



Beyond Tradition: Caralluma's Pharmacological Marvels in Herbal Medicine

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ABSTRACT:

Numerous herbal remedies have been employed across several medical systems to address and manage various health conditions. In addition to providing main ingredients with therapeutic uses, medicinal plants are becoming a valuable source for identifying new therapeutic targets. One genus that has been used in conventional medicine is *Caralluma*. The categorization of *Caralluma* into subgenera, the number of species, its global distribution, and the medicinal properties of different *Caralluma* species were all carefully assessed in this paper. *Caralluma* has been used medicinally for six general types of diseases, including diabetes and digestive disorders, in India, Iran, and Pakistan, China, among other countries. *Caralluma* contains antimalarial, antitrypanosomal, anti-ulcer, antioxidant, antinociceptive, and antiproliferative properties. It is used as traditional medicine in various disorders including diabetes, paralysis, leprosy, rheumatism & inflammation. These bioactivities might result from the genus's many groups of chemicals being present. *Caralluma* contains pregnane-glycosides, flavones, megastigmane-glycosides, pregnane-steroids, and aromatic-volatile compounds. By critically analyzing the current fragmented literature on ethnobotany, phytochemistry, pharmacology, & toxicity, this study seeks to build a connection between traditional applications and scientific investigations on the species *Caralluma*. Nonetheless, the studies discussed here demonstrate its advantageous effects on boosting health.

1. Introduction

Medicinal plants have become significant research, particularly concerning their conservation and validating their traditional uses through pharmacological studies. As defined by the World Health Organisation, herbal phyto, or botanical medicines as the utilization of medicinal plants, plant materials, plant preparations, and finished herbal products having active plant components used in pharmaceuticals¹. The use of native medicinal plants to treat various ailments is gaining popularity. Due to the effectiveness, safety, and affordability of herbal medications.² Medicinal plants have different therapeutical potentials for discovering novel drugs. Some plants are used for trade and in making food

recipes. There are around 38,660 medicinal plant species in Asia.³

About 2000 species comprise the genus *Caralluma*, a member of the Apocynaceae family. These species are divided into three subgenera. *Caralluma* subgen. *Desmidorchis* M.G. Gilbert, *Boucerosia* M.G. Gilbert, and *Urmalcala* M.G. Gilbert are the subgenus names of *Caralluma*. It is found in dry regions of Africa's north, centre, and east, tropical Asia, and the southern Mediterranean. The genus was once classified under the Asclepiadoideae subfamily of the Asclepiadaceae family, but it has since been combined into the Apocynaceae family.^{2,4} Certain *Caralluma* species grow properly in little, open pots that drain properly. To



propagate a species, one can use seeds, cuttings, or divisions; nevertheless, division is the simplest method. It is consumed as food in many parts of the world. For example, people in India use the fruits of *Caralluma edulis* as a vegetable.⁵

The *Caralluma* genus is rich in phytochemical components with diverse medicinal qualities and varying nutritional and pharmacological values. Of these, *Caralluma* spp. are particularly noteworthy for their purported antidiabetic effects. Applications in conventional medicine include the treatment of cancer, TB, snake & fever, diabetes, inflammation, and scorpion bites. Hyperglycemia is linked to several illnesses, including diabetes mellitus, a metabolic disease. Because *Caralluma* species include b-sitosterol, megastigmane glycosides, flavones, and other phytochemicals, a range of biological activity can be anticipated from them.⁴

This review seeks to bridge the gap between traditional applications and scientific investigations, critically examining the literature on ethnobotany, pharmacology, and phytochemistry related to *Caralluma* species. This review also gives a unified understanding of its therapeutic potential. It lays the groundwork for upcoming studies that examine the plant's overall health advantages.

2. Different therapeutic activities of Genus *Caralluma* with their different species, geographical distribution, and responsible active phytoconstituents for the particular activity (Table No.1).

2.1 Antidiabetic

Various medicines are used to overcome blood glucose levels but have been reported for many causes. Plants have fewer adverse effects, are a good source to treat diabetes, and are cheaper.²² Traditionally multiple species of the genus *Caralluma* are well known as antidiabetics, in that most species like *Caralluma fimbriata*, *C. edulis*, *C. attenuates*, etc. are scientifically proven. *C. tuberculata* ethanolic extract, showed a significant reduction in G-6-Pase activity in isolated rat hepatic microsomes. Whole plant extract also reduces sugars.²³ Mechanisms behind different phytoconstituents such as pregnane glycoside enhance insulin production²⁴, quercetin increases glucose absorption, culminating in the translocation of glucose transporter 4, which reduces sugar synthesis by downregulating critical gluconeogenesis enzymes.²⁵ rutin induces insulin production, restoring glycogen. Various species of

Genus *Caralluma* are used traditionally as well as scientifically proven for antidiabetic activity.²⁶

2.2 Anticancer

Cancer is a widely distributed remarkable disease, several factors are responsible for forming huge amount of unstable free radicle that causes tumor formation, and tissue necrosis which may lead to developing cancer²⁷, furthermore, genetic factor, and lifestyle that is also responsible for causing cancer, various types of cancers caused due to various reasons like smoking, alcoholism, etc.²⁸ Multiple options are available to treat cancer but they have several side effects so by using medicinal plants with less adverse effect to treat such diseases, Genus *Caralluma* having potentially curable medication that is traditionally used for lung cancer, breast cancer, colorectal cancer some of the species are scientifically proven such as *C. tuberculata*, *C. attenuates*, *C. europaea*, etc.. In that study, three pregnane glycosides were isolated from the *C. tuberculata* herb, & it was found that russelioside had a substantial decrease in NF- κ B function in breast cancer.²⁹ such chemical components contained in the plant, which are pregnane glycosides, steroids may have a role in the *Caralluma* genus possessing anti-cancer and anti-tumor properties.³⁰

2.3 Anti-obesity

An abnormal accumulation of fatty tissue that may be hazardous to one's health is called obesity.³¹ In the United States, the proportion of persons over 20 who are obese increased from 15% to 30% between 1960 and 2000, according to the National Health and Nutrition Examination Survey.³² Treatments for obesity include lipase inhibitors, drugs that stimulate the central nervous system, and thermogenesis but these medications have been shown undesirable side effects. Medicinal plants such as Genus *Caralluma* are traditionally used as appetite suppressants for weight reduction.³³ Some *Caralluma* species have shown evidence of having anti-obesogenic qualities, including *C. fimbriata* and *C. tuberculata*. Inhibiting the synthesis of two enzymes—malonyl coenzyme A & and acetyl coenzyme A—that are essential for the production of fat building blocks is the mechanism seen in *C. fimbriata*. Pregnane glycoside, the plant's main ingredient, is thought to be responsible for this anti-obesity property.³⁴

2.4 Antimicrobial

Bacteria cause bacterial diseases, enter the body, reproduce rapidly, and damage body tissue.³⁵



antibacterial drugs that reduce microbial infections but in some cases overuse or misuse of antibacterial causes severe side effects.³⁶ Many medicinal plants have antibacterial potential like *C. quadrangula*³⁷, *C. nilagiriana*³⁸, *C. tuberculata*, etc. Pregnane glycosides are a relatively small contributor to the activity, whereas flavonoids are the primary cause of it.³⁹

2.5 Antifungal

Fungi are heterotrophs and get their carbon and energy from other organisms like animals. Fungi contaminate food and have adverse effects on humans.⁴⁰ Medicinal plants have antifungal properties with fewer side effects, Genus *Caralluma* contains many species with antifungal activity use as traditionally or some species are proven. *C. tuberculata* by suppressing mycelial growth, tuberculata has strong anti-alternaria alternate action in vitro tests. This results in a notable decrease in the number of mycelials (92.8%) as well as their dimensions, which include width (67.6%) & length (23.3%)⁴¹

2.6 Anti-rheumatic

Chronic autoimmune inflammatory illness known as rheumatoid arthritis results in joint degradation and persistent synovial inflammation. Causes lead to higher mortality and morbidity rates.⁴² Many treatments are available with multiple side effects, plants show minimum side effects with good therapeutic effects. Genus *Caralluma* shows anti-inflammatory and analgesic activity. carumbelloside-III and carumbelloside-IV showed significant anti-inflammatory activity. After being separated, Carumbelloside-III (4) was discovered to be the 20R isomer of the 1 (20S isomer) that was originally isolated under the name russelloside B from *C. russelliana*. A

review of Russelloside B (1)'s anti-rheumatic properties was conducted.⁴³

2.7 Antimalarial

Malaria is a serious disease caused by the Plasmodium parasite, due to its serious cause mortality rate is also high. Different type of antimalarial medicine is available in which medicinal plant is in high demand and most prefer medicine by people. *Caralluma* possesses antimalarial activity with active phytoconstituents like flavonoids, pregnane glycosides, etc. Flavonoids have a specific method of action that prevents L-glutamine myoinositol & from entering infected erythrocytes.^{44,45}

2.8 Antihypertension

High blood pressure in the arteries is a chronic medical condition known as hypertension.⁴⁶ Various side effects led to higher mortality rates; Synthetic drugs have side effects; dry cough is an example of an adverse effect of ACE inhibitors. Numerous herbal remedies, such as *Caralluma*, have active phytoconstituent flavonoids that act as secondary metabolites by influencing nitric oxide levels and improving the activity of endothelial cells, making them useful treatments for hypertension.⁴⁷

3. Conclusion

Caralluma, a genus with a long history in traditional medicine, shows remarkable medicinal promise. Its many applications include treating diabetes, and digestive diseases, and exhibiting various pharmacological qualities, which are supported by specific mechanisms within the plant for each disease. The presence of bioactive compounds underscores its significance. This study bridges traditional knowledge with scientific investigation, highlighting *Caralluma*'s potential for future drug development in herbal medicine.

Conflicts Of Interest

The authors reveal no conflicts of interest concerning the work reported in this article.

Species	Geographical distribution	Active therapeutic potential	Compound isolated	Reference No.
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<i>C. fimbriata</i> <i>Wall.</i>	Triable India, China, Pakistan.	Antioxidant, hypolipidemic, appetite suppression, antimalarial, antitrypanosomal, anti-ulcer, antinociceptive, genotoxicity, antiproliferative, and antiobesity.	Pregnane glycoside, beta- sitosterol, palmitic acid.	5,7
<i>C. adscendens.</i>	India, Sri Lanka, North Africa.	Antibacterial, antifungal, antimutagenic, anti- inflammatory.	petroleum ether extract, ether, petroleum, Methanol, aqueous, n-butanol	8
<i>C. penicillata.</i>	Saudi Arabia, Yemen and Oman.	Antitrypanosoma.	Penicillosides, Three C-15 oxy- pregnane glycosides,	9
<i>C. edulis.</i>	South Asian region.	parasitic diseases, alzheimer, hypertension, leprosy, Antidiabetic, rheumatism,	β -sitosterol, (E)- Stilbene, pentadecanoic acid, Campesterol, gallic acid	10
<i>C. attenuates.</i>	Peninsular India and Sri Lanka.	Antidiabetic, antihelminthic, antihyperglycemic, antitubercular and anticancer	Hydrocarbons	11,9
<i>C. tuberculata</i> <i>N</i>	Dir, Swat, Kohat, Punjab, and Pakistan.	Antioxidant, antidiabetic, antimalarial, anticancer, carminative, stomachic, and antipyretic.	vitamin, phenolic content, flavone glycosides, Ethanol, carbohydrate,	12
<i>C. russeliana</i>	East African– Arabian region.	Antidiabetic, antitrypanosomal	flavone glycoside, Acylated pregnane glycosides,	9
<i>C. europaea</i>	Egypt, Spain, Italy, Libya, Tunisia, and Algeria, and Morocco.	Antioxidant, antibacterial, anti- inflammatory, and anticancer.	Monoterpenoids, terpinolene, α -terpinene linalool and flavonoids.	13



<i>C. nilagiriana</i>	South India.	Antimicrobial, antibacterial	Terpenoids, Flavonoids, Steroids, Tannins, and Phenolic compounds	14,15
<i>C. quadrangula</i>	Africa, Asia, South Africa, and Southeast Europe	Wound Healing, antioxidant	β -D-cymaropyranoside	9,16

<i>C. stalagmifera</i>	Temperate regions of Asia mostly India	Antioxidant, anti-inflammatory, antidiabetic, antimicrobial.	Stalagmoside-V, steroidal glycosides	9,17
<i>C. umbellata</i>	South India	Anti-inflammatory, hypocholesterolemic, pesticide, anti-androgenic, anti-arthritis, antimicrobial, anti-coronary, insectifuge, antinociceptive, hypoglycaemic,	Carumbellosides, pregnene-type steroid, bourcergenin, caraumbellogenin.	18,19,20
<i>C. arabica</i>	Arabia and the Middle East.	Antioxidant, lipoxygenase inhibitory anti-gastric, ulcer, and cytoprotective antinociceptive	Flavonoids	15,21

Table No. 1

Malaria	Five pregnane glycosides (caratuberside A-E) Pregnant glycoside-Russelloside;	Prevent myoinositol and L-glutamine from entering infected erythrocytes.	51
Cancer	pregnane glycosides Tannins Steroids	The Russelloside NF- κ B activity in breast cancer is significantly decreased.	29
Appetite suppression	New pregnane glycosides (2-13)	Increased thermogenesis, decreased absorption of fat, suppression of pancreatic lipase activity, and modifications to lipogenesis	5,52



Fungal Infection	Petroleum ether	Anti-Ahavernaria alternate activity by inhibiting the growth of myceli was included by reducing their numbers, length, and width.	53
Gastroprotective	Pregnant glycoside-Russelioside	Increased protection of the stomach mucosa by normalization of endothelial growth factor, heat shock protein70&prostaglandin E2.	43

Table No.2

Diseases	Active Phytoconstituents	Mode of action	Ref. No.
Diabetes Mellitus	Pregnane glycoside Quercetin Rutin Saponin	The reduction in the absorption of glucose into the gut is the primary cause of the hypoglycemic effect. enhances the release of insulin Increase insulin synthesis to restore the amount of glycogen. mitigation of oxidative stress	12,24
Rheumatoid arthritis	Russelioside B	The intensity of bone loss and osteoclastogenesis, together with a decrease in cartilage and bone-degenerating enzymes	19,20
Hyperlipidemia	Flavonoid Quercetin	Display a suppressive impact on pancreatic lipase reduces the generation of reactive oxygen species & has anti-inflammatory properties	48,49



Hypertension	Flavonoids	Capable of controlling nitric oxide levels or endothelial function to modify blood pressure	47,46
Obesity	Pregnane glycoside	helps reduce appetite and burn fat by inhibiting the citrate lyase enzyme, which stops the body from generating fat.	50
	Quercetin	Diminish the activity of an enzyme associated with adipogenesis	

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