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PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW OF GOTU KOLA (CENTELLA ASIATICA)

Mr. P. Jothiprakash[1]*, Dr. C. Jothimanivannan[2], Mr. A. Mohammedkabeer[1], Mr. M. Suriya[1], Mr. P. Kesavan[1]

[1]Students, SS Institute of Pharmacy, Sankari, Salem-637301.

[2]Professor & Principal, SS Institute of Pharmacy, Sankari, Salem-637301.

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***Corresponding Author**
Mr. P. Jothiprakash
Students, SS Institute of Pharmacy, Sankari, Salem-637301.
Contact Number-9345205565

ABSTRACT

The perennial herbaceous plant Centella asiatica, also referred to as gotu kola, is utilised extensively in traditional medical systems like Ayurveda, Traditional Chinese Medicine, and Jamu. Known for its wide range of pharmacological actions, gotu kola has become well-known around the world as a powerful medicinal substance with anti-inflammatory, anti-anxiety, wound-healing, neuroprotective, and antioxidant properties. Triterpenoids including asiaticoside, madecassoside, asiatic acid, and madecassic acid are the plant's main bioactive components and are primarily in charge of its therapeutic properties. According to scientific research, gotu kola promotes collagen production and angiogenesis, which improves cognitive function, maintains vascular integrity, and speeds up the healing of chronic wounds. Gotu Kola has shown promise as an adjuvant treatment for neurodegenerative diseases like Alzheimer's disease by modulating oxidative stress and neuroinflammation. Furthermore, because of its adaptogenic qualities, it may be used to treat stress-related illnesses and enhance mental clarity. Gotu Kola has a relatively good safety record, albeit in rare instances, excessive dosages or prolonged use may cause hepatic or dermatological side effects. Gotu Kola's phytochemistry, pharmacological properties, and clinical significance are examined in this paper, with an emphasis on its uses in complementary medicine, neurology, and dermatology. Given its extensive ethnomedical background and recent scientific validation, gotu kola is a promising natural remedy that needs to be further studied through carefully planned clinical trials to ensure long-term safety, proper dosage, and efficacy.

KEYWORDS: *Gotu Kola, Centella asiatica, Phytochemical constituents, Pharmacological activities, Antioxidant activity, Traditional herbal medicine.*

INTRODUCTION

Gotu Kola, also known as Asiatic pennywort, Indian pennywort, or Spadeleaf, is a plant from the Umbelliferae (Apiaceae) family. It grows in places like China, Southeast Asia, India, Sri Lanka, Oceania, and Africa, where people have used it for a long time as a vegetable and a traditional medicine. In Southeast Asia, Gotu Kola is used to treat many health problems such as skin diseases, joint pain (rheumatism), inflammation, syphilis, mental disorders, epilepsy, hysteria, dehydration, and diarrhea. In India, it is an important part of traditional medicine, used to improve memory and treat skin and nerve-related problems. People in Java and Indonesia have also used this plant for its healing properties. In China, it has been known for over 2,000 years as one of the ancient "miracle elixirs of life". Gotu Kola is also known as Centella asiatica or Hydrocotyle asiatica. In India, it is used to treat many conditions, including body aches, headaches, insanity, asthma, leprosy, ulcers, eczema, and for wound healing. Today, scientists are showing more interest in Gotu Kola because of its many health benefits. It is also considered an adaptogen, meaning it helps the body manage stress. Research and testing of such medicinal plants are important to discover new useful compounds for future medicines.[1,2]

Fig. 1: Gotu Kola Plant.

Synonyms

i. Asiatic Pennywort,

ii. Centella asiatica

iii. Gotu kola (English)

iv. Indian pennywort

v. Mandukaparni (Brahmi in Ayurveda, but often confused with Bacopa monnieri)

vi. Pegaga (Malay)

Biological source

It is dried or fresh whole plant of herb called Centella asiatica, belonging to the family Umbelliferae (Apiaceae).

Geographical source

In the southeast of the United States, it can be found in South Africa, sections of China in the South pacific islands, Sri Lanka, Southeast Asia, and the eastern half of South America. The plant can be grown, harvested, and economically dried in the sun in tropical climes all year round.

BOTANICAL DESCRIPTION OF GOTU KOLA

CLASSIFICATION	NAME
Kingdom	Plantae
Class	Magnoliopsida
Order	Apiales
Family	Apiaceae
Genus	Centella
Species	Centella asiatica(L.) Urban

Description

Growing near the ground, gotu kola is a petite, slender plant. It spreads by infiltrating the ground. The delicate stem can be either green or reddish-green. Despite its weakness, the stem aids in the plant's growth and movement. The leaves of gotu kola are tiny and green. The leaves have a circular or fan-like form. They feel smooth to the touch, thin, and delicate. The leaves have rounded rather than pointed points.[3] From the centre of the leaves, the lines extend outward like fingers. We refer to these lines as veins. On long stalks, the leaves grow. We refer to these stalks as petioles. Little dots on the stem give rise to the stalks. We refer to these locations as nodes. Gotu Kola prefers moist, shaded areas, such as those next to rivers or ponds. It thrives in warm, humid climates. Numerous Asian and African nations are home

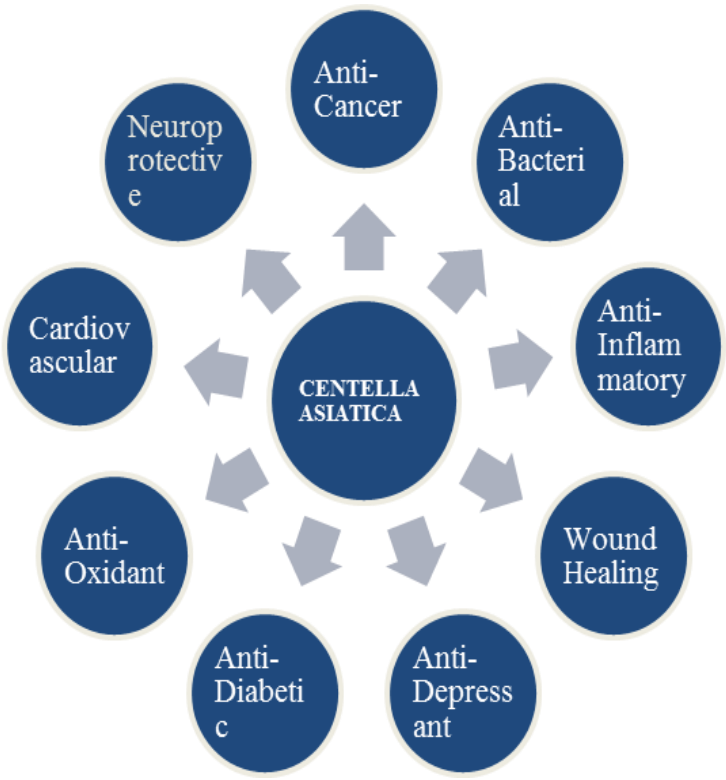
to the plant. Gotu kola is used as a natural remedy. It is well recognised to promote healthy skin, heal wounds, and enhance memory. It is also consumed as a vegetable or turned into juice in some regions.

Chemical composition of Gotu Kola

The fatty acid composition of gotu kola leaves. The fatty acids are palmitic acid (55.70%), linoleic acid 17.50%) and lauric acid (13.73%). The highest saturated fatty acid is palmitic acid (55.70%) and linolenic acid (17.50%) is the highest unsaturated fatty acid. Myristic acid is found in trace amount of 0.50%.[2]

Chemical composition	Concentration
Asiaticoside	0.1-0.6%
Asiatic acid	0.1-0.5%
Madecassic acid	0.1-0.5%
Myristic acid	0.50%
Palmitic acid	55.70%
Stearic acid	8.55%
Lauric acid	13.73%
Linolenic acid	4.03%
Linoleic acid	17.50%

MEDICINAL PROPERTIES



MEDICINAL USES

Anti-cancer activity

The potential anticancer effects of the medicinal herb gotu kola (Centella asiatica) have sparked interest. Numerous bioactive compounds, including triterpenoids such asiatic acid, asiaticoside, madecassoside, and madecassic acid, are responsible for its therapeutic properties. These compounds have demonstrated the ability to halt the growth and spread of cancer cells by inducing apoptosis, a natural mechanism of programmed cell death. Gotu kola also interferes with the cell cycle, which prevents the growth of cancer cells. It also has anti-angiogenic effect by inhibiting the growth of new blood vessels, which tumours need to multiply and spread. The herb's antioxidant properties help reduce oxidative stress and protect cells from DNA damage, while its anti-inflammatory properties can reduce chronic inflammation, which frequently contributes to the development of cancer.[4] Studies have shown effectiveness against a range of cancer cell types, including those of the breast, liver, colon, and brain, in both laboratory and animal experiments. There aren't many human clinical investigations at the moment, despite these positive findings. Thus, more investigation is needed to confirm gotu kola's safety, dosage, and effectiveness in cancer treatment and prevention.

Anti-bacterial activity

Gotu kola, or Centella asiatica, has demonstrated potent antibacterial qualities. One of its primary active ingredients, Asiaticoside, has been shown to be effective against dangerous microbes such as Entamoebahistolytica, Mycobacterium TB, and Bacillus leprae. Clear zones of inhibition have been shown by the methanolic extract of Centella asiatica, suggesting antibacterial action against Streptococcus species, Vibrio vulnificus, and Vibrio alginolyticus. This indicates that these bacteria's growth can be inhibited or stopped by the plant extract. The methanolic extract was also found to be effective against three different Vibrio bacterial species: V. harveyi, V. alginolyticus, and V. parahaemolyticus, according to Sankar et al. However, no antibacterial activity was seen when the plant chemicals were extracted using different solvents, such as acetone, chloroform, and hexane. This implies that the kind of solvent employed has a significant impact on the active chemicals' extraction. The traditional usage of gotu kola to treat bacterial infections is mostly supported by these investigations.[5]

Anti-inflammatory activity

Anti-inflammatory studies are commonly used in cancer research to test the ability of natural and synthetic compounds to reduce inflammation. Natural compounds like betulinic acid, α-amyrin acetate, lupeol acetate, oleanolic acid, and ursolic acid have shown promising results. One important group of natural compounds found in plants is terpenoids. These help plants deal with stress and support their defense systems. Medicinal plants, like Centellaasiatica (Gotu Kola), are rich in such compounds, including ceramides and various terpenoids. In C. asiatica, pentacyclic triterpenoids and saponins—together called centelloids—are believed to be responsible for its healing properties.[6] In laboratory studies, C. asiatica helped protect red blood cells from breaking down, showing up to 94.97% membrane protection at a dose of 2000 µg/ml. At a dose of 2 mg/kg, it also showed moderate anti-inflammatory effects in prostaglandin E2-induced inflammation in a dose-dependent manner. In another test, the plant's aqueous and alcoholic extracts reduced swelling (edema) by 46.31% and 71.18% after 3 hours, compared to 66.66% reduction by ibuprofen. In a study using λ-carrageenan to cause swelling, asiatic acid from C. asiatica helped reduce paw swelling by boosting antioxidant enzymes like catalase, SOD, and glutathione in the liver. In the same type of test, methanolic extract of the plant showed strong anti-inflammatory effects at the 3rd hour with a 200 mg/kg dose, which was almost as effective as the standard drug indomethacin.

Wound healing

Centella asiatica, or gotu kola, is well renowned for its superior wound-healing capabilities. It has active ingredients that are essential for tissue regeneration, including triterpenoids, madecassoside, and asiaticoside. These substances increase the production of collagen, stimulate the creation of new cells, and boost blood flow to the wound site, all of which hasten the healing process.[7] Because of its antimicrobial qualities, gotu kola also aids in lowering inflammation and preventing infections. According to studies, Gotu Kola extracts applied topically or taken orally can greatly speed up wound healing, lessen the formation of scars, and fortify newly formed skin. Owing to these benefits, gotu kola is frequently used to treat cuts, burns, ulcers, and other skin injuries in both traditional medicine and contemporary skin care products.

Anti-depressant activity

Fig. 2: Antidepressant activity mechanism of Gotu Kola.

Current research supports gotu kola's (Centellaasiatica) potential as a natural antidepressant, and it has long been utilised for its relaxing and mood-enhancing properties. Bioactive substances found in the plant, such as madecassoside and asiaticoside, are thought to affect brain function via modifying neurotransmitters like GABA, serotonin, and dopamine. These substances aid in mood regulation, anxiety reduction, and relaxation. Extracts from gotu kola have been found to boost memory, lessen the symptoms of depression, and shield brain cells from oxidative damage.[8] Regular usage of gotu kola has been associated with better sleep, less stress, and general mental well-being in both clinical and animal trials. As such, it is a promising herbal medicine for naturally controlling anxiety and depression.

Anti-diabetic activity

Numerous research have demonstrated the potential anti-diabetic effects of gotu kola (Centella asiatica). Its active ingredients, including flavonoids and triterpenoids, improve insulin secretion and cell uptake of glucose, which helps control blood sugar levels. Additionally, gotu kola has antioxidant properties that shield beta cells in the pancreas from oxidative stress, a key contributing cause to the development of diabetes. Extracts of C.[9] asiatica have been shown to improve lipid profiles and dramatically lower blood glucose levels in animal trials. Additionally, because of its neuroprotective and regenerative properties, it helps avoid diabetic consequences such nerve damage and poor wound healing. According to these results, gotu kola might be a helpful natural supplement for diabetes management and enhancing metabolic health in general.

Anti-oxidant activity

Gotu kola (Centella asiatica) has been shown in numerous studies to have possible anti-diabetic properties. Its active components, including as triterpenoids and flavonoids, enhance insulin secretion and glucose absorption by cells, assisting in blood sugar regulation. Furthermore, gotu kola contains antioxidant qualities that protect the pancreatic beta cells from oxidative stress, which is a major factor in the development of diabetes. In animal experiments, C. asiatica extracts have been demonstrated to significantly reduce blood glucose levels and enhance lipid profiles. Additionally, it helps prevent diabetes complications including nerve damage and poor wound healing due to its neuroprotective and regenerative qualities. These findings suggest that gotu kola may be a useful natural supplement for managing diabetes and improving overall metabolic health. The plant's strong antioxidant activity is attributed to its potent antioxidants, which include polyphenols, flavonoids, β-carotene, tannins, and vitamin C. In a different study, mice treated with methanolic extract for 14 days had higher levels of antioxidant enzymes.[10] With low IC50 values, the methanolic extract demonstrated the strongest antioxidant capability across the various solvent extracts and the highest capacity to scavenge free radicals.

Cardiovascular activity

The phytochemical composition of gotu kola (Centella asiatica), particularly the triterpenoids asiaticoside, madecassoside, and asiatic acid, has promising cardiovascular preventive properties. The plant's capacity to promote vascular health and enhance circulation is facilitated by these chemicals. Gotu Kola's vasoprotective function is one of its main cardiovascular effects. It is helpful in treating varicose veins, venous hypertension, and chronic venous insufficiency because it fortifies blood vessel walls, especially those of veins and capillaries. According to clinical research, gotu kola extracts can enhance venous tone, lessen leg oedema, and lessen symptoms including discomfort and limb heaviness. By increasing capillary permeability and encouraging collagen formation in vascular tissues, gotu kola also enhances microcirculation.[11] This activity helps control arterial insufficiency and hypertension. Atherosclerosis and other cardiovascular diseases are largely caused by oxidative stress and endothelial damage, which are lessened by its antioxidant qualities, which also aid in the neutralisation of free radicals. Though additional clinical evidence is required for confirmation, some research indicates that gotu kola may have a beneficial effect on lipid metabolism, assisting in the reduction of cholesterol and triglyceride levels.

Neuroprotective activity

Gotu Kola (Centella asiatica) is good for the brain and nervous system. It helps with Alzheimer's disease and memory loss that comes with getting older because it improves memory, learning, and focus. Asiaticoside and madecassoside are two active compounds in the herb that help lower oxidative stress and inflammation in the brain. These effects help keep brain cells safe from harm. Gotu Kola also helps with anxiety and depression by balancing the brain chemicals serotonin and dopamine. It helps the brain heal and grow back, which is useful for recovering from strokes and nerve injuries. In short, Gotu Kola protects the brain, makes it work better, and helps it heal after damage.[12]

CONCLUSION

Gotu kola (Centella asiatica) is a versatile medicinal herb that has a long history in traditional medicine and is becoming more and more important in modern therapies. Its wide range of bioactive compounds, particularly triterpenoids like asiaticoside and madecassoside, facilitate a variety of pharmacological activities, such as antioxidant, anti-inflammatory, neuroprotective, wound-healing, anticancer, and cardiovascular effects. Scientific study has confirmed many of its traditional benefits, and it also shows promise in treating chronic conditions like diabetes, cancer, neurological disorders, and vascular diseases. Even if preclinical and in vitro studies show promising results, more clinical research is needed to determine standardised dose, long-term safety, and therapeutic efficacy in human populations. Taking everything into account, gotu kola remains a herbal remedy with a lot of potential for integration into modern healthcare systems.

REFERENCES

1. Samruddhi Pudke and Dr. Monica Borikar; THE ROLE OF GOTU KOLA IN COSMECEUTICAL: A REVIEW; World Journal of Pharmaceutical Research; DOI: 10.20959/wjpr202211-25076; 21 July 2022; 11(11).
2. Arpita Roy and Navneeta Bharadvaja; Centella asiatica: A pharmaceutically Important Medical Plant; Curr trends Biomedical Eng & Biosci., 2017; 5(3): 555661. DOI:10.19080/CTBEB.2017.05.555661; 0047
3. Manjula S. Bandra; The Americans Journal of plant Science and Biotechnology, 5(2): 20-31.
4. Ali, K., Kumar, S., & Khan, M. F. (2025). A concise review on bioactive pentacyclic triterpenoids of Centella asiatica (Gotu Kola). Discover Chemistry, 2, Article 54.

5. Roy, A., & Bharadvaja, N. Centella asiatica: A pharmaceutically important medicinal plant. Current Trends in Biomedical Engineering & Biosciences, 2017; 5(3), Article 555661.
6. James, J. T., & Dubery, I. A. Pentacyclic triterpenoids from the medicinal herb, Centella asiatica (L.) Urban. Molecules, 2009; 14*(*10): 3922–3941.
7. Suguna L, Sivakumar P, Chandrakasan G. Effects of Centella asiatica extract on dermal wound healing in rats. Indian J Exp Biol., 1996; 34(12): 1208-11.
8. Mando, S. S., Manoharan, P., Surya, S., & Kowsalya, R. (2024). Biomarker triterpenoids of Centella asiatica as potential antidepressant agents: combining in vivo and in silico studies. The Multifaceted Therapeutic Profile of Madecassoside series.
9. Barinda, A. J. et al. (2025**)**. Centella asiatica extract improves senescence-associated metabolic dysfunction by targeting inflammation in adipose tissue and macrophage in obesity-induced insulin resistance mice. Frontiers in Endocrinology, 16, Article 1589444.
10. Kandasamy, A., Aruchamy, K., Rangasamy, P., Varadhaiyan, D., Gowri, C., Oh, T. H., Ramasundaram, S., & Athinarayanan, B. Phytochemical analysis and antioxidant activity of Centella asiatica extracts: an experimental and theoretical investigation of flavonoids. Plants, 2023; 12*(*20): 3547.
11. Chang, Y. B., Ahn, Y., Seo, D., Bae, S., Suh, H. J., Hong, Y. H., & Jung, E. Y. Centella asiatica lowers body fat accumulation via regulating cholesterol homeostasis- and lipid metabolism-related genes in mice with high-fat, high-sugar diet-induced obesity. Applied Biological Chemistry, 2023; 66(1): 88.
12. Wahyuni, R., Suriwahyuni, A. H., & Silitonga, M. Centella asiatica: Alzheimer's Neuroprotective. International Journal of Ecophysiology, 2025; 7(1): 38–47.