



# A Pharmacognosy, Ethanobotany and Phyto-pharmacology of *Tagetes erecta* Linn.

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## Abstract

Various portions of plant sources have been employed as nutraceuticals, food supplements, ancient remedies, significant constituents in contemporary medications and Ayurveda since the Rig-Veda. India is known for its diverse plant species, and over 2500 medicinal plants are currently utilized in various manufacturing businesses. Since ancient times, African marigold (*Tagetes erecta*) has been utilized for therapeutic purposes. Herbal medicine's beneficial effects are usually due to a combination of secondary metabolites formed in the herbs, such as glycosides, alkaloids, flavonoids, tannins, gums, and so on. There is a need for documenting of scientific work done on these herbs, therefore a current review of *Tagetes erecta* Linn is in order. The oil is derived from African marigold plant parts such as fresh flowers, dry flowers, fresh leaves, and dry leaves using two different methods: hydro-distillation and solvent extraction. *Tagetes* species, which belong to the Asteraceae family, are the most common in the plant kingdom and are used in a variety of applications including cosmetics, pharmaceuticals, and ornamentals. Flowers are mostly used in the extraction process for all of these functions.

**Keywords:** *Tagetes erecta* Linn., ethanobotony, phytochemistry and pharmacological activities.

## Introduction:

Traditional medicines have gained widespread recognition in recent decades for their potential therapeutic usefulness, and it is believed that 80 percent of the population relies on traditional medicine for their primary treatment<sup>1</sup>. With around 0.126 percent million species, India has over 8% of the world's estimated biodiversity.

According to the World Health Organization (WHO), almost 80% of the world's population relies on traditional

medicines, usually plant pharmaceuticals, for their health care. Ayurveda is still extensively utilized and practiced today,

coexisting with contemporary medicine. Natural origin medicines account for around 30% of all presently utilized therapies<sup>2</sup>. Herbal pharmaceuticals have been the subject of research in the areas of natural product chemistry, pharmacognosy, pharmaceutics, pharmacology, and clinical therapies, and most of the major pharmaceutical companies have updated their strategy to favor natural products. Many herbal cures have been advised for the treatment of various ailments, either separately or in combination, in various medical treatises. The medicinal efficacy of *Tagetes erecta*, sometimes known as Marigold, has been acknowledged in several traditional medical systems for the treatment of various human illnesses.

There is a need for recording of studies on these therapeutic plants, hence a timely review of *Tagetes erecta* Linn is in need. *Tagetes* is a sunflower genus that includes annual and perennial herbaceous plants (Asteraceae). Linnaeus classified it as a genus in 1753. The name *Tagetes* is derived from the Etruscan name *Tages*. *Tagetes erecta* L. is the scientific name for the most extensively grown variety of *Tagetes*, which are often known as African marigold<sup>4</sup>. Medicinal plants provide livelihood and health security to a huge percentage of the Indian population, as well as a major resource base for traditional medicine and the herbal business.

### **Habitat and Distribution:**

*Tagetes* is a genus of annual or perennial herbaceous plants in the Asteraceae family with roughly 50 species. *Tagetes erecta* Linn is a plant that grows upright. Genda Phul is the local name for it (Marigold)<sup>6</sup>. It is a robust, branching herb native to Mexico and other warmer parts of America, but it has been seen throughout the tropics and subtropics, including India and Bangladesh. These are fast-growing annual flowering plants with heights varying from dwarfs of 6 to 8 inches to medium and taller, erect-growing plants with heights ranging from 10 to 3 feet, displaying huge pompon-like double flowers up to 5 inches across, and a shorter flowering time from midsummer to frost<sup>7</sup>. Marigold production in the globe is estimated to be around 600,000 tones, with India accounting for roughly 75-80 percent of that. India utilizes almost 80% of its own output. The best marigold in the world is Indian marigold. *Tagetes erecta* is the most common commercial species, with flowers found in India, China, Sri Lanka, Indonesia, Jamaica, and Peru. Erode, in the southern Indian state of Tamil Nadu, is the country's largest marigold producing and trading centre.

## Morphology:

*T. erecta* Linn and *T. patula* Linn are the two most common marigold species. *T. erecta*, also known as the American marigold, has larger flowers, while *T. patula*, popularly known as the French marigold, has smaller flowers. Flowers in yellow, orange, golden, or bicolored hues are raised high above the finely textured dark green foliage or hidden in within it<sup>8</sup>. The plant reaches a height of 1 to 3 feet and a spread of 0.5 feet. The leaves are organized in an opposite/subopposite manner, with odd pinnately complex leaf kinds. The form is oblong and the edge is dentate. The length of the leaf blade is less than 2 inches, and the color of the leaf is green. The flower's color ranges from orange to yellow to golden to bicolored<sup>4</sup>. Marigold is a typical garden plant that is coarse, upright, branching, and grows to a height of about 1 meter. Short or dwarf types are also available. The leaves are severely carved and have sharp teeth. Solitary flower heads with long stalks and thickening upwards. The flowers are bright yellow, brownish yellow, or orange in colour.

**Taxonomical Classification:** *Tagetes erecta* is a tall, branching herb that is native to Mexico and other warmer parts of America, but has been discovered in the tropics and subtropics, including India and Bangladesh.

Kingdom : Plantae Order :

Asterales Family :

Asteraceae Subfamily :

Asteroideae

Class : Magnoliopsida Division :

Magnoliophyta Genus : *Tagetes*

Species : *erecta*



**Figure 1:** *Tagetes erecta* Linn. Plant with flowers

## Ethanobotany:

Various components of this plant, particularly the bloom, are used in folk medicine to treat a variety of ailments. The leaves are said to help with piles, kidney problems, muscular soreness, ulcers, wounds, and earaches, among other things. Boils and carbuncles are treated externally with the pulverized leaves. Fevers, epileptic fits, astringent, carminative, stomachic, scabies, liver ailments, and eye diseases are all treated with the flower. They purify the blood, and flower juice is used to treat bleeding piles, as well as rheumatism, colds, and bronchitis.

Flowers juices are sometimes used as a blood purifier and a treatment for piles in India. Flower and leaf

infusions are used as a vermifuge in Brazil. Mexicans employed flower and leaf decoctions as diuretics and carminatives. Marigold was utilized by the Aztecs to treat eye problems<sup>9</sup>. Marigold is used to treat joint pain and muscle spasms in Brazil and Mexico. Anemia,

irregular menstruation, stomach pain, and muscle and bone pain are among the other folkloric uses of *Tagetes*. *Tagetes* is used internally to treat indigestion, colic, cough, and dysentery. Externally, it's used to treat ulcers, eczema, itchy eyes, and rheumatism.

### **Pharmacognostic and Phytochemistry:**

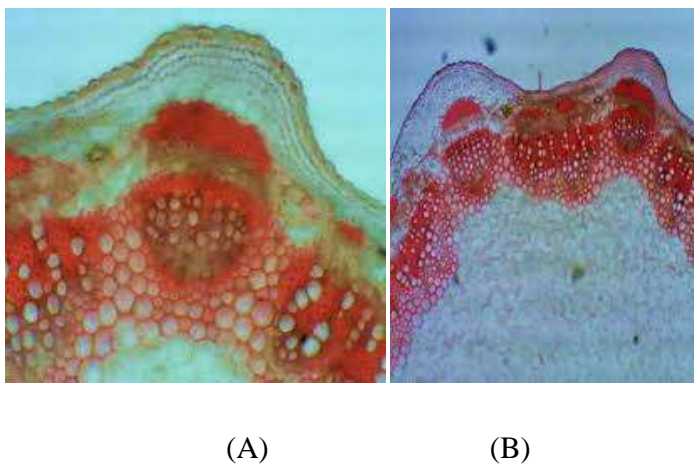
Pharmacognostic and Phytochemical parameters of *Tagetes erecta* Linn. is as follows,

#### **Anatomical Study**

The study of anatomical characteristics has been used to clarify taxonomic status and aid in the identification of various species. In cross sections, the stem of *T. erecta* showed a circular shape with 9-10 ridges and furrows, and the tissue began with cutinized oblong ovate to circular ovate epidermal cells with a mean thickness of 25.25  $\mu$ m. Below the epidermis, the cortex layer is made up of angular collenchymas in the ridges and furrows, 4-5 rows of lamellate collenchymas, and 2-3 rows of ovate parenchyma cells in the stem's remaining regions<sup>10</sup>. The mean thickness of these tissues was 65.24  $\mu$ m for the angular layer, 89.54  $\mu$ m for the lamellar layer, and 53.22  $\mu$ m for the parenchyma layer, respectively.

The epidermis in a transverse section of the root is composed of a single layer of rectangular to oblong rectangular cells with a mean thickness of 25.33  $\mu$ m. Below the epidermis, a cortex of 6-10 rows of parenchymatous cells with a thickness of 220.53  $\mu$ m appeared, with some of these cells storing starch grains (storage parenchyma tissue). The phloem is made up of a ring of cuboidal and rectangular cells with a thickness of 198.5  $\mu$ m. A regular diffused porous wood with a half diameter of 350.5  $\mu$ m was observed in the root's centre.

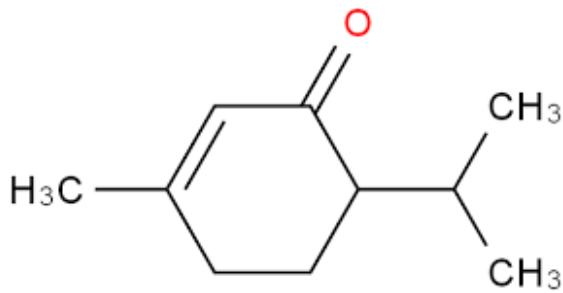




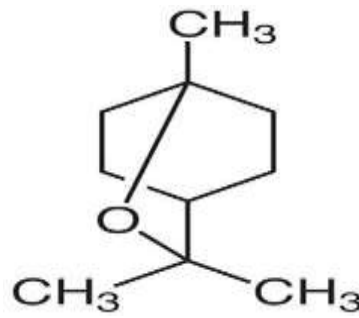
**Figure 2:** A - T.S of Stem, B - T.S of Root

### Phytochemical Parameter

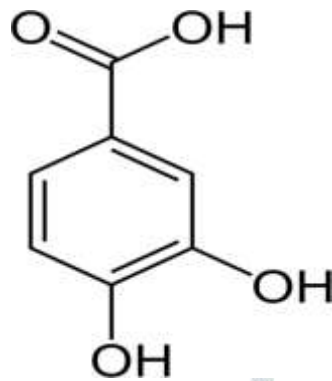
The isolation of several chemical compounds such as thiophenes, flavonoids, carotenoids, and triterpenoids has resulted from phytochemical investigations of its various portions. Quercetagenin, a glucoside of quercetagenin, phenolics, syringic acid, methyl-3, 5-dihydroxy-4- methoxy benzoate, vinyl, and ethyl gallate have all been found in *T. erecta*<sup>3</sup>. Syringic acid, quercetin, 6-hydroxykaempferol, protocatechuic acid, and quercetagenin are all found in *Tagetes erecta's* ethanol extract. The anticancer compounds quercetin and 6-hydroxykaempferol were found to be effective against lung malignancy. These chemicals were shown to impede proliferation and cause cytotoxicity in human liver cancer cell lines (HepG2) and lung cancer cell lines (A549) 40. With large contributions from components such as patuletin and patulitrin, the related flower *T. patula* (French marigold) has shown significant cytotoxic, growth inhibitory, and free radical scavenging activities. HeLa cell lines were used to illustrate the anticancer capabilities<sup>9</sup>. Through GC and GC/MS analysis, 33 components in leaf and stem oil and 34 components in flower oil were identified. In leaf and stem and flower oils, the principal described phytoconstituents were caryophyllene, terpinolene, (E)-ocimene, (Z)-ocimene piperitenone, (Z)-ocimene, and limonene, respectively<sup>4</sup>. The major components in the leaf oil of *T. erecta* gathered from Nigeria were piperitone (50.7%), piperitenone (13.2%), and (E)— ocimene (6.7%). The presence of 1, 8-cineole, -pinene, -terpineol, piperitone, and sabinene as significant components in the flower oil was noted.



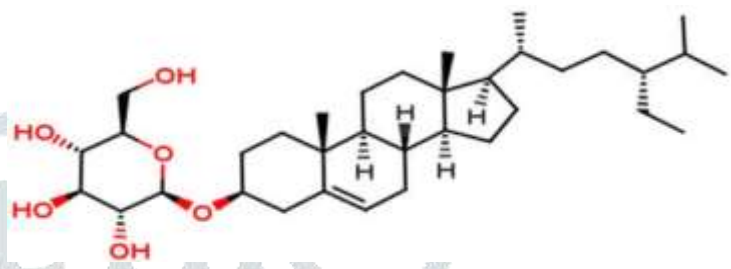
Piperitone



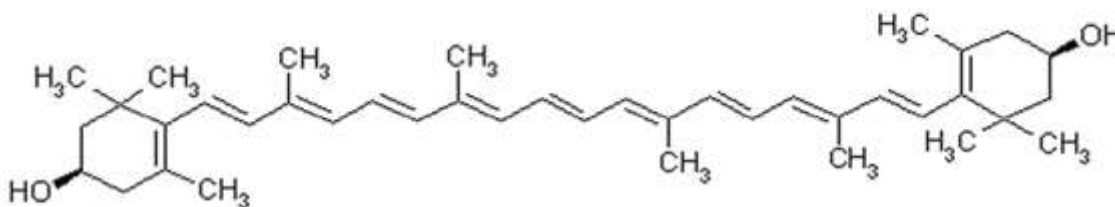
1, 8 Cineole



Protocatechuic acid



Daucosterol



Zeaxanthin

## Pharmacology:

### Antibacterial activity

Different solvents from *Tagetes erecta* flowers were tested for antibacterial activity against *Alcaligenes faecalis*, *Bacillus cereus*, *Campylobacter coli*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Streptococcus mutans*, and *Streptococcus pyogenes*. The flavonoid has antibacterial activity against all pathogens tested, with a greatest inhibitory zone for *Klebsiella pneumoniae* (29.50 mm). One of the probable components for its antibacterial activity is flavonoid-patulitrin. The flower portions had the strongest inhibitory effect against the strain of *Neisseria gonorrhoea*.

### **In- vitro antioxidant activity**

*Tagetes erecta L.* leaves extract and its separated components, AK1, AK2, and AK3, were tested in vitro for antioxidant activity. The researchers used two separate in-vitro antioxidant assays: hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) radical scavenging antioxidant test and hydroxyl ion (OH) scavenging antioxidant assay. As a control, ascorbic acid was employed.

### **Insecticidal activity**

The toxicity of *Tagetes erecta* was investigated against six different larval and adult stages of *Tribolium castaneum* in this study. The findings of the ethanol extract, petroleum ether fraction, and chloroform fraction, respectively, were recorded and statistical data on LC, 95 percent confidence limit, and Chi-square value were determined. In comparison to the LC values, the chloroform fraction of *Tagetes erecta* flower was more poisonous to both larvae and adults of *Tribolium castaneum* than the ethanol extract and petroleum ether fraction. Even after 3 days without meals, there was no mortality in the control groups. The toxicity of plant extracts decreased as the larvae grew older, according to the findings of this study. This could be because only a small amount of extracts were consumed, yet it was enough to kill a big number of them. The results of this study demonstrated that *Tagetes erecta* has strong insecticidal action and can be utilised in an integrated pest management system to control *Tribolium castaneum* populations, which appears to be both economically and environmentally sound.

### **Larvicidal activity**

The larvicidal activity of *Tagetes erecta* essential oil against *Aedes aegypti* 3rd instars, as well as the quantities of larvicidal thiophenes in all plant tissues. There were 14 chemicals found in the oil produced by steam distillation and examined by gas chromatography/mass spectrometry. Piperitone (45.72 percent), d-limonene (9.67 percent), and piperitenone were the most common chemicals (5.89 percent). The essential oil had an LC<sub>50</sub> of 79.78 g/ml and an LC<sub>90</sub> of 100.84 g/ml against *Aedes aegypti* larvae<sup>16</sup>. High-performance liquid chromatography research revealed that the roots and flowers have higher levels of larvicidal thiophene. As a result, *Tagetes erecta* is a rich source of a wide range of chemicals with larvicidal activity against *Aedes aegypti*.

### **Nematicidal activity**

For the management of *M. incognita*, the nematicidal efficacy of four medicinal plants, *Azadirachta indica*, *Calotropis procera*, *Datura stramonium*, and *Tagetes erecta*, was determined. In comparison to the untreated control, all leaf amendments at various dosages dramatically improved okra plant development characteristics and reduced rootknot infections.

### **Diuretic activity**

The extract's diuretic effect was tested using the metabolic cage approach. The test animals were picked at random and put into five groups of ten mice each. Group I, often known as the control group, was given only normal saline solution and 1% Tween 80 orally at a dose of 10 ml/kg body weight. The urea solution was administered to Group II at a dose of 500 mg/kg. Furosemide, a commonly used diuretic, was given to Group III at a dose of 0.5 mg/kg. The test groups were given a methanolic extract of the whole plant *T. erecta* at doses of 200 and 400 mg/kg, respectively. The urinary of each group was recorded after five hours from the graduated urine chamber of the metabolic cage after oral administration of test samples. Following centrifugation of the entire urine output, sodium and potassium ions are measured using a digital flame photometer.

The effect of a methanolic extract of *T. erecta* on mouse urination was studied for 5 hours, revealing that the extract has a significant diuretic effect in test animals. This was analogous to the effects of the common diuretic furosemide and the diuretic urea. The  $\text{Na}^+/\text{K}^+$  excretion ratio of methanolic extract of entire plant at doses of 400 and 200 mg/kg was found to be similar to that of the loop diuretic furosemide.

### **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<sup>3</sup>. *Tagetes erecta* ethanolic extract demonstrated antiepileptic activity. The findings suggested that ethanolic extract may lower the seizure threshold in epileptic patients, but the chances of seizure precipitation are increased, so use in epilepsy is advised with caution<sup>21</sup>.



### Anticancer activity

Flavanoids including quercetin, quercetagenin, and 6-hydroxykaempferol were discovered to be the bioactive elements of *T. erecta* flowers. These chemicals were found to suppress the proliferation of human liver cancer cell lines (HepG2) and lung cancer cell lines, as well as cause cytotoxicity (A549)<sup>22</sup>. According to the findings, *Tagetes erecta* petal extract has the potential to be a promising lead drug for the treatment of fungal infections and breast cancer. Simple screening methods were used to acquire an initial notion of the floral extract's activity. More in-vitro assays are needed to confirm this finding before moving on to in-vivo animal investigations to see if it can be used in the real world<sup>23</sup>. The plant's active chemical ingredients with antifungal and anticancer activities must be investigated further. Cell cycle analysis can be useful in determining *Tagetes erecta*'s specific anticancer mode of action<sup>17</sup>.

### In-vitro antibacterial activity

The presence of plant secondary metabolites (alkaloids, glycosides, flavonoids, tannins, and terpenoids) in these extracts could explain their antibacterial properties. According to previous findings, *Tagetes erecta* flowers contain a substantial amount of free flavonoids and flavonoid glycosides<sup>24</sup>. All extracts were tested for antibacterial activity using the agar diffusion method,

### Conclusion:

The literature survey revealed that the plant *T. erecta* is an important source of many pharmacologically and medicinally important phytoconstituents. Many Indian herbs are being used in traditional practices

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