

Review Article

A comprehensive review of medicinal uses and phytochemicals isolated from *Caralluma tuberculata*

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ABSTRACT

Caralluma tuberculata N.E. Brown is a xerophytic, perennial herb. Asclepiadaceae is the family where it originates. The species *C. tuberculata* has been the subject of investigation by the biologists because either the crude extracts or the purified compounds have a wide variety of biological activities such as anti-cancer, anti-diabetic, antioxidant, anti-microbial and to cure human diseases such as stomach disorders, diabetes, muscular ache, skin problems and as appetizer. The present article made the review on phytochemical and pharmacological activity of *C. tuberculata* and summarized the biological activities of the crude solvent extracts. Finally, it can be concluded that the crude extracts of *C. tuberculata* have both in vitro and in vivo biological activities.

Keywords:

Asclepiadaceae;
phytochemical activity;
pharmacological activity

INTRODUCTION

Medicinal plants have had a long history and have been used in traditional care systems since ancient times, and a vast majority of the population of the world still uses medicinal plants for treatment [1–3]. Around 70–80% of the world's population, according to some estimates, relies on medicinal plants for their basic medical needs [4]. Millions of people utilize medicinal plants not only for their main healthcare but also for money generation and the improvement of their quality of life [5]. The use of native medicinal plants to treat various ailments is gaining popularity. Due to the effectiveness, safety, and affordability of herbal medications, interest in them has been rekindled in European and Arabian nations. [6].

90% of the more than 1300 medicinal plants that are utilized in Europe come from wild sources. In the United States, natural sources account for around 118 of the top 150 prescription medications [7]. Moreover, up to 80% of people in underdeveloped nations rely only on herbal medications for their primary treatment, and over 25% of recommended medicines in developed nations originate from wild plant species [8]. In Canada, the annual sale of medicinal plants was 400 million US dollars in 2001 [9], with a 15% annual increase [10]. Indigenous people gained substantial knowledge of medicinal plants and transferred this knowledge from one generation to the next as part of their tradition [11, 12]. However, recently, there have been concerns that native knowledge and medicinal plants are going to go extinct due to disruptions in traditional ways of life [13, 14]. Therefore, the correct documentation of this traditional knowledge as well as the conservation and sustainable management of medicinal plants is necessary, which can help in safeguarding this heritage [15]. Some plants are used for trade and in making food recipes. There are around 38,660 medicinal plant species in Asia [16–21]. China, Bangladesh,

Nepal, Pakistan, Indonesia, and Myanmar all have medicinal herb cultivation and extraction as part of their cultures [22–28].

The medicinal plant *Caralluma tuberculata* belongs to the Asclepiadaceae family, genus *Caralluma*, and has a perennial succulent branching herb known as Gems of the Hills. In subtropical and tropical Africa, South America, as well as North Asia and Southeast Asia, more than 2000 species of this family can be found [29]. Fever, paralysis, rheumatism, leprosy, diabetes, and joint pains are all treated with *C. tuberculata* in traditional medicine [30]. As a rheumatism, carminative, stomachic, and antipyretic, *C. tuberculata* is also in practice [31]. A review showed *Caralluma* extract has anti-cancer and anti-inflammatory applications [32]. The chemical components contained in the plant, which are pregnane glycosides, may have a role in the *Caralluma* genus possessing anti-cancer and anti-tumor properties [32]. The biological activities of *C. tuberculata* are presented in the Table 1, Table 2 and Fig. 1. The results of the literature study encouraged us to review the biological potentials of *C. tuberculata* in detail.

2. Phytochemicals reported from *C. tuberculata*

A literature survey indicates that *C. tuberculata* contains compounds, namely terpenes, i.e., α amyryl acetate, lupeol, α and β , α amyrylcinnamate, and amyryl. Pregnanes i.e. sterols found mainly glucosides, taraxasterol, and β -sitosterol [33]. Other compounds such as caratubersides C-G, coumarin, flavonoids, phenol, steroids, tannins, saponins, betacyanin, alkaloids, ethanol, vitamins, proteins, and carbohydrates are also found in *C. tuberculata* [29,33-35]. Some previous studies reported compounds such as acylated pregnane glycoside, acylated androstan glycoside, and flavone glycosides.



Table 1. List of different phytochemicals reported from *C. tuberculata*.

Sr. No	Source (Plant part used)	Phytochemicals	References
1	Whole plant	Caratubersides C–G	[34]
2	Grown plant, calli root and aerial parts	Phenol and flavonoids	[29][35]
3	Whole plant	Amyrin, α amyriincinnamate, α amyricin acetate and lupeol, α , β . Caratubersides, taraxasterol, β -sitosterol, glucosides, anthocyanin, saponins, coumarin, betacyclin, tannins and alkaloids.	[33]
4	Whole plant	Ethanol, vitamin, phenolic content, carbohydrate, protein. Acylated pregnane glycoside and acylatedandrostan glycoside	[32]
5	Whole plant	Flavone glycosides	[38]
6	Whole plant	Luteolin-4'-O- β -D-glucopyranosyl,(2 \rightarrow 1)- α -L-rhamnopyranoside, Caratubersides Steroids, terpenoids, reducing sugars, tannins, beta cyanin and amino acid	[39, 40]
7	Aerial parts	3-O- β -D-glucopyranosyl-(1 \rightarrow 4)- β -D-(3-O-methyl-6desoxy)-galactopyranosyl)-14-hydroxy14 β -pregnane-20-one	[41]
8	Whole plant	Caratubersides C & D pregnane glycosides	[42]
9	Whole plant	Pregnane glycosides, Caratubersides A and B 3-O-[B-D-glucopyranosyl-(1-4)-B-D-(3-O-methyl-6-desoxy)-galactopyranosyl-14-hydroxy- 14 B-pregnane-20-one [I] and 3-O-[B-D-glucopyranosyl-(1-4)-B-D- (3-O-methyl-6-desoxygalactopyranosyl1) l- 14,20dihydroxy- 14B-pregnane I21	[43]
10	Not mentioned	Caratubersides A2	[36]
11	Vegetable part	Flavones glycosides, (Aglycone/Glycoside) luteolin.4'-beta-D-glucopyranosyl-(2-->1)-alpha-L-rhamnopyranoside, luteolin-40-O- β -D-glucopyranosyl-(2-1)- α -L-rhamnopyranoside, kaempferol-7-O- β -D-glucopyranosyl-(2-1)- α -L- rhamnopyranoside and kaempferol-3-O- β -D-glucopyranosyl-(6-1)- α -L-rhamnopyranoside	[44]
12	Whole plant	Caratuberside C, Caratuberside D, Caratuberside E Caratuberside F and Caratuberside G	[45-53]
13	Aerial parts	Phenol, flavonoids, tannin and steroids	[54]
14	Not mentioned	Sinapic acid, Gallic acid, Catechin, Caffeic acid Chloregenic acid, Rutin, Quercetin, p-Coumaric acid, Coumarin, Carvacrol , Vanilin , Trans-ferulic acid , Hesperidin, Ellagic acid, Eugenol, Hesperetin and Rosmarinic acid	[37]

Table 2. Medicinal value and its therapeutic uses of *C. tuberculata*.

Sr. No	Part used	Therapeutic Uses	References
1	Not mentioned	Having no acute and chronic toxicity effect.	[59]
2	Whole plant and Aerial parts.	Anti-cancer	[40][67][60][68][69][70][34, 41][32][71]
3	Not mentioned	Anti-fungal	[70]
4	Not mentioned	Anti-bacterial	[70]
5	Aerial parts, whole plant, roots, fruits, stem, fresh leaves	Anti-diabetic	[40][67][88][69][90][94][95][184][96][89][97][98][91][60][87][93][92]
6	Not mentioned	Anti-hypertensive	[103]
7	Root and aerial parts	Anti-lipid peroxidation	[35]
8	Aerial parts	Anti-malarial	[41][34]
9	Whole plant	Anti-nociceptive activity	[39]
10	Root, aerial parts, stem, leaves, fruit and whole plant	Anti-oxidant	[35][29][119][118][87][120][54][40]
11	Aerial parts	Anti-trypanosomal	[34]
12	Aerial parts	Blood purifier	[68]
13	Stem, leaves and whole plant	Carminative	[96][98]
14	Whole plant, stem	Dysentery	[129][130][92, 98]
15	Not mentioned	Entomocidal effect	[133]
16	Whole plant	Fever	[91]
17	Not mentioned	Gastric ulcer	[142]
18	Whole plant and fruit	Hepatitis B & C	[145]
19	Whole plant	High blood pressure	[129][92]
20	Aerial parts	Hypolipidaemic effects	[88]
21	Whole plant	Jaundice	[92, 129]
22	Whole plant	Muscle relaxants	[39]
23	Whole plant	Neuroprotective	[173]
24	Not mentioned	Phytotoxic activity	[40]
25	Stem	Rheumatism	[176][96, 98]
26	Whole plant	Sedative activity	[39]
27	Stem	Stomach ache	[98, 130][92, 142][68, 96]
28	Whole plant	Tonic	[91]
29	Fruit	Typhoid fever	[145]

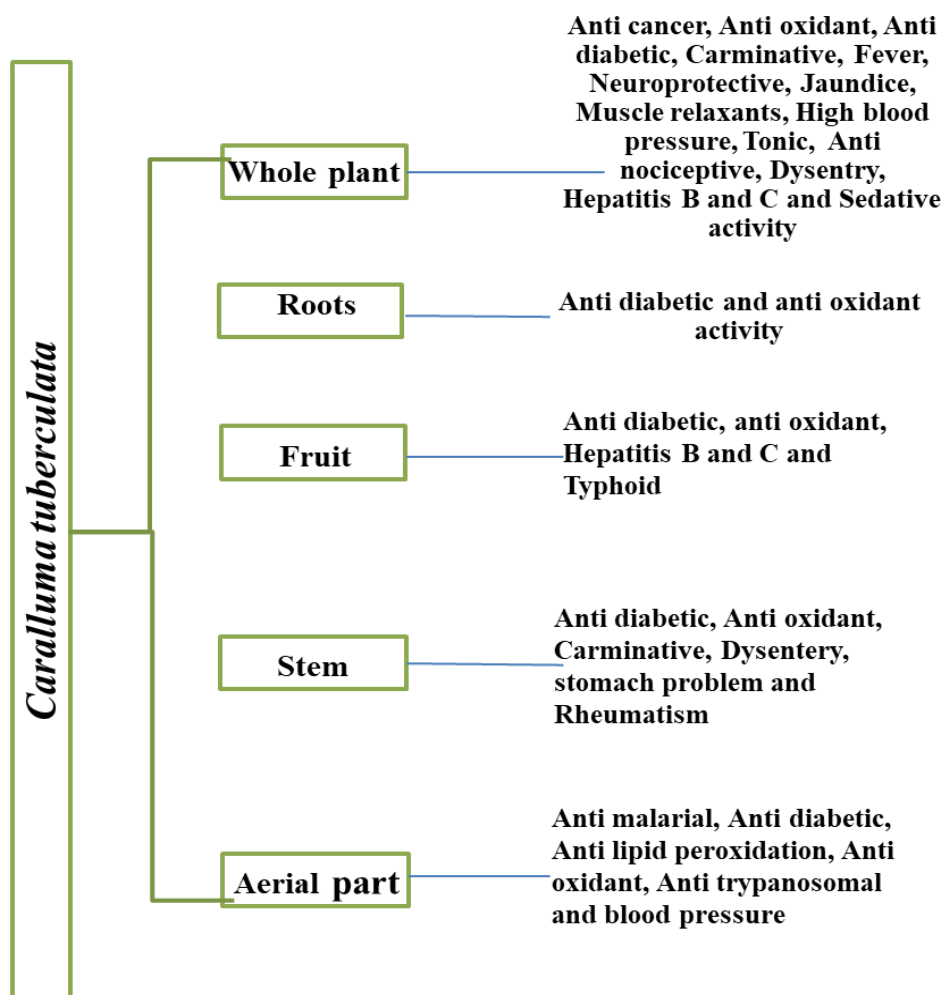


Fig. 1. Flow chart diagram of pharmacological potentials of *C. tuberculata*.

Pregnane glycosides are named Caratubersides A and B, Caratubersides C and D, and Pregnane Caratubersides A2 [36, 32]. Sinapic acid, gallic acid, catechin, caffeic acid, chlorogenic acid, rutin, quercetin, p-coumaric acid, coumarin, carvacrol, vanilin, trans-ferulic acid, hesperedin, elagic acid, eugenol, hesperetin, and rosmarinic acid have also been isolated [37].

Scientific researches and pharmacological potentials

Acute and chronic toxicity activity

Plants have been used for different diseases worldwide from ancient times to date [55]. Plants contain various chemical compounds and are valuable sources of medications [56]. World Health Organization statistics reported that plants are used as medicines for a variety of diseases in developing nations [57]. Plants are safe, effective, and have a low cost; therefore, people are using herbal remedies as important medicines to treat a variety of ailments [58]. *C. tuberculata* acute and chronic toxicity studies revealed the ethyl acetate fraction was safe in mice at doses up to 3 g/kg body weight. In addition, *C. tuberculata* has no effect on body weight, sperm, vital organs, blood biochemistry, or hematology. It was concluded from this research that an ethanolic extract of *C. tuberculata*, including an ethyl acetate fraction, had no harmful effects on test animals [59].

Anti-cancer activity

Cancer is defined as the uncontrollable proliferation of abnormal cells, often known as cancerous or malignant cells [60]. Several mutagenic

causes have been linked to cancer, for example, genetic problems, obesity, exposure to dietary and environmental toxins, radiation, benzene, and other chemicals [60]. Plants have a long history of being used in cancer treatment [61]. Chemical substances originating from plants have been utilized to manage human ailments since the beginning of medicine [62]. Currently utilized chemotherapeutic drugs include flavopiridol for colorectal cancer, paclitaxel for breast cancer, and vinca alkaloids for leukemia, which were initially obtained from plants [63-66]. *C. tuberculata* has anti-cancer properties because of its pregnane glycosides, flavone glycosides, and other phytochemicals [40,67-69]. Pregnane glycoside and androstane glycoside, two newly discovered steroid glycosides that were isolated from the bacterium *C. tuberculata*, have mild, micromolar cytotoxic activity on breast cancer and other cells in vitro. They also demonstrated cytotoxic effects on colon cancer cell lines and estrogen-dependent breast cancer cell lines [32,34,41,70,71].

Anti-fungal activity

Fungi are a type of eukaryotic organism that digests food from the outside and absorbs nutrients through its cell wall [68]. Fungi are heterotrophs and get their carbon and energy from other organisms, just like animals [72]. Fungi contaminate food and have adverse effects on human and animal health [73]. Medicinal plants produce certain chemicals that are anti-fungal, and these chemicals are relatively non-toxic for human health as well as cheap in price [70]. Plant extracts from *C. tuberculata* has a strong anti-*Ahavernaria alternata* activity in in vitro studies by inhibiting the growth of mycelia;

C. tuberculata has also been reported to significantly affect yield. Other characters were included by reducing their numbers (92.8%), length (23.3%), and width (67.6%) [70].

Anti-bacterial activity

Bacteria cause different bacterial diseases and illnesses in humans, animals, and plants as well [74]. Bacteria enter the body, reproduce rapidly, and damage body tissue [74]. Bacteria are mainly of two types, i.e., Gram positive and Gram negative. Both types of bacteria cause different types of infections [75]. Antibiotics are antibacterial drugs that reduce microbial infections and increase life expectancy [76]. Antibiotics have had a large positive impact globally, including a reduction in human morbidity and mortality due to bacterial illness, especially in developing nations with limited public health infrastructure [77]. Antibiotics, on the other hand, have been overused and misused in the general population, leading to a rise in antibiotic resistance among a variety of microbes [76, 77]. Antibiotic resistance has been identified as a serious worldwide health problem these days [77]. As a result, researchers have made efforts to control the threat of antibiotic resistance and are also investigating alternate-source medicinal plants as antibacterial agents [78]. *C. tuberculata* indicated a mild inhibitory concentration (MIC) and also showed some anti-bacterial properties and very little effect on the growth of bacterial species, including *Escherichia coli*, *Xanthomonas*, *Campestris*, and *Citrobactor* [70].

Anti-diabetic activity

Diabetes mellitus, often known as Type 1 or Type 2 diabetes, is the most common metabolic condition brought on by insufficient insulin release or tissue resistance to insulin [79]. Nearly 382 million people worldwide had diabetes in 2013, and it's predicted that 592 million people will have the condition by 2035. The majority of diabetic patients live in developing countries [79]. A lot of medicines are available on the market to overcome blood glucose levels but have reported adverse effects [80, 81]. Plants have fewer side effects, are a good source of treatment for diabetes patients, and are cheap in price. [82, 83] [84] [85, 86]. *C. tuberculata* has anti-diabetic properties because of its pregnane glycosides, flavone glycosides, and other phytochemicals [40,69,60]. The *C. tuberculata* plant (500 mg/kg) reduces the blood glucose level up to 54% in hyperglycemic cases by week 4, while plasma insulin increases by 206.8 percent, which has been confirmed through the methanolic extract plant and was investigated in streptozotocin (STZ)-induced diabetic rats [87, 88]. The *C. tuberculata* whole plant reduces the amount of sugar in the blood [89-94]. In streptozotocin-induced diabetic rats, *C. tuberculata*'s methanolic extract (ME), as well as its chloroform (CF), n-butanol (BF), and the residual water fractions (RFs), demonstrated anti-diabetic efficacy. The ethanolic extract, its n-butanol, and water fractions all shown a significant reduction in G-6-Pase activity in isolated rat hepatic microsomes. Whole plant extract also reduces sugars [95]. *C. tuberculata* stem and aerial parts of methanolic extract are used for diabetes [96-98, 88].

Anti-hypertensive Effect

High blood pressure in the arteries characterizes the chronic medical condition known as hypertension [99]. For circulating blood through blood vessels, a normal functioning heart needs to work harder than usual [99]. Hypertension has a high impact on morbidity and mortality rates. As a result, it is a globally known serious health issue [100]. Synthetic drugs have adverse effects; dry cough is an example of an adverse effect of ACE inhibitors and a major barrier to their use [100]. Plant-derived medicines have been used to treat hypertension [101]. A number of biological activities have been attributed to *C.*

tuberculata in the past. Rats have shown a considerable reduction in blood pressure after consuming *C. tuberculata* shoots [102, 103].

Anti-lipid peroxidation

Lipid peroxidation is the reaction of reactive oxygen species (ROS) and reactive nitrogen species (RNS) in the cell membrane to produce malondialdehyde (MDA) and lipid peroxides. 4-hydroxy-2-nonenal (4-HNE) are two RLS produced by lipid peroxidation that have been associated with a number of disorders that include diabetes, heart disease, cancer, neurodegeneration, and liver disease [104]. Both the hydroalcoholic extracts of the roots and aerial sections of *C. tuberculata* significantly and dose-dependently decreased lipid peroxidation (P 0.05) [35].

Anti-malarial activity

Malaria is a serious disease caused by the Plasmodium parasite, which causes significant mortality worldwide [105]. Official figures show that there are 300–500 million new malaria cases each year recorded, but the total number of cases is still unknown. Current estimates show that the genuine numbers could be significantly higher than government figures suggest [106, 107]. In endemic nations, malaria disease is treated based on traditional herbal remedies [108]. Furthermore, researchers estimate that 80% of the world's population uses herbal treatments. *C. tuberculata* showed *in vitro* anti-malarial activity [34].

Anti-nociceptive activity

The International Association for the Study of Pain (IASP) defined pain for the first time in 1986, classifying it as an acute or chronic, adaptive or non-adaptive reaction of the CNS to an emotional change or tissue injury [109], as well as physiological or harmful [111]. The neurological process of coding and processing unpleasant stimuli is known as nociception [112]. Plant-derived natural products contain a diverse range of bioactive chemical components, making them an alternative to synthetic medicines [113], [114], and [110]. Extracts or fractions of the plant in a dose-dependent manner (50 and 100 mg/kg i.p.) indicated significant (P<0.05) anti-nociceptive activity and also contained potential molecules with anti-nociceptive activity [39].

Anti-oxidant activity

In the human body, free radicals play an important role in physiological activities and intracellular signaling, and endogenous antioxidants scavenge them as their production rises to maintain an intracellular balance [115]. Synthetic medicines are not completely safe, have some negative effects in experimental animals, and cause liver damage as well [116]. On the other hand, plant-derived compounds phenolic and flavonoid suggest important sources to reduce antioxidants, which have no harmful effects and are less expensive than synthetic medications, as well as being more compatible with the human body [117]. Both *C. tuberculata* root hydroalcoholic extract and aerial parts hydroalcoholic extract have powerful scavenging effects on DPPH and iron-reducing power assays [35] [118]. *C. tuberculata* plant extracts and calli have antioxidant potential [29]. 80% methanol, ethanol, and ethyl acetate solvents on the antioxidant potential of *C. tuberculata* stem extracts were investigated and showed antioxidant activities [119]. *C. tuberculata* has antioxidant activity in STZ-induced diabetic rats [87]. The antioxidant activity of phytochemicals in *C. tuberculata* fruit was dramatically boosted after gamma radiation [120]. A rich source of various bioactive compounds, including methanolic extraction and its chloroform fraction, has shown good antioxidant activity, and this experiment was performed through a DPPH radical scavenging assay [40].

Anti-trypanosomal activity

To control trypanosomiasis, it makes sense to look for new chemical entities that are effective against trypanosomes while also being safe and economical for disease-endemic areas. Plants have a variety of secondary compounds that have pharmacological effects, making them potential sources of novel compounds [121]. Exploration of traditionally claimed plants for biological activity resulted in the development of a variety of antiprotozoal drugs [122]. *C. tuberculata* with a petroleum ether-soluble fraction showed anti-trypanosomal and potent activity [34].

3.12 Blood purifier

Blood purification, often known as blood cleaning or detoxification, is an old idea that is popular among complementary and alternative medicine philosophies but lacks a current scientific foundation [123]. There is a strong link between using medicinal herbs as a tonic and purifying the blood [124]. The use of herbal blood purifiers is very common worldwide and in African traditional medicine [124]. *C. tuberculata* and its aerial parts are used for blood purification [68].

3.13 Carminative

Carminatives are food items that, when consumed, cause a sensation of warmth in the intestines and are thought to reduce postprandial bloating symptoms by causing flatulence and eructation [125]. Medicinal plants remain an essential medicinal resource in the treatment of human illnesses. People's interest in traditional medicine has shifted recently, resulting in a growing demand for plant-derived drugs [127]. This renewed interest in herbal remedies is largely owing to the prevalent perception that green medicine is both safer and less expensive than synthetic drugs, many of which can have dangerous side effects [127]. *C. tuberculata* stem used in the form of powder or cooked used for carminative [96] [98].

3.14 Dysentery

Dysentery, often known as bloody flux, is a kind of gastroenteritis characterized by bloody diarrhea. Stomach pain, fever, and a sense of incomplete feces are all possible symptoms. Dehydration is a possible complication [128]. Powder form of whole plant *C. tuberculata* is considered a better source to reduce and cure dysentery [92, 98,129,130].

3.15 Entomocidal effect

Sitophilus zeamais is the pest that damages maize storage the most and poses serious control issues for agriculture in underdeveloped countries [131]. Plant components have been added to a commodity at a rate of 1 to 5% (w/w) to preserve stored grains from insect pest infestations [132]. Aqueous extract of *C. tuberculata* exhibited entomotoxic effects against specific plants, such as maize weevil Coleoptera: *Curculionidae Sitophilus zeamais* (Motschulsky) [133].

3.16 Fever

Fever, also known as pyrexia, is a condition in which a person's temperature rises over the normal range due to an elevation in the body temperature set point, which in humans is between 37.2 and 38.3 °C (99.0 and 100.9 °F) [134-138]. Increased muscular contractions are triggered by an increase in set point, resulting in a feeling of cold or chills [139]. The whole plant of *C. tuberculata* is used for the treatment of fever [91].

3.17 Gastric ulcer

A deep defect in the stomach wall that pierces the mucosa and muscularis mucosae is called a gastric ulcer [140]. When noxious

factors such as *H. pylori* infection, NSAIDs, or stomach acid hypersecretion overpower the mucosal defense, an ulcer form [141]. *C. tuberculata* showed significant results against gastric ulcers and gastric wall mucous in rats by decreasing the protein and nucleic acid concentrations and decreasing the NP-SH concentration in the gastric mucosa. It also depleted the malondialdehyde concentration, and this plant was found to protect gastric mucosal damage caused by ethanol, sodium hydroxide, and sodium chloride [142].

3.18 Hepatitis B and C

Hepatitis is a kind of liver inflammation caused by A, B, C, D, and E viruses [143, 144]. Hepatitis B and C viruses are the two most frequent viruses that cause hepatitis [143, 144]. Except though infection with HBV can also be passed from mother to child and sexual contact during the prenatal stage, the same basic elements are responsible for the spread of both HBV and HCV infections, for example, the usage of syringes and injectable drugs and exposure to infective blood [143, 144]. whole plant and fruit of *C. tuberculata* powder are prepared and used to treat hepatitis B and C [92] and [145].

3.19 High blood pressure

Systolic blood pressure (SBP) of 140 mmHg or diastolic blood pressure (DBP) of 90 mmHg is considered high blood pressure [146]. Stroke, chronic kidney disease, heart disease, dementia, and other cardiovascular diseases all have high blood pressure as a risk factor. [147-159]. People used *C. tuberculata* to cure and treat high blood pressure [129,92].

3.20 Hypolipidaemic effects

Elevated TC and low-density lipoprotein cholesterol (LDL-C) are the most common clinical indicators, but non-optimal levels of high-density lipoprotein cholesterol (HDL-C), TG, and apo lipoprotein B are also common [160-162]. Environmental factors such as a saturated, rich diet and sedentary lifestyle, trans fats, diseases such as hypothyroidism, type 2 diabetes, and chronic renal disease, and drugs such as anabolic steroids, blockers, thiazide, and progesterone are all potential causes of lipid disorders [163, 164]. Modifying one's lifestyle can be the first step toward lowering cholesterol levels [165]. Aerial parts of the methanolic extract of *C. tuberculata* have hypolipidaemic effects, which have been confirmed through oral glucose tolerance tests in diabetic rats [88].

3.21 Jaundice

The French word *jaune*, which signifies yellow, is where the word jaundice originates. The skin, sclera, and mucous membranes turn yellow because of bilirubin, a yellow-orange bile pigment. Bilirubin is made up of heme rings that have been broken down mainly from metabolized red blood cells. Once the serum bilirubin level rises above 3 mg per dL (51.3 mol per L), the discoloration is usually observed clinically [166]. Powder of whole plant *C. tuberculata* used to treat jaundice [92, 129].

3.22 Muscle relaxants

The word muscle relaxer refers to a group of drugs that act as tranquilizers as well as musculoskeletal relaxants and CNS depressants [167]. Muscle relaxants are used to treat fibromyalgia syndrome, low back pain, myofascial pain, tension headaches, and neck pain, which are all prevalent musculoskeletal illnesses [168, 169]. A crude extract of *C. tuberculata* showed significant effects and was used as a muscle relaxant [39].

3.23 Neuroprotective effect

The word neuroprotection refers to techniques and related systems that protect the central nervous system against neuronal damage produced by chronic, e.g., Parkinson's and Alzheimer's illnesses, or acute, e.g., neurodegenerative disorders (stroke) [170]. These chronic disorders are caused by the breakdown and degradation of CNS neurons, and they frequently cause the sufferers cognitive and intellectual faculties to deteriorate [171, 172]. The onset of ND symptoms is usually gradual and progressive and includes short-term memory loss, learning difficulties, motor coordination problems, and a variety of other functional losses [171, 172]. The methanolic extract of *C. tuberculata* indicated a significant relieving effect on memory, learning, and spontaneous activities in mice, which has been confirmed through the passive and active avoidance tests, the Hole-Board test, the novel object recognition task, and the Morris water maze [173].

3.24 Phytotoxic activity

Plants are sessile organisms that are exposed to a variety of biotic and abiotic stressors on a daily basis and are always competing for edaphic resources with other organisms. Because of the pressure to cope with stress and struggle for species survival, some species have evolved defense mechanisms and increased competitive capacity in favor of a single plant or the entire species [174, 175]. *C. tuberculata* plant extract contains phytotoxic activity [40].

3.25 Rheumatism

Palindromic rheumatism (PR) is an inflammatory illness that causes severe pain and swelling in and around the joints. Patients are asymptomatic in between flares, which are typically unpredictable and temporary [176]. The stem of *C. tuberculata* in powder form is used to treat rheumatism [96, 98].

3.26 Sedative activity

Sedatives are drugs that depress the central nervous system in order to increase sleepiness and anxiolysis [177]. Sedatives can often generate a state that resembles natural NREM sleep, with greater delta oscillations, a lower respiratory rate, and a lower body temperature [178]. *C. tuberculata* showed significant sedative activity [39].

3.27 Stomach ache

Abdominal discomfort is one of the most prevalent complaints, with a prevalence of 2.8 percent in general practice and 5–10 percent in emergency rooms [179]. Plant powder of *C. tuberculata* is used to treat stomach aches [98, 130,92, 142,68, 96].

3.28 Herbal Tonic

Herbal tonics are used to effectively heal, tone, and energize the body system [180]. Also promotes general well-being and health [181]. Herbal tonics are liquids or other preparations produced from herbs [181]. People soaked in hot or cold water and then consumed it [180]. The whole *C. tuberculata* plant is used as a tonic [91].

3.29 Typhoid fever

Salmonella typhi, a gram-negative bacterium, causes typhoid fever, an infectious disease with a variety of clinical stages that most frequently manifest as vomiting, stomach pain, fever, loss of appetite, and constipation [182]. Researchers are trying to focus their research on medicinal plants for the treatment of typhoid [183]. The fruit part of *C. tuberculata* is used to treat typhoid [145].

CONCLUSION

Extracts of many plant species have been used for traditional therapeutic applications. Among many species, *Caralluma tuberculata* has been the most neglected one, was selected for the present review article. This species is found in Asia's semi-arid and desert regions, as well as the Mediterranean region of the world. The key phytochemical components of the *C. tuberculata* plant that have been discovered for their known therapeutic values include pregnane glycosides, pregnane aglycone, flavone glycosides, bitter principles, saponins, triterpenes, and various flavonoids. *C. tuberculata* is also known for its hypoglycemic, anti-rheumatic, and weight-loss properties in folklore. *Caralluma* is a neglected genus of vegetables that is rarely farmed and has seen very little effort put into protecting its species despite being utilized as a food during times of hunger. Thus, it can be concluded that, based on the results, the species can be searched for in vitro or in vivo.

CONFLICT OF INTEREST STATEMENT

No conflict of interest to declare.

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