J. Phytol. Res. **35**(2): 139-150, 2022 **ISSN 0970-5767**

ADVANCES IN NUTRACEUTICAL, PHARMACEUTICAL, AND ETHNOBOTANICAL USES OF AN INDIAN MEDICINAL PLANT: GUGGUL [*COMMIPHORA WIGHTII* (ARN.) BHANDARI]

DILIP KUMAR SHARMA
Vardhman Mahaveer Open University, Kota, Rajasthan, India- 324010
Corresponding Author's Email: drdilipsharma12@gmail.com

Small shrub known as Guggul [*Commiphora wightii* (Arn.) Bhandari] is found in tropical and subtropical areas. It is supposed to be originated in arid regions of central Asia and northern Africa prevalent in the eastern Himalayas and western India on Rocky Tracks. The gum and bark of the plant are effective in treating obesity, arthritis, indolence, piles, gonorrhoea, cough, hernia, and leucoderma. Guggul is a 1.8-4.0 m tall, shrub with tangled, twisted branches and glandular-pubescent juvenile portions. Traditionally, it is used to treat several diseases by the tribes or ethnic groups in various parts of the country. It is pharmaceutically and therapeutically relevant owing to the existence of different secondary metabolites.

Keywords: Botanical study, *Commiphora wightii,* Ethnobotany of guggul, Guggul, Nutraceutical, Phytochemical.

Introduction

The genus *Commiphora* comprises more than 200 species mainly distributed in northeastern Africa, southern Arabia, and India. The genus name comes from the Greek words "phora" and "kommis," which translate to "gum bearer." Oleogum resins from *Commiphora* species has 30-60% water-soluble fraction containing proteins and polysaccharides, 3-8% essential oil, and 25-40% alcohol-soluble resin containing terpenes, steroids, and sterols. Guggulis scientifically known as *Commiphora wightii* a significant member of the Burseraceae family used as a medicine to cure several diseases. Locally, it is known as Googal, Mukul, Myrhh and in English Indian Bdellium or Gum Guggul. Guggul, Devadhoop, Kaushika, Pur, Mahishaaksha, Palankash, Kumbha, and Ulukhala are some of its Ayurvedic names. It is referred to as a MuqallalYahood, a Muql, Bu-e-Jahudaan, and Erumaikan Kungiliyam in Unani and Siddha/Tamil, respectively[1]. Guggle has bitter qualities, i.e., Visada (non-slimy), Suksma (subtle), and Picchila (slimy). It acts potently as a hot or dipana (digestive stimulant). Sara (a laxative), Vrsya (an aphrodisiac), Svarya (a voice enhancer), Rasayana (a rejuvenator), Balya (a strength enhancer), and Kapha and Vayu alleviators are the particular acts. By using it therapeutically, vrana (ulcer), apaci (cervical adenitis), medas (adiposity), and meha have all been treated[2].

Different languages have different names for it. The names include Gogil, Gugal, Guggul, Mukul, and Ranghanturb in Hindi; Bhavabhishtha, Bhutahara, Devadhupa, Deveshta, Dhurta, Divya, Durga, Guggalu, Jatala, Jatayu, Kalaniriyasa, Kaushika, Kumbha, Kumlhi, Kumbholu, Kumbholu-K in Sanskrit or Ayurveda. It occurs in most of the hot parts of the country, like Rajasthan, Madhya Pradesh, Assam, Andhra Pradesh, and Karnataka. It is a short, robust, thorny shrub, occasionally a tree with tiny, sparse leaves. It features little red blooms and a glossy, peeled bark, and during the colder months, it releases a resin known as Indian bedellium or gum Guggul. Due to overexploitation, the species is

endangered and in danger of extinction. It was listed as vulnerable (VU) in the 1997 IUCN Red List's vulnerable section and as a data deficit in the 2004 IUCN Red List. The Indian government has recently stopped gum exports because the price of gum on the international market is so high.

Origin and Distribution:

The Guggul plant is mostly found in arid regions of northern Africa and central Asia, although it is most prevalent in the eastern Himalayas and the Rocky Tracks of western India. The Guggul plant is found in the desert regions of Pakistan, Bangladesh, and India in central Asia. It may be found in the stony desert regions of Rajasthan, Gujarat, Karnataka, Mysore, Deccan, Khandesh, and Bellaryin India. The Guggul plant, which may be found in dry and semi-arid regions, can grow on subpar soil. The Aravalli hills in India are its only known location, along with Gujarat and Rajasthan.

Plant Description:

The plant is resembles a tiny tree or shrub, dioeciously grown, up to 4 m tall, heavily branched. The branches that are knotty, twisted, and spiral upward until they terminate in sharp spines and silver paper-like bark peelings. The plant grows slowly and takes 8–10 years to reach a height of 3–3.5 meters. The under bark, which is greenish in color, glossy and ranging in color from ash to yellowish white, likewise peels off in thin, papery rolls. The plant has leaves that are about 1 to 5 cm long and 0.5 to 2.5 cm wide. The leaves are tiny, sessile, and have one or two leaflets. They are strongly scented, leathery, bright green above and grayish below, with erratic teething on the edges. The lateral leaflets are smaller than the terminal ones, and the leaves are rhomboid-ovate, 1-3 foliate and serrate-toothed in the top section.

It is a dimorphic plant, with male and bisexual blooms on one side and female flowers with staminodes on the other. There has been information about a third kind of plant that solely produces male blooms. Small, brownish-red, sessile, unisexual flowers may be found alone or in clusters of 2-4. Flowers grow in groups of two to three, and their pedicles are quite short. The calyx is campanulate, glandular and has 4-5 triangular, hairy lobes that are as long as the tube. Brownish-red, widely linear, almost three times the length of the calyx, and reflexes at the tip are the petals. Eight to ten stamens, alternately long and short and measuring half as long as the petals, are present. The disc is with 8–10 lobed, deeper alternative sinuses where shorter stamens are inserted. The ovary is attenuated into the style and is oblong-ovoid[3].

The berries-like fruit (6-8 mm diameter), ovoid, green fruit are tiny and shaped like drupes. Fruit sections that are exposed to the sun grow four tiny petals with a pinkish tint. For many months, fruit may be found on the shrub. Typically, an embryonic tissue called a seed is present. The seed exhibits polyembryonic characteristics[4-5]. The aromatic gum resin is made from the plant's bark, ranging in color from pale yellow to brown. Agglomerated resin tears are brittle, have a waxy surface, and are slightly translucent. When heated in the sun, gum-resin, which is thick, fragrant, and liquefies, is released. It takes on a milky white color when dissolved in water.

It may grow from seeds or by vegetative means. Because seed germination is very low so there should be other appropriate methods as well required to propagate the plant. Stem cutting for vegetative growth is the most popular and effective technique. Careful farming is also required for healthy development of the plant and seedling. The oleo gum resin that is produced by each plant that is harvested from January to March weighs between 0.5 and 1 kg.

Phytoconstituents:

The plant is medicinally important due to presence of various bioactive. Guggul resin contains natural steroids such as guggul sterones-Z and E, guggul sterols I–V, diterpenoids, volatile oil, terpene hydrocarbons, and cembrene-A. The differentiating components that set *C. mukul* apart from other *Commiphore spp.* include

E- and Z-guggul sterones. Along with modest levels of sesamin and other unidentified components, *Commiphora wightii* also includes diterpenoids, triterpenoids, steroids, long-chain aliphatic tetrols, aliphatic esters, ferulates, lignans, polysaccharides, and a variety of inorganic ions[6].

(i). Triterpenoids-

Myrrhanol- A, -B, and -C, Myrrhanone-A, Myrrhanone-B, Myrrhanone-A acetate, Commipherol, Commipherin, and the octanordammaranetriperpene,

Epimansumbinol, were extracted from the gum resin. These polypodane-type triperpenes Mansumbinone and mansumbinoic acid and two additional triterpenoidal components that have been isolated are described[7-10]. In contrast to myrrhanol-A, which has a 5S stereostructure at C-5; myrrhanol-B has a 5R stereostructure. The 3-keto counterparts of myrrhanols-A and -B are called myrrhanone-A and-B, respectively[8]. Additionally, the compounds (13E, 17E, 21E)-8-hydroxypolypoda-13, 17, 21-trien-3-one and (13E, 17E, 21E)-polypoda-13, 17, 21-trien-3, 18-diol, which are derivatives of myrrhanol, have been identified[11].

(ii). Steroids-

There have been reports of numerous steroidal components being isolated from gum resin. E-guggul sterone, Z-guggul sterone, guggul sterol-l, guggul sterol-II, guggul sterol-III, guggul sterol-IV, guggul sterol-V, and guggul sterol-VI are some of the main components. The 20-hydroxy-4-pregnen-3-onee, 20-hydroxy-4-pregnen-3-one, and 16-hydroxy-4, 17 (20) -Z-pregnadien-3-ones are further isolated steroids name Z-guggulsterol[12-15]. As well as progesterone, related steroids such as 4-pregnene-3, 16-dione, (20R), 20-acetoxy-4-pregnene-3, 16-dione, 16-acetyloxypregnan-4, 17(20)-trans-diene-3-one, 3-acetyloxy-5-pregnan-16-one, and 20R, 22R-dihydroxycholest-4-en-3-one have been identified[9]. Additionally, cholesterol has been linked to the plant. Guggul sterone-M, dihydro-guggul sterone-M, and guggul sterol-Y are three newly discovered and freshly isolated steroids[10]. The steroidal components are linked to the medication's anti-inflammatory and hypolipidemic effects[11, 16-20].

(iii). Volatile oil and terpenoidal constituents monoterpenoids-

By steam distilling the gum resin, 0.4% of the essential oil is produced; myrcene, dimyrcene, and polymyrcene are its main constituents[21]. Oil has been shown to include D-limonene, -pinene, linalool, cineole, -terpineold-phellandreneene,

methylheptanone, bornyl acetate, and several other undiscovered chemicals[22-23].

(vi). Sesquiterpenoids-

The bicyclic sesquiterpene cadinene may be found in the gum resin. Diterpenoids, such as camphorenee, cembrene-A, cembrene, and other cembrenoids, are present in Guggul. One of the most fundamental tetraenes, cembrene-A, is produced by cyclizing geranylgeranyl pyrophosphate from C-1 to C-14. A novel cembrane alcohol called mukulol (allylcembrol) was isolated from the aerial portions and resin of Guggul[12,24]. Isocembrol and 4-episocembro are two more isolated cembrane-type diterpenes isolated from plants [11, 25].

(v). Flavonoids-

An ethanolic extract of the *C. wightii* tree trunk was separated on a silica gel-packed column to produce muscanone, a novel antifungal flavone; in addition to naringenin, a well-known antifungal flavone. In a microbiological sensitivity test, muscanone was discovered to be effective against *Candida albicans*. Quercetin (quercetin-3-O-L-arabinose, quercetin-3-O-D-glucuronidede, and quercetin-3-O-D-galactosideid) was found to be the primary flavonoid present in the flowers. Pelargonidin-3, 5, di-O-glucoshave and quercetin-3-O-L-rhamnoside has been identified[15, 26].

(vi). Guggultetrols-

The saponified gum resin contained a crystalline substance that was isolated and identified as a blend of octadecan-1,2,3,4-tetrol, nonadecan-1,2,3,4-tetrol, and eicosan-

1,2,3,4-tetrol with trace amounts of other substances, possibly lower (C-16 and C-17) and higher (C21 and C-22) homologous tetrols[14]. These substances make up the guggultetrols, a novel family of naturally occurring lipids. These tetrols have hydroxyl functions at the C-1, C-2, C3, and C-4 positions. They are long-chain linear aliphatic tetrols. Guggultetrol-18 and guggultetrol-20 were made pure using derivatization and preparative GLC. The drug's cytotoxic effects were caused by a blend of two ferulates (n = 16, 17) with a unique skeleton. They were extracted from the cytotoxic portion of a Guggul ethyl acetate extract. Based on homologous long-chain tetrols and acid, it was recognized as a combination of esters [25, 27].

(vii). Lignans-

Two lignanshave been identified in guggulu as sesamin[12] and diayangambin[7]. It has been said that it is in the methanolic extract of 5, 5-tetrahydro-1H, 3H-furoro (3, 4-c) [11].

(viii). Sugars-

The gum portion of the resin underwent complete hydrolysis, producing L-arabinose, D-galactose, L-fructose (traces), and 4-Omethyl-D-glucuronic acid. Aldobiouronic acid was produced by the gum's gradual hydrolysis. 2,3,4,6-tetra-O-methyl-D-galactose, 2,3-di-O-methyl-L-arabinose, 2,3,4-tri-O-methyl-D-galactose, 2,4-di-O-methyl-D-galactose, and 2,3,4-tri-O-methyl-D-glucuronic acid were produced upon hydrolysis of methylated gum in a 1:1:1:2:1 ratio. The gum was shown to be a highly branched polysaccharide with 1-6, 1-3, and 1-5 forms of linkage according to the tentative structure [6, 22].

(ix). Amino Acids-

The aqueous fraction of the alcoholic extract was chromatographed after it had been divided between water and ether. The results showed that there were a number of amino acids, such as cystine, histidine, lysine, arginine, aspartic acid, serine, glutamic acid, threonine, alanine, proline, tyrosine, tryptophan, valine, leucine, and isoleucine[16].

Applications of Guggul:

A. Therapeutic and pharmaceutical uses-

Guggul gum is made up of 61% resin, 29.3% gum, 6.1% water, 0.6% volatile oil, and 3.2% foreign substances. Obesity, rheumatoid arthritis, osteoarthritis, sciatica, hyperlipidemia, and hypercholesterolemia may all be treated with oleo-gum-resin. This resin contains three sterols: gugglusterols I, II, and III; two sterones; and two dieterpines. A hypocholesteremic drug called guggulipid is used to treat obesity. Guggul resin prevents platelet aggregation, has anti-inflammatory properties, and seems to stimulate the thyroid gland in rats and chickens. It also boosts catecholamine production and activity in rabbits given cholesterol. The Z-guggul sterone may boost the thyroid glands intake of iodine and the liver and bicep tissues consumption of oxygen[28].

Hemiplegia and atherosclerotic diseases are treated with the gum. Resin is helpful for pharyngitis, chronic tonsillitis, pyrrhoea alveolaris, and slow-healing wounds[29,30]. For hay fever, chronic bronchitis, nasal catarrh, laringitis, and phthisis, inhaling gum-burning fumes is advised.

The plant is botanically classified domain: Eukaryota, kingdom: Plantae, sub-kingdom: Tracheobionta, division: Magnoliophyta, class: Spermatopsida, sub-class: Magnoliidae, order: Sapindales, family: Burseraceae, genus: *Commiphora*, species: *wightii*[31].

The oleo-gum resin of *Balsamodendron caudatum* is compared to Guggul in Siddha treatment. The oleo-resin exhibits hypocholesterimic, expectorant, carminative, aphrodisiac, demulcent, anti-inflammatory, and antirheumatic properties. There are antimicrobial qualities to the essential oil. Patients with ischemic heart disease saw an increase in fibrinolytic activity. Guggul lipid is beneficial for treating gout, spondilitis, and cardiac conditions. It is helpful in situations of infectious hepatitis and rhinosinusitis[5-32]. In Ayurveda, Krishnan (black), Peet Varn (yellow), Neel (blue), Kapish (light brown), and Rakt (blood red) are the five various ways

that Guggul is utilized in Ayurveda[33].

Compared to the contemporary allopathic system, Guggul is employed more in ayruvedic medicine. The Guggul plant is used in the practice of ayurveda, an ancient Indian school of medicine, to cure a number of ailments. The oldest mention of medicinal and therapeutic powers of plant is found in the Atharvaveda that is one well-known Hindu Holy Scriptures (Vedas) in our Vedias[16]. The Charaka Samhita (1000 BC), Sushruta Samhita (600 BC), and Vagbhatta were detailed in Guggul's descriptions (seventh century AD). Inflammation, arthritis, atherosclerosis, obesity, hyperlipidemia, rheumatism, haemorrhoids, urinary disorders, skin diseases, high cholesterol, neuro-degeneration, Parkinson's diseases, mongolism, and the ageing process are all treated by different medical lexicons [5,32,34,36].

Ayurvedic proportions and their uses-

All types of malignant boils, sinus problems, expansion of the neck glands, and leucoderma are treated with saptanga Guggul[37,38]. Dropsically swellings, abdominal swellings, abdominal dropsy, chlorosis, anemia, malignant jaundice, piles, fistula-in-ano, and abdominal tumors were all treated with Cothodarari Lauha[37].

Lauha Rasayana treats leucoderma, gonorrhea, fever, anemia, chlorosis, fistula-in-ano, swoons, and poisoning. It treats obesity and serves as an aphrodisiac[39]. Gonorrhea, strangulated calculus, urine retention, and chlorosis are all treated with Chandraprabha Bati. It is a wonderful tonic, an aphrodisiac, and it boosts strength[40]. Gonorrhea is cured with Cilajitwadi Bati[41]. Mahamudgara Batika treats leucoderma, fistula-in-ano, chlorosis, anemia, gonorrhea, strangury, urinary retention, calculi, piles, abscesses, and malignant jaundice[42].

Cakramatrika Bati stokes the digestive fire, boosts the strength and enhances the appearance. Ushakadi Gana aids in the elimination of calculus stones, urination discomfort, and tumours in the belly brought on by phlegm[43].

Gulmacarddula Rasa is used to treat abdominal tumors, anemia, epistasis, enlarged spleen and liver, and dropsically swellings[44]. Amavatari Batika is used to treat intestinal worms, leprosy, piles, fistula-in-ano, bronchocele, goitre, hernia, abdominal tumours, enlarged spleen, abdominal dropsy, neurological diseases, headaches, bronchitis, and other conditions[45]. Guggulu from Vrihat Singhanada is used to treat acute rheumatism. It gives the sufferer vigour and rekindles their digestive fire[46]. Vatari guggulu is used to treat abdominal dropsy, sciatica, lameness, and acute rheumatism.Vataraktantaka Rasa is used to treat leprosy, neurological disorders, and all forms of tuberculosis.

To treat tubercular leprosy, which results in lesions all over the body, langaladyaluha is used.

Leucoderma, boils, gonorrhoea, diabetes, carbuncles, cough, stomach tumours, chlorosis, and indigestion are all treated with kaicora guggulu. Rasabhra guggulu is used to treat intestinal worms, eczema, itching, psoriasis, herpes, warts, leprosy, indigestion, and enlargement of the lymphatic glands. Nervous system disorders are treated with Vatari Rasa. Asthma, dropsical swellings, cough, consumption, indigestion, and epistasis are all treated with plihantaka rasa.

Dashanga guggulu is a substitute, tonic, stimulant, and remedy for obesity, nervousness, and rheumatic ailments. The traditional medicine and tonic Pakshavadna Guggul is used to treat paraplegia and hemiplegia. Gokshuradi Guggul is effective for treating albuminaria, phosphaturia, euresis, dysuria, calculi, gonorrhoea, and rheumatism.

Albuminaria, phosphaturia, gout, gonorrhea, renal calculi, chicken pox, herpes, and lumbago are all treated with Chandraprabhagutika. Trayodashang Guggul is used to treat internal neuralgic diseases, asthma, cystitis, and prostate gland enlargement. It also treats bladder incontinence. Kanchnar guggulu may be used to treat leprosy, ulcers, scrofula, sinusitis, and fistulas. Kisorguggulu may be

used to treat ulcers, boils, chronic gonorrhea, fistula, sciatica, and rheumatism, bronchitis, laryngitis, gleet, and gonorrhea tablets.

In order to treat abscesses, boils, ulcers, and fistulas, swayambhuvaguggulu is often used. Yograja Guggulu treats synovitis, paraplegia, sciatica, hemiplegia, and other neurological diseases. Rasnaguggulu is used for paraplegia and sciatica. Lohaguggulu is used to treat scrofula; anaemia, chlorosis, general debility, sexual debility, and the debility associated with ageing.Rheumatoid arthritis, intestinal obstructions, excruciating joint pain, and a variety of mental illnesses are all treated by Maharasna Kadha No. 1. Joint discomfort, facial oedema, stomach burning, and skin conditions are treated with Visrapa Kadha. Flatulence, sciatica, stomatitis, sloughing, ulcers, dysentery, worms, and bleeding piles may all be treated with agasti guggulu. Obesity, thirst, general senility, and excessive sweating are treated with medoroga gutika. Guggul and sinhan are used to treat renal disorders, gout, neuralgia, sciatica, and bleeding piles. Yograj Gutika not only heals ulcers, but also mumps, scrofula, Tuberculosis, Sooj Lep Drospy, and erysipelas[37, 38, 41].

B. Traditional and Ethnobotanical uses-

Guggul is often administered in the form of Yog, a concoction of castor oil or Indian clarified butter, additional medications, and Guggul. The Guggul might also be cooked with water and other herbal medication powders to make the yog. The ayurvedic remedies yograjgugguluvati, pachamritioh Guggul, kaishoreguggulu, triphlaguggulu, and sinhaguggluvati are well-known for having Guggul[47]. Guggul is used to treat cardiac conditions in both the traditional Ayurvedic medical system and contemporary medicine. But owing to its usage in the regions of Gujarat and Rajasthan, Guggul became rare (the main cultivating areas). In India's Ayurveda, an extract from the Guggul tree known as guggul lipid is used.

Resins are used to treat a variety of conditions, including wounds, pain, fractures, mouth ulcers, inflammatory illnesses, stomach issues, and microbiological infections. This resin is used to speed up the recovery of wounds, intestinal worms, lymphadenopathy, mouth ulcers, sore throats, and bone fractures[48]. In India, it is used to treat inflammatory conditions, arthritis, and pain[49, 50].

For the treatment of obesity, the gum of Guggul is cleaned by boiling it in a decoction of triphala or cow's urine. The dosage is 10 to 20 grains with a cup of warm milk. Two tablespoons of panchatiktaghrta Guggul are administered twice a day with warm milk or water for the treatment of psoriasis (a skin condition). For gout, Suddha Guggul 2-4 gm and Guduchi 14–28 ml of decoction are used three times a day (acute pain and swelling of joints). To treat arthritis, 1-3 g of Guggul is administered three times a day with warm water. Guggul is used for digestive issues. Oedema is treated with cow urine or a decoction of *Boerhaavia diffusa* and Guggul.

For the treatment of tumours and abscesses, guggul, dried ginger, and purified silajeet (rock exudate) are administered three times a day. Haritaki (*Terminalia arjuna*), Silajeet, and Guggul with cow's urine should be taken twice daily to treat rheumatoid arthritis. Guggul and triphala decoctions are used for treating sinusitis, fistula-in-ano, wounds, and skin conditions. It is an excellent treatment for foetid ear. Guggul consumption along with cow pee usage eliminates chronic scrotal hypertrophy. The damaged areas of the Guinea worm are treated with a mixture of water and the seeds of palasa, camphor, and Guggul. The therapeutic properties of *Commiphora agallocha* and *Commiphora stocksiana* are extensively employed globally.

The Guggul tree's bark is used by the Santhal people to heal ulcers. In the eastern portion of the nation, toothbrushes are made from Guggul wood and bark. Guggul resin is used to cure asthma, boils, and headaches in northern India[39]. For bronchitis and nasal catarrh, the Ajmer division uses fumigation and Guggul resin inhalation[40, 42]. The plant's vapors are used to treat typhoid and its resin to ward off mosquitoes. In West Rajasthan[46],

pyorrhea and other dental and gum issues are treated with Guggul's bark and twig.

C. Socioeconomic uses-

It is the most priceless, endangered plant in the Red Data Book, medicinal herb. When burnt, its resin has a scent like myrh and is used as incense. Its continued survival is now under danger because of limited seed production and recent environmental changes, including altered rainfall patterns and rising pollution levels. The plant species is attempting to establish itself in the Western Indian Thar Desert at several locations[5, 51]. Under the arid environmental conditions, plants need ten years to achieve full development.

Figure 1: Various plant parts of Guggul (*Commiphora wightii*)

Causes of Decline of Guggul:

The plant is listed as an endangered species for a number of reasons, some of which are thought to have a greater impact on the population's ability to survive. Invasive alien species are among the various factors, along with slow growth, poor seed-setting and seed germination rates, a lack of cultivation, unsustainable overexploitation, excessive and irrational tapping methods, and poor seed germination rates[52-54]. Out of these the main causes include improper methods of tapping and overexploitation, poor seed germination, seed-based regeneration, and alien species invasion. The plant has never been cultivated, but the existing natural populations of this species have been impacted by changing environmental factors, such as climatic conditions, soil erosion, low rainfall, termite infestation, over-grazing by domestic animals, and mining activities. Other issues include a narrow range of occurrence, a small area of occupancy, and severe fragmentation.

Security and Toxicology:

Ayurvedic writings have noted that taking raw Guggul orally sometimes causes skin rashes, irregular menstruation, diarrhea, headaches, moderate nausea, and, in extremely large quantities, liver damage[55]. Ayurveda offers a variety of purifying procedures (shodhan vidhi) in various "dravyas," or fluids that may be used to mitigate the negative effects of raw Guggul while simultaneously enhancing the therapeutic action. Guggul is the main ingredient in many commercial polyherbal anti-inflammatory formulations[56].Clinical research using standardized gum Guggul extracts noted temporary adverse effects including rashes on the skin, diarrhea, and irregular menstrual cycles. According to one study, 10 of the 22 people who received 2160 mg of Guggul daily for 12 weeks experienced one or more side effects, including gastrointestinal discomfort, exhaustion, and skin rash[57]. Other studies utilizing 1-2 g of guggulipid (ethyl acetate fraction) daily for a month also produced skin rashes. Intestinal discomfort was not reported in this study[58, 59]. Guggul includes oligogum resin, furanosesequiterpenoids, and other substances that are useful to cure malignancies such as those of the breast, skin, and others[60–65]. Information about guggul's toxicity is scant or nonexistent.

Conclusion

In this review the information on the *C. wightii* tree has been collected by various write-ups. A number of the plant's extracts and chemical components have shown hypolipidemic/hypocholesterolemic action, effect on platelet aggregation and fibrinolytic activity, thyroid stimulatory activity, antioxidant, antibacterial, cytotoxic, anti-inflammatory, and hypoglycemic effects. Apart from trace levels of sesamin and other unknown compounds, its phytochemical makeup suggests the existence of diterpenoids, triterpenoids, steroids, long-chain aliphatic tetrols, aliphatic esters, ferulates, lignans, polysaccharides, and a variety of inorganic ions. Many different substances extracted from Guggul shown to exhibit a variety of biological characteristics. There are lots of work has been done on this plant but studyon phytochemical characteristics, biological activities, pharmacokinetics, and clinical trials is still needed. Experimental in vitro, in vivo, and toxicological analyses of Guggul and study of its phytochemical components is still required.

References

1. Raghunath K and Mitra R 2005, Pharmacognosy of Indigenous drugs. *central council for research in Ayurveda and Siddha, India,* **1** 354-373
2. Prathap BC, Rajitha B, Anusha CH, Nagasirisha M, Madhusudhana Chetty C and Mohamed Saleem TS 2012, *Pterocarpus marsupium* Roxb: A potent herb for life threatening diseases. *Int. J. Res. PhytPharma.* **2012** (2) 75-83.
3. Bhardwaj M and Alia A 2019, *Commiphora wightii* (Arn.) Bhandari. Review of Its Botany, Medicinal Uses, Pharmacological Activities and Phytochemistry. *Journal of Drug Delivery & Therapeutics* **9** (4-S) 613-621.
4. Gupta P, Shivanna KR and Mohan Ram HY 1996, Apomixis and Polyembryony in the Guggul Plant, *Commiphora wightii*. *Annals of Botany* **78** 67–72.
5. Pareek A and Pareek LK 2012, *Commiphora wightii* (Guggal) an endangered medicinal plant of Rajasthan needs attention of biotechnologists for its conservation. *Journal of Pharmaceutical, Biological and Chemical Sciences* **3**(1) 83-89.
6. Ali MA and Hasan M 1967, Chemical investigation of *Commiphora mukul* Engl. (Burseraceae). *Pakistan Journal of Scientific and Industrial Research* **10** 21-23.
7. Matsuda H, Morikawa T, Ando S, Oominami H, Murakami T, Kimura I and Yoshikawa M 2004, Absolute stereostructures of polypodane-type triterpenes, myrrhanol A and myrrhanone A, from guggul-gum resin (the resin of *Balsamodendron*

mukul). *Chemical and Pharmaceutical Bulletin* **52** (10) 1200–1203.
8. Kimura I, Yoshikawa M, Kobayashi S, Sugihara Y, Suzuki M, Oominami H, Murakami T, Mastuda H and Doiphode VV 2001, New triterpenes, myrrhanol A and myrrhanone A, from guggul-gum resins, and their potent anti-inflammatory effect on adjuvant-induced air-pouch granuloma of mice. *Bioorganic and Medicinal Chemistry Letters* **11** (8) 985–989.
9. Xu J, Guo Y, Zhao P, Xie C, Jin Da-qing, Hou W and Zhang T 2011, Neuroprotective cadinanese squiterpenes from the resinous exudates of *Commiphora myrrha*. *Fitoterapia* 82(8) 1198–1201.
10. Hanus LO, Rezankab T and Dembitskya VM and Moussaieffa A 2005, Myrrh—*Commiphora* chemistry. *Biomedical papers* **149**(1) 3–28.
11. Francis JA, Raja SN and Nair MG 2004, Bioactive terpenoids and guggulu steroids from *Commiphora mukul* gum resin of potential anti-inflammatory interest. *Chemistry and Biodiversity* **1**(11) 1842–1853.
12. Patil V D, Nayak UR and Dev S 1973, Chemistry of ayurvedic crude drugs—II. Guggulu (resin from *Commiphora mukul*-2): diterpenoid constituents. *Tetrahedron* **29** (2) 341–348.
13. Purushothaman KK and Chandrasekharan S 1976, Guggul sterols from *Commiphora mukul* (Burseraceae) *Indian Journal of Chemistry* Section B **14** 802–804.
14. Bajaj AG and Dev S 1982, Chemistry of ayurvedic crude drugs-V Guggulu (resin from *Commiphora mukul*-5) some new steroidal components and, stereochemistry of guggul sterol-I at C-20 and C-22. *Tetrahedron* **38** (19) 2949-2954.
15. Fatope MO, Al-Burtomani SKS, Ochei JO, Abdulnour AO, Al-Kindy SMZ and Takeda Y 2003, Muscanone: a 3-O-(1″,8″,14″-trimethylhexadecanyl) naringenin from *Commiphora wightii*. *Phytochemistry* **62** 1251–1255.
16. Satyavati GV 1991, Guggul lipid: a promising hypolipidemic agent from gum guggul (*Commiphora wightii*). *Economic and Medicinal Plant Research* **5** 48-82.
17. Singh RB, Niaz MA and Ghosh S 1994, Hypolipidemic *Commiphora mukul* therapy in patients and antioxidant effects of as an adjunct to dietary with hypercholesterolemia. *Cardiovascular Drugs and Therapy* **8** 659–664.
18. Chander R, Khanna AK and Kapoor NK 1996, Lipid lowering activity of guggul sterone from *Commiphora mukul* in hyperlipaemic rats. *Phytotherapy Research* **10** (6) 508–51.
19. Hasani RS, Nayebi N, Moradi L, Mehri A, Larijani B and Abdollahi M 2010, The efficacy and safety of herbal medicines used in the treatment of hyperlipidemia; a systematic review. *Current Pharmaceutical Design* **16** (26) 2935–2947.
20. Chander R, Khanna AK and Kapoor NK 1996, Lipid lowering activity of guggul sterone from *Commiphora mukul* in hyperlipaemic rats. *Phytotherapy Research* **10** (6) 508–511.
21. Bhati A 1950, Essential oil from the resin of *Commiphora mukul*, Hook. Ex. Stocks. *Journal of the Indian Chemical Society* **27** 436-440.
22. Bose S and Gupta KC 1966, Structure of *Commiphora mukul* gum I: nature of sugars present and the structure of aldobiouronic acid. *Indian Journal of Chemistry* Section A **2** 57-60.
23. Saxena VK and Sharma RN 1998, Constituents of the essential oil from *Commiphora mukul* gum resin. *Journal of Medicinal and Aromatic Plant Sciences* **20** 55–56.
24. Prasad RS and Dev S 1976, Chemistry of ayurvedic crude drugs-IV: guggulu (resin from *Commiphora mukul*-4 absolute stereochemistry of mukulol. *Tetrahedron* **32**(12) 1437–1441.

25. Kumar V and Dev S 1987, Chemistry of ayurvedic crude drugs-VII guggulu (resin from *Commiphora mukul*)-6: absolute stereochemistry of guggul tetrols. *Tetrahedron* **43** (24) 5933-5948.
26. Kakrani HK 1981, Flavonoids from the flowers of *Commiphora mukul. Fitoterapia* **52** (5) 221-223.
27. Su S-L, Duan J-A, Tang Y-P, Zhang X, Yu L, Jiang FR, Zhou W, Luo D and Ding AW 2009, Isolation and biological activities of neomyrrhaol and other terpenes from the resin of *Commiphora myrrha, Planta Medica* 75(4) 351–355.
28. Singh DC, Dhyani S and Kaur G 2015, A critical review on *guggulu* [*Commiphora wightii* (Arn.) Bhand.] & its miraculous medicinal uses. *International Journal of Ayurveda and Pharma Research* **3** (1) 1-9.
29. Dai L, Ma S and Qi Y 2001, Frankincense prescription used for the treatment of 386 skin ulcer cases. *Hebei Medical Journal* **23** 587.
30. Al-Harbi MM, Qureshi S, Raza M, Ahmed MM, Afzal M and Shah AH 1997, Gastric antiulcer and cytoprotective effect of *Commiphora molmol* in rats. *Journal of Ethnopharmacology* **55** 141–150.
31. Rout OP, Acharya R and Mishra SK 2012, Oleo gum resin guggulu: a review of the medicinal evidence for its therapeutic properties. *International Journal of Research in Ayurveda and Pharmacy* **3** (1) 15-21.
32. Chaudhary G 2012, Pharmacological Properties of *Commiphora wightii, Intern. J. of Pharma and Pharmaceutical Sciences* **4** (3) 73-75.
33. Goyal P, Chauhan A and Kaushik P 2010, Assessment of *Commiphora wightii* (Arn.) Bhandari (Guggul) as potential source for antibacterial agent. *Journal of Medicine and Medical Sciences* **1** (3) 71–75.
34. Polterait O 1997, Antioxidants and free-radical Scavengers of Natural origin. *Current Org. Chem.* **1**(4) 1415-1440.
35. Prior RL 2003, Fruit and vegetables in the prevention of cellular oxidative damage. *American J. Clin. Nut.* **78** 570-578.
36. Devasagayam TP, Tilak JC and Boloor KK 2004, Free radicals and antioxidants in human health. *Curr. Stat. Fut. Prosp*. **52** 794-804.
37. Dash B and Kashyap L 1992, Five specialized therapies of Ayurveda (Pancakarma) based on Ayurveda saukhyam of Todarananda. *Concept publishing Company, New Delhi* **10** 229.
38. Chitale PK 1997, A comparative study of Ayurveda and treatment of Indian drugs. *Sri Satguru Publication Delh.* p 267.
39. Jain SK 1997, Contribution to Indian ethnobotany. *Scientific Publishers, India* 3rd Edition.
40. Mishra R and Dixit RD 1976, Studies on ethnobotany of some less known medicinal plants of Ajmer forest division, Rajasthan. *Nagarjun* **19** 20-22.
41. Pathak RR 1970, Therapeutic guide to ayurvedic medicine. *A hand book of Ayurvedic medicine* Shree Baidyanath Ayurved Bhawan Pvt. Ltd. Patna,
42. Shah NC 1982, Herbal folk medicines in northern. *Indian J. Ethnopharmacology* **6** 293- 301.
43. Sharma S and Kumar A 2001, Ayurvedic plants for cure of hepatic diseases. *Int. J. Mendel* **18** 13-14.
44. Sharma S and Kumar A 2011, Studies on Growth and Physiology of Some Medicinal Plants: Improving growth and productivity of medicinal plants. *Germany LAP LAMBERT Academic.*
45. Sharma S and Kumar A 2012, Pharmacognostical studies on medicinal plants of Semi-arid region. *Prime Research on Medicine* **2** (3) 505-512.
46. Shekhawat GS and Sunil Anand 1984, An ethnobotanical profile of Indian desert. *J. Econ. Tax. Bot.* **5** 591-598.
47. Mishra SA 1996, Bhaishjaya, Surbharti pakashan, Varanasi.
48. Mohite PP and Deshmukhe PN 2022,

Ayurvedic and modern approach to Diabetic Neuropathy: A Review. *Journal of Ayurveda and Integrated Medical Sciences* **7**(1) 199 - 204.

49. Ding X and Staudinger JL 2005, The ratio of constitutive androstane receptor to pregnane X receptor determines the activity of guggul sterone against the Cyp2b10 promoter. *Journal of Pharmacology and Experimental Therapeutics* **314** 120–127.
50. Singh BB, Mishra LC, Vinjamury SP, Aquilina N, Singh VJ and Shepard N 2003, The effectiveness of *Commiphora mukul* for osteoarthritis of the knee: an outcomes study. *Alternative Therapies in Health and Medicine* **9** 74–79.
51. Vineet S 2008, In situ conservation of *Commiphora wightii* a red-listed medicinal plant species of Rajasthan state. *India. Final project report of IUCN*.
52. Bhatt JR, Nair MNB and Mohan Ram HY 1989, Enhancement of Oleo Gum Resin Production in *Commiphora wightii* by Improved Tapping Technique. *Current Science* **58** (7) 349-357.
53. Mertia RS, Sinha NK, Kandpal BK and Singh D 2010, Evaluation of Indian Myrrh (*Commiphora wightii*) Landraces for Hyper Arid Thar Desert. *Indian Journal of Agri cultural Sciences* **80** (10) 869-871.
54. Reddy CS, Meena SL, Krishna PH, Charan PD and Sharma KC 2012, Conservation Threat Assessment of *Commiphora wightii* (Arn.) Bhandari-An Economically Important Species. *Taiwania* **57** (3) 288-293.
55. Masten SA 2005, Gum Guggul and Some of Its Steroidal Constituents: Review of Toxicological Literature. vol. 2, US Department of Health and Human Services, National Toxicology Program (NTP), National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health, Durham, NC, USA
56. Karan M, Sarup P, Suneja V and Vasisht K 2012, Effect of traditional ayurvedic purification processes (sodhan vidhi) of guggulu on carrageenan-induced paw oedema in rats. *Journal of Pharmaceutical and Biomedical Sciences* **21** (5) 1–5.
57. Nohr LA, Rasmussen LB and Straand J 2009, Resin from the mukul myrrh tree, guggul, can it be used for treating hypercholesterolemia? A randomized, controlled study. *Complementary Therapies in Medicine* **17** (1) 16–22.
58. Szapary PO, Wolfe ML, Bloedon LT, Cucchiara AJ, DerMarderosian AH, Cirigliano MD and Rader DJ 2003, Guggulipid for the treatment of hypercholesterolemia: a randomized controlled trial. *Journal of the American Medical Association* **290** (6) 765–772.
59. Ulrich J, Stiltz S, St-Gelais A, El Gaafary M, Simmet T, Syrovets T and Schmiech M 2022, Phytochemical Composition of Commiphora Oleogum Resins and Their Cytotoxicity against Skin Cancer Cells. *Molecules* **27** 3903.
60. Schmiech M, Lang SJ, Werner K, Rashan LJ, Syrovets T and Simmet T 2019. Comparative analysis of pentacyclictriterpenic acid compositions in oleogum resins of different *Boswellia* species and their in vitro cytotoxicity against treatment-resistant human breast cancer cells. *Molecules* **24** 2153.
61. Ijaz S, Akhtar N, Khan MS, Hameed A, Irfan M, Arshad MA, Ali S and Asrar M 2018, Plant derived anticancer agents: A green approach towards skin cancers. *Biomed. Pharmacother.* **103** 1643–1651.
62. Schmiech M, Ulrich J, Lang SJ, Büchele B, Paetz C, St-Gelais A, Syrovets T and Simmet T 2021, 11-Keto-alpha-boswellic acid, a novel triterpenoid from *Boswellia spp*. with chemotaxonomic potential and antitumor activity against triple-negative breast cancer cells. *Molecules* **26** 366.
63. Jiang Z, Jacob JA, Loganathachetti DS, Nainangu P and Chen B 2017, beta-

Elemene: Mechanistic studies on cancer cell interaction and its chemosensitization effect. *Front. Pharmacol.* **8** 105.

64. Ahmed R, Wang YH, Ali Z, Smillie TJ and Khan IA 2016, HPLC method for chemical fingerprinting of guggul (*Commiphora wightii*) - Quantification of E- and Z-guggul sterones and detection of possible adulterants. *Planta Med.* **82** 356–361.
65. Ayyad SE, Hoye TR, Alarif WM, Al Ahmadi SM, Basaif SA, Ghandourah MA and Badria FA 2015, Differential cytotoxic activity of the petroleum ether extract and its furanosesquiterpenoid constituents from *Commiphora molmol* resin. *Z. Naturforsch. C J. Biosci.* **70** 87–92.