,12,14bdodecahydro-1H-picene2-carboxylic acid | C30H4604 | | 3230 |
| 11 | Liquiritin [85] | (2S)-7-hydroxy-2-[4-[(2S,3R,4S,5S,6R)-3,4,5-trihydroxy-6-(hydroxymethyl)oxan-2-yl]oxyphenyl]-2,3-dihydrochromen-4-one | C21H2209 | 418.4 | 503737 |
| 12 | Kanzonol R [86] | 3-[2-hydroxy-4-methoxy-3-(3-methylbut-2-enyl)phenyl]-5-methoxy-3,4-dihydro2H-chromen-7-ol | C22H2605 | 370.4 | 1.32E+08 |
| 13 | α-Terpineol [87] | 2-(4-Methylcyclohex-3-en1-yl)propan-2-ol | C10H180 | | |
| 14 | Glisoflavone [88] | 3-[3,4-dihydroxy-5-(3-methylbut-2-enyl)phenyl]-7-hydroxy-5-methoxychromen-4-one | C21H2006 | 368.4 | 5487298 |
| 15 | Shinpterocarpin [89] | (2R,10R)-17,17-dimethyl-3,12,18-trioxapentacyclo[11.8.0.02,10.04,9.014,19]henicosa1(13),4(9),5,7,14(19),15,20-heptaen-6-ol | C20H1804 | 322.4 | 10336244 |
| 16 | Isoangustone A [90] | 3-[3,4-dihydroxy-5-(3-methylbut-2-enyl)phenyl]-5,7-dihydroxy-6-(3-methylbut-2-enyl)chromen-4-one | C25H2606 | 422.5 | 21591148 |
| 17 | 2,3-Butanediol [91] | Butane-2,3-diol | C4H1002 | 90.12 | 262 |
| 18 | 1-Methoxyficifolinol [92] | (6aR,11aR)-1-methoxy-2,8-bis(3-methylbut-2-enyl)-6a,11a-dihydro-6H-[1]benzofuro[3,2-c]chromene-3,9-diol | C26H3005 | 422.5 | 480872 |
| 19 | Licoriphenone [93] | 1-(2,4-dihydroxyphenyl)-2-[6-hydroxy-2,4-dimethoxy-3-(3-methylbut-2-enyl)phenyl]ethanone | C21H2406 | 372.4 | 21591149 |

Silybum Marianum

| | | | | | |
|---|--------------------------------|---|-----------|-----|---------|
| 1 | 2, 3-dehydrosilybin [94] | 3,5,7-trihydroxy-2-[3-(4-hydroxy-3-methoxyphenyl)-2-(hydroxymethyl)-2,3-dihydro-1,4-benzodioxin-6-yl]chromen-4-one | C25H20010 | 480 | 5467200 |
| 2 | Dehydrodicoumaril alcohol [95] | 4-[3-(hydroxymethyl)-5-[(E)-3-hydroxyprop-1-enyl]-7-methoxy-2,3-dihydro-1-benzofuran-2-yl]-2-methoxyphenol | C20H2206 | 358 | 5372367 |
| 3 | Silybin [96] | (2R,3R)-3,5,7-trihydroxy-2-((2R,3R)-3-(4-hydroxy-3-methoxyphenyl)-2-(hydroxymethyl)-2,3-dihydrobenzo[b][1,4]dioxin-6-yl)chroman-4-one | C25H22010 | 482 | 31553 |
| 4 | Silymarin [97] | 3,5,7-trihydroxy-2-[3-(4-hydroxy-3-methoxyphenyl)-2-(hydroxymethyl)-2,3-dihydro-1,4-benzodioxin-6-yl]-3,4-dihydro-2H-1-benzopyran-4-one | C25H22010 | 482 | 5213 |

Table 3: Pharmacological activities of different herbs.

Herbal medicines contain more bioactive components than synthetic drugs, and possess health benefits superior to those provided by chemically synthesized drugs. Since consumers are increasingly focusing on natural food alternatives as a result of changing lifestyles, the application of herbs extracted bioactive components in the formulation of functional foods and nutraceuticals is gaining immense popularity in the modern era, in addition to basic nutrition [98].

Globally, health organizations are focusing on using natural herbs for their identification, extraction, bioavailability, and pharmacological properties in the light of safety concerns regarding synthetic medicines. Plant phytochemicals in natural medicinal herbs possess higher antioxidant properties than chemically synthesized medicines in terms of radical scavengers, hydrogen donors, and singlet oxygen quenchers. Formulations for treating various ailments can be made from herbal medicines with quality assurance [99].

Role of Different Herbs in Prevention of COVID - 19

Infections of COVID-19 can be minimized by using curry leaves mouthwash containing essential oils and saponin. Inhibitors of glycoprotein adhesion on the surface of SARS-CoV-2 found in essential oils and extracts of *Ocimum* genus species prevent viral replication and therefore strengthen the immune system. COVID-19 can be managed with *Ocimum* species [24]. As a potential drug molecule for treating SARS-CoV-2 (COVID 19), phyto-compounds from *Vitex negundo* including oleanolic acid, ursolic acid, 3 β -acetoxyolean-12-en-27-oic acid, and isovitexin interact with the PLpro via hydrogen bonds [100]. A significant decrease in ACE2 expression in the small intestine is observed after treatment with *Glycyrrhiza glabra* root extract, which may represent an entry point for transport of nutrients SARS CoV-

2. Silybin, an active constituent found in *Silybum marianum* exhibited higher binding affinity with targets in SARS-CoV-2 in comparison to the drugs against SARS-CoV-2 [101].

Application of Herbal Plants in Formulation of Functional Foods and Nutraceuticals

Large amounts of food formulation based on functional benefits of medicinal plants are marked throughout the world depending on nutrigenomics of inhabitants in a particular region [102]. These food products ranging from

baked items, snacks, ready to eatables and beverages are fetching higher marginal profits due to their therapeutic properties besides nutrition. A variety of developed food products have depicted to reduce the incidence of chronic and other commonly prevailing disabling disorders among consumers and thus have proved to potential contributors of enhancing health and wellness of consumers [103]. A number of herbal plant infusion available in market as ready to serve drinks, instant tea, or squashes have been found to possess antidiabetic properties due to presence of functional ingredients including phenols, flavonoids, tannins, alkaloids, essential oils that have been validated in increasing sugar metabolism by stimulating excessive insulin secretion and maximising excretion of sugar by causing excessive renal diuresis [104].

The nutraceuticals made from derivatives of medicinal plants have revealed to possess antimicrobial, anti-depressant, anti-anxiety, anti-dementia, anti-convulsions, anti-inflammatory effects and prevent the body from metabolic diseases that leads to different types of complications [105]. Nutritional therapist has becoming an emerging discipline with promising impact focusing on utilisation of plant-based nutraceuticals and functional foods for treatment of chronic ailments. Some of the commonly available herbal based nutraceuticals are discussed in Table 4 [106].

| S.NO. | Product Name | Ingredients | Health Benefits |
|-------|--|---|---|
| 1. | HealthKart HK Vitals Multivitamin with Multimineral, Taurine & Ginseng Extract | 100% RDA of vitamins like Vitamin C, Vitamin A, Biotin and Vitamin B12, 8 essential minerals including iron, magnesium, copper, zinc, manganese, chromium, iodine and selenium, Standardised ginseng extracts derived from <i>Panax ginseng</i> , Special amino acids blend including essential amino acids and branched chain amino acids. | <ul style="list-style-type: none"> · Get 3 times the amount of Zinc and Calcium for enhanced immunity · Fortified with amino acids to aid muscle development · Complete With Anti-Oxidising Natural Extracts Like Ginseng · Contains all essential vitamins and 8 essential minerals to conveniently balance your diet. |
| 2. | Nutrabay Wellness Curcumin Extract with Piperine 1000mg | Curcumin Extract, Piperine Nigrum Extract (Piperine), Glidant (INS 553 (iii)) and Diluent (INS 460 (i)) | <ul style="list-style-type: none"> · Anti-inflammatory · Powerful Antioxidant · Mental Health Support |

| | | | |
|-----|---|---|--|
| 3. | Carbamide Forte Garcinia Cambogia 3000mg for Weight Loss Supplement, 60% HCA & Chromium | Garcinia Cambogia Extract, Piper Nigrum Extract, Binder (INS 1404), Firming Agent (INS 341), Anticaking Agent (INS 460 (i) & INS 551), Stabilizer (INS 1201), Thickener (INS 464), Emulsifier (INS 466), Antifoaming Agent (INS 1521) | · Rapid Fat Burn, |
| | | | · Appetite Suppression, |
| | | | · Natural Weight Loss, |
| | | | · Carb Blocker, |
| | | | · Reduce Emotional Cravings, |
| 4. | Nutrabay Wellness Milk Thistle Extract (Silymarin Marianum) 1000mg | Milk Thistle Extract (Silymarin Marianum), Glidant (INS 553 (iii)) and Diluent (INS 460 (i)) | · Improve Metabolism |
| | | | · Liver Care |
| | | | · Boost Metabolism |
| 5. | Fast&Up Ashwagandha (KSM-66) 600mg, 5% Withanolides - Natural Vitality Booster | Ashwagandha (KSM-66) (Withaniasomnifera)- (5% Withanolides) Root Extract | · Powerful Antioxidant |
| | | | · Promotes Vitality, Energy and Vigor |
| | | | · Promotes Muscle Strength and Endurance |
| 6. | Wellbeing Nutrition Slow Liver Health High Strength Milk Thistle, Arjuna & Berberry | Milk Thistle, Kasani, Himsra, Vitamin D, Vitamin E, Berberry, Daruharidra, Arjuna | · Supports Immune System and general wellness |
| | | | · Liver protection |
| | | | · Reduces Inflammation |
| | | | · Control Cholesterol |
| 7. | Healthyhey Nutrition Panax Ginseng 400Mg | Panax Ginseng Root Extract 400mg (20% Ginsenosides) | · Improves Fat Metabolism |
| | | | · Supports physical & intellectual work capacity |
| | | | · Improve Digestion |
| 8. | Foresta Organics Brain Health with Brahmi, Shankpushpi & Ginkgo Biloba | Shankpushpi, Brahmi, Ginkgo Biloba | · Enhanced Memory Retention |
| | | | · Better Eye Health |
| | | | · Control Mood Swings |
| | | | · Reduce Anxiety |
| 9. | Wellbeing Nutrition Apple Cider Vinegar w/ Mother & Garcinia Cambogia | Himalayan Red and Gold Apples, Pomegranate, Garcinia Cambogia | · Heathy Weight Loss |
| | | | · Boosts Metabolism |
| | | | · Improves Heart Health |
| | | | · Supports Glowing Skin |
| | | | · Helps Digestion |
| 10. | Bigmuscles Nutrition Spirulina Organic Tablets (1500mg) | Organic Spirulina, Black Pepper Extract | · Skin & Hair |
| | | | · Blood Pressure |
| | | | · Anti-Inflammatory |
| | | | · Lowers Cholesterol |
| 11. | Doctor's Choice Trans4orm 4 Forms of CARNITINE Blend CLA Garcinia Cambogia | Black Pepper Extract, CLA, Garcinia Cambogia, Vitamins, TRANS4ORM Blend | · Promotes Fat Burning |
| | | | · Regulates Cravings |
| | | | · Weight Management |
| | | | · Increases Metabolism |

| | | | |
|-----------------------------------|--|--|--|
| 12. | Neuherbs Plant Based Green Coffee Instant Charge in Classic Coffee Flavour (20 Effervescent tablets) | Green Coffee Beans Extract, Chlorogenic Acid, Natural Caffeine, Vitamin B6, Vitamin B12 | <ul style="list-style-type: none"> · Helps boost up metabolism · Helps fuel up daily energy level instantly, Aids in reducing fatigue & daily body exhaustion |
| 13. | Foresta Organics Menz-X Health with Shilajit, Ashwagandha, Kaunch& Safed Musli | Shilajit, Kaunch, Akarkara, Ashwagandha & Safed Musli | <ul style="list-style-type: none"> · Helps boost stamina · Helps enhance male libido · Helps improve energy levels · Helps improve potency · Manages stress and fatigue |
| 14. | Dr Vaidya's Stress Relief | Ashwagandha, Tagar, Brahmi, Jatamansi | <ul style="list-style-type: none"> · Helps combat anxiety & promote sound sleep |
| 15. | Bigmuscles Nutrition Natural Neem Extract (800mg) | Organic Neem Extract | <ul style="list-style-type: none"> · Promotes Radiant Skin · Supports Immune System · Acne Relief · Improves Mood |
| 16. | Bigmuscles Nutrition Natural Neem Extract (800mg) | Tila (Sesamum indicum) seed powder, | <ul style="list-style-type: none"> · Beneficial for skin elasticity |
| | | Fructo-oligosaccharides, | <ul style="list-style-type: none"> · Skin moisture |
| | | Honey, | <ul style="list-style-type: none"> · Advanced anti-aging formula |
| | | Water, | |
| | | Amino acid blend 7% (Glycine, L- Proline, L- Alanine, L-Hydroxyproline, L-Arginine, L-Lysine), Rose hips extract, Aloe vera extract, Gajar (Daucus carota) powder, | |
| | | Glutathione, | |
| | | Badam (Prunus amygdalus) Kernel powder, | |
| | | Tila (Sesamum indicum) oil, | |
| | | Pumpkin seed powder, | |
| | | Agathi (Sesbania grandiflora) flower extract, | |
| | | Nature Identical flavouring substances, | |
| | | Flaxseed powder, | |
| | | Cranberry extract, | |
| | | Sodium Hyaluronate, | |
| | | Moringa leaf extract, | |
| | | Blueberry extract, | |
| | | Vitamin E, | |
| Zinc, | | | |
| Green tea extract, | | | |
| Preservatives (INS 202, INS 211), | | | |
| Sitawar powder | | | |

| | | | |
|-----------------------------------|--|--|--|
| 17. | Patanjali Nutrela Diabetic Care | Fructo-oligosaccharides, | Diabetic Care is a scientifically designed formulation to help manage blood sugar levels and weight. |
| | | High Oleic, | |
| | | Sunflower Oil, | |
| | | Stabilizer (INS 414), | |
| | | Caseinates, | |
| | | Hydrolysed whey peptide, | |
| | | Diluent (Maltodextrin), | |
| | | Emulsifier {INS 322(i), INS 415}, | |
| | | Anti-caking agent (INS 551), | |
| | | Mineralsn 0.4% (Phosphorus, potassium, Zinc, Tricalcium phosphate, Maganesium, Ferrous fumarate, Manganese, Copper, Iodine, Selenium, Molybdenum, Chromium), | |
| | | Nature-identical flavouring substances, | |
| | | Bitter gourd, | |
| | | Gudmar (Gymnerasytvestre) Extract (0.1%), | |
| | | Kokam (Garcinia indica) Powder (0.1%), | |
| | | Giloy (Tinosporacardifolia), | |
| | | Taurine, | |
| | | Banaba leaves extract (0.1 %), | |
| | | Vitamin Premix (0.06%) {Vitamin B1, Vitamin B2 (Bio-fermented), | |
| | | Vitamin B3, | |
| | | Vitamin B5, | |
| | | Vitamin B6, | |
| | | Vitamin B7, | |
| | | Vitamin B12 (Bio-fermented)} | |
| | | Sweetener (INS 950), INS 955), | |
| | | Jamun seed powder, | |
| | | Licorice extract 0.01%, | |
| | | Fenugreek, | |
| Rosemary Extract (0.01 %), | | | |
| Cinnamon Extract (0.01%), | | | |
| Myo- inositol, | | | |
| Alpha-lipoic acid, | | | |
| L-camitine, | | | |
| Vitamin D (Bio-fermented) (0.01%) | | | |
| 18. | Himalayan Organics Pcos Multivitamin Supplement 2000Mg | Myo-Inositol, Alpha Lipoic Acid, AlgasCalcareas, Caonositol, Vitamin D2, Folate, Chromium Picolinate | · Acne Control |
| | | | · Weight Management |
| | | | · Hormonal Balance |
| | | | · Minimizes Facial Hair |

| | | | |
|-----|--|--|---|
| 19. | Wellbeing Nutrition Melts Testosterone, Himalayan Shilajit, Ginkgo Biloba – Plant Based (30 Oral Strips) | Testofen*(A patented Fenugreek extract), Pure Himalayan Shilajit, Ginkgo Biloba, Saffron | · Increases Testosterone Production |
| | | | · Reduce Stress & Uplifts Mood |
| | | | · Supports Lean Muscle Gain |
| | | | · Enhance Performance |
| | | | · Improve Stamina |
| 20. | Nutrova Complete Omega 3 | Algal extract containing 17% DHA | · Boosts Energy Levels |
| | | | · DHA is an omega-3 fat that forms structures of our brain, nerves, eyes and skin and also regulates inflammation |

Table 4: Commonly available herbal supplements in market.

Conclusion

An overview of the distribution, ethnobotany, metabolites, ethnopharmacology, and potential medicinal uses of different herbs was provided in this review. It is also important to explore and discuss the clinical efficacy and toxicity studies. Due to the controversy surrounding herbal drug characterization, the secondary metabolites in extracts of all herbs must be identified and characterized analytically. Considering that herbal drugs may interact with other drugs and with foods, the effects of herbal extracts on drug-food interactions must be experimentally validated in a clinical setting. A study of high-throughput experiments and DNA microarrays may also provide a platform for researching and developing drugs from natural products thanks to advances in experimental research [107-119].

Conflict of Interest

The authors are having no conflict of interest with anyone related to publishing this review paper.

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