

Phytonutrient Rich Medicinal Plant “*Centella Asiatica*” As Brain Enhancing Potential-A Reviews

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Abstract: *Centella asiatica* (L.) Urban, previously named as *Hydrocotyle asiatica* L. is a valuable medicinal herbaceous aromatic creeper belonging to Apiaceae family which has been valued for centuries in ayurvedic medicine. Vernacular names of this plant is: Thankuni (Bengali), Mandoikaparni (Hindi), Pegaga (Malay), Kodagam (Malayalam), Gotukola (Sinhalese), Vallarai (Tamil) and Bekaparanamu (Telugu). *Centella asiatica* is a psychoactive phytonutrient rich medicinal plant which contain highly variable triterpenoid, glucoside, phenolic compounds, alkaloids, saponins, including asiaticoside, oxyasiaticoside, centelloside and related saponinins have remarkable pharmacological activities such as antioxidant, antimicrobial, anticancer, wound healing, neuroprotective, immune modulatory, anti-inflammatory, hepatoprotective which stimulates mental functions like memory power concentration and general ability and hence it is primarily known as a "Brain food" in India. This brain boosting herb is known for its effect on both mental and physical vitality. The present review is an up-to-date and comprehensive literature of health importance of phytonutrients and brain enhancing potential of the *Centella* plant.

Keywords: *Centella asiatica*, Medicinal plants, Phytonutrients, Antioxidant, Neuroprotective, Hepatoprotective.

1. Introduction

From the ancient times, medicinal plants have been used all over the world as unique sources of medicines and may constitute the most common human use of biodiversity. (Bannerman 1982; Hamilton 2004; Hiremath and Taranath, 2010). World Health Organisation (WHO, 2008) has defined medicinal plants as plants that contain properties or compounds that can be used for therapeutic purposes or those that synthesize metabolites to produce useful drugs. It has been estimated that eighty percent of the world's population primarily those of developing countries still rely on traditional medicines for their psychological and physical health requirements (Rabe and Van Stoden, 2000). India is extremely rich in medicinal plant diversity distributed in different geographical and environmental conditions and associated tribal and folk knowledge systems (Kshirsagar and Singh, 2000). Approximately seventy percent of the India's population relies on traditional medicine to meet primary health care needs (Lavekar and Sharma 2005). *Centella asiatica* is one of the chief herbs for treating skin problems, to heal wounds, for revitalizing the nerves and brain cells, hence primarily known as a "Brain food" in India (Singh et al., 2010).

2. Phytonutrient and its health benefit

Phytonutrients are the natural bioactive compounds found in plants. They are called as antioxidants, flavonoids, flavanols, flavanones, isoflavones, catechins, epicatechins, anthocyanins, anthocyanidins, proanthocyanidins, isothiocyanates, carotenoids, allyl sulfides, polyphenols and phenolic acids. They are promoted for the prevention and treatment of many health conditions including cancer, heart disease, diabetes and high blood pressure (American Cancer Society, 2013).

Phytochemicals help to stimulate the immune system, block the potential for carcinogens (cancer causing substances), also reduce oxidation, inflammation that provides a setting favorable for cancer growth and also help in regulating hormones such as estrogen and insulin as it increases risk for breast and colon cancer when it is in excess level (www.villanova.edu/healthpromotion). Phytochemicals are the natural bioactive compounds found in plants. These phytochemicals work with nutrients and fibres to form an integrated part of defense system against various diseases and stress conditions (Donovan *et al.*, 2006). The phytochemicals of most importance are carotenoids, β -carotene, lutein and zeaxanthin along with phenolic compounds. Other phytochemicals include chlorophyll, glutathione, α -lipoic acid and betaine (Joseph *et al.*, 2002). The antioxidant activities of plant phytochemicals occur by preventing the production of free radicals or by neutralizing/scavenging free radicals produced in the body or reducing/chelating, the transition metal composition of foods (Melo, 2006; Oboh *et al.*, 2007). Deep coloured vegetables and fruits are known to be good sources of phenolics, including flavonoid, anthocyanin and carotenoids. Phenolic compounds comprise one of the most numerous and widely distributed groups of substances in the plant kingdom, with more than 8000 phenolic structures currently known (Bravo, 1998). Polyphenolic compounds are a large group of phytochemicals and depending on their chemical structure they can be divided into the following classes; flavonoids, phenolic acids, tannins, stilbenes and lignans (Ignat *et al.*, 2011). The health related properties of phenolic compounds, particularly flavonoids, are believed to be based on their antioxidant activity as hydrogen donating free radical scavengers (Evans *et al.*, 1996). Natural polyphenols are capable of removing free radicals, chelating metal catalysts activating antioxidants

enzymes, reducing α -tocopherol radicals and inhibiting oxidases (Amic *et al.*, 2003). Research has shown that their consumption can decrease the risk of chronic diseases, such as heart disease, type 2 diabetes and cancer (Sancho and Pastore, 2012). Natural polyphenols exert their beneficial health effects by their antioxidant activity; these compounds are capable of removing free radicals, chelate metal catalysts, active antioxidant enzymes, reduce α -tocopherol radicals and inhibit oxidases (Amic *et al.*, 2003). Phenolic compounds can protect the human body from free radicals, whose formation is associated with the normal natural metabolism of aerobic cells. The antiradical activity of flavonoids and phenols is principally based on the structural relationship between different parts of their chemical structure (Evans, 1996). Consumption of isoflavones, a phytochemical present in soybean has a multiple beneficial effects in a number of chronic diseases and medical conditions, including certain types of cancer, heart disease, bone functions and also prevention of obesity. Phytochemicals also provide protection against neurodegenerative diseases such as Alzheimer's and Parkinson's. Some of the phytochemicals via capsaicin, curcumin, epigallocatechin gallate and resveratrol (found in grapes, wine, and peanuts) may have neuroprotective effects (Lee *et al.*, 2012). Plant based foods are known to contain significant amounts of bioactive compounds that can provide desirable health benefits beyond basic nutrition and reduce the risk of degenerative diseases (Ames *et al.*, 1993). Consumption of green leafy vegetables which contain dietary polyphenols may inhibit carbohydrate digestion and glucose absorption in the intestine, stimulate insulin secretion from the pancreas, modulate glucose release from the liver, activate insulin receptors and glucose uptake in insulin sensitive tissue and modulate intracellular signaling pathways and gene expression (Carter *et al.*, 2010). Green leafy vegetables are popularly used for food in many countries of the world, being a rich source of β -carotene, ascorbic acid, minerals and dietary fiber (Obboh and Rocha, 2007). Isothiocyanate, phytochemical found in cruciferous vegetables such as broccoli, cabbage and cauliflower helps in preventing the risk of prostate, lung, breast and colon cancers especially sulforaphane in broccoli (Juge *et al.*, 2007). The consumption of whole grains rich in phytochemicals also associated with lower blood pressure, which aids in the prevention of cardiovascular disease. Consuming four or more servings of whole grains daily is associated with twenty three percent lower risk of high blood pressure. Plants typically produce several phytochemicals that act as a protective mechanism against environmental stressors; the more environmental stressors, the more phytochemicals a plant produces and thus phytochemical content vary with growing conditions (Chalker, 1999). Flavonoids have antioxidant activity and could therefore lower cellular oxidative stress, which has been implicated in the pathogenesis of various neurodegenerative diseases, including Alzheimer's disease, Parkinson's disease and amyotrophic lateral sclerosis. Vegetables and fruits were believed to be attributed to the presence of various antioxidants that protect humans against oxidative damages by inhibiting or quenching free radicals and reactive oxygen species. Phytochemicals from medicinal plants play a vital role in maintaining the brain's chemical balance by influencing the function of receptors for the major inhibitory

neurotransmitters. In traditional practice of medicine, several plants have been reported to treat cognitive disorders. Some medicinal herbs focusing on their neuroprotective active phytochemical substances like fatty acids, phenols, alkaloids, flavonoids, saponins, terpenes phytochemicals that may have a neuroprotective effect which may prove beneficial in different neuropsychiatric and neurodegenerative disorders.

Phytonutrient contents of *Centella asiatica*

The phytonutrient constituents of *C. asiatica* were first examined in the 1940s, which then continued throughout the 20th century and become more extensive in the 21st century. The considerable volume of work on the identification of the chemical constituents of *C. asiatica* reflected the widespread interest in this plant possibly because it is an herb commonly used in Ayurvedic medicines for its effect on the mind, blood circulation, wound healing and skin diseases (Brinkhaus *et al.*, 2000, Bevege, 2004). *Centella asiatica* (CA) belonging to family *Apiaceae* (*Umbelliferae*) is a psychoactive phytonutrient rich medicinal plant which contain highly variable triterpenoid, saponins, including asiaticoside, oxyasiaticoside, centelloside, brahmoside, brahminoside, thankunoside, isothankunoside and related saponinins. (Nalini *et al.*, 1992). It also contains triterpenoid acids viz. asiatic acid, madecassic acid, brahmnic acid, isobrahmic acid and betulic acid which possess neuroprotective potential against cerebral ischemia (Dipankar *et al.*, 2009) and decrease the oxidative stress parameters. *Centella asiatica* and its extract contain asiaticoside an active principle of *C. asiatica*, in which a trisaccharide moiety is linked to the aglycone asiatic acid. The other triterpenoid derivative isolated from *C. asiatica* is called madecassol. These triterpene saponins and their saponinins are probably responsible for the wound healing and vascular effects. Centelloside and its derivatives are found to be effective in the treatment of venous hypertension. Flavonoids modulate neuronal function and prevent age-related neurodegeneration (Youdim, 2004). Triterpenoid, brahminoside and monoterpenes, β -pinene and γ -terpinene are active chemical substances in revitalizing and strengthening the nervous function. In addition, the total extract contains plant sterols, flavonoids and other components with no known pharmacological activity. Alkaloid provides the cholinesterase inhibiting treatments routinely prescribed for the cholinergic dysregulation of Alzheimer's Disease (AD) such as galantamine, huperzine, physostigmine and rivastigmine. The main components of *Centella asiatica* are saponins are asiaticoside (ester of the asiatic acid and a trisaccharide) and madecasoside. It also contains abundant tannins (20-25%), beta-caryophyllene, trans-beta-farnesene and germacrene, phytosterols, mucilages, resins, free amino acids, flavonoids, an alkaloid, a bitter principle, fatty acids (Srivastava *et al.*, 1997).

Medicinal properties of *Centella asiatica*

Plants have been demonstrated as an extraordinary source of medicine, and recently focus on medicinal plant research has increased. *Centella asiatica* is well known for its traditional uses and medicinal properties for the treatment of many diseases where it contains bioactive compounds isolated which can be widely used for the treatment of various human ailments (Dipankar *et al.*, 2013). *Centella asiatica* L.

has been used as a medicinal herb for thousands of years in India, China, Sri Lanka, Nepal and Madagascar. *Centella asiatica* is one of the chief herbs for treating skin problems, healing wounds, revitalizing nerves and brain cells, hence it is primarily known as a "Brain food" in India (Sakshi *et al.*, 2010). *Centella asiatica* previously also named Hydrocotyle asiatica and commonly referred to as Indian pennywort or gotu kola. It is an herbaceous plant belonging to the Apiaceae family with great medicinal value. The plant is known as the following vernacular names: Thankuni (Bengali), Mandookaparni (Hindi), Pegaga (Malay), Kodagam (Malayalam), Gotukola (Sinhalese), Vallarai (Tamil) and Bekaparanamu (Telugu) (Kirtikar *et al.*, 1987). *Centella asiatica* has a long history in ancient Ayurvedic remedy, used in wound healing, cleansing for skin problem and digestive disorders and effective in treatment of stomach ulcers, mental fatigue, diarrhoea, epilepsy, hepatitis, syphilis and asthma (Goldstein and Goldstein, 2012). It is widely used for its medicinal properties like sedative, analgesic, antidepressive, antimicrobial, antiviral and immunomodulatory. In classical Indian ayurvedic literature it is considered to be one of „Rasayana“ (rejuvenator) drugs (Jayashree, 2003). The main components of *Centella asiatica* are saponins are asiaticoside (ester of the asiatic acid and a trisaccharide) and madecassoside responsible for the wound healing and vascular effects by inhibiting the production of collagen at the wound site and decreasing venous pressure in venous insufficiency (Kashmira *et al.*, 2010). The brain has a large potential oxidative capacity but a limited ability to counteract oxidative stress. Oxidative stress has been implicated in mechanisms leading to neuronal cell injury in various pathological states of the brain, including neurodegenerative disorders. Although the brain accounts for less than two percent of the body weight, it consumes about twenty percent of the oxygen available through respiration. Therefore, because of its high oxygen demand, the brain is the most susceptible organ to oxidative damage. Medicinal plants have long been used to treat neural symptoms. Medicinal plants contain complicated mixtures of organic chemicals, which may include fatty acids, sterols, alkaloids, flavonoids, glycosides, saponins, tannins, terpenes and so forth and help in the improvement of memory loss associated with abnormalities in the blood circulation by increasing the supply of oxygen and eliminate free radicals thereby improving memory (Pueyo, 2009).

3. Conclusion

Medicinal effects of plants are due to metabolites especially phytonutrient produced by plants. Phytonutrients are bioactive compounds naturally occurring in the different parts of plants, leaves, vegetables and roots that have potential health benefit and act as an antioxidant, anti-inflammatory, anticancer and also enhance the immunity. Chlorophyll, proteins and common sugars are included in primary constituents and secondary compounds have terpenoid, alkaloids and phenolic compounds. *Centella asiatica* commonly known as India Pennywort is a natural brain developing herb and have been known as „brain boosting herbs“. *Centella asiatica* has diverse and complex chemical constituents which included saponin as an active component and other components are terpenes

(monoterpenes, sesquiterpenes, diterpenes, triterpenes, tetraterpenes), phenolic compounds (flavonoids, phenylpropanoids, tannins), polyacetylenes group, alkaloids, carbohydrates, vitamin, mineral and amino acid and flavonoid which possess neuroprotective potential against cerebral ischemia. It also exerts diverse pharmacological activities such as antibacterial, antidiabetic, antiemetic, antineoplastic, antioxidant, antithrombotic, anxiolytic, gastroprotective, immunomodulatory, antigenotoxic, nerve regenerative, reproductive, wound healing etc.

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