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Review Article

AN OVERVIEW ON *CALENDULA OFFICINALIS* LINN.: (POT MARIGOLD)

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ABSTRACT

Since times immemorial, plants are considered as an important source for the treatment of a wide range of diseases. Herbal medicine is the study of pharmacognosy and the use of medicinal plants, which are the basis of traditional medicine. These herbal therapies are cost effective and free from any side effect. Although there are around 8,000 medicinal plant species used by different communities in India across different ecosystems, only around 10% of them (880 species) are in active trade. So, there is a need of exploration of plants for their medicinal efficacy. India has a very rich source of plants for healthcare to prevent different diseases and *Calendula officinalis* L. is among such aromatic herbs (family: Compositae), which is used in the traditional system of medicine i.e., Ayurveda, since long because of its rich ethnomedicinal importance. *Calendula* is commonly known as Pot marigold. It contained a good range of phytochemical constituents including essential volatile oils, saponins, triterpenes, triterpenoids, esters, flavonoid, steroids, carotenoids, amino-acids and polysaccharides. It is mainly used due to its various biological activities to treat various diseases and act as an analgesic, anti-diabetic, anti-ulcer and anti-inflammatory agent. It exerted many therapeutic effects including antibacterial, antifungal, anthelmintic, antiviral, antioxidant, hepatoprotective, cardioprotective and wound healing. It is also used as a cure for gastrointestinal disease, eye disease, skin injuries and cases of burn.

Keywords: *Calendula officinalis*, Carotenoids, Flavonoids, Anti-inflammatory, Antioxidant, Skin care.

1. INTRODUCTION

Calendula officinalis is a well-known medicinal plant and is the member of the aster family (Asteraceae). The genus is native to the Mediterranean countries. It is an annual plant which can attain a height of 30-60 cm. Pot marigold Linn., has been traditionally used for the treatment of various dermatological lesions, skin tumors, swellings, ulcers and nervous disorders. Presence of different secondary metabolites carotenoids, phenolic acid, lipids, triterpenoids, esters flavoxanthin and astaxanthin etc. are reported from different plant parts of this plant [1]. Its leaves and stems are rich in carotenoids, mostly Lutein (80%) and zeaxanthin (5%) and beta-carotene. Calendula shows biological properties as antibacterial, antifungal, anthelmintic, antiviral, cytotoxic, antioxidant, anti Inflammatory, analgesic, hepatoprotective, cardio-protective, wound healing and many other effects [1]. Thus, Calendula products have been widely used for about 200 cosmetic formulations, i.e., in cosmetics like creams, lotions, shampoos due to the presence of compounds such as saponins, resins and essential oils [2]. so present review emphasizes genus Calendula, its morphological features, phytoconstituents, pharma-cological effects, toxicology and industrial or traditional uses of this very useful plant.

1.1. The Genus Calendula

The genus *Calendula* (Asteraceae) contains approximately 25 herbaceous annual or perennial species, commonest being common marigold Linn., (*Calendula arvensis Linn.*, *Calendula suffruticosa Vahl.*, *Calendula stellata Cav Calendula alata Rech Calendula tripterocarpa Rupr)* [3].

Synonyms: *Calendula officinalis* is also known as pot marigold, ruddles or common marigold.

1.2. Morphological Features

C. officinalis Linn., is an annual or biennial plant. It attains a height of 30-60 cm. Its stem is angular, hairy and solid; leaves are lower spatulate, 10-20 cm long and 1-4 cm wide; higher oblong and mucronate, 4-7 cm long; anomocytic stomata within the apical region of outer epidermis, covering and glandular trichomes, elongated sclerenchyma cells, marginal flower heads are bright yellow to orange in color; corolla oblong spatulate, 15-

25 mm long and about three mm wide; corolla of disc flowers rounded, at the very best tridentate, 1.5-2.5 cm long and 4-7 mm in diameter with 5 mm long tubular florets. The powdered *C. officinalis* is raw sienna with a characteristic, aromatic odor and a quite bitter taste [4-6].

Table 1: Systematic Position of *Calendula Officinalis* (Data from ICN)

Kingdom -	Plantae
Subkingdom-	Tracheobionta
Division-	Magnoliophyta
Class -	Magnoliopsida
Subclass-	Asteridae
Order-	Asterales
Family-	Asteraceae
Tribe-	Calendulae
Genus-	*Calendula*
Species-	*Officinalis*

2. CHEMICAL CONSTITUENTS OF COMMON MARIGOLD

A number of phyto-chemical studies have demonstrated the presence of several classes of chemical compounds like terpenoids, quinones, coumarins, flavonoids, essential oil, carotenoids and amino acids within the plant [7-8]. Advanced analytical and phytochemical techniques done on different plant parts confirms the presence of different chemical components like isorhamnetin, rutin, quercetin and glucoside, which are utilized in food and cosmetic industry as well [9].

2.1. Terpenoids

Terpenoids, also known as isoprenoids, are the foremost numerous and structurally diverse natural products found in plants. These are volatile substances responsible for peculiar fragrance in flowers and plants. They occur widely within the leaves and fruits of conifers and upper plants like citrus and Eucalyptus. Broadly categorizing there are two types of terpenoids-simple and sophisticated terpenoids. Simple terpenoids occur in steam volatile essential oils and is obtained from sap and tissues of certain plants and trees whereas complex terpenoids are not steam volatile and obtained from gum and resins of plants [10].

2.2. Flavonoids

Flavonoids are a group of phytonutrients found in most fruits and vegetables from plants. In *C. officinalis* various flavonoids are isolated from the ethanolic extract of the inflorescence that include quercetin, isoquercetin, narcissin, rutin, etc [11].

2.3. Coumarins

Coumarins are phenolic substances composed of fused benzene and alpha-pyron rings. Ethanolic extract of *C. officinalis* is reported to contain scopoletin from its inflorescence [12].

2.4. Quinones

Quinones are conjugated cyclic diketones. Quinones like plastoquinone, phylloquinone, alpha-tocopherol, chloroplast, ubiquinone, phylloquinone, alpha-tocopherol and phylloquinone are reported from the leaves *C. officinalis* [13].

2.5. Volatile oil

Volatile oils are mixtures of hydrocarbon terpenes, polyterpenes and sesquiterpenes and their oxygenated derivatives obtained from different parts of the plant. Quantitative estimations suggest stage dependent synthesis of essential oil as in flowers *of C. officinalis* it contain minimum essential oil during the pre flowering stage and maximum at full bloom stage [14].

2.6. Carotenoids

Leaves, petals and pollen of *C. officinalis* flowers showed presence of carotenoids when extracted in methanol [15]. The carotenoids found within the pollen and petals were violaxanthin, neoxanthin, auroxanthin, lutein xanthin, flavoxanthin, mutatoxanthin, lycopene, alpha-carotenes.

2.7. Amino Acids

Amino acids are building blocks of proteins and act as intermediary pool in different metabolic reactions. In the flowers of the plant presence of 15 amino acids in free form like Alanine, Arginine, Asparagine, Valine, Histidine, Glutamic acid, Leucine, and lysine etc is reported when extracted in ethanol [16].

Table 2: Phytoconstituents and Biological Activities of Different Parts of *Calendula* [8, 17]

Extract	Phytoconstituents	Biological activity
Flower extract	Saponin, oleanolic acid, stigmasterol	Antitumor, Anti-inflammatory
Leaves extract	Quinones, plastoquinone phylloquinone	Anti-inflammatory, antioxidant activities
Inflorescence extract	Flavonoids; quercetin, isoquercetin, rutin [8]	Antioxidant activities [8]

3. PHARMACOLOGICAL EFFECTS

3.1. Antimicrobial and Anthelmintic Effects

Methyl alcohol (CH_3OH) and ethyl alcohol (C_2H_6O) extracts of common marigold petals show antimicrobial activity in case clinical pathogens including bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) and fungi (*Candida glabrata*, and *Candida albicans*). Mouthwashes containing common marigold reduce the number of microbes adhered to the molars and premolars. Organic extracts of *Calendula officinalis* found sensitive against HIV-1 reverse transcriptase [1].

3.2. Wound and Burn Healing

The temporal and oral application of flower extract of *Calendula officinalis* shows wound and burn healing effects. Increment in hexosamine and collagen-hydroxyproline indicates the wound healing with the treated person or animal [7]. The photo-protective effect of the topical formulations containing marigold extract (ME) (common marigold extract) is shown on ultraviolet (UV-B) irradiation-induced skin damage. For the topical delivery of marigold extract, gel formulation is best. This formulation is during a position to require care of glutathione reduced levels but it doesn't affect the gelatinase and myeloperoxidase activities which increase by exposure to UVB irradiation. Additionally, gel formulation reduces the histological skin changes induced by UVB irradiations [9].

3.3. Anti-inflammatory and Palliative Effect

Calendula officinalis flower extract possesses significant anti-inflammatory activity against carrageenan and dextran induced acute paw edema. The hydroalcoholic extracts of plant of common marigold suppress the cell-free systems activities if lipoxygenase (5-LO) and cyclooxygenase-2 (COX-2), the key enzymes within the formation of proinflammatory eicosanoids from arachidonic acid. Nine oleane-type triterpene Glycosides isolated from common marigolds show 12-O-tetradecanoylphorbol-13-acetate (TPA) induced inflammation [18].

3.4. Antioxidant Effect

Calendula extract is found to scavenge radicals of superoxide generated by Fenton reaction and forbid lipid peroxidation. Superoxide generation in macro-phages is inhibited by oral administration of *Calendula* extract. The extract produces a big escalation in glutathione levels in blood and liver. The enzyme, glutathione reductase was increased, however declination in peroxidase is found after administration of calendula extract. [8].

3.5. Cardiovascular Effect

Calendula officinalis might be cardio protective in case of ischemic heart condition. Two groups of hearts were used: the treated rat hearts were perfused with common marigold solution at 50mM in KHB buffer (in mM common salt 118mM, potassium chloride 4.7mM, salt 1.7mM, bicarbonate of soda 25mM, potassium biphosphate 0.36mM, sulfate 1.2mM, and glucose 10mM) for 15 min before subjecting the guts to ischemia, when the control group was perfused with the buffer only. Calendula achieved cardio protection by stimulating left ventricular developed pressure and aortic flow as by reducing myocardial infarct size and cardiomyocytes apoptosis. Cardiac protection appears to be achieved by reforming ischemia reperfusion mediated death signals into a survival signal by modulating antioxidant and anti-inflammatory pathways [10].

3.6. Effects on Oral Health

Flowers extracted from *Calendula officinalis* are used in mouthwashes such as in oral gel, showing effects on radiation induced oropharyngeal mucositis (OM) in patients head and neck cancer. Chemotherapy induced in oral mucositis evaluated the therapeutic effect of common marigold gel (5-FU) [19].

3.7. Toxicology

Calendula preparations on rare contact with skin may cause an allergy to the herb as during a study the extract was found to cause allergy in 9 patients out of 443 (2.03%) when assessed by patch testing method [20]. Hence, it is recommended that the persons who have a longtime allergy to the Asteraceae (daisy) family should use it with caution [21]. Sensitization to Calendula and allergic contact reactions are observed. Infusion of Calendula after gargling shows anaphylaxis incidents [22].

4. COMMERCIAL USES OF CALENDULA

The use of calendula for its' lenitive properties' dates to the XII century. Due to anti-inflammatory properties of Calendula, its flower extract is used in adjunctive skin care treatments and cosmetics with soothing properties such as after-sun, sensitive skin and eye contour products [23, 24].

4.1. Skin care products

The results of a clinical study showed the effect of marigold flowers extract cream as an antioxidant which protected the skin in particular from oxidative damage after sunburn and reduced the symptoms of skin aging due to the presence bioactive compounds such as rutin and quercetin derivatives, vitexin, luteolin, apigenin and kaempferol. HPLC analysis indicated that marigold flowers extract contains nine different active compounds, including Vitexin 11.40%, Rutin 12.29%, Quercetin-3-3galactosid 12.64%, Luteolin-7-glucose 9.27%, Quercetin-3-glucoside 7.38%, Quercitrin 9.83 %, Myricetin 10%, Luteolin 10.72%, Apigenin 7.08% and kaempferol 9.37 % [25].

4.2. Sedative drugs

In early animal studies, ingestion of high doses of calendula preparations were reported to act as sedatives. So, its mixture with sedative agents may cause additive effects. In mice, hexobarbital induced sleeping time was extended by calendula. Its systemic effect in humans is not clear yet [25].

4.3. Antihypertensive drugs

In early animal studies, preparations of high doses of calendula were reported to have hypertensive effects [26]. Hence, use of calendula with hypertensive agents may cause additional effects.

4.4. Hypoglycemic drugs

The activity of hypoglycemic medications or insulin may be increased by calendula [27].

4.5. Cholesterol-lowering drugs

Extracts of calendula may cause additive effects with agents that reduce lipids and triglycerides [27].

Table 3: Some Commercial products of *Calendula officinalis*

S No	Product	Make	Uses
1	Calendula Serum Infused Water Cream	Kiehl's	Skin Nourishment and healthcare.
2	Calendula Herbal Extract Toner Alcohol Free	Kiehl's	An alcohol-free facial toner that soothes the skin and gives a healthy glowing skin.
3	Calendula Nectar Antiseptic Cream	Wheezal Homeopathy	an antiseptic cream; which is effective for dry skin, acne, pimples, scars, burns, cracked nipple and blotches.
4	*Calendula Officinalis* Mt (17)	Dr. Willmar Schwabe	It is the most remarkable healing agent, applied locally. It is useful for open wounds, parts that will not heal, ulcers etc. It promotes healthy granulations and rapid healing by first intention. It is used as haemostatic after tooth extraction. It is also of use in constitutional tendency to erysipelas. Pain is excessive and out of proportion to injury. Great disposition to take cold, especially in damp weather. It is used in cancer, as an intercurrent remedy. It has remarkable power to produce local exudation and helps to make acrid discharge healthy and free. Flowers are stimulant, antiseptic and reported to be emmenagogue. Leaves are reported as diaphoretic.
5	*Calendula Officinalis* Ch [17]	Dr. Willmar Schwabe	1. It is one of the most remarkable healing remedies when applied locally. It is useful in treating open wounds, slow healing ulcers, etc by promoting healthy granulation and increases the blood circulation and thereby rapid healing. 2. Head: Very nervous, easily frightened with tearing headache. Sensation as if weight on the brain. Submaxillary glands swollen and painful to touch. It helps to arrest the

			bleeding after tooth extraction. Lacerated wounds on the scalp. Prone to frequent skin infections with reddish, raised, well demarcated eruptions. 3. **Eyes:** Injuries to eyes with tendency to suppuration. For injuries after surgeries, and increased discharge of mucus from lachrymal sac due to infection. 4. **Ears:** Difficulty in hearing which is worse in damp surroundings with itching eruptions. Can hear well on a train and sounds from distance. 5. **Skin:** It is indicated for superficial burns and scalds, raised reddish plaques. It promotes scar formation with less suppuration. Skin yellowish, slough, proud flesh and raised edges. 6. **Female:** Inflammation and enlargement of uterus, sensation of weight and heaviness in the pelvis. Chronic inflammation of the cervix, with external os lower than usual. Warts at the external os of the cervix. Stretching pain in the groins on sudden movements. Increased flow or menses suppressed from cough.
6	Pure Calendula/*Calendula Officinalis* Cold Pressed Oil	Deve Herbes	It is a sudorific, emmenagogic and anti-spasmodic, but it is mainly used dermato-logically. It is useful for very sensitive skin, and to help heal the scars of those who have had very bad acne. It is very calming, even in the smallest proportions, mixed with other Oils. A drop of Calendula Oil in a bath is good for psoriasis.

5. TRADITIONAL USES

In Europe, the leaves are used as resolvent and diaphoretic whereas the flowers are used as a stimulant, antispasmodic and emmenagogue. In England, the decoction of the flowers was used as a posset drink for the treatment of measles and smallpox, and therefore the fresh juice as a medicine for jaundice, costiveness (constipation) and suppression of menstrual flow [28]. In India, the florets are utilized in ointments for treating wounds, herpes, ulcers, frostbite, skin damage, scars and blood purification. The leaves are used for treating varicose veins externally.

6. CONCLUSION

In this review, we've represented the information on botanical description, traditional uses, phytochemistry and pharmacology of *C. officinalis Linn.* (Asteraceae), a medicinal plant found in central and southern Europe, Western Asia and in the United States. A number of phytochemicals like carotenoids, coumarins, terpenoids, flavonoids, quinones, essential oil etc. are reported to be present in this plant. Varied number of pharma-cological properties are allocated in preclinical research to varied constituents, including anti-inflammatory, immune-stimulating, antibacterial, antiviral, anti-protozoal and anti-neoplastic properties. An infusion or tincture of the herb is additionally helpful in cases of painful or delayed menstruation, and therefore the herb may be a beneficial ally within the transition to menopause. This review emphasizes the normal uses and clinical potential of Calendula species. Despite an extended tradition of use of some species, the genus has not been explored properly. So, this genus needs to be discovered systematically to work out its dose dependent standardization and allergic reactions, if any, so that this can be explored as potential therapeutic agents.

Conflict of interest

The authors declare no conflict of interest.

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