

# Chemical Analysis of the Essential Oil from *Tagetes minuta*

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## التحليل الكيميائي للزيت الجوهري من تاجيتس ماينتا

**المخلص:** تاجيتس ماينتا لِن، نبات عشبي ذو رائحة عطرية قوية يزرع بكثرة في شمال غرب الهملايا بين ارتفاع ١٢٥٠ و ٢٥٠٠ متر عن سطح البحر. الجزء العلوي لهذا النبات بعد تقطيره هيدروجيا أنتج ١,٢% (على أساس الوزن) من الزيت الرمادي المصفر برائحة عطرية قوية. بعد اختبار الزيت بمقاييس الطيف الكتلي الكروماتوغرافي للغاز، وجد أنه يحتوي على نسبة كبيرة من التاجيتون و ترانس-كاربوفيلين. المكونات الأخرى التي تم التعرف عليها أيضاً كانت بيتا-بابسابلين و كارفوتان أسيتون و كارفاكرو و سبترال و بيتا-كوبيبين و ب-سايمين و داي هايدروتاجيتون و آيسو-إيوجينول و بيتا-إينون و ليناليل أسيتات و لينالول و إسوليمونين و ميثيل-ن-هبتيل كيتون و بيتا-مايرسين و مينثول و نيروليدول و ٢ نونانول و بيتا-أوسيمين و أوسيمينون و ١-بينتن-٣-ول و فينيل أسيت ألدهايد و ألفا-بينين و ساتولينول و ألفا-ترينبول و جاما-ترينبول.

**ABSTRACT:** *Tagetes minuta* Linn. is a highly aromatic herb that grows wild on the North-West Himalayas between the altitudes of 1,250 and 2,500 m. The aerial part of the plant, on hydro distillation, yielded 1.2% of yellow-brown colored essential oil, on a dry weight basis, having a strong aromatic odor. Gas chromatograph-mass spectrometry examination of the oil showed that it contains tagetone and trans-caryophyllene as major constituents. The other constituents identified were  $\beta$ -bisabolene, carvotanacetone, carvacrol, citral,  $\beta$ -cubebene, p-cymene, dihydrotagetone, iso-eugenol,  $\beta$ -inone, linalyl acetate, linalool, isolimonene, methyl-n-heptyl ketone,  $\beta$ -myrcene, menthol, nerolidol, 2-nonanone,  $\beta$ -ocimene, ocimenone, 1-penten-3-ol, phenyl acetaldehyde,  $\alpha$ -pinene, spathulenol,  $\alpha$ -terpineol, and  $\gamma$ -terpineol.

*Tagetes minuta* Linn. Syn. *T. glandulifera* Schrank (family Compositae) is a highly aromatic herb that occurs in waste places on the Northwest Himalayas between the altitudes of 1,250 and 2,500 m. The volatile oil from the plant is reported to possess many medicinal properties and synergistic activity with pyrethrum (Nadkarni, 1954). It is also reported to bear antiviral activity (Hethelyi *et al.*, 1986). The oil also shows positive juvenile hormone activity on *Dysdercus koenigii* chiefly due to the presence of tagetone, a highly active juvenile hormone analogue (Ickes *et al.*, 1973). The flowers are used as a stomachic, diuretic, and diaphoretic. They contain a volatile oil that exhibits tranquilizing, hypotensive, spasmolytic, bronchodilatory, and anti-inflammatory properties. The ethanolic extracts of the entire herb show antiviral activity against Ranikhet animal virus disease.

The *Tagetes* oil, obtained by steam distillation of wild-flowering plants from Simla, had a pleasant odor comprising of aromadendrene, tagetone, phenyl ethyl alcohol, ocimene, and salicylaldehyde as major constituents (Handa *et al.*, 1963; Chopra *et al.*, 1963; Baslas and Singh, 1981).  $\beta$ -myrcene, aromadendrene, and limonene are also extracted from the essential oil from the leaves (Ickes *et al.*, 1973; Gupta and Bhandari, 1975). Ocimenone was isolated from flowers and leaves of the plant (Maradu *et al.*, 1978). The essential oil exhibited antimicrobial activity against fungi, gram-

positive, and gram-negative bacteria (Hethelyi *et al.*, 1986, 1987). Dihydrotagetone, tagetone,  $\beta$ -ocimene, and ocimenones were identified in the essential oil of flowers by GC-MS. Baser and Malyer (1996) have detected twenty two compounds from the essential oil of *T. minuta* with hydrotagetone,  $\beta$ -ocimene, and tagetone being the major constituents. Tagetone, limonene, and p-cymene were detected from aerial parts of the plant (Sigueira *et al.*, 1982). Garg and Mehta (1998) isolated three new acyclic monoterpene ketones from the essential oil of *T. minuta* flowers. The present study was aimed at investigating the essential oil components of *T. minuta* from the Himalayas.

## Materials and Methods

*Tagetes minuta* was collected from Kumaon region of Uttar Pradesh by a survey and plant collection team of the National Botanical Research Institute, Lucknow, India. It was identified by the systematic botanists of the Institute and a representative specimen was kept in the herbarium. On hydro distillation, the aerial part of the plant yielded 1.2% of yellow-brown colored essential oil, on dry-weight basis, having a sweet floral odor. Physio-chemical properties of the extracted essential oil were examined according to the methods of Baslas and Singh (1981).

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TABLE 1

*Physico-chemical properties of essential oil extracted from Tagetes minuta.*

Property	Value
Refractive index 20	1.4935
Specific gravity 20	0.8725
Optical rotation (in ethyl alcohol)	+3.5°
Ester value	18.4
Ester value after acetylation	50
Solubility in 90% alcohol	1:1
Carbonyl content as C <sub>10</sub> H <sub>16</sub> O	40%

Essential oil samples were analyzed with a Hewlett-Packard 5890 Ser II Plus Gas chromatograph-mass spectrophotometer (HP 5989B). A 30 meter, 320  $\mu$ m cross-linked methyl silicone (HP5MS) capillary column was used. Helium was used as carrier gas with a flow rate of 30 cm/s. The temperature program consisted of 50 °C for 1 min then 5 °C per min until 230 °C and 15 °C per min until 270 °C, which was maintained for 5 min. MS conditions consisted of optics autotuned at 69, 219, and 502 using DFTPP. The mass scan range was set from

TABLE 2

*Compounds identified in the essential oil of Tagetes minuta aerial part by GC-MS analysis.*

Compound	Retention Time (min)
Hydrocarbon	
$\beta$ -bisabolene	2.45
Trans caryophyllene	11.07
$\beta$ -cubebene	3.75
p-cymene	2.10
$\beta$ -myrcene	5.94
Isolimonene	4.63
$\beta$ -ocimene	0.50
$\alpha$ -pinene	2.18
Alcohol	
Linalool	1.68
Menthol	1.84
Nerolidol	0.93
1-penten 3-ol	5.10
Spathulenol	2.88
$\alpha$ -terpineol	1.35
$\gamma$ -terpineol	1.20
Aldehyde	
Citral	2.27
Phenyl acetaldehyde	1.72
Ketone	
Carvotanacetone	1.37
$\beta$ -ionone	3.06
Methyl-n-heptyl-ketone	1.53
2-nonanone	2.68
Tagetone	17.40
Dihydrotagetone	3.50
Ocimenone	1.10
Esters	
Linalyl acetate	2.24
Phenol and Phenolic Ether	
Carvacrol	3.72
Isoeugenol	2.69

50 to 550 amu and threshold 30. Compounds were identified using a computer search of mass spectra of 138,000 compounds. Match quality of 90% or above was considered as positive identification for each compound.

## Results and Discussion

The physico-chemical properties of the extract are shown in Table 1. *T. minuta* oil contains twenty seven constituents belonging to different categories of compounds such as hydrocarbons, saturated  $\alpha$ -pinene, terpenes, camphene and  $\beta$ -myrcene, isolimonene, sesquiterpene, caryophyllene, and bisobolene (Table 2). Caryophyllene appears to be the major constituent with a concentration of 11.07%. The other terpene derivatives are various alcohols, aldehydes, ketones, and esters (Table 2). The ketone tagetone and dihydrotagetone are principal terpene constituents with concentrations of 17.4% and 3.5%, respectively. They were identified from the essential oil. It also contains phenolic constituent such as phenyl acetaldehyde carvacrol and isoeugenol. The physio-chemical properties of the oil were similar to those reported earlier (Baslas and Singh, 1981).

The floral note to the oil is contributed by the presence of several terpene constituents like linalool, linalyl acetate, nerolidol, citral, nonaldehyde,  $\beta$ -ionone and iso eugenol. Tagetone and dihydrotagetone are the important compounds providing characteristic ketonic marigold odor to the oil. The plant may be a potential source of essential oils bearing floral ketonic notes for the perfume industry.

## Conclusion

*Tagetes minuta* is a highly aromatic herb. Chemical analysis yielded 27 constituents in different categories of compounds. The plant may be a potential source of oils for the perfume and other industries.

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