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A Review on Centella Asiatica Plant and It's Chemical Constituents and Related Products in Cosmetology

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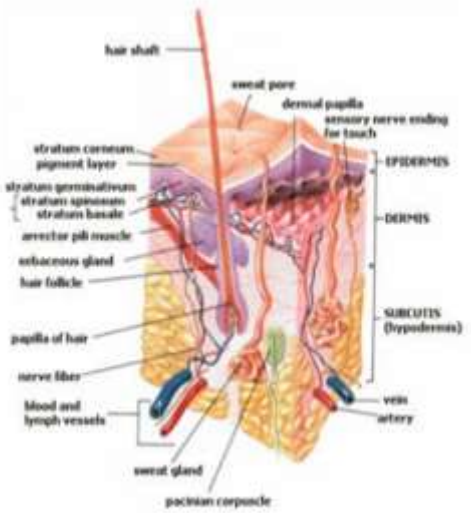
ABSTRACT:
Centella asiatica is traditional Ayurveda medicine widely used in India and across Asia for treating a variety of diseases. The aerial parts and roots are used for medicinal purpose, and its chemical constituents have wide therapeutic applications in areas of antimicrobial, anti-inflammatory, anticancer, neuroprotective, antioxidant, and wound healing activities.Centella asiatica is a medicinal plant that was already used as a 'panacea' 3000 years ago. The active compounds include pentacyclic triterpenes, mainly asiaticoside, madecasosside, asiatic acid and madecassic acid. Centella asiatica (gotu kola) is one of the important rejuvenating herbs for nerve and brain cells and is believed to be capable of increasing intelligence, longevity, and memory. Thankuni, scientifically known as Centella asiatica is a ground creeper and whole plant is used for medicinal purpose.

I. INTRODUCTION:

The largest organ in the body is the skin. The epidermis, dermis, and hypodermis are the three primary layers of skin. One of the sense organs is the skin. The epidermis is the topmost layer of the skin, followed by the dermis, and the subcutaneous layer.

EPIDERMIS: The stratified keratinized squamous epithelium makes up the epidermis. It is the skin's outermost layer that adds to skin tone and acts as a waterproof barrier. From the deepest basic layer to the most superficial stratum corneum, the skin's epidermal layer is further separated into multiple layers (stratum basal, stratum spinosum, stratum granulosum, stratum lucidum, and stratum corneum). Blood arteries and nerve endings were absent from the epidermis.
DERMIS: Dermis is the which located beneath the epidermis, dermis layer consists of the connective tissue, sweat glands, hair follicles, lymphatic vessels, sensory nerve endings. HYPODERMIS: Hypodermis is the deepest layer of the skin which is composed mainly of fat and connective tissue.

FUNCTIONS OF THE SKIN:
• PROTECTION: Skin has a main function protection of body by providing barrier against invade microorganisms, chemicals, and physical agents like ultraviolet light.
• REGULATIN OF BODY TEMPERATURE: To maintain constant body temperature skin place a major role in the thermal regulation.
• SENSATION: Skin is a sensory organ, it helps to detect the touch, pressure, temperature, and cold.
• FORMATION OF VITAMIN D: The skin helps to convert the 7-dehydrocholesterol into the vitamin D by sunlight. These vitamin D helps in the formation and maintena-nce of bone.



TYPES OF SKIN:
There are several types of skin among some of them are categorized into following types are:

- Normal
- Dry
- Oily

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- Combination
- sensitive

Skin types are depended on the genetics, but even through the external and internal factors affects the condition of the skin.[1]

FACE SERUM:

A face serum is a skin care and cosmetic product that works as a potent agent on the skin, which is the formulation's primary goal. A concentrated solution, serum contains active ingredients like ceramides, amino acids, antioxidants, and more. With its active ingredients, serum is a topical treatment that efficiently penetrates the skin.[2]

HISTORY OF FACE SERUM:

Face serums have been around since ancient times. The Egyptians employed natural oils and plant extracts for skin treatment, and the Greeks and Romans made their formulations with substances like olive oil. Face serums are made with substances like hyaluronic acid and antioxidants to treat certain skin conditions, thanks to advancements in cosmetic sciences during the 20th century.[3]

TYPES OF FACE SERUMS:

1.THE OIL SERUM:

Among all the varieties, oil serums are the easiest to make. They have moisturizing, barrier-repairing, nourishing, and texture-improving qualities on average.

2. GELSERUMS:

Gels and serums are lightweight treatments that penetrate easily into the skin and typically have positive effects. Gel serums improve the texture of the skin and aid in hydration.

3. WATER BASED SERUMS:

This product is lightweight, deeply penetrates into the skin, and hydrates the skin.

4.EMULSION SERUMS:

When water and oil are utilized in the formation of emulsion serums, an emulsifier is necessary since the two immiscible phases—oil and water—do not miscible with one another. This emulsifier is used to stabilize the formulation.

BENEFITS OF USING FACE SERUMS:

- Hydration: By absorbing moisture from the air, the serum hydrates the face when it is applied.
- Improve in skin texture:using components like vitamin C and retinol to produce smoother, more even skin tone.
- Reduced fine lines and wrinkles: Face serums aid in the synthesis of collagen, which lessens wrinkles and fine lines on the skin.[4]

Based on their modes of action, all of the serums are divided into the following groups.:

- Nourishing
- Moisturizing
- Revitalizing
- Anti-inflammatory
- Anti-stress
- Smoothening[5].

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CENTELLA ASIATICA:

INTRODUCTION:

Commonly referred to as "tiger grass" or "gotu kola," Centella asiatica is also known as "Indian pennywort." It is a member of the Apiaceae family. Centella asiatica and its extracts were included to the pharmacopoeia in the 19th century because of their therapeutic qualities.

Numerous phytochemical components found in Centella asiatica have a range of pharmacological effects. A native of Aisa, Centella is a perennial plant that typically grows in wetlands in the southeast United States, sections of Australia, South Africa, and India's tropical and subtropical areas.

Among the top 10 therapeutic plants with anti-aging and central nervous system activities worldwide is Centella asiatica. Among Centella asiatica's many qualities are its culinary applications, nutritional value, and therapeutic benefits. Essential oils, flavonoids, phytosterols, genin triterpenoids, pentacyclic triterpenoid saponins, and other active components are all found in Centella asiatica.[6]

PLANT DETAILS (TAXONOMY):

- Kingdom: Eukaryota
- Subkingdom: Embryophyta
- Division: Spermatophyta
- Subdivision: Angiospermae
- Class: Dicotyledoneae
- Subclass: Rosidae
- Superorder: Aralianae
- Order: Araliales(Umbelliflorae)
- Family: Apiceae
- Genus: Centella
- Species: Asiatica.

MORPHOLOGY:

The plant species that are cultivated in marshes and other moist locations are Centella asiatica. These plants are typically found at elevations between 300 and 1800 meters. The plant is characterized by semi-erect stems, creeping herbaceous perennial growth, and heights that range from 10.0 to 45.0 cm. The plant can be propagated through vegetative reproduction and is entomophilous.

The plant has reniform, shovel-shaped leaves that alternately emerge at the nodes as rosettes.[7]

CHEMICAL CONSTITUENTS:

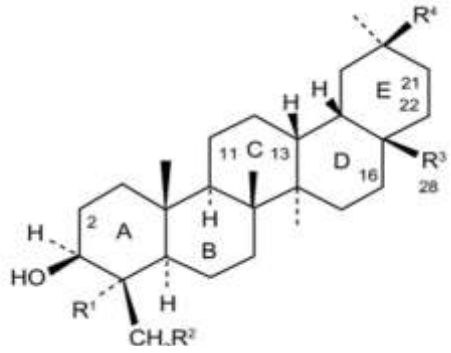
Because centella asiatica plants contain bioactive triterpene saponins, their chemical constituents have both medical and nutraceutical uses. Asiatic acid, madecassic acid, asiaticosside, madecassoside, brahmoside, brahmic acid, brahminoside, thankiniside, isothankunisode, centelloside, madasiatic acid, centic acid, and cenellic acid are among the several chemicals that make up the triterpenes of the Centella asiatica plant. Among these triterpenes, asiatic acid, madecassic acid, asiaticosside, and madecassoside are the most significant bioactive constituents. [8]

1. TRITERPENOIDS:

Large amounts of pentacyclic triterprnoid saponins, or centelloids, make up the majority of Centella asiatica. Asiaticoside, centelloside, madecassoside, brahmoside, brahminoside, thankuniside, sceffoleoside, centellose, asiatic-, centellic-, brahmic, and madecassic acids are among the constituents of these triterpenoids.

CHEMICAL DIVESTRY OF TERPENOIDS:

The chemicals that are often produced from isoprene units are called terpenes. Finding and fixing the amount and location of double bonds is made easier by the polymerise of the CH_8 isoprene units. The multiplier of the isoprene (C5H8) units is the molecular formula for terpenes.



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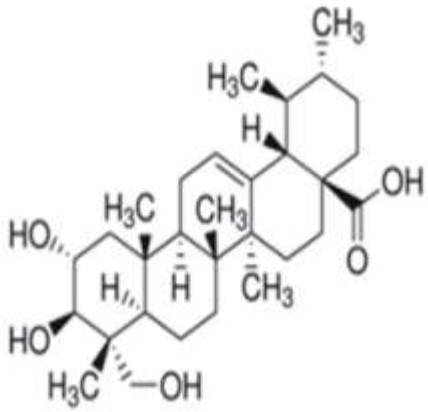
By the number of C5 isoprene units, the majority of terpenes are categorized as follows: monoterpenes (C10), sesquiterpenes (C15), diterpenes (C20), sesterterpenes (C25), triterpenes (C30), carotenoids (C40), and polyterpenes, which are composed of numerous isoprene units. Triterpenes, which are compounds of triterpene groups, are found in plants in excessive numbers along with saponins.

BIOSYNTHESIS OF THE CENTELLA ASIATICA TRITERPENES:

The synthesis of terpenes involves a number of steps, such as the formation of isoprene units, their subsequent combination, cyclization of these isoprene units to create the carbon skeleton, and subsequent processes like hydroxylation and oxidation, which aid in the production of terpenoids.[9]

- **ASIATIC ACID:**

Asiatic acid is an aglycone pentacyclic triterpene that occurs naturally. Many therapeutic herbs contained Asiatic acid. This herb typically has a variety of therapeutic benefits, including the ability to heal wounds and treat neuropsychiatric disorders.



CHEMISTRY:

[trans-(1R,9S)-8-methylene-4,11,11-trimethylbicyclo[7.2.0]undec-ene] is its chemical name. Due to its quick metabolism, asiatic acid exhibits lowerbioavailability.

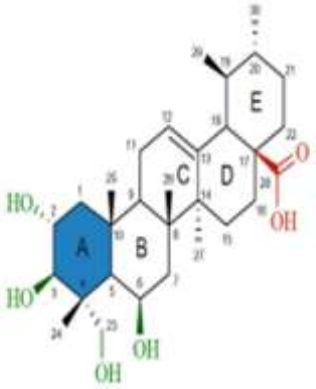
Asiatic acid has a molecular weight of 488.71 and the chemical formula is C30H48O5. In terms of structure, asiatic acid has three hydroxyl groups at positions two, three, and twenty-three; an olefin group at position C-12; and a carboxylic group at position C-28.[10]

- **MADECASSIC ACID:**

A significant pentacylic triterpenoid with carboxylic groups is madecassic acid. The pharmacological actions of madecassic acid are diverse.

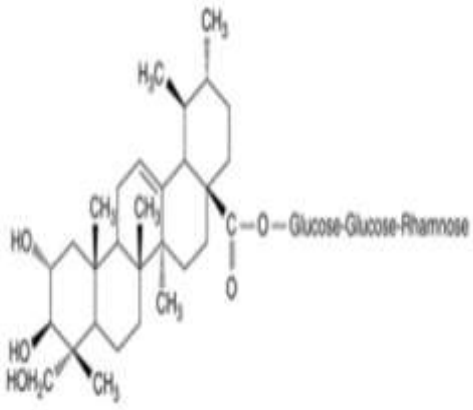
CHEMISTRY:

The molecular weight of madecassic acid is 504.71, and its formula is C30H48O6. The process by which pentacyclic triterpenes are attached to the G-G-R sugar chain is part of the biosynthesis of madecassic acid.[11]



- **ASIATICOSIDE:**

Asiaticoside is a triterpene of the pentacyclic triterpenoid saponins, which are composed of one or more sugar moiety on the side chain of the aglycone molecule.[12]



CHEMISTRY:

The molecular weight of Asiaticoside is 959.12, and its chemical formula is C48H78O19. The process by which pentacyclic triterpenes are joined to the G-G-R sugar chain is part of the biosynthesis of asiaticoside.[13]

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- **KAEMPFEROL:**

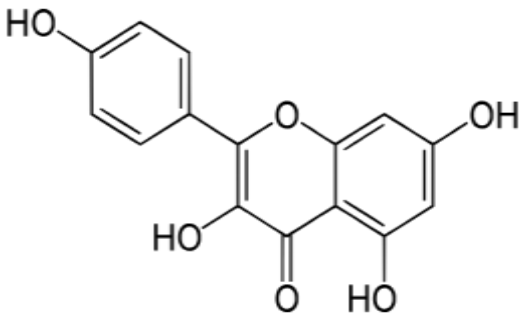
CHEMISTRY:

One type of flavonol is kaempferol. The rhizome of Kaempferia galanga is the original source of kaempferol, which has the molecular weight 286.23 and the chemical formula C15H10O6.[14]

BIOSYNTHESIS:

Kaempferol's biosynthesis process demonstrates that naringenin was the source of its synthesis. First, the hydroxylase enzyme flavanone 3 beta-hydroxylase transforms naringenin into dihydrokaempferol, and then the synthase enzyme flavonol synthase transforms dihydrokaempferol into kaempferol.

Tetrahydroxyflavone, or kaempferol, is a chemical with four hydroxy groups at positions C-3, C-5, C-7, and C-4.[15]



Classes of chemical constituents	Chemical constituents
Monoterpenes	
Acyclic monoterpenes	3-none-2-one
Monocyclic monoterpenes	Linalool, myrcene, γ-terpinene, terpinolene, limonene, A-terpinene, α-phellandrene, ρ-cymene, terpinen-4-ol, pulegone, menthone, methyl carvacrol, methyl thymol
Bicyclic monoterpenes	A-thujene, α-pinene, β-pinene, camphene, bornyl acetate, chrysanthenyl acetate
Sesquiterpenes	
Acyclic sesquiterpenes	Trans-β-farnesene, decan-1-ol
Monocyclic sesquiterpenes	Germacrene a, germacrene b, germacrene d, β-elemene, Γ-elemene, γ-curcumene, bicyclogermacrene, bicycloelemene, humulene epoxide, α-humulene
Bicyclic sesquiterpenes	Epibicyclosesquiphellandrene, α-cadinene, δ-cadinene, caryophyllene oxide, β-acoradiene, β-caryophyllene.
Tricyclic sesquiterpenes	Spathulenol, allo-aromadendrene, viridiflorol, epiglobulol, mintsulfide, α-copaene
Diterpenes	
Acyclic diterpenes	Neophytadiene
Triterpenes	
Ursane-type pentacyclic triterpenes	Asiatic acid, madecassic acid/ brahmic acid/ 6β-hydroxyasiatic acid, 2α, 3α-dihydroxyurs-12-en-28-oic acid,

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	2α, 3β, 23-trihydroxyurs-20-en-28-oic acid, 2α, 3β, 20, 23-tetrahydroxyurs-28-oic acid, pomolic acid, corosolic acid, ursolic acid
Ursane-type pentacyclic triterpenes saponins	Asiaticoside a/ madecassoside/ brahminoside, asiaticoside c, asiaticoside d, asiaticoside e, asiaticoside f, asiaticoside, 2α, 3β, 23-trihydroxyurs-20-en-28-oic-acid o- α-l-rhamnopyranosyl-(1→4) -o-β-d-glucopyranosyl-(1→6)-o-β-d-glucopyranosyl ester, centellasaponin b, centellasaponin c, scheffuroside b, 3-o-[α-l-arabinopyranosyl] 2α, 3β, 6β, 23-α tetrahydroxyurs-12-ene-28-oic acid, 23-o-acetylmadecassoside
Oleanane-type pentacyclic triterpenes	3-epi-maslinic acid, terminolic acid
Oleanane-type pentacyclic triterpenes saponins	Asiaticoside b, centellasaponin d, scheffoleoside a, 23-o-acetylasiaticoside b
Steroid type triterpenes	Stigmasterol, sitosterol, campesterol, sitosterol 3-o-β-glucoside, stigmasterol 3-o-β-glucoside
Tetraterpenes	B-carotene
Phenols	
Flavonoids	Kaempferol, kaempferol-3-o-β-d-glucuronide, castilliferol, quercetin, quercetin-3-o-β -d-glucuronide, castillicetin,
Phenylpropanoids	Rosmarinic acid, chlorogenic acid, 3,4-di-o-caffeoyl quinic acid, 1,5-di-o-caffeoyl quinic acid, 3,5-di-o-caffeoyl quinic acid, 4,5-di-o-caffeoyl quinic acid, isochlorogenic acid
Tannin	Tannin, phlobatannin
Alkaloid	Alkaloids
Carbohydrate	
Monosaccharide	Glucose, mesoinositol
Oligosaccharide	Centellose
Polysaccharide	Pectin, arabinogalactan
Amino acid	Alanine, arginine, aspartic acid, glutamic acid, leucine, iso-leucine, valine, methionine, lysine, histidine, tyrosine, phenylalanine, threonine, glycine, serine, threonine, proline, cystine
Polyacetylene	8-acetoxycentellynol, cadiyenol, dotriacont-8-en-1-oic acid, 11-oxoheneicosanyl cyclohexane

PHARMACOLOGICAL ACTIVITIES:

Centella asiatica is an herb, which contain chemical constituents that have various pharmacological activities:

- **ANTIOXIDANT:**oxidative stress can be prevented by the stimulation of the nuclear factor erythroid-2-related factor 2 (Nrf2), these factor also plays a role cognitive impairment.[16]
- **WOUND HEALING:**Extracts from Centella asiatica have long been used to treat wounds. The primary active ingredients in Centella asiatica herbs that promote the healing of burn wounds are the glycosides asiaticoside and madecassoside.[17]
- **NEUROPROTECTIVE:**Centella asiatica has a strong protective effect on the central nervous system. It can minimize oxidative stress, a key cause of nerve injury and long-term problems such as paralysis and neuropathic pain.[18]
- **ANTI-INFLAMMATORY:**the rise in antioxidant stress factors (SOD ↑, CAT ↑, and GPx ↑) and the decrease of associated inflammatory factors (IL−1β ↓, IL−2 ↓, IL−6 ↓, IL−10 ↓, IL−12 ↓, and TNF−α ↓). Additionally, C. asiatica may lower MDA and COX-2 levels, which would lessen damage to the stomach mucosa.[19]
- **RADIOPROTECTIVE:**using centella asiatica extracts in the clinical radiotherapyhelps in preventing radiation-inducedbehavioral changes.[20]

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- **ANTI-DEPRESSANT:**The reduction of immobility time and the amelioration of amino acid imbalance brought on by imipramine and total triterpenes validated Centella asiatica's antidepressant activity.[21]
- **HEPATOPROTECTIVE:**the protection against the hepatic damage can be done through inhibitingthe expression of TNF-alpha and MAPKs by active constituent asiaticoside, and also madecassic acid can also acts as the hepatoprotective.[22]
- **MEMORY ENHANCING:**The active ingredients of Centella asiatica are brahminoside, brahmic acid, and brahmoside; an aqueous extract of CA has been demonstrated to markedly enhance memory.[23]
- **ANTI-CANCER:**Asiatic acid can influence the expression of epithelial-mesenchymal transition marker proteins in colon cancer cells. It can also cause the death of liver cancer cells by disrupting mitochondrial activity.[24]
- **ANTIEPILEPTIC:**Centella asiatica can boost brain GABA levels, which may explain its historical use as an anticonvulsant and antianxiety medication.[25]
- **ANTI-AGING:**aging of the skin is effected by the both internal factors and environmental factors, thus the asiaticoside and madecassic acid helps in treating the hyperpigmentation, photoaging, scars and wrinkles.[26]

EXTRACTION METHODS:

There are various types of herbal plant extraction method

- MACERATION: A simple method that uses water are aqueous and non-aqueous solvent at room temperature. However, it has a long extraction time and low efficiency.
- PERCOLATION: A continuous process that uses water or aqueous and non-aqueous solvents at room temperature or occasionally under heat. Its more efficient than maceration.
- DECOCTION: Uses water under heat and the extract contains a lot of water-soluble impurities.
- REFLUX EXTRACTION: Uses aqueous and non-aqeous solvents under heat and is more efficient then percolation and maceration.
- SOXLET EXTRACTION: Combines the advantages of reflux extraction and percolation to continuously extract the herb with fresh solvent.
- SUPERCRITICALFLUID EXTRACTION: Uses supercritical fluid as the extraction solvent.
- ULTRASOUND ASSISTED EXTRACTION: Also called ultrasonic extraction or sonication, it uses ultrasonic wave energy in the extraction.

Name of the product	company	Applications
	PUNH	It is boosts the body's ability to synthesise the collagen, and also reduces the wrinkles.
	ANASTORE	It helps in maintaining blood sugar balance.

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	NATURE ESSENTIAL	It consists of the anti inflammatory property
	TREXGENICS	It as various functions like Blood circulation, cognitive function, and skin health.
	EARTH RHYTHM	It is a lightweight gel-cream, it can also heals and clams the inflammation
	EARTH RHYTHM	It has various properties like anti-ageing by fighting against the face acne, and also used in scar treatment.

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	WILD & ORGANIC	It is a supplement that used in thesupporting the brain and memory.
	LAB Factory	The multi balm is a anti-ageing skin care product mainly reduces the wrinkles.
	BANYAN BOTANICALS	It is a supplement used to support the brain and nervous system function.

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	MIXSOON	It is a hydrating serum which effectively soothe the skin.
	COSRX	It is a effective toner which helps to reduce the redness, blemishes on the sensitive skin.
	SKIN1004	It is a face care product for causal occasion.

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	PERENNE	It is a moisturizing cream whivh provides prolonged hydration of the skin by moisturizing.

II. CONCLUSION:

Centella can be a potential herbal plant in many healthcare applications.Centella asiatica has been in use since time immemorial to treat wide range of indications. It has been subjected to quite extensive phytochemical, experimental and clinical investigations. The dynamic nature of indigenous knowledge has led to its survival through centuries. The use of this knowledge is necessary as it is not only socially desirable but is economically affordable, sustainable and involves minimum risks and procedures. More studies are required to characterize and establish the chemical compounds responsible for a wide range of therapeutic activity. Due to the presence of wide bioactive compound, the plant has vast application. Centella asiatica has been used for many years for the treatment of various diseases. A significant amount of work has been done on its pharmacological activity and possible applications of chemical compounds from the whole part of the plant. The present review shows that Centella asiatica contains several different phytocompounds like saponins, glycosides, phytosterols, flavonoids, etc. Out of these phytocompounds saponins i.e. asiaticoside is an important one which is responsible for the different pharmacological activity.

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