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Review

Exploring the Pharmacogenetic Standard Bioactive Potential Tagetes Erect

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Abstract: Marigold is a hardy annual plant native to Southern Europe and widely cultivated in tropical countries like India and China. Marigold (Tagetes species) has been used for centuries in traditional medicine and more recently in modern therapeutic applications. It produces brightly colored, fragrant flowers most commonly yellow which are edible and used as natural colouring agents and spices. Medicinal benefits of *Calendula officinalis* include wound healing, anti-inflammatory, antimicrobial, skin protective, menstrual supportive, oral care, and digestive protective properties. According to phytochemical analysis, carotenoids, flavonoids, terpenoids, thiophenes, essential oils. Different parts of the plant contain important phytochemicals such as lutein, quercetin, quercetagenin and its glucoside, syringic acid, thienyl compounds, terpenes, and various phenolic compounds. Various pharmacological properties include, wound healing, anti-inflammatory, antimicrobial, skin protective, menstrual supportive, oral care, and digestive protective properties.

Keywords: Tagetes erecta, Marigold, Phytochemical constituents, Pharmacological activities, Flavonoids, Carotenoids, Antimicrobial activity, Antioxidant activity, Wound healing, Medicinal plants.

INTRODUCTION

Marigold (Tagetes species), a member of the Asteraceae family, has been cultivated for centuries for its ornamental, medicinal, and culinary properties[1]. The traditional uses of marigold span a wide range of applications, from treating digestive disorders and skin ailments to addressing eye problems and infections[2].

The most common Tagetes are African marigold, scientifically known as *Tagetes erecta* L.

The name Tagetes is originated from the name of the Etruscan Tages. It belongs to a Asteraceae family and Tagetes genus, containing about 50 species. This plant needs temperatures between 20°C and 30°C and flowers grow large amount annually in winter and rainfall seasons[3].

In recent years, renewed scientific interest has focused on their therapeutic potential, driven by growing evidence of diverse bioactive compounds and associated health benefits. The

genus *Tagetes* comprises nearly 50 species, among which *Tagetes erecta* (African marigold), *Tagetes patula* (French marigold), and *Tagetes minuta* (wild marigold) are the most extensively studied for their medicinal applications [4].

Tagetes has a long history of human usage as drinks, sauces, ornamentals, and medical purposes such as analgesics, antiseptics, carminatives, diuretics, antispasmodics, anthelmintics, stimulants, vermin repellents, and treatment of stomach and intestinal disorders [5].

Scientific classification

Kingdom: Plantae

Division: Magnoliophyte

Class: Magnoliopsida

Order: Asterales

Family: Asteraceae

Genus: *Tagetes*

Species : *erecta*

Botany

Tagetes erecta L. (African marigold): These are rapid-growing annual flowering plants in height ranging from dwarfs of 6-8 inch, to medium and taller and erect-growing plants with heights from 10 in to 3ft, bearing large pompon-like double flower up to 5 in across and has a shorter flowering period from midsummer to frost. [6]. This species is characterized by large, pompon-like flower head standing from yellow to orange. It is the most widely cultivated species for ornamental and medicinal purposes[7].



Fig 1: flower of *tagetes erecta*

Pharmacognosy and Botanical identification

Description

Powder Microscopy:

Take 3-5g powder drug sample was weighed, mixed with 50ml of distill water in a beaker and warmed gently in order to make complete dispersion in water. Then mixture was centrifuged and decanted supernatant. The sediment washed several times with distilled water, centrifuged again and decanted the supernatant. Small quantity of the sediment was taken and mounted in 58eculariz, out of which another small quantity was taken in watch glass and a few drops of phloroglucinol and concentrated hydrochloric acid were added, mounted in 58eculariz to locate lignified cells. The following characters in different mounts were observed (Wallis, 1987; Johansen, 1940).

Microscopic Peduncle:

Peduncle T. S. and LS. Peduncle from young flower shows almost circular in outline; epidermis consisting of single layer of thick-walled parenchyma cells with numerous trichomes; cortical parenchyma consisting of few layers of collenchyma's, chlorenchyma and parenchyma cells; vascular bundles arranged in the form of ring shaped with numerous collateral vascular bundles with xylem towards inner side and phloem towards outside; sclerenchyma fibres present above the phloem; pith prescre – Young flower:

T. S. shows an outline deeply convex on the abaxial and slightly concave on the adaxial side; epidermis consisting of single layer of thin-walled parenchyma cells on the upper side and thick-walled cells on the lower side; mesophyll consisting of few layers of parenchyma cells; vascular bundle present in the centre with sclerenchyma cap towards the outer side. (Shown in Fig 2, a. & b. respectively.)

Powder:

Yellowish green; thin-walled elongated parenchyma cells with tapering ends from the pappus hairs of calyx, rectangular thin walled parenchyma cells with fibro-vascular bundles from calyx and corolla, thin walled elongated parenchyma cells from the corolla and some of the cells filled with yellowish brown contents, thick

walled epidermal cells in surface view, papillose epidermal from the corolla and spiral vessels up to 15 μ . (Clearly sowed and mentioned in Figer-2 a. b. c. d. & f. respectively.)

Involucre – Flower:

T. S. of lower side of the involucre shows an almost straight in outline; epidermis consisting of single layer of thick walled parenchyma cells on the upper side and thin walled cells on the lower side; mesophyll consisting of several layers of very thick walled parenchyma cells on the upper side; vascular bundle present with sclerenchyma cap; numerous parenchyma cells of circular to oval shaped cells arranged with large intercellular spaces present in the lower side.

T. S. of upper side of the involucre shows an almost straight in outline with slight raised portion on the upper side and concave on the lower side; epidermis consisting of single layer of thick walled parenchyma cells on the upper side and thin walled cells on the lower side; mesophyll consisting of few layers of very thick walled parenchyma cells on the upper side; vascular bundle present with sclerenchyma cap; numerous polygonal parenchyma cells present in the mesocranic region and some of the cells filled with chloroplast. (Shown in Figer-5 a. b. c. d. e. f. & g. respectively.).

T.S. of flower



L. S. of the flower



Powder

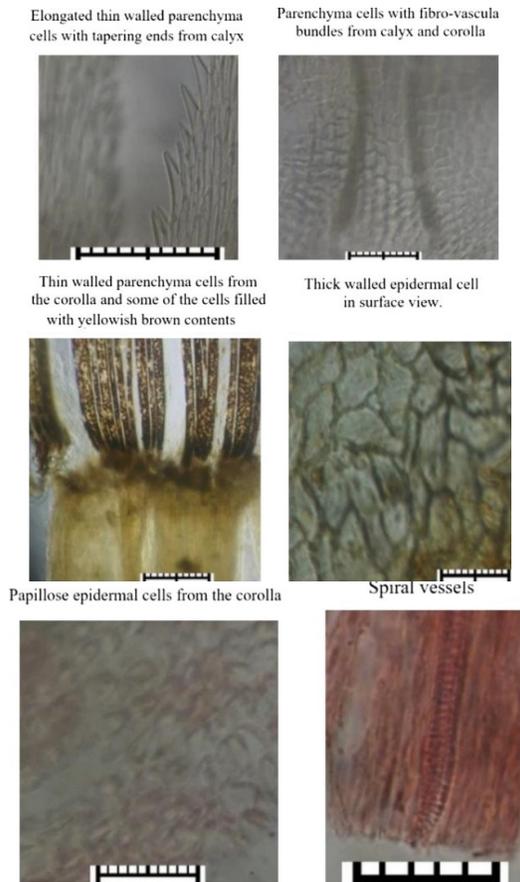
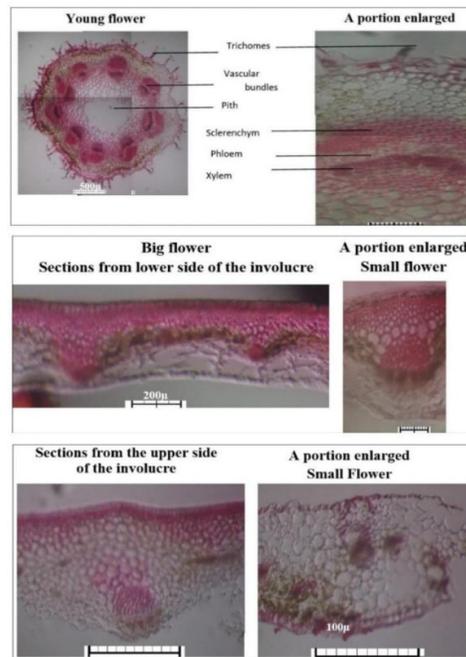


Fig 2: a., b., c., d., e. & f.

T. S. of peduncle involucre



Ethnomedicinal Uses:

Different parts of this plant including flower are used in folk medicine to cure various diseases. Leaves are used as antiseptic, in kidney troubles, muscular pain, piles and applied to boils and carbuncles. The flower is useful in fevers, epileptic fits (Ayurveda), astringent, carminative, stomachic, scabies and liver complaints and is also employed in diseases of the eyes. They are said to purify blood and flower juice is given as a remedy for bleeding piles and also used in rheumatism, colds and bronchitis. Different species of *Tagetes* have been found to possess antimicrobial, anti-inflammatory, hepatoprotective, wound healing, insecticidal, analgesic activities. The pharmacological activity of *Tagetes erecta* is related to the content of several secondary metabolites and the most important compounds are terpenes, essential oils, flavonoids, carotenoids and polyphenols.

CHEMICAL CONSTITUENTS

Marigolds (*Tagetes* species) contain carotenoids, terpenoids, thiophens, flavonoids, and phenolic compounds .

Tagetes erecta contains quercetagenin, a glucoside of quercetin, as well as thienyl and ethyl gallate. Lutein is an oxycorticoid or xanthophyll with two cyclic end groups (one one-ionone ring) and the fundamental C-40 isoprenoid structure that all carotenoids have in common. It is a significant component and the primary pigment of *Tagetes erecta* [8] .

Twenty two natural occurring Phyto constituent including β sitosterol, hydroxy sitosterol, lupeol, erythritol, erythrodiol-3-palmitate, α -therthienyl, quercetagenin, quercetagenin-7-methyl ether, quercetagenin-7 O-glucoside, kaempferol, syringic acid, gallic acid, 3- β galactosyldisyringic acid, 3- α -galactosyldisyringic acid, 6 ethoxy- 2,4-dimethyl quinoline, poloidal, (3S,6R,7E)- hydroxy-4,7megasigmadien-9-one, palmitin, ethylene glycol lineate, and N- hexadecane various fraction of Ethanolic extract of flower of *Tagetes erecta* [9]. steam distillation of fresh leaves yields 0.3 percent essential oil, which includes d-limonene, linalyl acetate, n-nonyl aldehyde, and lutein and has a strong, pleasant, long-lasting odor. 4-methoxy-eupatolytin-3-O-glycoside, kaempferitrin, β sitosterol, daucosterole, and gallic acid were

discovered in the stem and leaves of *Tagetes erecta* [10].

Pharmacological effect :

Antibacterial activity: The antibacterial activity of different solvents of *Tagetes erecta* flowers against *Alcaligenes faecalis*, *Bacillus cereus*, *Campylobacter coli*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Streptococcus mutans* and *Streptococcus pyogenes*. The flavonoid possesses antibacterial activity against all the tested strains and shows a maximum zone of inhibition for *Klebsiella pneumoniae* (29.50 mm). Flavonoid-patulitricin is one of the potential elements for its anti-bacterial activity [11].

Antimicrobial activity: Antimicrobial activity of flavonoids from *T. minuta* L. leaves has been reported, with the presence of quercetagenin-7 arabinosylgalactoside as the antimicrobial agent in the extract, as well as patuletin and patulitricin in certain fractions [11]. The tincture made from its leaves and flowers, as well as its n-hexane, ethanol, and aqueous extracts, were evaluated for antibacterial activity against *Vibrio cholerae*, with the best antibiotic activity being recorded [12].

Cytotoxic activity: Cytotoxic activity Chkhikvishvili et al. (2016) [13] discovered that certain *T. patula* flavonoids, particularly patuletin, can exhibit cytotoxic effects on Jurkat cells, signifying anticancer activity. The *Tagetes* species had previously been reported to exhibit cytotoxic action, as aqueous and ethanol extracts of *T. lucida* aerial parts were effective against HeLa (GI50: 13.2 g/ml and GI50: >50 g/ml) and breast cancer (T47D) cell lines (GI50: 18.9 g/ml and GI50: 1.82 g/ml, respectively) [14].

Wound healing activity: Marigold has long been used traditionally for wound treatment, and recent studies provide scientific validation for these applications.(15) In vivo studies: Topical application of *T. erecta* extract significantly accelerated wound contraction and enhanced collagen deposition in rat models [16].Mechanism: The wound healing efficacy is attributed to a synergistic action of antimicrobial, anti-inflammatory, and antioxidant properties,

along with stimulation of fibroblast proliferation [17].

Antinociceptive and anti-inflammatory activity:

Antinociceptive and anti-inflammatory activity of chloroform, methanol and ether fraction of *Tagetes erecta* reported by using acetic acid induced writhing in mice and carrageenan-induced paw oedema in the rat (Shinde et al., 2009)[18]. Anti nociceptive and anti-inflammatory activity of hydroalcoholic extract of leaves of *Tagetes erecta* reported by using acetic acid-induced writhing and hot plate method in mice and carrageenan-induced paw oedema in the rat .[19].

Antiepileptic Activity:

The ethanolic extract *Tagetes erecta* was evaluated using the in vivo models such as pentobarbitone induced sleeping time, MES and PTZ induced convulsions, potentiation of PTZ induced convulsion, spontaneous locomotor activity, forced swim test and learned helplessness test model [20].

Hepatoprotective activity:

Ethyl acetate fraction of *T. erecta* at the dose of 400 mg/kg orally significantly decreased the elevated serum ALT, AST, ALP and level of bilirubin almost to the normal level compared to CCl₄ intoxicated group. Histological changes in the liver of rats treated with 400 mg/kg of the extract and CCl₄ showed a significant recovery except for cytoplasmic vascular degenerations around portal tracts, mild inflammation and foci of lobular inflammation [21].

8. antioxidant activity:

Marigold extracts exhibit significant antioxidant activity, primarily due to their rich content of carotenoids and flavonoids. In vitro studies: Extracts from *T. erecta* and *T. patula* have demonstrated strong free radical scavenging abilities and effective inhibition of lipid peroxidation [22]. In vivo studies: Oral administration of *T. erecta* extract in rats significantly increased antioxidant enzyme levels and reduced oxidative stress biomarkers [23].

9. mosquitocidal activity:

Mosquitocidal effects of ethanolic extract of flowers of *Tagetes erecta* and its chloroform and petroleum ether soluble fractions against the larvae of *Culex*

quinquefasciatus have been investigated . The larvicidal effect of ethanol extract and their solvent fractions were determined by the standard procedure of WHO against different instars of *C. Quinquefasciatus* [24]

10. Anti-cancer activity :

Marigold has long been used as a medicinal herb for a number of therapeutic activities. The cytotoxic activity of ethanol and ethyl acetate extracts of marigold flowers and their inhibitory effects on elastase and tyrosinase enzymes were investigated.[25]

Conclusion

Tagetes erecta (African marigold) is a valuable medicinal plant widely recognized for its diverse pharmacological properties and rich phytochemical composition. The plant contains several bioactive compounds such as flavonoids, carotenoids, terpenoids, thiophenes, and phenolic compounds that contribute to its therapeutic potential. Various studies have demonstrated significant biological activities including antimicrobial, antioxidant, anti-inflammatory, wound healing, hepatoprotective, cytotoxic, and mosquitocidal effects. Traditional medicinal systems have long utilized different parts of the plant to treat conditions such as skin infections, digestive disorders, fever, and inflammatory diseases. Modern pharmacological investigations further support these traditional claims and highlight the potential of *Tagetes erecta* as a promising natural source for the development of new therapeutic agents. Therefore, further research focusing on isolation of active compounds, clinical validation, and formulation development is necessary to fully explore and utilize the medicinal potential of this plant.

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