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Exploring Calendula officinalis Linn: Ethnobotanical Uses, Phytoconstituents, and Medicinal Potential"

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Abstract:

Calendula officinalis Linn, commonly referred to as pot marigold, is a medicinal plant that belongs to the Asteraceae family. This review consolidates information sourced from various online bibliographic databases, including Google Scholar, Pub Med, Sci Finder, and Web of Science. Calendula officinalis holds a prominent place in Homoeopathic, Unani, and Ayurvedic medicine, where it is employed as a diaphoretic, analgesic, antiseptic, and anti-inflammatory agent. It has been traditionally used to address gynecological ailments, gastrointestinal disorders, oral and pharyngeal mucosal inflammations, eye conditions, skin injuries, burns, visual impairments, and menstrual irregularities. Numerous studies have identified Calendula officinalis as a rich source of bioactive compounds, including terpenoids, flavonoids, coumarins, quinones, and carotenoids. Both in vivo and in vitro evaluations of its pharmacological properties indicate that the plant exhibits antidiabetic, anti-inflammatory, anti-tumor, anticancer, and gastroprotective effects. This review aims to present a comprehensive summary of the traditional uses, phytochemical profile, and pharmacological activities of Calendula officinalis.

Key words: Calendula officinalis, Ethno botanical Uses, pharmacological activity

Introduction:

The plant Calendula officinalis Linn (C. officinalis), commonly referred to as pot marigold, is a flowering plant that belongs to the Asteraceae family and the Calenduleae tribe. The name "calendula" is derived from the Latin word "calendas," meaning "first of the month." The term "marigold" is associated with calendula, previously referred to as "gold's," and linked to Queen Mary and the Virgin Mary. C. officinalis is a sessile, hispid, acute, oblanceolate, annual, or biennial herbaceous plant that grows to a height of 30 to 60 centimeters. The leaves are hairy, alternate, petiolate, oblong, and spatulate, with

edges that are either entire or slightly toothed. The lower leaves have rounded tips and an oval shape, while the upper leaves are lanceshaped with pointed tips. Leaf blade lengths range from 2 to 4 inches. The plant features a taproot system with multiple secondary roots. Figure 1 illustrates various parts of C. officinalis, including its flowers, leaves, and roots.

C. officinalis produces essential oils extracted from its flowers and glandular hairs. The daisy-like flowers are yellow to bright orange in color, curved, sickleshaped, tubular, and possess ringed achene, disc florets, and hermaphroditic characteristics. The Calenduleae tribe consists of eight genera and over 110 species, predominantly found in South Africa (11). The plant is indigenous toMacaronesia, extending eastward through the Mediterranean region, Western

TraditionalUses:

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through the Mediterranean region, Western Asia, the United States, Europe, Cyprus, Turkey, Iran, and several Middle Eastern countries, where it is cultivated as an ornamental plant (12).

Traditional Uses Ayurveda, Unani, Homeopathic, and other traditional systems of medication utilize C. officinalis widely for curing different ailments. C. officinalis is valued as a diaphoretic, analgesic, antiseptic, and antiinflammatory agent and isused to treat gynecological issues, gastrointestinal disorders, inflammations of oral and pharyngeal mucous, eye problems, skin injuries (20), and certain burns (21), poor eyesight, and menstrual irregularities (8,22-24). It is also used as a sudorific, blood refiner, and blood sugar reducer (25). The flower's head has been utilized as tinctures, balms, and salves for its cicatrizing, anti-tumor (26), blood refining, peptic-ulcer, astringent, diuretic, hypoglycemic, and antipyretic properties (27-30). In India, Calendula ointments are applied topically to treat skin damage, gangrene, wounds (31), acne, chickenpox, mumps, scars, herpes, ulcers, frostbite, and wounds (32).

This study compiles dispersed reports on the traditional applications, pharmacological properties, and phytochemistry of C. officinalis. The primary focus is to emphasize its importance as a natural therapeutic remedy, supported by positive findings in the literature. The aim of this review is to concisely summarize existing research, address knowledge gaps, and propose avenues for further studies validating traditional claims and ensuring the safe and effective use of C. officinalis in treating various diseases.

Chemical Constituents of Calendula officinalis:

Calendula officinalis is a valuable medicinal plant, known for its diverse phytochemical composition. Various plant parts contain different concentrations and types of bioactive compounds, including terpenoids, flavonoids, saponins, sterols, phenolic acids, coumarins, quinones, amino acids, essential oils, and carotenoids (Table 2) (38–41).

Category	Compounds	References
Terpenoids	calenduladiol-3-O-palmitate, stigmasterol, lupeol, Ψ-taraxasteol, calenduladiol-3-O-myristate, arnidiol-3-O-myristate, arnidiol-3-Olaurate, arnidiol-3-O-palmitate, faradiol-3-O-laurate, faradiol-3-Opalmitate, faradiol-3-O-myristate, calendulosides A–H, calendulaglycosides A and B	1, 8, 42, 43, 37, 44, 27, 45
Flavonoids	quercetin, calendoflaside, calendoflavoside, isoquercetin, calendoflavobioside, rutin, gallic acid, isorhamnetin, isorhamnetin-3-O-D-glycoside, narcissin, pinobanksin 3-acetate, neohesperidoside, isorhamnetin-3O-2G-rhamnosyl rutinoside, quercetin-3-O-glucoside, isorhamnetin-3-O-2G quercetin, scopole- tin-7-O-glucoside, isorhamnetin-3-O-glucoside calendoflavobioside	46, 47, 48, 49
Coumarins	umbelliferone, scopoletin, esculetin, isobaisseoside, haploperoside A, haploperoside D, neoisobaisseoside	55, 56, 57, 58
Category	Compounds Details	
Carotenoids	Flavoxanthin, lutein, 19 carotenoids identified, astaxanthin, variations determine shade of violaxanthin, β-carotene orange and yellow (67,70–72)	
Amino Acids	Leucine, valine, proline, 15 free amino acids identified histidine, asparagines, in flower extracts (26,73,74) glutamic acid, lysine, serine, threonine,	
Carbohydrates	methionine, alanine, arginine, aspartic acid, tyrosine, phenylalanine	Present in the plant (75,76)

Lipids and Fatty Acids	Neutral lipids, glycolipids, phospholipids, palmitic acid, myristic acid, lauric acid, stearic acid, linoleic acid, oleic acid, linolenic acid	Seed oils contain calendic acid (51.47–57.63%), linoleic acid (28.5–31.9%), oleic acid (4.44–6.25%), palmitic acid (3.86–4.55%) (73,77,78,79)

Pharmacological Activities of Calendula officinalis

Overview:

Calendula officinalis is widely recognized for its medicinal applications, offering antibacterial, antioxidant, anti-inflammatory, antiseptic, antiviral, hepatoprotective, gastro-intestinal, obstetric, anti-mutagenic, and antidiabetic properties (80–82).

Antidiabetic Activity:

Diabetes mellitus (DM) remains a global health challenge, particularly Type 2 DM, which is prevalent in industrialized nations. Reports indicate approximately 5 million deaths caused by DM globally in 2017 (83). Natural plant-based treatments are being explored as safer and more effective alternatives to conventional drugs (84). Studies have demonstrated the antidiabetic effects of Calendula officinalis extracts in both in vivo and in vitro models.

Chakraborthy et al. evaluated the hydroalcoholic extract of Calendula officinalis in alloxan-induced diabetic rats. Oral administration (100 mg/kg) resulted in reduced serum lipid levels, urine sugar, and blood glucose (85). Studies on streptozotocin (ST/)-induced diabetic rats revealed increased insulin, glutathione, and reduced glucose and inflammatory cytokines at doses of 200–400 mg/kg (86). Moradkhani et al. confirmed a significant reduction in plasma glucose with hydroalcoholic extracts (300 mg/kg) (87).

Antioxidant Effects:

Reactive oxygen species (ROS) are implicated in diseases such as diabetes, inflammation, and cancer. Extensive research has identified Calendula officinalis as a potent antioxidant due to its ability to neutralize ROS (92,93).

Various methods, including DPPH, ABTS, nitric oxide (NO) radical scavenging, and ferric reducing antioxidant power (FRAP), have demonstrated the antioxidant capabilities of Calendula officinalis extracts. The extract showed IC50 values of 500 µg/mL for superoxide radicals, 480 µg/mL for hydroxyl radicals, and 2000 µg/mL

for lipid peroxidation. Oral administration of extracts (100–250 mg/kg) increased glutathione and catalase activity in vivo (94–96).

Anti-inflammatory and Analgesic Activity:

Calendula officinalis has long been used in traditional medicine for treating pain and inflammation. Extracts prepared as tinctures, ointments, and lotions exhibit anti-inflammatory and analgesic effects (43).

Animal studies reported that calendula flower extract suppressed nitric oxide(NO) production by 50% (147 µL/mL) without cytotoxicity (45). Carrageenaninduced paw edema and dextran-induced acute inflammation models showed significant reductions in inflammatory markers such as IL-1beta, IL-6, and TNF-alpha at doses of 250–500 mg/kg (24). Terpenoids, especially faradiol, contribute to these anti-inflammatory properties (90).

Antibacterial and Antifungal Activity:

Calendula officinalis has shown promising antibacterial and antifungal properties. The floral oil inhibited Bacillus subtilis, Escherichia coli,

Pseudomonas aeruginosa, and Staphylococcus aureus using agar well diffusion assays. Tinctures at 60% concentration (v/v) were particularly effective against bacterial strains.

Conclusions:

Calendula officinalis is recognized as one of the most potent and beneficial flowering plants, offering a wide range of health benefits and pharmacological activities. It is rich in diverse chemical constituents, including terpenoids, glycosides, flavonoids, volatile oils, and carbohydrates, which contribute to its various physiological effects.

The extracts derived from Calendula officinalis flowers have demonstrated superior biological activities compared to other plant parts. Despite its promising therapeutic applications, further comprehensive studies are required to assess its safety, efficacy, and toxicity. Such investigations will aid in the development of well-designed formulations and expand its use in modern medicine.

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