The Bioscan 12(1): 633-636, 2017 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

STUDIES ON BIOACTIVE PHYTOCHEMICALS IN HYDRO-DISTILLED ESSENTIAL OIL OF AFRICAN MARIGOLD (*TAGETES ERECTA* L.)

SANDEEP KUMAR RAJVANSHI, DEEPA H DWIVEDI AND NAMRTA SINGH
Department of Applied Plant Science (Horticulture),
Babasaheb Bhimrao Ambedkar University,
A Central University, Vidya-Vihar Rae Bareli Road, Lucknow - 226 025, U.P. INDIA
e-mail: sandeeprajvanshi786@gmail.com

KEYWORDS
Fourier Transform Infra-red Spectroscopy
Tagetes erecta
Hydro-distillation
Bioactive phytochemicals

Received on:
08.09.2016

Accepted on :
03.02.2017

***Corresponding author**

ABSTRACT
Secondary phytometabolite fingerprinting provides useful information about qualitative, quantitative and compositional aspects of biomolecules in plant species. A study was conducted to evaluate the bioactive phytochemicals in hydro-distilled volatile oil from African marigold (*Tagetes erecta* L.) cv. Pusa Narangi from fresh flower (FFCE), dry flower (DFCE), fresh leaf (FLCE) and dry leaf (DLCE), extracted using clevenger apparatus. Samples were subjected to Fourier transform infrared spectroscopy (FTIR) where spectra of samples from different parts of the plants have shown the presence of major functional groups *viz*., aliphatic amines, phenols alkanes and nitro compounds *etc*. Oil extracted from the marigold leaf after drying (DLCE) shows maximum peaks (724.5, 758.2, 797.8.887.3, 1060.9, 1135.8, 1247.5, 1296.8, 1342.6, 1379.2, 1461.7, 2674.1, 2733.4, 2862.7, 2923.8 and 2957.5 cm^{-1}) correlating with aliphatic amines, alkanes and phenols *etc* functional groups followed by the FFCE (724.2, 885.2, 1060.9, 1135.6, 1247.0, 1296.4, 1342.9, 1379.3, 1461.7, 1629.6, 2674.6, 2734.0, 2863.2, 2924.0, 2958.1 and 3361.7 cm^{-1}). The FTIR signal ranging from 600 to 1700 cm^{-1} were considered indicative of presence of aromatics and polyphenols in the oil samples studied.

INTRODUCTION

Marigold (*Tagetes* spp.) is widely used for beautification and as landscape plants and is ideal for rockeries, edging, hanging baskets and in window boxes. These are also grown around field crops to control pest activity (Tereschuk *et al*., 1997). The oil of marigold species is used in high quality perfumes and its carotenoid pigments are used in food industry. Further, Tagetes oil, mainly from *T. minuta*, is used in perfumery and as a flavoring constituent (Aruna *et al*., 2013). The pharmacological activity of marigold is related to the content of several classes of secondary metabolites such as essential oils and carotenoids (Vidal-Ollivier *et al.,* 1989) which have characteristic fragrances and tastes but are mixtures of known and unknown compounds. They may contain hydrocarbons, terpenes, alcohols, aldehydes, ketones, phenols and esters (Jain *et al.,* 1991). The essence or aromas of plants are due to volatile or essential oils, many of which have been valued since antiquity for their characteristic odors. Due to their antimicrobial, insecticidal, antifungal, and antibacterial activities, essential oils have been intensely screened and applied in the fields of pharmacology, medical and clinical micro-biology, phytopathology and food preservation (Daferera *et al.,* 2000). The review of literature revealed that considerable contributions have been made on medicinal plants by (Dadsena *et al*., 2013). Techniques commonly employed for extracting essential oils include hydro distillation American Spice Trade Association (ASTA) steam distillation (Chialva *et al.,* 1982) solvent extraction (Burbott *et al.,* 1967) and supercritical fluid extraction. Hydro distillation or steam distillation is the most widely utilized physical method for isolating essential oils from the botanical material (Whish *et al.,* 1996). The leaves of marigold are reported to be effective against piles, kidney troubles, muscular Pain, ulcers, wound and earache. The chief chemical constitutions of *Tagetes erecta* is volatile oils, terpenoids and saponins (Lokesh, 2009 and Basavaraj, 2011). Phytochemical studies carried out on different species of *Tagetes* have revealed the presence of flavonoids and terpenes displaying pharmacological and insecticidal properties (Tereschuk *et al.,* 1997 and Perich *et al.,* 1995). The present study was planned with the hypothesis that generally *Tagetes minuta* (wild marigold) is used for extraction of oil and to study their phytochemicals but now a day's African marigold (*Tagetes erecta* L.) is a very important flower commonly grown as loose flower for use for religious purposes and for decoration in marriages. However, post harvest processing of Marigold for its oil, extracted from its flower as well as its plant parts may enhance value of the crop multifold since it is reported to be a rich source of biocolour, pigments and bioactive molecules which may be exploited in the food and pharmaceutical industry. To best of our knowledge, limited work has been reported regarding oil extraction from African marigold and their phytochemical screening. Therefore, this study was planned with the objective

to profile the bioactive phytochemicals in hydro-distilled essential oil of African marigold (*Tagetes erecta* L.).

MATERIALS AND METHODS

Collection of biological material

Biological material was collected at full blooming stage in December 2014 from the Horticulture Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow U.P. The collected material was classified and separated into two parts, leaves and flowers. The material was aired for 24 hours in a well ventilated room, protected from direct sunlight and stored in air tight containers for further study.

Hydro-distillation (extraction of essential oil)

Hydro distillation is a method of extraction, which is sometimes used instead of steam distillation. This process of extraction is one of the most commonly used traditional methods of extraction. Fresh and dried plant material (100g flower and 100g leaves) were subjected individually to hydro-distillation using Clevenger's apparatus for 4 hours by , the process was repeated three times. The extracted oil were dried over anhydrous sodium sulphate and stored in sealed vials at low temperature for analysis.

Fourier Transform Infrared Spectroscopy (FTIR)

The IR spectra were reported in % transmittance. All samples was loaded in FTIR spectroscope (Nicolet™ 6700, Thermo scientific: USA), with a scan range from 400 to 4000 cm^{-1}. The functional groups present in the essential oil were determined by comparing the vibration frequencies in wave numbers of the sample spectrograph from its library and previous studies.

RESULTS AND DISCUSSION

Results of FTIR spectroscopic analysis of the all samples have revealed the existence of various chemical constituents (Fig, 1, 2, 3 and 4). The bonds, the wave number (cm^{-1}) of prominent peaks obtained from spectra are described in Table 1. The Dry leaf (DLCE) shows maximum peaks (724.5, 758.2, 797.8.887.3, 1060.9, 1135.8, 1247.5, 1296.8, 1342.6, 1379.2, 1461.7, 2674.1, 2733.4, 2862.7, 2923.8 and 2957.5 cm^{-1}) Figure: 4 and Table 1 and the fresh flower {FFCE} shows peaks at 724.2, 885.2, 1060.9, 1135.6, 1247.0, 1296.4, 1342.9, 1379.3, 1461.7, 1629.6, 2674.6, 2734.0, 2863.2, 2924.0, 2958.1 and 3361.7 cm^{-1} (Figure:1 and Table 1) which showed the presence of maximum number of bioactive compounds compared to the other samples. This was followed by dry flower {DFCE} (724.7, 802.9, 890.8, 1060.8, 1135.3, 1219.4, 1378.3, 1460.3, 1618.4, 1708.4, 2733.7, 2863.9, 2924.1, 2957.7 and 3402.8 cm^{-1}) epicted in Figure 2 and Table 1 and FLCE (723.1, 864.3, 1062.1, 1140.0, 1219.8, 1295.4, 1377.8, 1459.9, 1625.0, 1670.5, 2865.1, 2924.6, 2958.3 and 3375.6 cm^{-1}) depicted in Figure: 3 and Table 1. Depending on the fingerprint characters of the peaks positions, shape and intensities, the fundamental components may be identified (Chen *et al.*, 2001). The peak in the range of 3001-3500 cm-1 obtained in all the samples corresponds to hydroxyl (-OH) group (Meenambal *et al.,* 2012) All samples studied have shown a major absorption in the wavelength range of polyphenols (1700-600 cm-1) thus indicating their potential nutraceutical value (Gorinstein *et al.,* 2010). Biochemical screening of *T.patula* and *T.erecta* leaf and flower extracts have indicated the presence of alkaloids, flavonoids, steroids, tannins and phenolic compounds as the major secondary metabolites. Many of these compounds have been

Table 1: FT-IR spectral range of different extracts of African marigold (*Tagetes erecta* L.) oil

S.no.	Frequency (cm^{-1})	Fresh flower	Dry flower	Fresh leave	Dry leave	Bond	Functional group
1.	3450-3400	-	3402.8	-	-	O-H stretch	alcohols, phenols
2.	3390-3300	3361.7	-	3375.6	3383.4	N-H Stretch	1*, 2* amines, amides
3.	2990-2950	2958.1	2957.7	2958.3	2958.2	C-H Stretch	Alkanes
4.	2950-2900	2924.0	2924.1	2924.6	2926.0	C-H Stretch	Alkanes
5.	2880-2850	2863.2	2863.9	2865.1	2867.7	C-H Stretch	Alkanes
6.	2750-2700	2734.0	2733.7	-	-	H-C=O: C-H Stretch	Aldehydes
7.	2690-2650	2674.6	-	-	-	H-C=O: C-H Stretch	Aldehydes
8.	1750-1700	-	1708.4	-	-	C=O Stretch	á, â- unsaturated al dehydes, ketones
9.	1690-1650	-	-	1670.5	1684.6	C=O Stretch	Carbonyls (general).
10.	1650-1600	1629.6	1618.4	1625.0	1617.0	N-H Bend	1* amines
11.	1550-1500	-	-	-	1514.2	N-O asymmetric stretch	Nitro compounds
12.	1490-1450	1461.7	1460.3	1459.9	1454.2	C-H bend	alkanes
13.	1390-1350	1379.3	1378.3	1377.8	1375.9	C-H rock	alkanes
14.	1350-1300	1342.9	-	-	-	N-O Symmetric stretch	Nitro compounds
15.	1300-1250	1296.4	-	1295.4	1268.6	C-O Stretch	carboxylic acid
16.	1250-1200	1247.0	1219.4	1219.8	1219.3	C-O stretch	carboxylic acid
17.	1150-1100	1135.6	1135.3	1140.0	1149.1	C-N Stretch	Aliphatic amines
18.	1090-1050	1060.9	1060.8	1062.1	1065.1	C-N Stretch	Aliphatic amines
19.	1050-1020	-	-	-	1033.2	C-N Stretch	Aliphatic amines
20.	890-850	885.2	890.8	864.3	875.1	C-H "oop"	aromatic
21.	850-800	-	802.9	-	812.3	C-H Bend (para)	aromatic
22.	800-760	-	-	-	-	C-H "oop"	aromatic
23.	760-730	-	-	-	-	C-H Bend (ortho)	aromatics
24.	730-700	724.2	724.7	723.1	723.4	C-H rock	alkanes

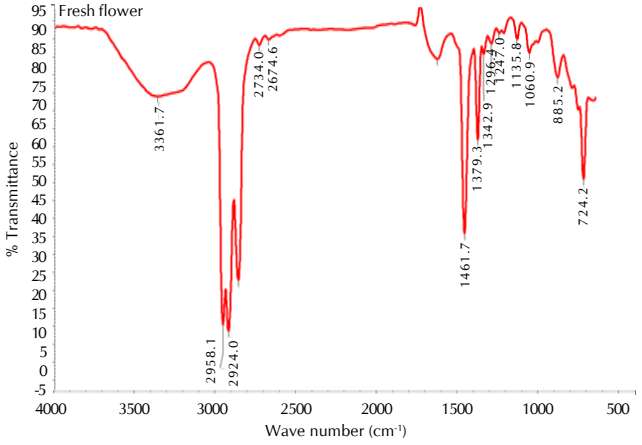

Figure 1: FT-IR absorbance spectrum of fresh flower clevenger extract (FFCE)) from transmittance african marigold (*Tagetes erecta* L.)

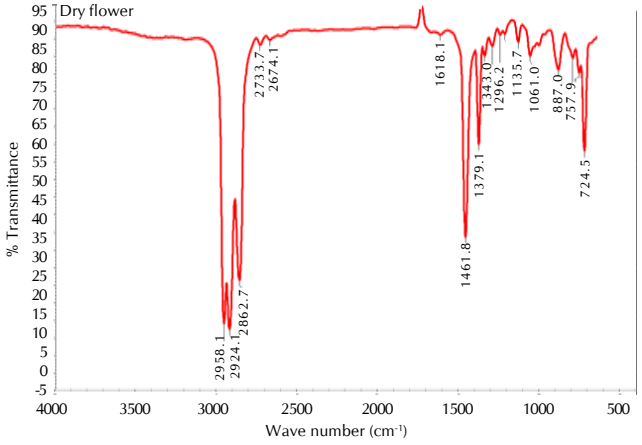

Figure 2 : FT-IR absorbance spectrum of dry flower clevenger extract (DFCE)) from transmittance african marigold (*Tagetes erecta* L.)

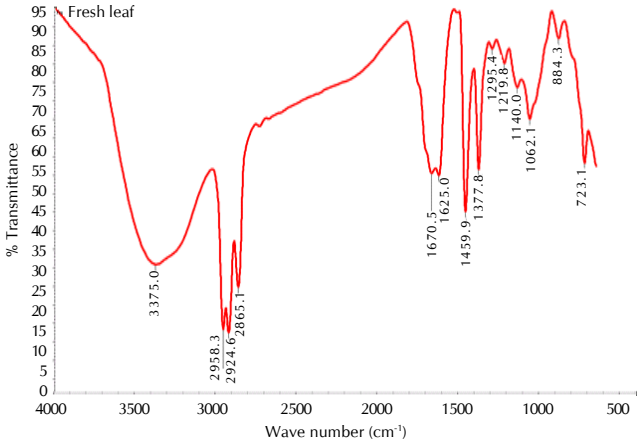

Figure 3 : FT-IR absorbance spectrum of fresh leaf clevenger extract (FLCE) from transmittance african marigold (*Tagetes erecta* L.)

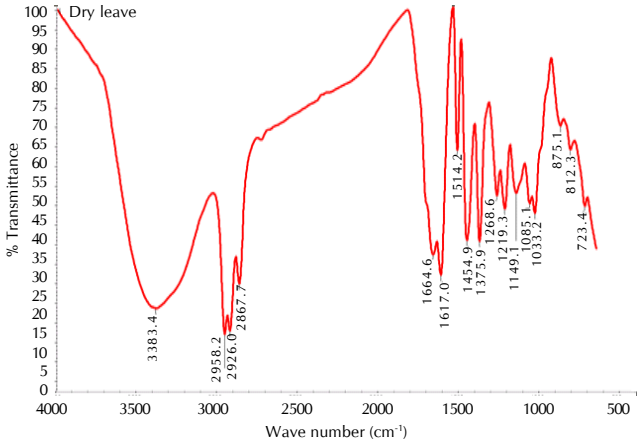

Figure 4: FT-IR absorbance spectrum of dry leaf clevenger extract (DLCE)) from transmittance african marigold (*Tagetes erecta* L.)

reported to have various bioactive properties on living organisms including bacteristatic or bactericidal action (Barnabas *et al.*, 1988 and Harborne *et al.*, 1988) Current study has confirmed the highest bioactive phytochemicals in the dry leaf (DLCE) compared to other samples which can be used as the source for large scale production of the active ingredient.

ACKNOWLEDGMENT

We hereby express our sincere thanks to University Science Instrumentation Centre (USIC) Babasaheb Bhimrao Ambedkar University, Lucknow for providing us FTIR facility during my work.

REFERENCES

Aruna, S., Supriya, S. and Soma, R. 2013. Induction of callus and DNA extraction from seeds and fresh leaf tissues of marigold (*Tagetes erecta*).*The Ecosacn*. **4:** 213-217.

ASTA. 1968. Official analytical methods of the American Spice Trade Association. ASTA, Englewood Cliffs, NJ.pp. 8-11.

Barnabas, C. G. Nagarajan, S.1988. Antimicrobial activity of flavonoids of some medicinal plants. *Fitoterapia*. **3:** 508-510.

Basavaraj, V. C., Karnakumar, V., Rajabhau, S. S. 2011. Evaluation of Hepatoprotective Activity of Flowers of Tagetes erecta Linn. International Journal of Pharmaceutical and Biological Archives. **2(2):** 692-695.

Burbott, A. J., Loomis, W. D.1967. Effects of light and temperature on the monoterpenes of peppermint. *Plant Physiology*. **42:**20-28.

Chen, R. J., Xu, G. Y., Wang, H.Y., XU, H. Z., Liu, Y. M. 2001. Study on isolation and structure of polysaccharide XC-1 from Angelica sinesis (oliv) diels. *Chemitry Bulletin/ Huaxue Tonghao*. **64(6):** 372-374.

Chialva, F., Gabri PAP, Liddle, Ulian. 1982. Qualitative evaluation of aromatic herbs by direct head space (GC) analysis. Applications of the method and comparison with the traditional analysis of essential oils. In: N. Margaris, A. Koedam, and D. Vokou. *Aromatic plants–basic and applied aspect*. Martinus Nijhoff, Netherlands.pp.183-195.

Dadsena, R., Sahu, N. K., Agrawal, S. and Kumar, A. 2013. Phytochemical analysis of three endangered plants (*Costus specious, Gloriossa superba* Linn and *Rauvolfia serpentine* (Linn) Benth from Kanker district of Chhattisgarh, India. *The Bioscan*. **8(2):** Supplement on Medicinal Plants. pp.655-659.

Daferera, D. J., Ziogas, B. N., Polissiou, M.2000. . GC-MS analysis of essential oils from some Greek aromatic plants and their fungitoxicity on Penicillium digitatum. *J. Agricultural and Food Chemistry*. **48:** 2576-2581.

Gorinstein, S., Haruenkit, R., Poovarodom, S., Vearasilp, S., Ruamsuke, P. and Namiesnik, J. 2010. Some analytical assays for the determination of bioactivity of exotic fruits. *Phytochem Anal*. **21:**355-362.

Harborne, J. B. 1988. The flavonoid advances in Research since 1980. Chapman and Hall, London.

Jain, S. K., Fillips, D. R.1991. Medicinal Plants of India. Algonac Publications. MI, p.558.

Lokesh, J. S. 2009. Pharmacological evaluation of ethanolic extract of flowers of Tagetes erecta on epilepsy. *J. Pharmacy Research*. **2(6):** 1035-1038.

Meenambal, M., Pughalendy, K., vasantharaj, C., Prapkaran, S., Vijayan, P. 2012. Phytochemical information from FTIR and GC-MS studies of methol extract of *Delonix elat* leaves. *International J. chemical and analytical sciences*. **3(6):**1446-1448.

Perich, M., Wells, C., Bertsch, W., Tredway, K.1995. Isolation of the insecticidal components of *Tagetes minuta* (Compositae) against mosquito larvae and adults. *J. American Mosquito Control Associate*.**11:** 307-310.

Tereschuck, M., Riera, M., Castro, G. ,Abdala, L. 1997. Antimicrobial activity of flavonoids from leaves of *Tagetes minuta*. J. Ethnopharmacol.**56:** 227-232.

Vidal-Ollivier, E., Elias, R., Faure, F., Babadjamian, A., Crespin, F., Balansard, G. and Boudon, G. 1989. Flavonal glycosides from *Calendula officinalis* flowers. *Planta Medica*. **55**: 73-74.

Whish, J. P. M., Williams, R. R.1996. Effects of post-harvest drying on the yield of tea tree oil (*Melaleuca alternifolia*). *J. Essential Oil Research*. **8:** 47-51.