



ANCIENT HERB TO MODERN SKINCARE: A REVIEW OF *CENTELLA ASIATICA* IN COSMETICS.

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ABSTRACT

The Apiaceae family of medicinal herbs, including *Centella asiatica* (L.), has long been utilized in Chinese and Ayurvedic medicine to treat a wide range of illnesses. Its medicinal applications and metabolic characteristics are examined in this review. In addition to amino acids such as aspartic acid, glycine, glutamic acid, alanine, and phenylalanine, the plant also includes sugars, tannins, inorganic acids, and resins. A thorough examination demonstrates that the leaves have more moisture and ash than the roots, and that the compound hydrocotylin (C₂₂H₃₃NO₈) was isolated from the dried plant material, suggesting a significant amount of sand and earthy components. Flavonoids such as 3-glucosylquercetin and 7-glucosylkaempferol make up the majority of the phenolic chemicals found in *C. asiatica*. According to recent studies, the plant has several contemporary uses. One such use is the creation of hydrogel-based anti-acne patches, which effectively combat *Propionibacterium acnes*, a key acne-causing bacteria. Additionally, a pegagan ethanol extract sunscreen spray gel has been evaluated for its UV protection across 290 to 320 nm, demonstrating the herb's utility in dermatological products. This review underscores *Centella asiatica*'s extensive cosmetic value and its emerging role in contemporary skincare solutions.

Keywords: medicinal plants, cosmetics, *Centella asiatica*

INTRODUCTION

Centella Asiatica (L.) is a valuable medicinal herb that is part of the Apiaceae family. This herb has long been utilized in Chinese and Ayurvedic medicine to treat a wide range of illnesses [1]. By accelerating fibroblast proliferation and collagen production, *Centella asiatica* (CA), commonly referred to as gotu kola or tiger grass, is growing more and more well-liked as a cutting-edge cosmeceutical component that demonstrates efficacy in tissue regeneration, cell migration, and healing. The three main components of the CA extract are madecassic acid (MA), asiaticoside (AS), and asiatic acid (AA). Several phytochemical compounds are also present, including flavonoids, sesquiterpenes, plant sterols, pentacyclic triterpenoids, and derivatives of eugenol [2]. A variety of herbal plants, including Gotu kola, are found growing in tropical and subtropical regions across the world, including South Africa, Madagascar, China, India, and Sri Lanka. They thrive in high moisture, humus-rich soil, and both sandy and clayey soils [3]. The plant is called by a variety of colloquial names in different parts of India and tongues, such as Thankuni (Bengali), Barmi (Gujarati), Mandookaparni (Hindi),

Supriya Mutthil (Sanskrit), Brahmi (Urdu), Babassa, Saraswataku (Telegu), Bat syiar/Khlieng syiar (Khasi Meghalaya), Peruk (Manipuri), Lambak (Mizoram), and Manimun (Assam) [4].

Table 1. Taxonomy of *Centella Asiatica* [12]

Kingdom	Plantae
Subkingdom	<i>Tracheobionta</i>
Division	<i>Magnoliophyta</i>
Class	<i>Magnoliopsida</i>
Subclass	<i>Rosidae</i>
Order	<i>Apiales</i>
Family	<i>Apiaceae</i>
Genus	<i>Centella</i> L.
Species	<i>Centella asiatica</i> (L.)

Microscopy

A microscope is essential for the quantitative assessment of medications and contaminated powders in microscopic evaluation. A particular histological property, such as the stomatal index, vein islets, palisade ratio, or the size, shape, and relative positions of various cells and tissues, are counted to achieve this. The anatomical examinations of fresh plant components were examined under a microscope. For anatomical research, fresh hand sections (transverse sections) were employed. Safranin and phloroglucinol HCl were utilized as staining agents for plant tissues to facilitate histochemical identification. Under a foldscope, the structural identity and properties of plant samples were examined.

Microscopic analysis of the leaves

Lamina consisted of vascular tissues, mesophyll, and epidermis and was differentiated dorso-ventrally. On the lower epidermis, an anisocytic form of stomata was found [5]. Its leaf blade has blunt edges and is shaped like a kidney.

Microscopic analysis of the petiole

It revealed the presence of a collenchyma zone, or layer of three to four layers of cells, beneath the epidermis. Vascular threads were isolated from one another by large ground tissue. A calcium oxalate crystal was discovered lodged in the space between the cortical parenchyma's intervening walls.

Microscopic evaluation of stolon

The stolon's T.S. had an unevenly circular form and was composed of the inner stele, middle cortex, and outer epidermis. The layers of collenchyma cells were arranged after the unlayered epidermis. With periplomatid sclerenchyma arching over the vascular tissues, the vascular tissues form a continuous cylinder.

Microscopic evaluation of root:

Under a microscope, the young root's T.S. showed a circular outline with tissue organization arranged as an outside piliferous layer, middle cortex, and inner stele in order of precedence. Presence of a prominent cortex made up the majority of the root. The outer and inner cortices appeared to be two separate zones within the cortex. Higher fraction of schizogenous outer cortical cells created air chambers (aerenchyma).

Microscopy of powder

According to the World Health Organization (WHO), the most popular and practical method for verifying the authenticity of powdered herbal medication samples is powder microscopy examination. Cellular characteristics such as stomata, trichomes, lignified vessels, starch grains, calcium oxalate

crystals, etc. can be used to identify the source and quality of the botanical material. The dried, coarse powder made from stems, leaves, and roots of *Centella Asiatica* [6].

Cosmetically Active Part

Table 1.2 Cosmetically active parts and its uses [7,8]

PAR T	USES
Leaf	Antioxidants and skin protectant [7].
Root	Skin-conditioning [7].
Bark	Moisturizers, gel [8].

GEOGRAPHICAL DISPERSION

Many tropical and subtropical regions, including Bangladesh, Iran, Indonesia, South America, Madagascar, and South and Central Africa, as well as Asian nations, India, Malaysia, China, and Sri Lanka, are habitat to gotu kola plants. The gotu kola plant is known by a variety of common names in other languages, depending on where it is native. These include pennywort (English), gotu kola (America), byeong Pul (Korea), asiatisches Wassernabelkraut (German), Trachiek kramh (Khmer), silabola (Malagasy), tabao en Amhara (Africa), mandookaparni (India), violette marron (French), ji xue cao (Chinese), ohtosammakonputki (Finland), ab- boshghabi (Iran), gotu kola (Sri Lanka), Pegaga (Malaysia), and pegagan (Indonesia) [9].

CULTIVATION

For widespread dissemination, cultivation techniques need to be enhanced. These days, plant bioreactors are crucial biotechnological engineering tools for expanding the production of priceless medicinal plants. By growing plant material in a liquid media with repeated immersions, the temporary immersion system (TIS) is a plant tissue culture technique that makes automated propagation under sterile circumstances possible. Growth is aided by the bioreactor vessel's aeration. The area under cultivation A modest poly house measuring less than 5,000 square feet was used for cultivation, with just the temperature and humidity controlled. Climate and soil A soil analysis revealed 36 ppm of calcium, 14.1 ppm of magnesium, 3.4 ppm of sulfur, and 7.6 ppm of iron. pH - 8.3, Zink 0.9 ppm, Mangal 1.2 ppm, Copper 2.4 ppm the following values are reported: salt: 0.375 desisaiman/m; organic carbon: 0.74%; nitrogen: 519 kg/h; phosphorus: 0.95 kg/h; potassium: 220 kg/h; and rapid: 6.0% Preparing the ground: The ground was brought to a single tilth after receiving a thorough 4-6 plowing tillage. The dirt was leveled and pounded with a plank before being divided into ten tiny beds, each measuring 44 square feet. Cultivation Plant cuttings with at least a few leaves, nodes, and roots were used for propagation. The mother plants were chopped into little pieces and their roots were taken. Drip irrigation system weeding was done with the first irrigation immediately following transplantation and the second irrigation at intervals of three to four days [10].

Manure

The first dosage consisted of 300 kg of cow dung and 100 kg of neem cake. Throughout the year, the same amount of manure was applied every four to six months [11].

COLLECTION/HARVESTING

After the first, second, and third months of cultivation, the harvest was completed. The leaves that were taken after the third month of harvesting had higher ash values out of all the physicochemical parameters that were assessed. This suggests that the leaves had greater contents of sand or earthy materials coupled with higher moisture content. The samples taken from the initial harvesting had larger concentrations of phytoconstituents, according to the findings of the phytochemical examinations [5]. The harvested portions were put in a plastic bag with the appropriate label. To ascertain their fresh weights, the harvested herbage, including the vines and leaves, was weighed (in grams) using a weighing scale per procedure. Before packaging, the collected herbage was allowed to air dry for an entire night.[3]

CHEMICAL CONSTITUENTS

Centella asiatica's biochemical constitution has been extensively investigated and examined. Triterpenoids, volatile oil, fatty acids, alkaloids, glycosides, flavonoids, and various amino acids, among other substances. Additionally, it has volatile fatty acids, which include lignoceric, oleic, stearic, palmitic, and linoleic acids [7]. Triterpenoids include thankunside, madecossoside, centelloside, isothankunic acid, and centellose, asiatic, centellic, and madecassic acids. Less madecossoside and asiaticoside was found in the roots compared to the leaves. An alkaloid known as hydrocotylin (C₂₂H₃₃NO₈) has been isolated from the dried plants. Asiaticoside, Madecossoside, and Centelloside have been isolated from the plant components. All of these glycosides, with the exception of centellic acid, are found in the plant in their free forms. These glycosides hydrolyze to provide the triterpene acids centellic acid, madegascaric acid, and asiatic acid. Flavanoids such as 3-glucosylquercetin, 3-glucosylkaemferol, and 7-glucosylkaemferol have been isolated from the leaves. The plant is said to include tannins, sugars, inorganic acids, resin, and amino acids such aspartic acid, glycine, glutamic acid, -alanine, and phenylalanine [7,12] Pentacyclic triterpenoid saponins, sometimes referred to as centaloids, are regarded as a single class of secondary metabolites and are principally in charge of the biological effects linked to *C. asiatica's* pharmacological properties [13].

Figure 1.1 Asiatic Acid [12]

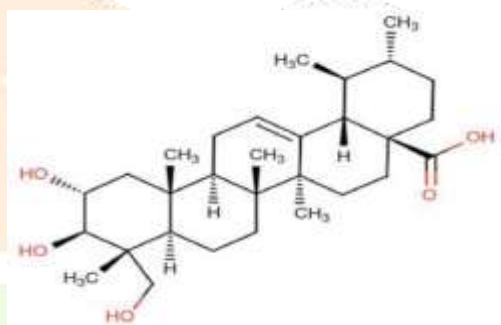


Figure 1.2 Madecassic [12]

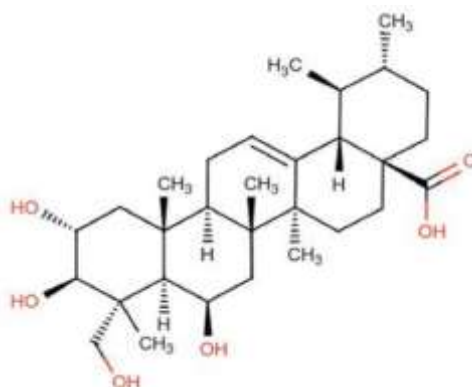
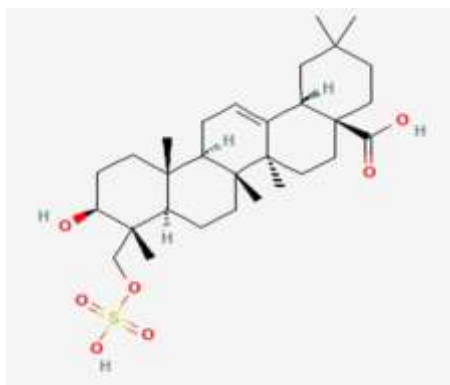


Figure 1.3 Triterpene [12]



COSMETIC USES

Anti-aging

By upregulating cellular antioxidant machinery, *Centella* extracts pretreat dermal fibroblasts to prevent Peroxide induced cytotoxicity. *Centella* extract supplementation increased the expression of superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPX) while APE pretreatment increased the expression of SOD2 after H₂O₂ treatment. Moreover, pre-treatment processes with CE as well as APE suppressed H₂O₂-mediated-upregulation of MMP-9 [7,20,21].

Collagen enhancer

After four weeks of use, the hydrogel eye mask comprising *Centella Asiatica* and Aloe vera extract significantly improved the skin's suppleness, moisture content, and collagen fiber ($p < 0.05$). In human skin fibroblast cells, Asiaticoside in *Centella Asiatica* extract stimulates the formation of collagen type I [8].

Preparation of hair care products

This plant's flavonoids are utilized in hair care products to promote a healthy scalp condition, boost the scalp's peripheral circulation, and stop hair loss [14].

Anti-acne patches

Propionibacterium acnes, anaerobic bacteria, is frequently the cause of acne, a chronic inflammatory skin disease (P. acnes). Hydrocolloid or hydrogel-based anti-acne patches have gained popularity as a topical remedy. It has been shown that CA extract enhances wound healing and lessens the production of scars. Additionally, the patches' in vitro cytotoxicity, antimicrobial activity, weight loss rate, and hydration retention rate were all examined. The new anti-acne patches were created in this study. They were made at various temperatures using a gelatin/chitosan (GC) mixture and loaded with extracts from PA and CA. Investigations were conducted into the patches' antibacterial efficacy against P. acnes [15]

As moisturizer

The greatest effectiveness in enhancing skin moisture was demonstrated by *Centella asiatica* extract, which also increased skin surface hydration and decreased trans epidermal water loss [16].

Stretch marks remover

Stretch marks can occur whenever the body experiences significant expansion and are not limited to pregnant women because the fibroblasts are unable to arrange the collagen fibers to keep up with the skin's stretching, stretch marks have an impact on the dermis. Compared to stretch marks, normal skin had a notable 11% increase in elastic fibers. Compared to the stretch-marked skin that was left untreated, elastin dramatically increased by 37% following treatment with CAST 0.5% [17].

As sunscreen

Sunlight interferes with the health of human skin, leading to skin damage. Sunscreen can prevent this interference by protecting the skin.

The goal of the study was to create an SPF-rated spray gel formulation of pegagan (*Centella asiatica* (L.) Urban) ethanol extract for UV radiation protection. Using 70% ethanol as a solvent, the maceration process was used to extract the pegagan. The pegagan ethanol extract sunscreen spray gel's activity was tested at intervals of 5 nm between 290 and 320 nm. Formula 3 (6%) had the best SPF value, with an SPF of 18,32, including the ultra category [18].

ADVERSE EFFECTS

A female applicant, eighteen, had applied. Apply ointment madecassol to a burn scar. Four days later, erythematous rashes and itching were noticed at the location. Madecassol, 10% TECA, and propylene glycol (5%, 10%, 20%, 30%, 40%, and 50%) all caused her to react favorably. [12]

MARKETING FORMULATION

Table 1.3 Marketed Formulations with its ingredients and uses [19]

Manufacturer	Product(s)	Ingredients	Used as/against
Biotique e advanced ayurveda	Smooth skin Lotion	Mandukaparni Panchang (<i>C. asiatica</i>) extract, Surajmukhi Tail (Sunflower oil), Sarso Tail (mustard oil), Ashwagandha (<i>Withania somnifera</i>) root extract, multi leaves extract, Mahua (<i>Madhuca longifolia</i>) seed extract, Lotion base Q.S	Skin care for parched and dry skin.
	Henna fresh powder hair color	Mehndi (<i>Lawsonia alba</i>), Brahmi (<i>C. asiatica</i>), Mulethi (<i>Glycyrrhiza glabra</i>), Aam beej (<i>Magnifera indica</i>), Harar (<i>Terminalia chebula</i>), Arjuna (<i>Terminalia arjuna</i>), Ritha (<i>Sapindus mukorossi</i>), Himalayan water Q.S	lessens hair loss and nourishes hair follicles.

Yeppen skin	Cicaless solution cream (soothing cream)	C. asiatica extract, pure ingredients from Jeju- Island, stearic acid, myristic acid, panthenol, shea butter, vitamin	Skin flaws, sensitivity, and difficulties.
	Skin Moisture Cream	C. asiatica extract, Bird's nest extract, Bambusa vulgaris sap extract, cucumber extract, hyaluronic acid, peptide	improved wrinkles, skin which is supple, elastic, and moisturized.



COSMAX	Skin tiger cica gelcream	C. asiatica extract (68%), dipropylene glycol, glycerin, butylene glycol, cyclopentasiloxane, alcohol denat., water, polyacrylamide,1,2-hexanediol, pentylene glycol, Citrus aurantium Bergamia (Bergamot) fruit oil, Citrus limon (lemon) peel oil, Lavandula angustifolia (lavender) oil, Cymbopogon schoenanthus oil, Cananga odorata flower oil, Citrus aurantium (Orange) peel oil, Eucalyptus globulus leaf extract, dimethicone, cyclohexasiloxane, C13-14isoparaffin, caprylyl glycol, dimethicone, laureth-7 hydrogenated lecithin, ethylhexylglycerin, dimethicone/vinyl dimethicone crosspolymer, stearic acid, glyceryl acrylate/acrylic acid copolymer, panthenol, tocopheryl acetate, ceramide AP, ceramide AS, ceramide EOP, ceramide NP, ceramide NS,	Sensitive, acne prone, and for itchy skin.
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		cholesterol, phytosphingosine, propanediol, sodium hyaluronate crosspolymer, hydrolyzed glycosaminoglycans, sodium hyaluronate, benzyl glycol, hydrolyzed hyaluronic acid, madecassoside, asiaticoside, asiatic acid, madecassic acid, hyaluronicacid, raspberry ketone, cetearyl alcohol, disodium EDTA	
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Just herbs	Beauty elixir facial serum	gotukola (<i>C. asiatica</i>) ext. 4%, Indian ginseng (<i>Withania somnifera</i>) 4%, rosehip (<i>Rosa mosqueta</i>) seed oil 2%, fumitory (<i>Fumaria officinalis</i>) ext. 2%, liquorice (<i>Glycyrrhiza glabra</i>) 2%, Indian chestnut (<i>Mesua ferrea</i>) 2%, safflower (<i>Carthamnus tinctorious</i>) seed oil 2%, moringa (<i>Moringa oleifera</i>) seed oil 2%, Chandrika (<i>Lepidium sativum</i>) 1%, cold pressed wheatgerm (<i>Triticum vulgare</i>) oil 1%, eucalyptus (<i>Globulus eucalyptus</i>) leaf ext. 1%, Indian senna (<i>Cassia angustifolia</i>) leaf ext. 1%, colloidal oats (<i>Avena sativa</i>) 1%, allantoin	Whitening and nourishing skin, it minimizes dark circles, fine wrinkles, and pigmentation.
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COSRX	Centella blemish cream	C. asiatica leaf Water, butylene glycol, glycerin, Helianthus annuus (sunflower) seed oil, zinc oxide, dimethicone, betaine, 1,2-hexanediol, Viola tricolor extract, Elaeisguineensis (palm) oil, Elaeis guineensis (palm)kernel oil, cetearyl alcohol, cetearyl olivate, sorbitan olivate, C. asiatica extract, zinc PCA, hydroxyethyl acrylate/sodium acryloyldimethyl taurate copolymer, Xanthan gum, Melaleuca alternifolia (tea tree) leaf oil, Scutellaria baicalensis root extract Skin irritation, redness, acne prone sheet masks C. asiatica, snail mucin, vitamin	Redness, inflammation, and skin prone to acne.
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Benton	Skin redness centella mask pack	C. asiatica leaf water (45%), water, glycerin, pentylene glycol, butylene glycol, microcrystalline cellulose, C. asiatica (Gotu Kola) extract (1000 ppm), sodium gluconate, sodium hyaluronate, propanediol, dipotassium glycyrrhizate, asiatic acid, madecassic acid, asiaticoside, madecassoside, Portulaca oleracea (Green Purslane) extract, Xanthan gum, cellulose gum, caprylic/capric triglyceride, hydrogenated phosphatidylcholine, 1,2- hexanediol, cetearyl alcohol, sucrose stearate	Skin irritation, for sensitive Skin.
Kiehl's dermatologist solution	Sensitive facial cleanser	C. asiatica extract, aqua/water, ethylhexyl palmitate, glycerin, dipropylene glycol, carbomer, sodium hydroxide, caprylyl glycol, ethylhexylglycerin, tocopherol, citric acid	Restore delicate skin and unclog pores while washing, calming, and providing comfort to the skin.

HOME REMEDIES

Preparation: hair fall 500 g of leaves mixed in 250 g fruit powder of Centella Asiatica and then boiled in coconut oil. Consistency: paste, Application: Topical Uses: Hair growth, Dandruff, and hair fall [19].

CONCLUSION

In conclusion, because of its many advantageous qualities, Centella Asiatica, a multipurpose plant with a long history of usage in traditional medicine, has attracted a lot of interest in the cosmetics sector. We have learned more about its structural traits through microscopic analysis, and the plant's global distribution and growing methods demonstrate its flexibility and accessibility. With the help of its distinct chemical components, Centella Asiatica has a wide range of cosmetic uses that have sparked the creation of several commercial formulations meant to improve the appearance and health of skin. Despite its effectiveness, it's important to take into account any potential negative effects, which emphasizes how crucial good

formulation and educated usage are. Furthermore, although they should be used carefully, home treatments that use *Centella Asiatica* provide easily available and natural options. All things considered, *Centella Asiatica* is still a promising cosmetic ingredient that combines conventional knowledge with cutting-edge research to provide significant skincare advantages.

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