Journal of Materials and Environmental Science
ISSN : 2028-2508
e-ISSN : 2737-890X
CODEN : JMESCN


J. Mater. Environ. Sci., 2023, Volume 14, Issue 04, Page 442-448

http://www.jmaterenvironsci.com

# Current Situation of Two Steppes of *Thymus Satureioides* in the Eastern High Atlas of Morocco

**Brahim Ouahzizi[1,3*], Hamza Elbouny[1], Khalid Sellam[2], Abdelmonaim Homrani Bakali[3], Chakib Alem[1]**

[1]*Biochemistry of Natural Products Team, Faculty of Sciences and Techniques, Moulay Ismail University, Errachidia, Morocco.*

[2]*Biology, Environment and Health Team, Faculty of sciences and Techniques, Moulay Ismail University,Errachidia, Morocco.*

[3]*Regional Center of Agricultural Research of Errachidia, National Institute of Agricultural Research, Avenue Ennasr, BP 415 Rabat Principale, 10090 Rabat, Morocco.*

[*]*Corresponding author, Email address: b.ouahzizi@edu.umi.ac.ma*

***Received*** *22 Mar 2023,*
***Revised*** *10 Apr 2023,*
***Accepted*** *13 Apr 2023*

***Citation****: Ouahzizi B., Elbouny H., Sellam K., Homrani Bakali A., Alem C., (2023) Current Situation of Two Steppes of Thymus Satureioides in the Eastern High Atlas of Morocco. J.Mater. Environ. Sci.,14(4), 442-448.*

**Abstract:** The Moroccan aromatic and medicinal plants are remarkable by a great richness, diversity and high socio-economic value. The objective of this study is to estimate the quantity of *Thymus satureioides*, in two steppes Zaouiat Sidi Hamza (ZSH) and Assoul (AS) located in the eastern high atlas of Morocco. The total area of *T. satureioides* steppe at ZSH is 340 Ha, which remains small compared to AS site (560 Ha). The results showed that the density in ZSH is higher (212.6 plant/100 $m^2$) than AS (136.6 plant/100 $m^2$). Also the results demonstrate regeneration rate, the amount of dry matter, and dry foliar mass are higher in ZSH than in AS. recovery of *T. satureioides* in the ZSH site was 33.6%. However, the AS site recovery 7.9%. Similarly, the yield of essential oil from *T. satureioides* is higher in ZSH site compared to the AS site. Therefore the two steppes are not exploitable but they are in need of rehabilitation.

**Keywords:** *Thymus satureioides; Rehabilitation; Medicinal plant; Density; Essential oil*

## 1. Introduction

The therapeutic qualities of herbal medicines are attributed to bioactive secondary metabolites (Croteau et al., 2000). According to the World Health Organization (WHO), 70% of the world's population relies on the Traditional Health Care System (THCS) to treat a variety of ailments and diseases. Thus, the development of this heritage suffers from a lack of precise knowledge regarding the existing potentialities. Harvesting medicinal and aromatic plants is a socioeconomic strategy to diversify agricultural production while still providing jobs for local people. This activity gives about 500 000 working days for a total income of 25 million MAD to the local community and creates additional cash for rural communities (Taleb, 2013). The eastern high atlas of Morocco is one of the

regions of Morocco which presents a distinguished floristic diversity. It is characterized by rich endemic flora. Another one is characterized by their richness in aromatic and medicinal plants. But despite these potentialities, the ecosystems of this area are particularly threatened by several anthropogenic and climatic factors. *Thymus* is a Lamiaceae genus, *T. satureioides* is an endemic Moroccan medicinal plant locally known as "Azkuni" or "Zaitra". It has been extensively used in folk medicine against numerous diseases, including arterial hypertension, cold, diabetes, fever (Abouri et al., 2012); (El Hafian et al., 2014). Essential oil of *T. satureioides* has shown an important antioxidant, antifungal and antimicrobial activity (Ou-yahia et al., 2017; Salhi et al., 2018) and corrosion inhibition (Bammou et al., 2010). *T. satureioides* is geographically found in forest clearings, scrub, matorrals, and low and medium mountains up to 2200 m altitude (Benabid, 2000). This species grows on siliceous limestone substratum and rocky to moderately earthy soils in the High Atlas and Anti-Atlas of Morocco. From a climatic point of view, *T. satureioides* is located in the arid to subhumid bioclimate, with hot, temperate, and fresh variants (Fennane et al., 2007). several studies have begun on the domestication conditions of *T. satureioides* by seed germination (Ouahzizi et al., 2023; Ouahzizi et al., 2022; Chetouani et al., 2017 ) or by mastering cutting techniques (karimi et al., 2018). Despite the efforts to cultivate this plant, the exploitation of wild resources remains the most used method.
The objective of our study is to knowledge the production potential of *T. satureioides* in order to see the possibility of exploitation of this plant.

## 2. Material and methods

### *2.1 Study area*

The sites characterized by the presence of *T. satureioides* steppes (Figure 1) are :

Site 1: named Zaouit Sidi Hamza located at the level of province of Midelt region of Drâa Tafilalet, south east of Morocco under the coordinates ( longitude: 32.445663 latitude: -4.710392 altitude: 1780 m).

Site 2: named Assoul located at the level of province of Tinghir region of Drâa Tafilalet, south east of Morocco under the coordinates (longitude: 31.956559 latitude: -5.208103 altitude: 1629 m).

### *2.2 Climate data*

The rainfall data for the study area consists of two observation posts belonging to the Hydraulic Basin Agency Guir Ziz Gheris. The data analyzed in this study comes from this agency. Monitoring of monthly precipitation between 1981 and 2020. However temperature data for the two stations are taken from https://power.larc.nasa.gov/.

### *2.3 Methodological approach*

We deliberately chose a minimum area of 100 $m^2$. Sampling was conducted in *T. satureioides* dominated step. During the survey, five plot of size (10 × 10m) were randomly constructed. Different traits like density, Young plants, regeneration rate and Recovery of *T. satureoides* in two steppes were investigated. For the biomass estimate, a quadrant of $1m^2$ is cut, transported and dried in order to estimate the dry mass, and dry foliar mass. Data were represented as mean and standard deviation (SD).

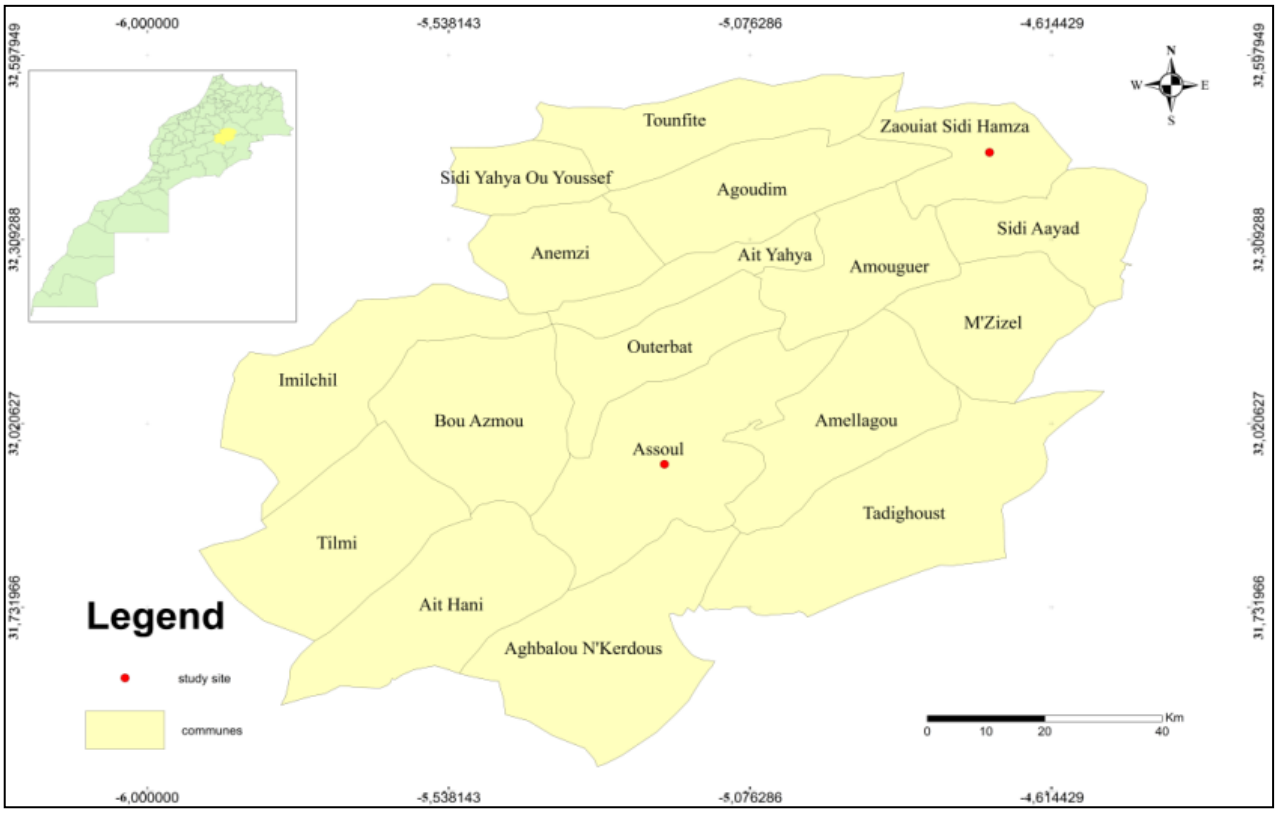


**Figure1.** The geographical location of the study area.

**Photo 1.** *Thymus satureioides*.

### *2.4 Essential oil isolation*

The plant materials were dried in shade. Then, 60g of the dried plant materials was subjected to hydrodistillation in 500 ml of distilled water for 4 h using a Clevenger-type apparatus. The essential oil was separated, then calculated the yield.

## 3. Results and Discussion

### *3.1 Description of the study area*

The AS site belongs to the Rheris basin which is characterized by geological formations made up mainly of sandstone-quartzitic and schists of Paleozoic age and predominantly limestone terrain of Mesozoic age (Margat, 1952). On the other hand, the site of ZSH belongs to the Ziz basin which is characterized by carbonate Jurassic series based in concordance on the red detrital formations of the lower Triassic-Lias. lithologically, it is essentially made up of dolomites, limestones, marl-limestone alternations and silico-clastic detrital (Chafiki et al., 2007; Charrire, 1990; Hinaje, 1995; Sadki et al., 1999).

### *3.2 Comparaison of climatic date between two site of study area*

The site ZSH characterized by a arid climate with cold and dry winters, hot and dry summers giving the average annual rainfall about 278.43±95.67 mm / year. Likewise the annual temperature is around 12.93 °C (Table1). concerning site AS it is also of arid climate with an average annual rainfall is about 179.09±97.03 mm / year (Table1), and an annual temperature of 14.73 °C. The ZSH site characterized by less dry years than the AS site, on the other hand the average temperature of AS always remains higher than that of ZSH.

**Table1.** Climate information of tow steppes of *T. satureioides*.

| Site | Longitude | Latitude | Altitude (m) | Annual temperature (°C) | Annual rainfall (mm) |
|---|---|---|---|---|---|
| **Z. S. Hamza** | 32.445663 | -4.710392 | 1780 | 12.93 | 278.43±95.67 |
| **Assoul** | 31.956559 | -5.208103 | 1629 | 14.73 | 179.09±97.03 |

### *3.3 Ecological parameters of two steppes of T. satureioides*

The ZSH steppe is characterized by a smaller area (340 Ha) than at the AS site which covers an area of 560 Ha (Table 2). The recovery of *T. satureioides* in this site was 33.6%. However, the recovery of AS site is 7.9%. These differences between the recovery of two sites may be due to differences in climate. The climate of the ZSH is less arid compared to the AS. *T. satureioides* of ZSH characterized by a regeneration rate of 25.96%. However, the regeneration rate of the AS does not exceed 16.83%.

Table 2 shows that the density of *T. satureioides* is 212.6 plants per 100 $m^2$, at the ZSH site, on the other hand in the AS site it does not exceed 136.6 plants per 100 $m^2$. Concerning the young plants of *T. satureioides*, the number of young plants at the level of site ZSH wait for 55.2 plants per 100 m2. However, this parameter remains weak at the level of site AS (23 individual per 100$m^2$).

**Table 2.** Ecological records of two steppes of *T. satureioides*

| Site | Z. S. Hamza | Assoul |
|---|---|---|
| **Aera (Ha)** | 340 | 560 |
| **recovery (%)** | 33.6% | 7.9% |
| **Density ( individuals /100m2)** | 212.6±20.15 | 136.6±23.21 |
| **Number young (individuals /100m2)** | 55.2±7.22 | 23±6.61 |
| **Regeneration (%)** | 25.96% | 16.83% |

### *3.4 Phytomass and yields of the essential oils of T. satureioides at two sites.*

Table 3 shows that the amount of dry matter, dry foliar matter and essential oil yields of *T. satureioides* was higher at the ZSH site compared to the AS site. The quantity of dry matter are 312.64 kg/ha and 99.59 kg/ha for ZSH and AS respectively. Also the amount of dry foliar mass are 108.48 kg/ha and 34.55 kg/ha in ZSH and AS respectively. In Ourika site, the quantity of dry matter of *T. satureioides* is 235.83 kg/Ha with an average selling price of 500 dh/kg of dry matter. The total dry mass and dry foliar mass of *T. pallidus* are 327.55 Kg/ha and 109.00 Kg/ha, respectively. *T. atlanticus* has the lowest total dry mass and dry foliar mass of 37.00 Kg/ha and 13.55 Kg/ha, respectively. On the other hand, the average selling price in the form of floral waters is 180 dh/kg (Arhinful, 2017). On the other hand, the annual production of *T. vulgaris* does not exceed 34 tonnes/year at the level of the cooperatives and associations of the Meknés-Tafilialt (Fadil et al., 2014). The average tonnage of this material exported each year is 1140 t, with a value of 12.9 million MAD (Taleb, 2017). The value of these exports for exporting dried aromatic and medicinal herbs, as well as locust beans, is 4% (Taleb, 2013). In particular, in 2014 Morocco exported 2693 tonnes of dried thyme to at least 20 markets, of which the top 4 countries are Nigeria, the USA, Turkey and Spain. The export packaging units are located in Marrakech, Casablanca and Fez. The processed raw materials are harvested far from these packaging areas, particularly in the terroirs of the Souss Massa region in the High Atlas. In the latter, a few small quantities are packaged and exported to the French, Swiss and German markets (Ouaddich et Bouzoubaa, 2016).

The yield of *T. satureioides* essential oils between the two sites is closer, the yield recorded in AS is 1.56%, and 1.98% for ZSH. Likewise, the yields of essential oils from *T. satureioides* vary between 1.4% and 2.7% (Ramzi et al., 2017). On another (El Bouzidi et al., 2013) shows that the yield of *T. satureioides* on essential oil was 1.86% for wild plants. Another the average yields from the essential oils of the air-dried aerial parts of the representative samples of *T. satureioides subsp. Pseudomastichina*, *T. leptobotrys*, *T. broussonnetii subsp. hannonis* and *T. riatarum* were 2.66, 1.73, 2.29 and 1.24% (v/w), respectively (Boubaker et al.,2016). The air-dried yielded 1.65%, w/w for *T. pallidus* and 0.7%, w/w, for *T. satureioides* (Ghalbane et al., 2011). (Salhi et al., 2018) shows that the yield of essential oils varied between 1.35 and 2.32%, and it was positively correlated with an altitude gradient.

**Table 3.** Dry matter and yields of the essential oils of *T. satureioides* at two study sites.

| Site | Essential oils yields (%) | Dry matter (kg/Ha) | Dry foliar mass (kg/Ha) |
|---|---|---|---|
| **Z. S. Hamza** | 1.98 | 312.64±29.96 | 108.48±10.39 |
| **Assoul** | 1.56 | 99.59 ±19.86 | 34.55±8.93 |

## Conclusion

It was concluded from the study that *T. satureioides* is a dominant plant and has very high value at two sites. However the status of *T. satureioides* at ZSH is good compared to the AS site, because of the differences in climatic conditions between the two sites. The two steppes of *T. satureioides* are not exploitable in this state. however they are in need of rehabilitation and safeguarding, because of ecological risk which can generate at the level of these two ecosystems. finally, to value this plant economically and develop these two rural communities, it is necessary to go through the cultivation of this plant, and the creation of cooperatives and associations.

**Acknowledgments:** The authors express their special thanks to the High Commission for Water and Forests and the Fight Against Desertification. The authors would also like to thank the Guir-Ziz-Rhéris Hydraulic Basin Agency for the climatic data.

**Disclosure statement:** *Conflict of Interest:* The authors declare that there are no conflicts of interest.***Compliance with Ethical Standards:*** **This article does not contain any studies involving human or animal subjects.**

**Funding:** This work was supported by CNRST.

## References

Abouri M., El Mousadik A., Msanda F., Boubaker H., Saadi B., Cherifi K., (2012), An ethnobotanical survey of medicinal plants used in the Tata province, Morocco*, J. Med. Plant Res.,* 1, no. 7, 99-123.

Arhinful M.A., (2017), Evaluation des potentialités de production et mesures de conservation des plantes aromatiques et médicinales dans le bassin versant de l'Ourika, Mémoire de 3éme cycle, ENFI, Sale, Maroc. 97p.

Bammou, L., Chebli, B., Salghi, R., Bazzi, L., Hammouti, B., Mihit, M., & Idrissi, H. (2010). Thermodynamic properties of Thymus satureioides essential oils as corrosion inhibitor of tinplate in 0.5 M HCl: chemical characterization and electrochemical study. *Green Chemistry Letters and Reviews,* 3(3), 173-178.

Benabid A., (2000), Flore et écosystème du Maroc: évaluation et préservation de la biodiversité, *Edition Ibis Press, Paris* ISBN : 2-910728-13-7, p 359.

Boubaker H., Karim H., El Hamdaoui A., Msanda F., Leach D., Bombarda I., Ait Ben Aoumar A., (2016), Chemical characterization and antifungal activities of four Thymus species essential oils against postharvest fungal pathogens of citrus, *Ind Crops Prod,* 86, 95-101. https://doi.org/10.1016/j.indcrop.2016.03.036.

Chafiki D., El Hariri A., Souhel A., Lachka N., Sarih S., Dommergues J., Garcia J.P., Quiquerez A., (2007), Données lithostratigraphiques et biostratigraphiques sur le Lias dans le cadre de deux transects du Haut Atlas central (Beni Mellal et Midelt Errachidia, Maroc), *J. Afr. Earth Sci,* 49 90-102. https://hal.archives-ouvertes.fr/hal-00198534.

Charrire A., (1990), Héritage hercynien et évolution géodynamique alpine d'une chaine intracontinental: Le Moyen Atlas au S de Fès (Maroc), Thèse Doct. Etat, Toulouse, 589.

Chetouani M., Mzabri I., Aamar A., Boukroute A., Kouddane N., & Berrichi A. (2017). Effect of gibberellic acid (AG3) on the germination of seeds of *Thymus satureioides* L and Lavandula dentate. *J. Mater. Environ. Sci,* 8(3), 942-948.

Croteau R., Kutchan T.M., Lewis N.G., (2000), Natural products (secondary metabolites), *In Biochemistry & Molecular Biology of Plants, American Society of Plant Physiologists, Beltsville, MD, USA* 1250-1318.

El Bouzidi L., Jamali, C. A., Bekkouche K., Hassani L., Wohlmuth H., Leach D., Abbad A., (2013), Chemical composition, antioxidant and antimicrobial activities of essential oils obtained from wild and cultivated Moroccan Thymus species, *Ind Crops Prod,* 43, 450-456. doi.org/10.1016/j.indcrop.2012.07.063.

El Hafian M., Benlandini N., Elyacoubi H., Zidane L., Rochdi A., (2014), Etude floristique et ethnobotanique des plantes médicinales utilis´ees au niveau de la préfecture d'Agadir-Ida-Outanane (Maroc), *J. Appl. Biosci.,* 81, 7198-7213, DOI: 10.4314/jab.v81i1.8.

Fadil M., Farah A., Haloui T., Rachiq S., (2014), Diagnosis of the aromatic and medicinal plant sector in Morocco: Case of the cooperatives and associations of the Meknès-Tafilalt area, *Lazaroa,* 35 155-166. doi: 10.5209/rev_LAZA.2014.v35.42697.

Fennane M., Ibn tattoo M., Ouyahya A., El oualidi J., (2007), Flore Pratique du Maroc [vol.2], Trav. Inst. Sci. Univ. Mohammed V, Sér. Bot. 2 478.

Ghalbane I., Belaqziz R., Ait Said L., Oufdou K., Romane A., El Messoussi S. (2011), Chemical composition, antibacterial and antioxidant activities of the essential oils from *Thymus satureioides* and *Thymus pallidus*, *Nat. Prod. Commun.,* 6(10), 1934578X1100601025. doi.org/10.1177/1934578X1100601025.

Hinaje S., (1995), Apport de l'analyse de la tectonique cassante tardi et post-panafricane à la modélisation de la mise en place des miniralisations dans la boutoniére de Bou-Azzer (Anti-Atlas, Maroc), Thèse de 3ème cycle, Faculté des Sciences Rabat, 238.

Karimi M., Berrichi A., Boukroute A. (2014). Study of vegetative propagation by cuttings of Thymus satureioides. J. Mater. Environ. Sci, 5(4), 1320-1325.

Margat J., (1952), Le Haut Atlas calcaire – (Hydrogéologie du Maroc-Chap. VI-2). Notes et Mémoires du Service Géologique du Maroc. n° 97 – Rabat.

Ouaddich B., Bouzoubaa, Z., (2016), Elaboration d'une strategie de promotion de la chaine de valeur thym dans le bassin versant d'aoulouz et dans la foret de mesguina region souss-massa. https://siredd.environnement.gov.ma/SoussMassa/Content/images/documents/Liens/c1elab.pdf.

Ouahzizi B., Elbouny H., Sellam K., Alem C., Homrani Bakali, A. (2023). Effect of Salinity and Drought Stresses on Seed Germination of Thymus satureioides. *Journal of Rangeland Science* 13, No. 1 33-38.

Ouahzizi B., ElBouny H., Sellam K., Alem C., Bakali A. H. (2022). Influence des températures alternées et la durée de stockage sur la germination des semences de Thymus satureioides. *African and Mediterranean Agricultural Journal-Al Awamia,* (135), 149-164. https://doi.org/10.34874/IMIST.PRSM/afrimed-i135.33277.

Ou-Yahia D., Chraibi M., Farah A., Fikri-Benbrahim K., (2017), Antimicrobial and antioxidant activities of Moroccan Thymus satureioides essential oil. *J. Mater. Environ. Sci,* 8(2), 1948-1952.

Ramzi H., Ismaili M. R., Aberchane M., Zaanoun S., (2017), Chemical characterization and acaricidal activity of Thymus satureioides C. & B. and Origanum elongatum E. & M.(Lamiaceae) essential oils against Varroa destructor Anderson & Trueman (Acari: Varroidae), *Ind Crops Prod,* 108, 201-207. https://doi.org/10.1016/j.indcrop.2017.06.031.

Sadki D., Elmi S., Amhoud H., (1999), Les formations jurassiques du Haut Atlas central marocain: Corrélation et évolution géodynamique, *Le 1er Coll. Nat. Sur le Jur. Marocain,* 122-123.

Salhi N., Fidah, A., Rahouti, M., Ismaili, M.R., Ramzi H., Kabouchi, B. (2008) Chemical composition and fungicidal effects of four chemotypes of Thymus satureioides Cosson essential oils originated from South-west of Morocco. *J. Mater. Environ. Sci,* 9(2), 514-519.

Taleb M.S. (2013), In Ministère de l'Énergie, des Mines, de l'Eau et de l'Environnement, Département de l'Environnement, Evaluation des besoins de renforcement des capacités nationales en matière d'APA. Partie2 : État des connaissances sur les ressources génétiques au Maroc, exploitation à l'échelle nationale et internationale, potentiel de valorisation. Cas des ressources génétiques des arbres forestiers et des Plantes Aromatiques et Médicinales (PAM).

Taleb M.S. (2017), Aromatic and Medicinal Plants in Morocco: Diversity and Socio-Economic Role. *World Acad Sci Eng Technol Int J Biol Biomol Agric Food Biotechnol Eng.* 11, 742-746. doi.org/10.5281/zenodo.1314574.