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**Short Communication**

# Chamomile biodiversity and essential oil qualitative-quantitative characteristics in Egyptian production and Iranian landraces

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**Abstract**: This study presents the genetic and environmental variations of essential oil and its sesquiterpene composition (/-/- α -bisabololoxide A, /-/- α -bisabololoxide B, /-/- α -bisabolol and chamazulene) in natural growing chamomile population in Iran in comparison with the cultivars, which are cultivated in Egypt. The highest contents of /-/-α-bisabololoxide A, /-/-α-bisabolonoxide A and /-/-α-bisabololoxide B were typical for chamomile plants, which flower anthodia were collected in various places in Egypt. These results showed that, there is a Bisabololoxide chemo type B of chamomile plants only. Contribution presents the results of the chamomile essential oil qualitative-quantitative characteristics of chemo types that are originated from different geographical parts of the Iranian country. The Zagros Mountains, as a nature barrier, divided the Chamomile populations: one to the Persian Gulf with the very high /-/-α-bisabolol content and one to the Alborz Mountains/Caspian Sea/ with the very high /-/-α-bisabololoxide A content. This Chamomile biodiversity on a relative small area was created during long time process (evolution) in regard to influence of eco-physiological conditions (biotic- and abiotic- factors) on the concrete place of chamomile population growth.

**Keywords**: Biodiversity, composition, essential oil, *Matricaria recutita*.

# التنوع البيولوجي لنبات البابونج والخصائص النوعية والكمية للزيوت الأساسية في سلالات مزروعة في كل من مصر وايران

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**الملخص:** تقدم هذه الدراسة الاختلافات الوراثية والبيئية للزيوت الأساسية ومكوناتها (/-/- α -bisabololoxide A, /-/- α - bisabololoxide B, /-/- α -bisabolol and chamazulene) لنبات البابونج في السلالات البرية في ايران ومقارنتها بالأصناف المزروعة في مصر. كانت أعلى محتويات من /-/-α-bisabololoxide A, /-/-α-bisabolonoxide A and /-/-α-bisabololoxide B من النباتات التي تم جمعها من أماكن مختلفة من مصر. وأظهرت هذه النتائج أن هناك Bisabololoxide chemo نوع ب من نباتات البابونج فقط. ساهمت هذه النتائج في تقديم الخصائص النوعية والكمية للزيوت الأساسية لأنواع البابونج التي نشأت من مناطق جغرافية مختلفة في ايران. قسمت جبال زاغروس التي تعتبر حاجز طبيعي مجتمعات البابونج الى مجتمعين: مجتمع في الخليج الفارسي ذو محتوى عالي من /-/-α- bisabolol وأخرى في جبال البرز، بحر قزوين، ذو محتوى عالي من /-/-α- bisabololoxide A. هذا التنوع البيولوجي لنباتات البابونج في منطقة صغيرة نسبيا جاء نتيجة عملية طويلة من الزمن (عملية التطور) في ما يتعلق بتأثير الظروف الفسيولوجية البيئية (العوامل الحيوية وغير الحيوية) على مكان نمو وتكاثر نبات البابونج.

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## Introduction

Chamomile (*Matricaria recutita* L.) has wide ecological amplitude and this species geological occurrence in partial all over the world. Plant habits and the creation of secondary metabolites in the chamomile are affected by the endogenous and exogenous factors, which can be divided in two groups: a) morpho–ontogenetic variability, b) genetic variability respectively genetic determination (Salamon, 2009).

Nowadays, Chamomile is a most favored and most used medicinal plant over the world. Phytotherapeutically useful are inflorescences whereby substantial part of their curative effects is determined by the essential oil content and composition (Salamon, 2007).

About 120 chemical constituents have been identified in chamomile as secondary metabolites, including 28 terpenoids, 36 flavonoids and 52 additional compounds (Mann and Staba, 1986). A substantial part of drug effects are determined by the essential oil content. Oil is collected from flower heads, either by steam distillation or solvent extraction, for yields of 0.24 to 1.90 percent of fresh or dry plant tissue. Among the essential oil constituents the most active are /-/-α-bisabolol and chamazulene. /-/-α-bisabolol has demonstrated anti-inflammatory,antispasmodic, antimicrobial, antiulcer, sedative and CNS activity. Chamazulene is also anti-inflammatory (Morgan, 1996).

The native world area of chamomile plant species was a Frontal Asia. One from eight of the Gene Pool Centers is mainly Iran and this area gave a base for a cultivation and domestication of grains and probably chamomile species, as a weed, too (Luppold, 1984; Seitz, 1987).

This contribution presents the genetic and environmental variation of essential oil and its sesquiterpene composition (/-/-α-bisabololoxide A, /-/-α-bisabololoxide B, /-/-α-bisabolol and chamazulene) in natural growing chamomile population in Iran in comparison with the raw-materials, which are cultivated in Egypt.

## Materials and Methods

### Plant materials

20 Chamomile landraces were collected from different ecological regions in Iran during 2006 (Figure 1). The dry flower heads were provided from localities of chamomile production in 4 regions of Egypt (1997/1998).

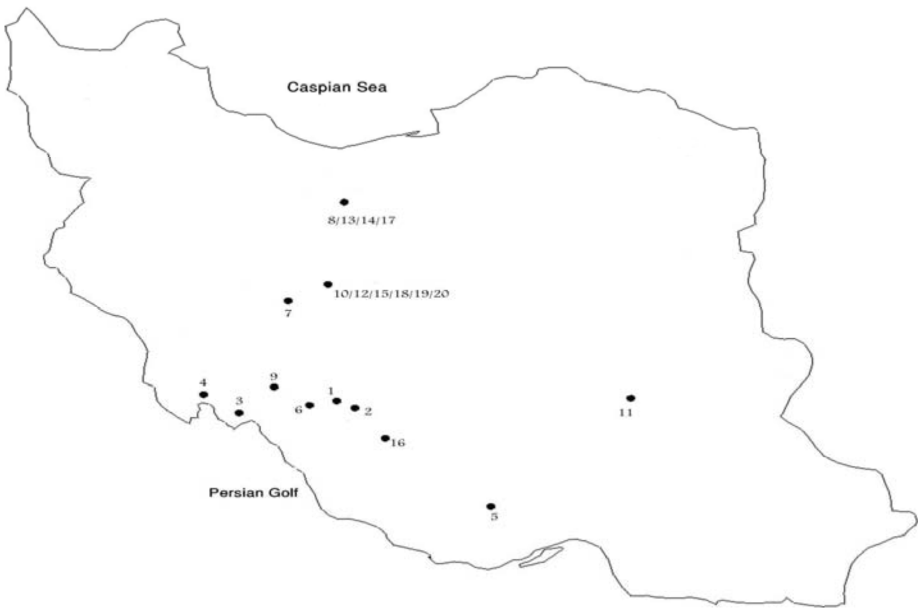



**Figure 1. Localities of wild chamomile population occurrence in Iran.**

**Hydrodistillation**

Chamomile essential oil was isolated by hydro distillation (Read, 1992). Hydro distillation lasted for two hours into n-hexane, sample weights were 2 g of dry drug matter. The modified distillation apparatus by Coocking & Middleton was used (Humphrey, 1992).

**Measurements and determination**

Compounds of essential oil were determined by the means HEWLETT – PACKARD 5890 Series II GC system, with capillary column HP – 5, FID detector, Split-split less system for injection and automatic injector HP 7 673.

The operating conditions were: injection temperature 150°C, detector temperature 250°C, carrier gas nitrogen. Sample sizes were used 1.0 μl and manual type of injection. The column was used HP-5 (50 m long x 0.20 mm i. d.). The following temperature program was used: 90°C (0 min), then 10°C $min^{-1}$ to 150°C (5 min), then 5°C $min^{-1}$ to 180°C (3 min), then 7°C $min^{-1}$ to finally isothermal 280°C for 25 min; nitrogen was used as carrier gas. Detector temperature 250°C, carrier gas nitrogen (flow velocity 274 mm $s^{-1}$), auxiliary gases were nitrogen (30 ml $min^{-1}$), hydrogen (30 ml $min^{-1}$), air (400 ml $min^{-1}$). Peak areas and retention times were measured by electronic integration with a Hewlett-Packard 3396 Series II integrator.

**Compound identification**

Determination of major components of essential oil was realized on the basis of use of standard compounds (/-/-α-bisabolol, chamazulene, cis-/trans-en-in-dicycloether and /-/-α-bisabololoxide A and B). Qualitative identification of selected components was carried out by the comparison the retention times of all detected components with retention time of standard compounds.

Results are presented in the percentage. Percentage of single chromatographic peak areas was measured on the basis of area of the single peaks to the total peak area ratio.

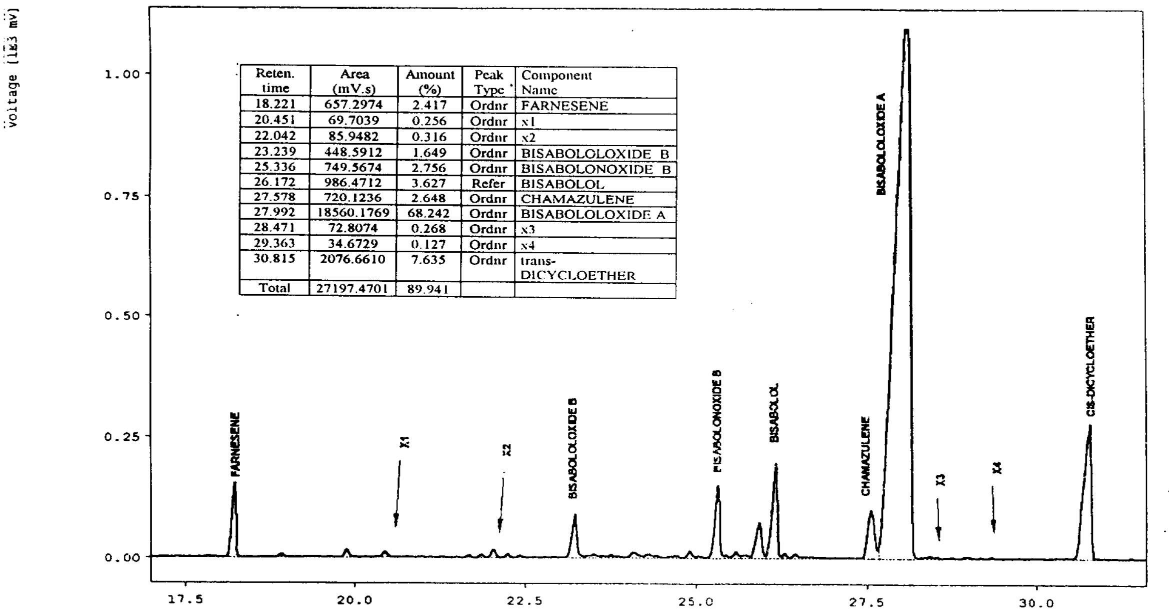
**Results and Discussion**

Chamomile flowers from different Egyptian regions showed a high range of /-/-α-bisabololoxide A content, from 40.1 to 68.2% (Table 1 and Figure 2). Although, the pharmaceutically effective components (/-/-α-bisabolol and chamazulene) had very low variation (from 2.1 to 3.6% respectively from 1.7 to 2.6%) (Table 1).

**Table 1. Quality of essential oil from the Egyptian chamomile cultivation (1997-1998).**

| Localities | Fa | BoB | BnA | Bo | Ch | BoA | Dc | |
|---|---|---|---|---|---|---|---|---|
| | % in essential oil | | | | | | -cis | -trans |
| El Fayoum | 18.2 | 4.9 | 9.8 | 2.1 | 2.0 | 40.1 | 9.7 | 1.3 |
| Beni Suef | 5.1 | 2.7 | 8.7 | 2.4 | 1.7 | 50.7 | 8.7 | 1.5 |
| El Tahrir Sahra | 3.5 | 2.4 | 7.3 | 2.5 | 2.0 | 51.1 | 5.9 | 2.1 |
| El Giza | 2.4 | 3.6 | 2.7 | 3.6 | 2.6 | 68.2 | 7.6 | 1.8 |

Fa - trans-β-farnesene, BoB -/-/-α- bisabololoxide B, BnA - /-/-α-bisabolonoxide A, Bo - /-/-α-bisabolol, Ch - chamazulene, BoA - /-/-α-bisabololoxide A, Dc - en-in-dicycloethers.




| Reten. time | Area (mV.s) | Amount (%) | Peak Type | Component Name |
|---|---|---|---|---|
| 18.221 | 657.2974 | 2.417 | Ordnr | FARNESENE |
| 20.451 | 69.7039 | 0.256 | Ordnr | x1 |
| 22.042 | 85.9482 | 0.316 | Ordnr | x2 |
| 23.239 | 448.5912 | 1.649 | Ordnr | BISABOLOLOXIDE B |
| 25.336 | 749.5674 | 2.756 | Ordnr | BISABOLONOXIDE B |
| 26.172 | 986.4712 | 3.627 | Refer | BISABOLOL |
| 27.578 | 720.1236 | 2.648 | Ordnr | CHAMAZULENE |
| 27.992 | 18560.1769 | 68.242 | Ordnr | BISABOLOLOXIDE A |
| 28.471 | 72.8074 | 0.268 | Ordnr | x3 |
| 29.363 | 34.6729 | 0.127 | Ordnr | x4 |
| 30.815 | 2076.6610 | 7.635 | Ordnr | trans-DICYCLOETHER |
| Total | 27197.4701 | 89.941 | | |

**Figure 2. The typical GC-analysis of essential oils from the Egyptian chamomile flowers.**

The identification of four chemical types of this plant species were different by the qualitative – quantitative compositions of chemical compounds in the essential oil (Schilcher 1973). This very important fact was referred to chamomile biodiversity from worldwide side.

The results of qualitative – quantitative characteristics of chamomile essential oil from Egypt showed that there was a high amount of the chemo type B (/-/-α-bisabololoxide A> /-/-α-bisabololoxide B> /-/-α-bisabolol) (Table 2).

**Table 2. Four basic chemo types of chamomile in regard to composition of main substances (%) in essential oil.**

| | Type A | Type B | Type C | Type D |
|---|---|---|---|---|
| α-bisabololoxide A | 4.74-15.68 | 31.07-52.25 | 2.13-18.50 | 9.62-25.83 |
| α-bisabolol | 4.37-15.41 | 8.81-12.92 | 24.18-77.21 | 8.49-19.58 |
| α-bisabololoxide B | 22.43-58.85 | 5.27-8.79 | 3.17-34.46 | 10.43-24.20 |
| en-yn-dicycloethers | 2.61-11.27 | 4.08-9.90 | 1.92-12.00 | 5.51-10.68 |
| Chamazulene | 2.70-17.69 | 5.40-7.95 | 1.45-14.90 | 1.91-7.89 |

| | | | | | |
|---|---|---|---|---|---|
| Type **A** : (South American collection) | α-bisabolol oxide B | > | α-bisabolol oxide A | > | α-bisabolol |
| Type **B** : (Egypt & central Europe) | α-bisabolol oxide A | > | α-bisabolol oxide B | > | α-bisabolol |
| Type **C** : (Spain/Catalonia, Malta, Crimea) | α-bisabolol | > | α-bisabolol oxide B | > | α-bisabolol oxide A |
| Type **D** : (Southeast Europe & Turkey) | α-bisabolol oxide B | ≈ | α-bisabolol oxide A | ≈ | α-bisabolol |

In regard to the sesquiterpenes, original forms mostly show bisabololoxides. A form rich in /-/-α-bisabolol (the chemo type C: /-/-α-bisabolol > /-/-α-bisabololoxide B > /-/-α-bisabololoxide A) could be found in Spain /Catalonia/ (Franke, 2005). First time of this proclamation was given in 1973. The endemically, local and isolate chamomile population could be a type rich in /-/-α-

Bisabolol. The results of two chamomile essential oil samples without any color were determined the /-/-α- Bisabolol chemo type on islands: Malta and Crimea (Ukraine) (Salamon, 2006).

It is surprising that an Egyptian cultivar or variety with the high content of bisabolol and chamazulene has not been released yet and a claim "for the future it is important to use selected seeds with a high percentage of azule" remains in force very long time (Fahmi, 2005) A long chamomile history and genesis of chamomile use springs from its origin.

**Table 3. Qualitative and quantitative characteristics of chamomile essential oils from the Iranian origin localities.**

| Localities | % of Essential Oil | Basic Composition of Essential Oil in % | | | |
|---|---|---|---|---|---|
| | | Fa | Bo | Ch | BoA |
| Baba Mydan /1§ | 0.50 – 0.55 | 1.5 -2.0 | 55.0 – 61.0 | 6.0 – 7,0 | 8.0 – 9.0 |
| Noor Abade Fars /2 | 0.20 - 0.22 | 1.5 -2.0 | 54.0 – 56.0 | 1.0 – 2.0 | 14.0 – 16.0 |
| Khoozestan-Hendijan /3 | 0.38 – 0.40 | 0.2 -0.3 | 23.0 – 28.0 | 0.0 | 0.0 |
| Mahshahr /4 | 0.21 – 0.28 | 4.0 -5.0 | 40.0 – 44.0 | 0.5 – 1.0 | 3.0 – 3..5 |
| Larestan /5 | 0.60 – 0.65 | 2.0 -3.0 | 40.0 – 44.0 | 10.0 – 12.1 | 13.0 – 15.0 |
| Gachsaran /6 | 0.40 – 0.45 | 2.0 -3.0 | 40.0 – 44.0 | 10.0 – 13.0 | 30.0 – 34.0 |
| Shahrekord /7 | 0.18 – 0.22 | 1.5 -2.0 | 37.0 – 40.0 | 1.0 – 2.0 | 11.0 – 18.0 |
| Tehran /8 | 0.70 – 0.80 | 1.5 -2.0 | 27.0 – 30.0 | 5.0 – 7.0 | 30.0 – 34.0 |
| Behbahan /9 | 0.10 | 1.5 -2.0 | 27.0 – 29.0 | 1.0 – 2.0 | 11.0 – 13.0 |
| Esfahan /10 | 0.65 – 0.72 | 2.0 -3.0 | 18.0 – 23.0 | 6.0 – 7.0 | 20.0 – 26.0 |
| Kerman /11 | 0.70 – 0.77 | 2.0 -3.0 | 21.0 – 23.0 | 6.0 – 8.0 | 41.0 – 49.0 |
| Esfahan /12 | 0.,80 – 0.88 | 1.5 -2.0 | 14.0 – 22.0 | 2.0 – 2.5 | 42.0 – 47.0 |
| Tehran /13 | 0.48 – 0.53 | 2.0 -4.0 | 13.0 – 19.0 | 5.0 – 9.0 | 28.0 – 35.0 |
| Tehran /14 | 0.75 – 0.87 | 2.0 -3.0 | 17.0 – 19.0 | 2.0 – 3.0 | 36.0 – 49.0 |
| Esfahan-Bagha Golha /15 | 0.50 – 0.65 | 3.0 -5.0 | 11.0 – 13.0 | 4.0 – 6.0 | 34.0 – 42.0 |
| Shiraz /16 | 0.80 – 0.95 | 4.0 -5.0 | 10.0 – 13.0 | 5.0 – 7.0 | 32.0 – 34.0 |
| Tehran /17 | 0.80 – 0.95 | 2.0 -3.0 | 8.0 – 11.0 | 3.0 – 4.0 | 53.0 – 56.0 |
| Esfahan /18 | 0.75 – 0.95 | 2.0 -3.0 | 6.0 – 10.0 | 1.5 – 2.6 | 48.0 – 55.0 |
| Esfahan /19 | 0.80 – 1.00 | 2.0 -3.0 | 6.0 – 11.0 | 3.0 – 4.0 | 51.0 – 55.0 |
| Esfahan /20 | 0.65 – 0.80 | 2.0 -3.0 | 4.0 – 9.0 | 6.0 – 8.0 | 56.0 – 62.0 |

Fa – trans-β- farnesene, Bo – /-/- α-bisabolol ,Ch – chamazulene, BoA – /-/- α-bisabololoxide A
§Number in bracket is identical with a locality of chamomile picking on the Figure 1.

Table 3 presents the results of the chamomile essential oil qualitative-quantitative characteristics that are originated from geographical various parts of the Iranian country, which were collected and analyzed in 2006. The Zagros Mountains, as a nature barrier, divided the chamomile populations: one to the Persian Gulf (mild winters, very humid and hot summers with annual precipitation ranges from 235 to 355 mm) with the very high /-/-α- bisabolol content (55 – 58%) and another one to the Alborz Mountains /Caspian Sea/ (arid whether with less than 200 mm of rain) with the very high /-/-α- bisabololoxide A content (50 – 60%). This chamomile biodiversity on relative small and heterogeneous areas was created during long time process (evolution) in regard to influence of eco-physiological conditions (biotic- and abiotic- factors) on the concrete place of chamomile population growth. The Iranian research of chamomile populations presents their rarity in respects of a geographic range (a small area of occurrence) and local population size (Rabinowitz, 1981; Salamon, 2007).

**Conclusion**

The highest /-/-α-bisabololoxide A content is typical for the Egyptian chamomile production and it belongs to the chemo type B. The role of these chemo types in phytomedicine is of particular interest to research and conservation because it so clearly highlights need to maintain biodiversity. From a biochemical perspective every chamomile population is unique and thus potentially could be the source of a major scientific breakthrough.

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