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A Review on *Centella asiatica (Gotu Kola)* as a Neuroprotective Agent

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Abstract: Particularly in societies, chronic and degenerative diseases have emerged as significant global problems in the fields of healthcare and research. There is a lot of attention on the importance of diet for healthy living, which has led to further research into the functional qualities of common foods that have been supported by science. The herbal plant *Centella asiatica*, popularly known as gotu kola, is prized for its medicinal properties and is frequently used as a green leafy vegetable in many different types of cooking. This study examines the data that is currently available regarding the health advantages of *C. asiatica*, with a focus on its neuroprotective qualities. It also provides information on the phytochemistry and pharmacological characteristics of the plant.

Keywords: *Centella asiatica (Gotu kola)*, neuroprotective agent, Morphology, Argo-botany and pharmacological interactions

Introduction

The improvement in life expectancy of the global population over the past years has resulted in the transformation of demographics, from young societies to hyper-ageing societies, especially in developed countries. It is reported that 12.5% (901 million) of the worldwide population were aged 60 and over in 2015 (World Population Aging report, United Nations, 2015). This change may affect economies and social aspirations as well as health and well-being. The emergence of chronic and degenerative diseases needs a better finding[1]. The perennial herbaceous creeper known as *Centella asiatica* (L.) belongs to the family Apiaceae. Triterpenes, namely substances such as asiatic acid (AA), madecassic acids (MA), asiatico-side (AD), and madecassoside (MD), as well as essential oils, amino acids, and other chemicals, are present in this substance[2]. Furthermore, it has been demonstrated that it has the ability to treat some diseases using traditional methods in China and other Asian nations. Furthermore, its numerous pharmacological effects have been proven by contemporary science, including anti-inflammatory, memory improvement, anticancer, antihepatoma, antioxidation, and antigenotoxic. Furthermore, it has been observed that *Centella asiatica* possesses an antioxidant capacity in vitro[3]. However, there are a limited number of data about the antioxidant and hypolipidemic properties of this plant in vivo.

The increasing prevalence of neurodegenerative disorders has become one of the major public health concerns of the twenty-first century. Diseases such as Alzheimer's disease, Parkinson's disease, Huntington's disease, and other forms of dementia are characterized by progressive neuronal loss, cognitive impairment, and functional decline. Current pharmacological therapies are largely symptomatic and provide only limited improvement in disease progression. Consequently, there is growing interest in identifying natural compounds and medicinal plants that possess neuroprotective

properties capable of preventing or delaying neuronal degeneration through multiple biological mechanisms.

Medicinal plants have been used for centuries in traditional healthcare systems, particularly in Ayurveda, Traditional Chinese Medicine, and other indigenous medical practices across Asia. Among these plants, *Centella asiatica* has attracted considerable scientific attention because of its broad spectrum of pharmacological activities and favorable safety profile. The plant is rich in bioactive constituents, especially pentacyclic triterpenoids such as asiatic acid, madecassic acid, asiaticoside, and madecassoside, which have demonstrated antioxidant, anti-inflammatory, anti-apoptotic, and neuroregenerative effects in various experimental models. These compounds are believed to contribute significantly to the therapeutic potential of *C. asiatica* in neurological disorders.

A major pathological feature common to many neurodegenerative diseases is the presence of oxidative stress and chronic neuroinflammation. Excessive production of reactive oxygen species (ROS) damages neuronal lipids, proteins, and nucleic acids, leading to mitochondrial dysfunction and eventual neuronal death. Simultaneously, activation of microglial cells and inflammatory signaling pathways further accelerates neuronal injury. Natural products capable of modulating oxidative stress and inflammatory responses therefore represent promising candidates for neuroprotective therapy. Evidence from experimental and preclinical studies suggests that *C. asiatica* can influence several of these pathological pathways simultaneously, making it a potential multi-target therapeutic agent.

Materials and Methods

This review was conducted using a qualitative narrative review approach to evaluate the available scientific evidence on the neuroprotective potential of *Centella asiatica* (Gotu kola)[4]. Relevant literature was collected from peer-reviewed journal articles, review papers, pharmacological studies, traditional medicine reports, and publicly available scientific databases. The review focused on studies related to the phytochemical composition, morphology and agro-botany, traditional medicinal uses, pharmacological activities, neuroprotective mechanisms, antioxidant and anti-inflammatory properties, safety profile, toxicity, and pharmacological interactions of *C. asiatica*.

The selected publications were screened for relevance to neurological and neurodegenerative disorders, particularly studies investigating compounds such as asiatic acid, madecassic acid, asiaticoside, and madecassoside. Information obtained from these sources was organized thematically and synthesized to provide a comprehensive understanding of the therapeutic potential of *C. asiatica* as a neuroprotective agent. This methodology enables the integration of evidence from experimental, preclinical, and clinical investigations and helps identify current research trends, limitations, and future directions for the development of *C. asiatica*-based neuroprotective therapies[5][6].

1. Morphology and agro-botany

C. asiatica is a member of the genus Centella, which is a member of the family Apiaceae. This family contains approximately fifty species, the most common of which being *Centella asiatica* (L.) Urban syn. Hydrocotile asiatica Linn. This particular plant is found in countries with warm climates that are located in tropical and subtropical regions. Some of these countries include India, Sri Lanka, Bangladesh, Indonesia, Malaysia, China, Iran, Papua New Guinea, Northern Australia, and certain locations inside of Africa and the United States. It is known by a variety of common names in a variety of languages: Many names for this plant include brahmi, Indian pennywort, and asiatic pennywort. *Centella asiatica* is the herb's botanical name. Pennywort is a plant that is native to wetland areas in Asia and is utilized in the cuisine of Burma, Sri Lanka, Thailand, and Indonesia.

2. Use in traditional medicinal systems

Since the beginning of time, people have been making use of the plant known as C. asiatica, which is highly recognized for its use in both the culinary and medical fields. The well-known health advantages of this ingredient are strongly intertwined with its culinary use in traditional countries.

Folk remedies and traditional medical practices, such as Ayurveda and Unani, both make use of C. asiatica, which is regarded to be an ethnomedicinal plant. It has been utilized as a medicine in a wide variety of ancient societies[7]. As evidenced by the body of literature, only a small number of German authors have made contributions.C. asiatica has been shown to have over seventy different phytochemicals, according to research conducted by scientists. Triterpenes, flavonoids, essential oils, alkaloids, and amino acids are all common components of this substance. According to the research that has been done, the most important phytochemicals found in C. asiatica are listed in Table 2. The chemical contents of C. asiatica are diverse and complex, with the following primary groups being present: terpenes (monoterpenes, sesquiterpenes, diterpenes, triterpenes, and tetraterpenes), phenolic compounds (flavonoids, tannins), alkaloids, carbohydrates, and compounds derived from phenolic compounds[8].

3. Drugs and Medicines

Initial insights into the pharmacologically significant compounds of the plant and the commencement of clinical studies began in the 19th century[9]. The therapeutic application of C. asiatica for the treatment of leprous lesions was first documented in 1887. The initial report of asiaticoside isolation as a therapeutically effective component from C. asiatica was conducted by Bomtemp in 1940, followed by the first systematic clinical studies.

4. *Centella asiatica* as neuroprotective agents

The pathomechanisms of the majority of neurological illnesses are attributed to ambiguous and complex aetiology. Therefore, the modulation of a singular target is inadequate. Consequently, scientists have concentrated their study on the creation of multi-target-directed medicines to combat neurodegenerative illnesses[10]. Despite the development of synthetic multifunctional agents as medication candidates, their potential hazards regarding safety, absorbability, and certain adverse effects remain a concern[11].

5. Safety, toxicity, and pharmacological interactions

The fact that C. asiatica has been used for a very long time in traditional medicine and cuisines all over the world are a guarantee that it is safe to use. Nevertheless, additional safety data will be necessary prior to its application in pharmacotherapy. The 2015 evaluation report by the Cosmetic Ingredient evaluation (CIR) expert panel has validated the safety of various extracts of C. asiatica in current applications, based on existing research, which includes limited evidence from human trials on oral administration and in vitro human cell analyses.

Results and Discussion

Additionally, C. asiatica possesses wholesome anti-oxidative properties that can reduce oxidative stress[12][13], a high anti-inflammatory potent, neuron regenerative ability[14], potential for neuron damage prevention, neurotoxicity inhibition effect, anti-anxiety and anti-depressive properties[15], properties that inhibit AChE, and the ability to reduce the accumulation of amyloid plaques[16]. These properties complement its reputation in traditional medicine as a memory booster. In addition to being able to simultaneously target various disease pathways in order to put a stop to neurodegenerative illnesses, it is also capable of boosting general neuroprotection thanks to its extensive multifunctional qualities. A proper evaluation of the active ingredients, the presence of any synergistic effects, efficient extraction methods, and the stabilization of the active ingredients until they are delivered in the body, not to mention the potential of the active ingredients to reach targeted pathological pathways[17], particularly the ability to cross the blood-brain barrier (BB), should be carried out in order for the substance to be used as a therapeutic agent[18].

The available evidence demonstrates that the neuroprotective activity of *C. asiatica* is not mediated through a single pathway but rather through a combination of complementary mechanisms. Experimental studies indicate that its triterpenoid constituents enhance endogenous antioxidant defense systems by increasing the activity of enzymes such as superoxide dismutase,

catalase, and glutathione peroxidase, while simultaneously reducing lipid peroxidation and the accumulation of reactive oxygen species. This antioxidant activity plays a crucial role in protecting neurons from oxidative damage, which is considered a major contributor to the onset and progression of Alzheimer's disease, Parkinson's disease, and cerebral ischemic injury.

Another important finding emerging from the reviewed literature is the anti-inflammatory potential of *C. asiatica*. Chronic neuroinflammation is strongly associated with activation of microglial cells and the release of pro-inflammatory cytokines, including tumor necrosis factor-alpha (TNF-α), interleukin-1β, and interleukin-6. Bioactive compounds present in *C. asiatica* have been reported to suppress these inflammatory mediators and modulate signaling pathways involved in neuroinflammatory responses. By reducing inflammation and limiting secondary neuronal injury, *C. asiatica* may help preserve neuronal integrity and improve neurological outcomes in both acute and chronic neurodegenerative conditions.

Conclusion

Centella asiatica has emerged as a promising medicinal plant with significant neuroprotective potential owing to its rich phytochemical composition, particularly triterpenoids such as asiatic acid, madecassic acid, asiaticoside, and madecassoside. The reviewed literature indicates that the plant possesses multiple pharmacological activities, including antioxidant, anti-inflammatory, anti-anxiety, antidepressant, neuroregenerative, and memory-enhancing effects, which are relevant to the prevention and management of neurodegenerative disorders such as Alzheimer's disease, Parkinson's disease, and cerebral ischemic injury. The multifunctional mechanisms of *C. asiatica*, including reduction of oxidative stress, inhibition of neuroinflammation, modulation of neurotransmitter systems, protection against neuronal damage, and enhancement of neuronal regeneration, support its potential as a multi-target therapeutic candidate. Furthermore, its long history of use in traditional medicine and the available safety data suggest that *C. asiatica* has a favorable safety profile when used appropriately.

REFERENCES

[1] Alzheimer's Association, "2016 Alzheimer's disease facts and figures," *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, vol. 12, no. 4, pp. 459–509, 2016.

[2] R. Azerad, "Chemical structures, production and enzymatic transformations of sapogenins and saponins from *Centella asiatica* (L.) Urban," *Fitoterapia*, vol. 111, pp. 94–111, 2016.

[3] M. Hussin *et al*., "Article title not provided," *Food Chemistry*, 2007.

[4] N. Kumari *et al*., "Studies on waste valorizations by doing metabolic engineering," *PARIPEX - Indian Journal of Research*, vol. 14, no. 1, pp. 1–2, 2025.

[5] K. Khawas, N. Kumari, and A. Sinha, "Unveiling atomic structure: Historical milestones, quantum theories and future perspectives," *Bharati International Journal of Multidisciplinary Research & Development (BIJMRD)*, vol. 2, no. 11, Dec. 2024.

[6] N. Kumari, K. Khawas, and A. Sinha, "Advancements in solid-state chemistry: A review of structure-property relationships in modern materials," *Bharati International Journal of Multidisciplinary Research & Development (BIJMRD)*, vol. 3, no. 1, Jan. 2025.

[7] A. Al-Nahain *et al*., "*Centella asiatica*: From ethnomedicinal uses to the possibility of new drug discovery," publication details not provided.

[8] H. Li *et al*., "Madecassoside attenuates inflammatory response on collagen-induced arthritis in DBA/1 mice," *Phytomedicine*, vol. 16, no. 6–7, pp. 538–546, 2009.

[9] B. Brinkhaus *et al*., "Chemical, pharmacological and clinical profile of the East Asian medical plant *Centella asiatica*," *Phytomedicine*, vol. 7, no. 5, pp. 427–448, 2000.

[10] E. L. Cooper *et al*., "Alzheimer disease: Clues from traditional and complementary medicine," *Journal of Traditional and Complementary Medicine*, vol. 7, no. 4, pp. 380–385, 2017.

[11] Alzheimer's Association, "FDA-approved drugs to treat Alzheimer's disease," Alzheimer's Association, Chicago, IL, USA. [Online]. Available: https://www.alz.org

[12] Y. K. Gupta *et al*., "Effect of *Centella asiatica* on pentylenetetrazole-induced kindling, cognition and oxidative stress in rats," *Pharmacology Biochemistry and Behavior*, vol. 74, no. 3, pp. 579–585, 2003.

[13] F. Ariffin *et al*., "Antioxidant capacity and phenolic composition of fermented *Centella asiatica* herbal teas," *Journal of the Science of Food and Agriculture*, vol. 91, no. 15, pp. 2731–2739, 2011.

[14] Y. Luo *et al*., "Neuroprotective effects of madecassoside against focal cerebral ischemia reperfusion injury in rats," *Brain Research*, publication details incomplete.

[15] R. Awad *et al*., "Effects of traditionally used anxiolytic botanicals on enzymes of the γ-aminobutyric acid (GABA) system," *Canadian Journal of Physiology and Pharmacology*, vol. 85, no. 9, pp. 933–942, 2007.

[16] N. R. Barbosa *et al*., "*Centella asiatica* water extract inhibits $iPLA_2$ and $cPLA_2$ activities in rat cerebellum," *Phytomedicine*, vol. 15, no. 10, pp. 896–900, 2008.

[17] M. Liu *et al*., "Anti-rheumatoid arthritic effect of madecassoside on type II collagen-induced arthritis in mice," *International Immunopharmacology*, publication details incomplete.

[18] O. T. Kim *et al*., "Cloning and expression of a farnesyl diphosphate synthase in *Centella asiatica* (L.) Urban," *Molecules and Cells*, vol. 19, no. 2, pp. 294–299, 2005.