COMPARATIVE STUDY OF ESSENTIAL OIL YIELDS OF SEVEN ACCESSIONS OF ARTEMISIA HERBA-ALBA ASSO, DOMESTICATED IN ERRACHIDIA (SOUTHEAST OF MOROCCO)

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ABSTRACT

To produce essential oils of high commercial value, the present work consists of studying the essential oil yield of seven accessions of Artemisia herba-alba Asso collected from different locations in Morocco: Midelt, Boumeriem, Taznakt, Missour, Zawiat Sidi Hamza, Boudnib and Idelsane. These accessions have been domesticated in the experimental field of Errachidia (southeast of Morocco) before the extraction of their essential oil. This study showed that the yield of essential oil of the domesticated Artemisia herba-alba Asso varies significantly depending on its origin: from 0.35% to 2.35% (expressed in % of the dry plant material). The best yields were recorded for accessions of Idelsane followed by Boudnib. These yields are higher than those reported by Moroccan literature.

I. INTRODUCTION

The Medicinal and Aromatic Plant Sector occupies an important place and plays a major role in the Moroccan national economy. The existing activities in this area allow an export of nearly 1000 tons of essential oils and various extracts and about 400 tons of dried herbs, for a total of about 300 million dirhams. They also allow the annual creation of approximately 500 000 working days for local communities (Hmamouchi & Fechtal, 2000).

Among the Medicinal and Aromatic Plants which have a great economic interest in Morocco, there is Artemisia herba-alba. Its essence is intended for the cosmetics industry and perfumery. Two countries share the international market for this essential oil: Morocco and Tunisia, but the big portion goes to Morocco which holds 90% of the global market (Chemonics et al., 2006). However, the over-exploitation of wild Artemisia herba-alba has resulted in a dreadful degradation of sagebrush steppes. A study by Mahyoub et al. (2001) showed that Artemisia herba-alba steppes are replaced by indicator species of the degradation of vegetation giving a way to bare soil. The steppe of Artemisia herba-alba completely disappeared. The majority of species, including Artemisia herba-alba, are at the spontaneous state; very few are the object of culture with a reasoned technical and agronomic monitoring (Chemonics et al., 2006). On the other hand, its morphological and physiological characteristics make it a species well adapted to arid climatic conditions. The division of the tuft into autonomous individuals for the water supply enables it to withstand the death of a part of the bunch without the individual disappearing (Ourcival, 1992). Seasonal dimorphism of its foliage allows it to reduce the sweaty surface to avoid water loss (Ourcival, 1992; Oppenheimer, 1961). Due to its root system which is very dense on the surface, Artemisia herba-alba is able to enhance the value of the surface moisture caused by sprinkles (Le Floc’h et al., 1989).

Artemisia herba-alba Asso, known also as desert wormwood (known in Arabic as shih or as Armoise blanche in French) (Segal et al., 1987), has been used in folk medicine by many cultures since ancient times, used in Moroccan folk medicine to treat arterial hypertension and/or diabetes (Zeggwagh et al., 2008). Herbal tea from this species has been used as analgesic, antimicrobial, antiinflammatory, and hemostatic agents (Laid et al., 2008). During an ethno-pharmacological survey carried out among the Bedouins of the Negev desert, it was found that Artemisia herba-alba relieved stomach disorders (Friedman et al., 1986). This plant is also suggested to be important as a fodder for sheep (Bennamsour & Taleb-Bendiab, 1998).

For these reasons, this species must benefit from a great scientific interest and a protection against excessive exploitation. In this context and for the preservation of the species, we believe that domestication can favourably contribute to its protection. Therefore, the present work consists of studying the essential oil yield of seven accessions of Artemisia herba-alba Asso collected from different locations in Morocco and domesticated at the Regional Center of the National Institute for Agronomic Research in Errachidia (southeast of Morocco).

II. MATERIALS AND METHODS

II.1 Domestication

The cultivation of Artemisia was produced by the method of transplanting wild individuals in the experimental field of Errachidia (Morocco). These individuals came from seven regions of Morocco: Midelt, Boumeriem, Taznakt, Missour, Zawiat Sidi Hamza,
Boudnib and Idelsane. We have selected twenty individuals (plants) for each accession. The selection of individuals was made from a homogeneous population.

![Figure 1. Domestication of Artemisia herba-alba in the experimental field of Errachidia](image)

### II.2 Oil Yield

Samples of the aerial part (stems, leaves and flowers) of *Artemisia herba-alba* were collected in June 2010. Every sample is composed of a single plant, selecting seven samples for each accession.

The extraction of essential oils was performed by hydrodistillation in a Clevenger type apparatus (Clevenger, 1928) in the laboratory of natural substances synthesis and molecular dynamics of the Faculty of Science and Technology of Errachidia. Seven repetitions were performed for each accession by boiling for two hours 200 g of plant material (dried in the shade and ground) with 1 liter of water in a 2 liter flask surmounted by a 60 cm long column connected to a condenser (monobloc). The distillations were organized so that the samples were treated after the same drying time. The essential oil obtained was dried under anhydrous sodium of sulfate and stored at 4 °C in the dark (AFNOR, 2000).

The essential oil yield, expressed in milliliters based on 100 g of dry matter of *Artemisia herba-alba*, is calculated by the following relationship:

\[
T_{\text{HE}} = \left( \frac{V}{M_s} \cdot 100 \right) \pm \left( \frac{\Delta V}{M_s} \cdot 100 \right)
\]

- **T** : essential oil yield
- **V** : volume of essential oils collected (ml)
- **ΔV** : reading error
- **Mₙ** : plant dry mass (g)

### III. RESULTS AND DISCUSSION

The essential oil yield of each domesticated accession of *Artemisia herba-alba* is shown in table 1:

<table>
<thead>
<tr>
<th>Accession*</th>
<th>Essential oil yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midelt</td>
<td>0.35 %</td>
</tr>
<tr>
<td>Bounriem</td>
<td>0.47 %</td>
</tr>
<tr>
<td>Taznakt</td>
<td>0.56 %</td>
</tr>
<tr>
<td>Missouri</td>
<td>0.97 %</td>
</tr>
<tr>
<td>Zawiat Sidi Hamza</td>
<td>1.13 %</td>
</tr>
<tr>
<td>Boudnib</td>
<td>1.42 %</td>
</tr>
<tr>
<td>Idelsane</td>
<td>2.35 %</td>
</tr>
</tbody>
</table>

*Origin of Artemisia herba-alba domesticated

We notice that the essential oil yield of *Artemisia herba-alba* domesticated in Errachidia varies with the source of the wild plant. The essential oil yield obtained in this study of *Artemisia herba-alba* from Idelsane (2.35 %) is much higher than that reported in the Moroccan literature (1-1.5 %) (Chemonics et al., 2006).

The essential oil yield of *Artemisia herba-alba* domesticated in Errachidia from Idelsane (2.35 %) and Boudnib (1.42 %), is much higher than the ones obtained in the Guercif region (Morocco) distilled in September (0.56 %) March (0.86 %) and June (1.23 %)) (Ghanmi et al., 2010). However, yields of essential oil of *Artemisia herba-alba* domesticated in Errachidia from Zawiat Sidi hamza (1.13 %) and Missour (0.97 %) recorded relatively higher yields than those documented in September (0.56 %) and March (0.86 %) in Guercif (Ghanmi et al., 2010). The yields of essential oil which we recorded about *Artemisia herba-alba* domesticated in Errachidia coming from Zawiat Sidi Hamza (1.13 %) and Missour (0.97 %) are relatively higher than those recorded in September (0.56 %) and march (0.86 %) in Guercif (Ghanmi et al., 2010). Nevertheless, the yield of essential oil from *Artemisia herba-alba* of Taznakt (0.56 %) is equal to the yield of the region Guercif distilled in September (0.56 %). On the contrary, the yields recorded in the present study for accessions originating from Midelt (0.35 %) and Bounriem (0.47 %) are lower than the harvest of September (0.56 %), March (0.86 %) and June (1.23 %) in the region of Guercif (Ghanmi et al., 2010).
The essential oil yield obtained in this study of Artemisia herba-alba domesticated in Errachidia (0.97 % - 2.35 %) is comparable with 18 accesses of Artemisia herba-alba (wild plants) in Tunisia (0.68 % - 1.93 %) (Haouari & Ferchichi, 2009), and that of 16 samples from 4 sources in Spain (0.41 % - 2.30 %) (Salido et al., 2004). Although, the accession of Idelsane used in the present study gave an even higher yield (2.35 %). Also in other studies carried out in the region of Biskra (Algeria) (Bezza et al., 2010) and in the region of Matmata (Tunisie) (Akrout, 1999), lower essential oil yields were obtained, respectively 0.95 % and 0.65 %.

It appears that the species studied in this investigation has a high essential oil yield compared with other species of the same genus; This variation in yield between the species of the genus Artemisia was noticed in Italy. The essential oil yield of Artemisia verlotiorum laid between 0.6 % and 0.1 % (Chericoni et al., 2004). However, the yield of Artemisia cano is 1.3 % and the yield of Artemisia frigida is 1.5 %. By contrast, the yield of the aerial part of Artemisia Absinthium, Artemisia biennis, Artemisia dracunculus, Artemisia longifolia and Artemisia ludoviciana osculates between 0.3 % and 0.5 % (Lopes-Lutz et al., 2008). Another study has shown that the essential oil yield of Artemisia mesatlantica from the region of Ifrane and Boulemane (Morocco) provided essential oil in a rate of 0.5 % (Bencheqroun et al., 2012).

This difference in performance between the Artemisia species can be attributed to many factors: stage of growth, pedoliclimatic and edaphic conditions of the region, extraction technique, genetics p, etc. (Fellah et al., 2006).

IV. CONCLUSIONS

Although the selected accesses of Artemisia herba-alba were domesticated in the same climatic conditions, (soil and water), essential oil yields significantly vary from one accession to another.

These results are of great importance and will serve as a guide to understand the environmental and genetic factors responsible for this disparity in the values of essential oil yield.

Based on the results, the accesses of Idelsane and Boudnib are most indicated for cultivation in the Errachidia region.

REFERENCES

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