Review Article

Ethnomedicinal and pharmacological properties of *Caralluma tuberculata* N. E. Brown – A review

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Citation

Mudrikah, Yamin Bibi, ShaistaTabassum, Kulsoom Zahara, Tasneem Bashir, and Shakeela Haider. Ethnomedicinal and pharmacological properties of *Caralluma tuberculata* N. E. Brown – A review. Pure and Applied Biology. Vol. 4, Issue 4, 2015, pp 503-510. <http://dx.doi.org/10.19045/bspab.2015.44008>

Received: 09/07/2015

Revised: 04/11/2015

Accepted: 13/11/2015

Abstract

Caralluma tuberculata N. E. Brown is herb distributed in dry regions of the world. The succulent stem of the plant is widely used to treat several ailments including diabetes, rheumatism, leprosy, peptic ulcer, inflammation, jaundice, dysentery, constipation, stomach pain, hepatitis B and C. Phytochemical investigation of plant discovered the presence of flavone glycosides, pregnane glycosides and lupeol because of which it possess antioxidant activity. The plant is documented to possess beneficial effects as antihyperglycemic, antibacterial, antifungal, antinociceptive and antiproliferative activities. The effect of this plant may delay the development of diseases and provide a rich source for antioxidants that are known to prevent different diseased states. Objective of current study is to review pharmacological and ethno botanical properties of *Caralluma tuberculata*.

Keywords. *Caralluma tuberculata*; Medicinal properties; Ethnobotany; Antioxidants; Glycosides; Conservation.

Introduction

Geographical distribution

Caralluma tuberculata N. E. Brown is a succulent, perennial herb growing in the wild in Pakistan, India (Andra Pradesh), United Arab Emirates, Saudi Arabia, south east of Egypt, Iran, Nigeria, [1] (Figure1).The plant is widely distributed in Waziristan, Punjab, Khyber Pakhtoonkhuwa, Dir, and Baluchistan (Nimargh, Harboi, Nichara, Gidar), provinces of Pakistan [2].

Taxonomy

Caralluma tuberculata N. E. Brown, locally known as Pamanghi, Aputag, Marmut, Marmootk, Boteri, Chung [3] and Pamanky in Pashto [4] was previously cited by different workers as *Boucerosia tuberculata*, afterward it was acknowledged that actually the species found in Pakistan are species of the genus *Caralluma* only and that the species of *Boucerosia* do not at all exist throughout the country. In the literature, the plant has also been reported as *Boucerosia aucheriana* [5]. The genus *Caralluma* consist of about hundred species found in

dry regions of the world. The genus belongs to sub family Asclepiadoideae and the

family Apocynaceae [6].

Figure 1. Worldwide distribution of *Caralluma tuberculata*

Morphology

C. tuberculata is erect fleshy, leafless, succulent herb [2]. Angular stem is devoid of leaves and has small flowers. Stem is succulent, angular and up to 15 cm tall. Branches are 8 to 13 mm broad. Flowers are in terminal cymes and pedicellate. Sepals

are ovate to lanceolate. Corolla is 8 to 9 mm in diameter, dark purple and deeply divided lobes which are lanceolate and glabrous. Follicles are 8 to 10.5 cm, glabrous and gradually taper towards the tip [3] (Figure 2).

Figure 2. *Caralluma tuberculata*: A, Part of Plant with Flowers; B, Flower; C, Corona and Gynostegium (Top view); D, Corona and Gynostegium (Lateral view); E, Fruiting Twig.

Phytochemistry of *Caralluma tuberculata*

Various chemical compounds have been isolated from *C. tuberculata* i.e. terpenes (lupeol, α and β amyrin, α amyrin acetate, α amyrincinnamate), pregnanes (caratuberside A, B, C, D, E, F and G) (Figure 3), sterols (β -sitosterol and its glucoside, taraxasterol), flavonoid (luteolin glycoside, and glycosides of kaempferol) [7]. *C. tuberculata* contains luteolin-4'-O-neohesperidoside. *C. tuberculata* also contain various bioactive

secondary metabolites such as steroids, terpenoids, reducing sugars, tannins, beta cyanin and amino acid; these chemical constituents are responsible for the therapeutic potential of *C. tuberculata*. And russelioside B, C and caratuberside C present in amounts of 239, 12.8 and 42.8 mg.g⁻¹ of the methanol extract [7]. Important chemicals of *C. tuberculata* have been shown in Table 1.

Figure 3. Bioactivities of *Caralluma tuberculata*.

Table 1. Chemicals isolated from *C. tuberculata* [4].

Name	Properties	Molecular Formula	Structure
Acylatedpregnane	A light-yellowish white, amorphous powder	C ₄₈ H ₇₂ O ₂₀	12- <i>O</i> -benzoyl-20- <i>O</i> -acetyl-3 β ,12 β ,14 β ,20 β -tetrahydroxy-(20 <i>S</i>)-pregnan-3-yl- <i>O</i> - β -D-glucopyranosyl-(1 $\rightarrow$ 4)- β -D-glucopyranosyl-(1 $\rightarrow$ 4)-3-methoxy- β -D-ribosepyranoside.
Androstan glycoside	light greenish-white, amorphous powder	C ₆₈ H ₁₀₆ O ₂₆	7- <i>O</i> -acetyl-12- <i>O</i> -benzoyl-3 β ,7 β ,12 β ,14 β -tetrahydroxy-17 β -(3-methylbutyl- <i>O</i> -acetyl-1-yl)-androstan-3-yl- <i>O</i> - β -D-glucopyranosyl-(1 $\rightarrow$ 4)-6-deoxy- β -D-allopyranosyl-(1 $\rightarrow$ 4)- β -D-cymaropyranosyl-(1 $\rightarrow$ 4)- β -D-cymapyranosyl-(1 $\rightarrow$ 4)- β -D-cymaropyranoside.

Nutritional composition of *Caralluma tuberculata*.

Caralluma tuberculata was evaluated as food plant by nutritional and proximate analysis. The plant contain good amount of nutrients and proximate contents. As succulent plant it has high moisture content. The plant also has carbohydrates, proteins, fiber and fats. Among the nutrients the plant contains calcium, manganese, antimony, molybdenum, potassium, sodium, cadmium, lead, copper, chromium, iron, zinc, copper, magnesium, silicon, silver and strontium [8].

Ethno-medicinal aspects of *Caralluma tuberculata*.

Fresh juice of *C. tuberculata* has some hypoglycemic activities is commonly used in the treatment of diabetes, blood disorders, rheumatism and leprosy [9]. In traditional Saudi folk medicine, *C. tuberculata* is used in the case of diabetes, peptic ulcers, inflammation and its juice as drops for ear inflammation [10]. The plant had been utilized as a traditional anti-diabetic therapeutic agent equally well in both urban and rural population in Pakistan [11]. It is also used as remedy for snake and scorpion bite, as a blood purifier, hypotensive agent

[1]. The plant is also cooked as a vegetable and is used for diabetes and high blood pressure. The whole plant is dried and powdered which is taken with water for jaundice, dysentery, stomach pain, constipation and hepatitis B & C. The fresh plant is masticated for freckles, pimples and for blood purification [12]. Whole plant is crushed and drinks in the form of tea to cure liver disorders, high blood pressure and diabetes [13]. The plant is also cooked as a vegetable and is used for diabetes and high blood pressure [12]. Plant is utilized for Jaundice and diabetes in different tribal societies [14].

Herb is pounded and drinks in the form of tea to cure liver ailments, high blood pressure and diabetes [14]. *Caralluma tuberculata* plant is cooked in a pot with water, dried and makes powder of it which is given for jaundice and gas trouble [12]. Plant is used as vegetable have bitter taste act as antidiabetic [15]. Fresh plant is directly eaten by diabetic patient and is very effective. [4, 12, 14-16]. Ethno botanical uses and mode of application of *C. tuberculata* have been summarized in Table 2.

Table 2. Ethno medicinal uses of *Caralluma tuberculata*.

S. No.	Disorder	Mode of application	Reference
1	Rheumatism, diabetes, antipyretic	Fresh juice	[9]
2	Ear inflammation	Juice as drops	[10]
3	Jaundice, dysentery, stomach pain, constipation and hepatitis B & C	Powder taken with water	[12]
4	Freckles, pimples	Fresh plant is chewed	[12]
5	Diabetes, high blood pressure	Cooked as vegetable	[12]
6	Liver ailments, high blood pressure	Tea	[14]
7	Blood purifier	Tea	[1]
8	Peptic ulcer	Fresh juice	[10]

Pharmacological activities of *Caralluma tuberculata*.

Antioxidant activity

Biological processes in living organisms are done by energy produced by oxidation inside the living organism. However, the *in-vivo* production of oxygen containing free radicals and other reactive oxygen species causes cell death and tissue wound. Oxidative damage caused by free radicals may be connected to aging and diseases, such as atherosclerosis, diabetes, cancer, inflammation, and cirrhosis [17, 18]. Methanols extract and chloroform fraction of *C. tuberculata* demonstrated good antioxidant activity. The maximum antioxidant activity was observed by the methanol fraction. The free radical scavenging effect of chloroform fraction was also significant. The free radical scavenging effect of ethyl acetate and n-hexane fractions was lower than other tested samples [4].

Hypolipidaemic activity

The hypolipidaemic effect of the extract of *C. tuberculata* was evident by the significant decrease in the levels of total cholesterol, triglycerides and low density lipid-cholesterol by 41.5%, 36.7% and 49.1%, respectively, compared to diabetic rat values [19]. Administration of *C. tuberculata* extract for four weeks to diabetic rats improved the lipid profile closely to the normal levels. The cholesterol dropping property of the extract may be credited to the stimulation of insulin secretion, which in turn inhibits lipoprotein lipase activity. *C. tuberculata* also increase the cardio-protective lipid high density lipid-cholesterol level [20].

Anti-hyperglycemic activity

C. tuberculata was reported to possess hypoglycemic activity [19]. Its aqueous fraction is effective in adjusting the raised blood glucose levels in STZ-induced diabetic rats. The effect of total extract is

more prominent than their fraction which is a common phenomenon in herbal remedy due to potential synergism of different constituents in different fractions [21].

Ethanol and aqueous extracts of *C. tuberculata* were diluted with distilled water and showed hypoglycaemic activity at a dose of 70.42 mg kg⁻¹ in allaxon-fed diabetic male Albino rats. The blood glucose level was reduced from 278.61 mg.100ml⁻¹ to 248.37 mg 100ml⁻¹ in ethanolic extract-treated diabetic rats, while in aqueous-treated diabetic rat; blood sugar level was lowered from 317.63mg 100ml⁻¹ to 295.64mg 100ml⁻¹ after 30–60 min of extract administration [3].

Anti-bacterial activity

Stem extracts of *Caralluma tuberculata* are active against all bacterial species except *Staphylococcus epidermidis*. They have the potential to be utilized in antibacterial drug production as they were found effective against some of pathogenic bacteria species. *C. tuberculata* extracts were reported to active against all the gram positive strains such as *Bacillus subtilis*, *Bacillus megaterium*, *Staphylococcus aureus*, *Streptococcus viridens* and gram negative bacteria such as *Escherichia coli*, *Salmonella typhi*, *Shigellasonnei* [3].

Anti-fungal Activity

Assessment of antifungal activity of *C. tuberculata* against *Alternaria alternata*, *Aspergillus niger*, *Fusarium oxysporum*, *Trichoderma harizanum*, *Aspergillus flavus*, *Aspergillus parasitica* and *Penecillium spp.* indicated that extracts are moderately effective against *Fusarium oxysporum* (30%) only. Remaining fungi are resistant to crude plant extracts. Anti-fungal activity to some extant against *Aspergillus niger* and *Aspergillus flavius* is also reported [22].

Anti-proliferative activity.

Anti-proliferative effects of *C. tuberculata* were studied using MTT assay and results confirmed the worth in the treatment of

cancer. A series of eight dilutions of *C. tuberculata* crude extract ($10 - 500 \mu\text{g ml}^{-1}$) were used to determine the concentration-dependent, anti-proliferative effect on three cancer cell lines (MCF-7, MDA-MB-468, Caco-2). The data indicated significant concentration-dependent growth inhibition of the malignant cells after 24 hours with an apparent IC_{50} value of about $100 \mu\text{g/ml}$ with the neutral red uptake (NRU) assay. Similar results were obtained with the MTT assay, where the IC_{50} value was about $200 \mu\text{g ml}^{-1}$ [23]. Bioactivities of *C. tuberculata* (Figure 4).

The ethyl acetate fraction of *C. tuberculata* was found to be the most potent anti-proliferative fraction against breast cancer (Michigan Cancer Foundation-7 (MCF7) human breast oestrogen-dependent adenocarcinoma and MDAMB-468 human breast oestrogen-independent adenocarcinoma and other tumour cell lines (Caco-2 human colon adenocarcinoma). Steroid glycosides isolated from *C. tuberculata* were found to possess moderate, micromolar cytotoxic activity on breast cancer and other cells in vitro [24].

Figure 4. Bioactivities of *Caralluma tuberculata*

Toxicity of *Caralluma tuberculata*.

Phytotoxicity.

Evaluation of phytotoxic activity of *C. tuberculata* stem extracts against *Lemna minor* at concentration of $1000 \mu\text{g ml}^{-1}$ was 75% displayed that this plant possess strong phytotoxic activity and hence could be further exploited for use in natural herbicide formulations. *C. tuberculata* methanol extract showed the inhibition of growth / germination of roots and shoots of rice (*Oryza sativa*) [22]. The plant was evidenced as plant growth inhibitor.

Acute and Chronic Toxicity.

Evaluation of safety profile of *C. tuberculata* by gross behavioural, acute and chronic toxicity study of ethyl acetate fraction of ethanol extract in Swiss albino mice support the safe folklore use of this plant as a drug as it did not affect the biochemical and hematological parameters and also has no effect on the growth of vital body organs [25].

Cytotoxicity.

C. tuberculata methanol extract was reported to possess excellent cytotoxic

activity at 1000 $\mu\text{g ml}^{-1}$ of which is 100% activity; at the 100 $\mu\text{g ml}^{-1}$ concentration the plant extract also shows 100% cytotoxic activity while at 10 $\mu\text{g ml}^{-1}$ it shows 70% cytotoxic activity [17].

Conservation status of *C. tuberculata*.

C. tuberculata is documented as a highly threatened species [26]; it is going towards decline because of over and unscientific collection. These valuable medicinal plants species are at the verge of extinction if are not used sustainably [13]. Suitable conservation strategies must be made to conserve those plants that have immense medicinal value. *Caralluma tuberculata* need to be conserved by educating the people to use them in a sustainable way. If such measurements are not adopted in due time, these valuable plants will be no more part of world.

Conclusions

C. tuberculata is an important source of many pharmacologically and medicinally important chemicals responsible for different biological activities. In the present review an attempt has been made to present *C. tuberculata* as medicinal plant by presenting its botanical, phytochemical, ethno botanical, and pharmacological information which will be supportive for future drug discovery and may be useful to the health professionals, scientists and scholars working in the field of pharmacology and therapeutics.

Authors' contributions

Conception and design of work: Y Bibi & Mudrikah. Accuracy of work is investigated and resolved: K Zahara & T Bashir. Revising critically for important intellectual content: Y Bibi, S Tabassum & S Haider. Wrote the paper: Mudrikah.

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