A BRIEF REVIEW ON PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE OF CARISSA SPINARUM L.

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ABSTRACT

Carissa spinarum L. belongs the Apocynaceae family, which officially itself has 94 synonyms and misspelled, misapplied, invalid, and illegitimate names. The plant is known as "Magic Shrub" in some of the African countries, as it is a source of treatment for various diseases and disorders. The plant contains certain major bioactive constituents such as acids, glycosides, terpenoids, alkaloids, tannins, and saponins which are responsible for medicinal value. Traditionally, the plant is used for treatment of malaria, chest complaints, stomach-ache, diarrhea, worms, a cough remedy, eye cataracts, gastric ulcers, polio, cancer, hypertension, kidney complication and for treating herpes, infertility, diabetes, asthma, rheumatism, and infections such as gonorrhea, syphilis, sickle-cell anemia, hernia, rabies, typhoid fever, jaundice, sexual asthma in males, measles, and as a cough expectorant. Apart from this, the plant is evaluated for various pharmacological activities by employing the animal models. The review has been written with the aim to provide a direction for further clinical research to promote safe and effective herbal treatments to cure a number of diseases.

Keywords: Carissa spinarum L., Pharmacological activities, Medicinal properties, Traditional uses, Carissa edulis.

INTRODUCTION

Carissa spinarum L., belongs to the dogbane family Apocynaceae [1], found to be widely distributed throughout tropical regions of Africa, Southern Asia, Australia, and various islands of the Indian Ocean. The shrub is commonly known as wild Karonda in India, referring to the related karanda (Carissa carandas). It is often misidentified as C. carandas due to similar appearance. Species in this family are significant in the food industry as well as in pharmacologically as traditional medicine. It is known as native currant or even blackcurrant in Australia; however, it is not related to Prunus or Currant species. In Africa, it is called as "enkeloring-noemnoem" which means "simple-spine num-num" [2].

Carissa belongs to Apocynaceae family which contains 5 subspecies, 410 genera, and 5556 species. The Apocynaceae family has been known as one of the enormous flowering plant families. Carissa genus was listed more than 500 species, but most of them are relegated as synonyms. C. spinarum L. officially itself has 94 synonyms [3] and 7 misspelled, misapplied, invalid, and illegitimate names [4]. Some of these are shown in (Table 1).

As it is often misidentified as C. carandas, here is the difference between them [5]

C. carandas C. spinarum

1. Lateral veins of leaf 8 pairs
2. Leaves 3.5–8 cm long
3. Leaf apex rounded, emarginated
4. Fruit ellipsoid, 15–25 mm long
5. Ripe fruit reddish-purple
6. Corolla tube 2–2.5 cm long

1. Plant profile [6]
   - Family: Apocynaceae
   - Common names: Currant Bush, Conkerberry, Bush Plum, Burrum

2. Taxonomical hierarchy
   - Kingdom: Plantae
   - Subkingdom: Viridaeplantae
   - Phylum: Tracheophyta
   - Class: Magnoliopsida
   - Subclass: Asteridae
   - Order: Gentianales
   - Family: Apocynaceae
   - Genus: Carissa
   - Species: Spinarum

3. Vernacular names [7]
   - Maharashtra: Karavada, Karanda, Karwant;
   - Andhra Pradesh: Vaka, Kalivi, Kalli;
   - Bengal: Karamacha;
   - Gujarat: Karmarda;
   - Karnataka: Karekayi, Garji, Kavali;
   - Himachal Pradesh: Karondhu, Garna, Kharu;
   - Hindi: Karunda;
   - Sanskrit: Karamarda, Avighna;
   - Tamil Nadu: Kalakkey, Kalachedi.

MORPHOLOGY [9]

1. Plant: Thorny shrub, with forked branches,
2. Height: 2–3 m
3. Wood: Very hard;
4. Bark: Light brown to green,
5. Thorns: 3.2 cm long, at the base brown to greenish and toward the tip deep brown colored,
6. Leaves: Ovate, 4.5 cm long, 2.5 cm broad, leathery; venation, reticulate pinnate; margin, entire; petiole 3 mm long; leaves exuding a white latex when plucked from the stem,
7. Flowers: Short-stalked, sweetly scented, bisexual, complete, and white colored,
8. Fruit: An ovoid berry, 5–12 mm in length, 6 mm in diameter, green when unripe, and Shining black when completely ripe (Fig. 1).
PHYTOCHEMICAL TESTING OF VARIOUS PARTS OF PLANT

Leaves [10]
Phytochemical testing of leaves of *C. spinarum* L. are shown in (Table 3). And Phytochemical parameters of leaves of *C. spinarum* L. are shown in (Table 4).

Roots and root bark
Phytochemical testing of roots and root bark of *C. spinarum* L. are shown in (Table 5).

Fruit [15]
Phytochemical testing of fruit of *C. spinarum* L. are shown in (Table 6).

Stem and stem bark [16]
Phytochemical testing of stem and stem bark of *C. spinarum* L. are shown in (Table 7).

CHEMICAL COMPOSITION [17-21]

Fruit
It consists of acids, sugars, reducing sugars, non-reducing sugars, tannins, pectin and Vitamin C. Carisol (an epimer of A-amyrin), lupeol, oxic acid, tartaric, citric, malic, malonic and glycolic acids, glycine, alanine, phenylalkaline, cerine, glucose, and galactose.

Root
The chemical compositions in root are carisone, carindone, carinol, odoroside H, digitoxigenin, glucose, and D-galactose.

Seed
It consists of palmitic acid, stearic acid, oleic acid, arachidic acid, and linoleic acid.

Leave
It consists of triterpene alcohol and ursolic acid.

Flower
It consists of myrcene, limonene, camphene, camene, dipentene, farnesol, nerolidol, dicydrojasmine, A-terpeneol, citronellal, β-ionone, nerylacetate, linolool, and geranyl acetate.

TRADITIONAL USE

*C. spinarum* L. is one of the main African ethnomedicine; it is one of the most prevalent traditional cures for a myriad of diseases. All the plant parts, roots, barks, leaves, and even the fruits are used to treat many diseases. As a multipurpose medicinal tree, some communities across Africa refer to *C. spinarum* as the "magic herb" [22] because it is used to cure several diseases including headache, chest complaints [23], rheumatism [23-25], gonorrhea, syphilis, rabies, herpes, malaria [26], sickle-cell anemia, hernia, edema, toothache, cough, ulcer, worm infestation [27] and as a diuretic, also for the treatment of typhoid fever, jaundice [28], sexual asthenias in males, measles, and as a cough expectorant [29]. The plant is also useful in the treatment of chickenpox and other skin diseases [30]. The decoction from the pounded root is also administered to treat epilepsy in some communities. In some cases, the patient is made to inhale the vapors coming from the root infusion to treat epilepsy. The traditional birth attendants use the decoction from dried leaves to increase labor and bring about quick child delivery especially during difficult labor.

Like the roots, a decoction from the leaves and bark of *C. spinarum* is used in many societies in Africa in the treatment and management of breast cancer, headache, chest pains, gonorrhea, lowering blood pressure, rheumatism, syphilis, rabies, immune booster, fever, edema, cough, ulcer, malaria [31], and to relieve toothache. Roots and root bark are used as anti-venom and snake repellent [32, 33]. The ripe fruits are eaten as snacks to treat and manage dysentery.

Apart from the plant being used as one of the most valued traditional medicinal plants and fruit trees, it has also found many other applications in a number of communities. For instance, *C. spinarum* can be an ornamental plant due to its abundant branching habit and the presence of thorns that make it suitable as a protective hedge plant, while its fruits are gathered and eaten as food and for the processing of traditional natural dyes.

ETHNOPHARMACOLOGICAL SIGNIFICANCE

*C. spinarum* is known to possess an extensive range of phytochemicals in its leaves, roots, barks, as well as fruits that impart enormous medicinal value to the plant. These active constituents offer medicinal value to the plant. Pharmacological importance of the plant fruits has been evaluated by several researchers through in vitro and in vivo advances. These activities of *C. spinarum* have been reported from the crude extract and their different fractions and isolates from fruit, leaf, and root.

PHARMACOLOGICAL ACTIVITIES

Antihelmintic activity
Antihelmintic activity was evaluated on adult Indian earthworm *Pheretima posthuma* by Harwansh et al. 2010. Earthworm was selected because of its anatomical and physiological resemblance with the intestinal roundworm parasites of human beings. The study was done at three different concentrations, each of crude extract of methanolic, aqueous, and chloroform (25, 50, and 100 mg/ml in distilled water) and Piperazine citrate served as standard drug. This study revealed that the methanolic (100 mg/ml) and chloroform extract (50 and 100 mg/ml) have equivalent potency compared to PC (10 mg/ml) in the time taken for both paralysis and death of *P. posthuma*. The possible mechanism was concluded as increased chloride ion conductance of worm muscle membrane produces hyperpolarization and reduced excitability that leads to muscle relaxation and flaccid paralysis [34].

Antiarthritic activity
Hegde et al. 2010 evaluated antiarthritic activity of ethanolic extract of *C. spinarum* root in Freund’s adjuvant-induced polyarthritis in rats. Arthritis was induced by injecting 0.1 ml of Freund’s adjuvant in sub-plantar region. Treatments were given as 100 mg/kg of phenylbutazone as a standard and 100, 200, and 400 mg/kg doses of ethanolic extract of *C. spinarum* root. The study concluded that the plant extract doses had significant (<0.05) dose-dependent antiarthritic activity [35].

Anticonvulsant activity
Yu’s et al. 2008 demonstrated significant anticonvulsant activity of hydroalcohol extract of root bark of *C. spinarum* in pentylenetetrazole.
(PTZ)-induced convulsion in mice as well as maximal electroschock-induced convulsion in chicks. For anticonvulsant screening 5, 10, and 20 mg/kg of hydroalcoholic extract was given through IP route. Naloxone and diazepam were standard drugs in PTZ-induced convulsion, and phenytoin was standard drug in MEST-induced convulsion [36].

**Antidiabetic activity**

El-Fiky et al. 1995 studied the effects of ethanolic extract of leaves of *C. spinarum* in streptozotocin-induced diabetes in adult male albino rats. 2000 mg/kg extract was given orally after to giving 40 mg/kg streptozotocin by ip route. Blood was collected at 0, 1, 2, and 3 h from each rat and evaluated for blood glucose levels. The extract showed significant antidiabetic activity on comparison with the reference drugs, which were metformin and glibenclamide [37].

**Anti-inflammatory activity**

Beck and Namdeo 2016 evaluated anti-inflammatory activity in petroleum ether, chloroform, alcoholic, and aqueous extracts of leaves of *C. spinarum* at a dose of 200 mg/kg, each given by oral route to albino rats. Formalin was used as an inducer for the inflammation, while analgin (30 mg/kg) acts as a standard drug. The result of the study shows the percentage of inhibition in standard drug (33.87%), aqueous extract (17.04%), alcoholic extract (6.93%), chloroform extract (6.93%), and petroleum ether extract (4.76%). Thus, it was concluded that *C. spinarum* leaves have significant (p<0.01) anti-inflammatory activity at a dose of 200 mg/kg [38].

Carrageenan-induced paw edema in chicks was used by Woode et al. 2007, to evaluate the extract of root powder with 70% ethanol for anti-inflammatory activity. The results of this study suggested that extract inhibits acute edema induced by carrageenan in the chick foot [39].

**Antioxidant activity**

The results of Sahreen et al. 2010 show considerable antioxidant activities of chloroform and aqueous fractions of *C. spinarum* fruits. The activity of these fractions is attributed to the phenolic and flavonoid contents. Consequently, the results suggested that the extracts can be utilized as an effective and safe antioxidant source, although the antioxidant activities of chloroform and aqueous fractions were lower than that of ascorbic acid and rutin. This research was done extraction by n-hexane, ethyl acetate, chloroform, butanol, methanol, and water [40].

**Table 1: List of some synonyms of *C. spinarum* L. [4]**

| Sr. No. | Synonyms |
|--------|----------|
| 1 | *Carissa abyssinica* R.Br. |
| 2 | *Carissa Africana* A.DC. |
| 3 | *Carissa axillaris* Roex. |
| 4 | *Carissa brownie* F. Muell. |
| 5 | *Carissa campenonii* (Drake) Palacky |
| 6 | *Carissa candollea* Jaub. and Spach |
| 7 | *C. carandas var. congesta* (Wight) Bedd. |
| 8 | *C. carandas var. paucinervia* (A.DC.) Bedd. |
| 9 | *Carissa coccinhenensis* Pierre ex Pit. |
| 10 | *Carissa comorensis* (Pichon) Markgr. |
| 11 | *Carissa congesta* Wight |
| 12 | *Carissa coriacea* Wall. |
| 13 | *Carissa cornfolia* Jaub. and Spach |
| 14 | *Carissa dalzellii* Bedd. |
| 15 | *Carissa densiflora* Baker |
| 16 | *Carissa diffusa* Roex. |
| 17 | *Carissa dulcis* Schumach. and Thonn. |
| 18 | *Carissa edulis* (Forssk.) Vahl |
| 19 | *Carissa hirsute* Roth |
| 20 | *Carissa horrida* Pichon |

**Table 2: Uses of different parts of the plant [8]**

| Description | Parts | Use |
|-------------|-------|-----|
| Medicinal uses | Root extract | Purgative, wounds in animals |
| All parts | Glycosidal extract | Cardi tonic |
| Commercial uses | Leaves and fruits | Fresh | Garlands |
| Fruit | Raw | Pickles |
| | Ripe | Syrup, jelly, preserves |
| Leaf | Green leaves | Fodder for goats, fodder for sheep |
| Plant | Dried leaves | Tanning industry |
| | Whole plant | Hedge plant, fragrant flower, cover crop in dry rocky areas |
| Other uses | Fresh flowers | Personal adornment |

**Table 3: Phytochemical testing of leaves of *C. spinarum* L.**

| Sr. No. | Test for | Petroleum ether extract | Chloroform extract | Ethanolic extract | Aqueous extract |
|---------|----------|-------------------------|-------------------|------------------|----------------|
| 1 | Alkaloids | − | − | + | + |
| 2 | Tannins | − | + | − | − |
| 3 | Flavonoids | − | + | − | − |
| 4 | Saponins | + | − | − | − |
| 5 | Glycosides | + | − | − | − |
| 6 | Terpenoids | + | + | − | − |
| 7 | Carbohydrate and sugars | − | + | + | + |
| 8 | Fats and fixed oil | + | − | − | − |
| 9 | Protein and amino acid | − | − | − | − |
| 10 | Steroids | − | + | − | − |
| 11 | Gums and mucilages | − | + | − | − |

*C. spinarum: Carissa spinarum*
Saponins
Methanolic extract
Chloroform soluble extractive value % w/w
5.3
Water-insoluble ash +
Cardiac glycosides −
Loss on drying +
Petroleum ether extract −

The aerial parts of the plant were ground and extracted with various solvents by cold maceration method. These extracts were subjected to testing against S. aureus and E. coli. The result of this study also showed that the activity of the extract was found to be more efficacious in Gram-positive bacteria than Gram-negative [14].

Antileishmanial activity
A study done by Njau et al. 2016 evaluated antileishmanial screening of C. spinarum extracts performed on the promastigote form of Leishmania major showed that their activity against promastigotes is not in relation to their polarity. The less polar petroleum ether, polar total methanol, and successive methanol extracts recorded moderate activity while the water and less polar extracts (dichloromethane and ethyl acetate) recorded weak activity. The activity of these extracts against the amastigote form of L. major was seen to be dose-dependent. Higher concentrations of C. spinarum extracts seemed to reduce the infection rate of macrophages. The polar extracts (water, total methanol, and ethyl acetate) recorded weak activity. The activity of these extracts occurs due to the secondary metabolites present in the plant which are tannins, saponins, and flavonoids. As the extract seems more active in Gram-negative bacteria than Gram-positive might be due to the structural difference between them [42, 43].

Table 4: Phytochemical parameters of leaves of C. spinarum L.

| Sr. No. | Analytical parameter Leaves | % w/w |
|---------|----------------------------|-------|
| 1       | Total ash                  | 14    |
| 2       | Acid-insoluble ash         | 5.3   |
| 3       | Water-insoluble ash        | 6.6   |
| 4       | Sulfated ash               | 10.3  |
| 5       | Alcohol soluble extract    | 4.56  |
| 6       | Water-soluble extractable value | 15.62 |
| 7       | Chloroform soluble extractive value | 4.3  |
| 8       | Loss on drying             | 3.62  |

Table 5: Phytochemical testing of roots and root bark of C. spinarum L.

| Sr. No. | Test for                          | ROOTS [11-13] | Root bark [14] |
|---------|-----------------------------------|---------------|----------------|
|         |                                   | Aqueous extract | n-butanol extract | Petroleum ether extract | Ethanolic extract | Methanolic extract |
| 1       | Tannins                           | +             | +                | +                         | +                | +               |
| 2       | Saponins                          | +             | +                | +                         | −                 | +               |
| 3       | Flavonoids                        | −             | −                | −                         | +                 | +               |
| 4       | Terpenoids                        | +             | −                | +                         | +                 | +               |
| 5       | Cardiac glycosides                | −             | +                | +                         | +                 | +               |

Methanolic extract of the leaf and root bark of C. spinarum for antileishmanial potential. The method utilizes formalin induces pain for evaluation of antinociceptive screening. 30 min after dosing with standard and reference drugs, all the animals were injected intraperitoneally with 0.1 ml of 2.50% formalin in the subplantar region of the left hind paw to induce nociceptive behavior of lifting, licking, and biting. The time that the rats spent lifting, licking, or biting the injected paw was, hence, recorded. The responses were divided into two phases, early phase (0–5 min) and late phase (15–30 min). The dichloromethane: Methanolic leaf and root bark extracts of C. spinarum, produced non-dose dependent analgesic activity. The highest analgesic effect determined by percent licking inhibition of leaf extracts was by 47.19% and 84.93% in the early and late phases, respectively, while by root bark extracts were by 41.89% and 90.62% in the early and late phases, respectively [45].

Antioxidant activity
Hegde and Joshi 2010 evaluated ethanolic extracts of C. spinarum roots for in chloroform (CQ) -induced as well as paracetamol (PCM)-induced hepatotoxicity. The livers were processed after sacrificing animals and tested for antioxidant activity for reduced glutathione (GSH) estimation, superoxide dismutase (SOD), catalase (CAT) activity, and lipid peroxidation of malondialdehyde (MDA). The results were found to as decreased levels of GSH and MDA, as well as a significant rise in hepatic SOD and CAT activities. These changes contribute to its overall antioxidant activity [47].

Antiplasmoidal activity
Kebenei et al. 2011 evaluated antiplasmoidal activity of nortrachelogenin, a compound which is isolated from the root bark of C. spinarum and found that the compound has potential to be the cheap antimalarial drug, and also proves the ethnopharmacological use of the plant [48]. Ayuko et al. 2009 screens the root bark extract and stem bark extract on CQ-sensitive and CQ-resistant strains of Plasmodium falciparum. The result of this study shows that the plant has mild antimalarial activity [49].

Antiviral activity
Tolo et al. 2006 demonstrated the antiviral activity of aqueous extract of root bark of C. spinarum against herpes simplex virus (HSV) for in vitro and in vivo anti-HSV activity, at different parameters such as plaque inhibition assay, cell cytotoxicity assay, virus yield reduction assay, and against Balb/C mice cutaneously infected with HSV. In plaque inhibition assay, the result shows that the resistant strains of the virus were more
susceptible to the extract than the wild-type strains. In yield reduction, assay 200 mg/ml dose of the extract significantly reduced the virus yields of APr HSV-1 by 100%, HSV-2 by 99.5%, HSV-1 by 97.8%, and TK-HSV-1 by 96.3%. In the animal experiments using Balb/C mice cutaneously infected with wild-type strains of HSV-1 or HSV-2 at 1×10^6 PFU/mouse, all the infected untreated mice ultimately died, whereas animals treated orally with the extract provided some protection [50].

Cytotoxicity studies

**In vitro** cytotoxicity studies on C. spinarum extracts by sulforhodamine-B assay method were evaluated by Doshi and Une 2015. C. spinarum extract showed equivalent activity comparable to the standard compound ADR for human breast cancer cell line MCF7, and also showed mild progressive activity on other two selected cell lines, i.e. human colon cancer cell line HT29 and human leukemia cell line MOLT4 [51].

Diuretic activity

Nedl et al. 2004 evaluated the diuretic effect of the root bark and root wood of the plant in albino Wistar rats with 80% methanol. The extract used in this study was root bark maceration extract, root bark Soxhlet extract, root wood maceration extract, and root wood Soxhlet extract.

For the study, all extracts were used at concentration of 50, 125, 250, 500, and 1000 mg/kg, while dichloromethane 10 mg/kg acts as a standard drug. The root bark maceration extract failed to show anti-diuretic activity, but root bark Soxhlet extract showed the significant diuretic activity. Similarly, the root wood maceration extract showed significant activity even at a dose of 50 mg/kg on electrolytes. The Soxhlet extract of root wood extract showed diuretic activity till 500 mg/kg, but then at more than 500 mg/kg test drug failed to produce the diuretic activity. As shown in this study, the extract did not produce a dose-dependent increase in activity, thus giving only moderate diuretic effect [52].

Similar study was conducted by Kebamo et al. 2015. The study was conducted on different solvent fractions of methanol extract of C. spinarum root bark. The study showed that the aqueous fraction of the methanol Soxhlet extract of the root bark of the plant has a significant diuretic activity while the petroleum ether and n-butanol fractions of the extract did not show significant diuresis at the tested doses in rats [11].

Erythropoietic effect

Koffuor et al. 2012 used the ethanolic root extract of C. spinarum against phenylhydrazine-induced anemia in Sprague Dawley rats at doses of 100, 300, and 1000 mg/kg, while 0.23 ml/kg bioferon acts as a reference drug. C. spinarum at doses of 300 and 100 mg/kg was able to reverse very significantly anemia caused by phenylhydrazine after 45 days of treatment without anisocytosis, thus concluding that the extract has erythropoietic activity with normocytosis [53].

**Hepatoprotective activity**

Hegde and Joshi 2010 evaluated ethanolic extracts of C. spinarum roots in chloroform (CCl₃) induced as well as PCM-induced hepatotoxicity. The significant elevation in the levels of serum marker enzymes in control group such as SGOT, SGPT, and SALT content of CCl₃/PCM shows degree of hepatotoxicity. Animals pre-treated with extract (100, 200, and 400 mg/kg) as well as a standard drug (silymarin) demonstrated significant hepatoprotection by decreasing serum marker enzymes in a dose-dependent manner [47].

Similar studies were conducted by Sahreen et al. 2011, but instead of roots, leaves were selected for screening of potential hepatoprotective activity. Phytochemical analysis of methanolic extract confirmed the presence of alkaloids, anthraquinones, cardiac glycosides, coumarins, flavonoids, saponins, phlobatannins, tannins, and terpenoids, which all are closely related to compounds useful in protection of liver in various mechanisms. CCl₃ decreases the activities of hepatic antioxidant enzymes increases the activity of serum marker enzymes, and also significantly increases the hepatic thiobarbituric acid reactive substances (TBARS) and H₂O₂ level whereas significantly decreased the GSH and protein content. The result of animals pre-treated with 200 mg/kg of methanolic extract of Carissa leaves showed reduction in serum marker enzyme activity, increased activity of hepatic antioxidant enzymes and also prevents alteration in TBARS, H₂O₂, GSH, and protein content [54].

**Wound healing**

Sanwal and Chaudhary, 2011, prepared ointment of the methanolic extract of C. spinarum root, which exhibited significant pro-healing activity when topically applied on mice by affecting various stages of healing process, significant amelioration potential by root extract evident by the rate of wound contraction and epithelization, suggesting that the plant has significant wound healing activity [55].

**CONCLUSION**

The evergreen shrub of C. spinarum has enormous medicinal and cultural value. The plant has a variety of use in day to day life, as well as pharmacological activities. These activities are present due to the presence of a variety of phytochemicals present in the plant. All plant parts have medicinal as well as nutritional value and used for the same traditionally throughout the world especially in African countries. Ethnopharmacological studies of the plant strengthen the concept for utilizing C. spinarum plant as a source to facilitate safe and effective herbal treatments for biological problems.

**C. spinarum**, similar to C. carandas has various medicinal properties [56]. All the plant parts have significant therapeutic activities. Carissa species have shown the presence of phytoconstituents such as alkaloids, flavonoids, glycosides, reducing sugar, steroids, terpenoids, tannins, and saponins, which mostly attributed for the pharmacological activity of the plant [57].

This review is prepared with the aim to provide a reference source for biology, phytochemistry, ethnopharmacology, and research done on the C. spinarum for aid in research of future researchers. The traditional and
ethnomedicinal literatures showed that the plant is very effective and safe for medicinal uses. Using the reverse pharmacological approaches in natural drug discovery a potent and safe drug can be investigated from the plant for various chronic diseases.

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AUTHOR’S CONTRIBUTION

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Mr. Diptesh T. Patil collected the data and prepared the manuscript. Mr. Imtiyaz Ansariprooof-read the whole manuscript, and suggested the necessary changes, and helps in designing manuscript.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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