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Short Communication

Comparison of essential oil content and composition in two German chamomile (*Matricaria chamomilla* L.) genotypes

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ABSTRACT

Two German chamomile genotypes (wild and domestic) were investigated for essential oil content and composition. Wild and domestic chamomile flowers were collected from Noor-Abad and Karaj regions and dried before essential oil extraction using distillation method. Essential oil components were identified by analytical gas-chromatography and mass spectrometry. Results revealed that essential oil efficiency in domestic and wild chamomile was recorded as 0.87 and 0.77%, respectively. Amongst fifteen different components identified in essential oil samples, (E)-â-farnesene, á -bisabolol oxide A and B and chamazulene were found to be the major components with frequency of 12.86, 31.86, 5.24 and 6.16% in domestic species and 8.83, 2.52, 1.81 and 55.606% in wild species. Irrespective of slight reduction in essential oil content and its components, wild German chamomile genotype can be used as valuable source in future domestication programmes.

Keywords: á-bisabolol oxide A, á-bisabolol oxide B, chamomile, chamazulene.

INTRODUCTION

German chamomile (*Matricaria chamomilla* L.) is a medicinal plant belongs to the family Asteraceae. Chamomile flowers are used as medicinal herb, cosmetic agent, herbal tea and aromatherapy ingredient (Omidbaigi, 2000). *M. chamomilla* (Syn: *M. recutita*) is known as German chamomile, European chamomile, wild chamomile or standard chamomile in Iran. *M. chamomilla* is an annual herbaceous plant with branched and erect stems which grows to a height of 10–70 cm (Ghanavati, 2007). The main active ingredients in *Matricaria* species include farnesene, α-bisabolol, chamazulene, flavonoids including apigenin, quercetin, patuletin and luteolin and coumarin (Azizi, 2006). Chamazulene and α-bisabolol have anti-bacterial, anti-inflammatory and anti-spasmolytic properties and are used in gastrointestinal drugs (Anne et al., 2001). In addition, it has been confirmed that chamomile extraction is effective in relaxing the nervous system and reducing paroxysm (Ghanavati, 2007). Chamazulene have anti-inflammatory and antifungal properties and are widely used in cosmetic products (Rahmai et al., 2009).

Unfortunately, in Iran, due to lack of knowledge on genetic resources and genes function in medicinal plants, there are no appropriate breeding programmes. Therefore, identification and characterization of desirable genes in different varieties and species can help researchers to take the appropriate steps to make their results more accessible to other researchers. Taviana (2001) assessed the genetic diversity in 13 German chamomile for flower yield and essential oil properties. D'Andrea (2002) investigated genetic diversity in diploids and tetraploids cultivars based on morphological attributes, flower yield and essential oil components. According to Cirecelav et al. (1993), essential oil components in the different chamomile biotypes were significantly different.

Medicinal plant growth and development is controlled by genetic factors, climate conditions, soil properties, geographical categorization and field management. Each of these factors and also interaction between them can significantly affect essential oil quality and quantity in medicinal plants. Most of the current researches refer to chemical analyses and determination of bioactive properties of wild stands and there are not many studies that can be used for comparison between wild and domestic species. Although, chamomile is one of the most important medicinal plants in global markets, it is not a commercial plant in Iran and also there is not enough information on its wild populations. Therefore, in this

study, two different German chamomile genotypes (wild and domestic) were compared for essential oil and its composition.

In order to compare two German chamomile genotypes (wild and domestic) in term of essential oil quantity and quality, wild and domestic chamomile flowers were collected in 2020 from natural habitat at Noor-Abad region in Fars province and a commercial field located in Karaj, respectively. The samples were confirmed at Yasooj University Central Herbarium.

To determine essential oil content, flower samples (100 g) were dried under shade, powdered using electric blender, replicated thrice during each harvest, was used to extract essential oil using Clevenger-type apparatus for 2 h. Finally, the aqueous essential oil was dehydrated by sodium sulfate (Zeinali et al., 2008) to calculate essential oil efficiency (%). Essential oil components were identified by analytical gas-chromatography and mass spectrometry. Obtained spectrums were compared with standard spectrums and the relative percentage of each component was calculated using area under the curve and area normalization method (Kapoor et al., 2008).

The essential oil extract was diluted with acetone and injected into the gas-chromatograph coupled with the mass spectrometer. The compounds were detected and identified by comparing their retention times and indices with those in the mass-spectral library maintained by the National Institute of Standards and Technology (NIST 11.0), Wiley MS data system (Wiley, Chichester, UK), and previous literature. Inhibition indexes were calculated using normal hydrocarbons (9-25 °C) under similar thermal conditions. Further identification was made by matching the mass spectral fragmentation patterns of different compounds with corresponding data (Adams and Wiley 7.0 library) and other published mass spectra (Adams, 2007).

A Thermo-UFM Gas-Chromatograph (Model 9A) with Hp-5 column was used. The column used was 10 m × 0.1 mm with 0.4 mm film thickness. The temperature programme was initial temperature 60ÚC for 3 min; increase to 285ÚC at a rate of 5.8ÚC per min, injector and detector (FID) temperatures were 280ÚC. Helium was used as the carrier gas for GC/FID analysis with the pressure of 3 kg per cm^2. Percentage was calculated by electronic integration of FID peak areas without the use of response factor correlation.

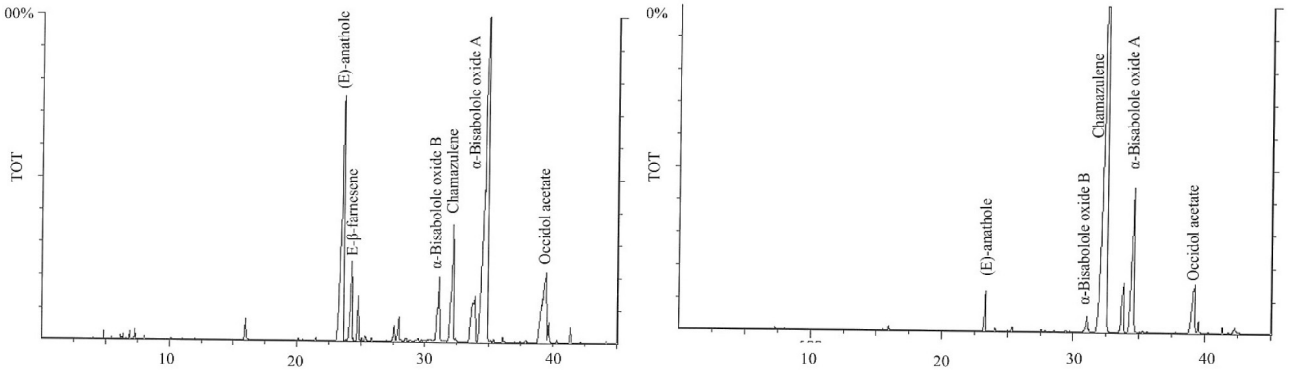
A Varian 3400 GC/MS connected to ion trap Mass Spectrophotometer was used. The used column was DB-5 (30 m × 0.25 mm, film thickness of 0.25 mm). Similar temperature program was used; however final column temperature was 250ÚC. Injector temperature was set at 260ÚC. Helium gas was used as the carrier gas with the flow rate of 31.5 cm per second. Ionization voltage was 70 eV, scanning time was one second, and mass range analyzed was 40-340 amu (Jalali et al., 2008). Identification of the essential oil components was accomplished by comparing their retention times, indices, and mass spectra with authentic standards. Percentage evaluation of the oil components was accomplished by assessing the area normalization.

The results indicated that domestic genotype (0.87%) contain more essential oil than wild genotype (0.77%). Moreover, essential oil constituents in two different German chamomile genotypes were determined using GC-MS. A total of fifteen different compounds were identified in chamomile samples (Table 1). These compounds were commonly found in essential oil extracted from chamomile flower heads with different percentages depending on genotypes. Qualitative and quantitative differences were observed, when a comparison was made between two different German chamomile genotypes (Fig. 1).

Chamomile essential oil properties like other plants is controlled by genetics factors, however, climate conditions and interaction between plant and environment affect essential oil properties (Ebadi et al., 2008). Considering the high essential oil content (0.77%) in wild genotype, wild genotype can be used in future breeding programs although compared to a domestic genotype, the essential oil content was less. It has been reported that essential oil percentage in domestic genotypes like Soroksari (0.9%) was significantly higher than wild genotypes such as Shiraz and Damavand (0.1%) (Omidbaigi, 1999). The results demonstrated that chamazulene content (55.606 %) in wild genotype was significantly higher than domestic genotype which indicates the higher ability of wild genotype in the synthesis of chamazulene. Therefore, wild genotype can be used in domestication programmes as a valuable source of chamazulene. Chamazulene content is affected by growth conditions.

Table 1 : Essential oil compositions in domestic and wild genotype of *Matricaria chamomilla*

Essential oil component	Retention indices	Domestic genotype	Wild genotype
Sabinene	984	0.263	——
á-Terpinene	1044	0.049	——
ñ-Cymene	1049	0.139	——
1,8-Cineole	1068	0.393	0.391
Artemisia ketone	1091	0.117	0.149
(E)- Anethole	1310	20.569	1.323
(E)-ß-Farnesene	1465	12.863	8.839
Germacrene D	1533	1.173	0.729
Bicyclo germacrene	1566	0.577	0.256
(E)-Nerolidol	1650	1.050	——
á-Bisabolol oxide B	1706	5.248	1.818
á-Bisabolone oxide A	1712	1.337	——
Chamazulene	1736	6.166	55.606
á-Bisabolol oxide A	1821	41.862	21.521
Occidol acetate	1955	7.279	7.370
Unknown compounds	——	8.194	1.998
Total identified (%)	——	91.806	98.002
Essential oil content (%)	——	0.87	0.77



Wild genotype Domestic genotype

Fig. 1 : Chromatograms for essential oil composition

α-bisabolol oxide A content in wild genotype (21.52%) was found to be less than domestic genotype (31.86%). Similar results were observed as to α-bisabolol oxide B, 5.24% in domestic genotype compared with 1.81% in wild genotype. E- ß-farnesene is another component found in chamomile essential oil which was found to be higher in domestic genotype compare to wild genotype. Jalali et al. (2008) have found 5 different components in *M. recutita* flower essential oil, the major compounds included α-bisabolen oxide A (63.6%), α-bisabolol oxide A (15.4%) and chamazulene (10.6%).

According to the obtained results, irrespective of slight reduction in essential oil content and some essential oil components, wild German chamomile genotype can be used as valuable source in future domestication programmes. However, further research is needed in the field of medicinal plant biochemistry and breeding to release appropriate cultivars and chemo types.

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