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Therapeutic properties of the woody plant *Haloxylon scoparium* Pomel in the steppe region of Naâma (Algeria)

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Abstract. *Haloxylon scoparium* (syn. *Hammada scoparia*, in Arabic: *remth*) is a steppe species characteristic of the Saharan Atlas and belongs to the family Amaranthaceae. An ethnobotanical survey on *H. scoparia* was carried out in the local population of the Naâma region. Using 200 questionnaire forms, this ethnobotanical study made it possible to identify the different uses of the species against various health problems. The results show that *H. scoparia* is well known by the population for its therapeutic virtues, with a level of knowledge of 96% and a fidelity index of 42%. As many as 192 respondents reported its use against 18 conditions, including diseases of the digestive system, injuries, skin inflammation, diabetes, and scorpion stings, which occupy the first place with a rate of 43%. Leaves have an intraspecific use value of 55.6%, and decoction of the leaves followed by the powder alone or in combination is the most used preparation method. This steppe species deserves to be valued on a large scale for its socio-economic and ecological aspects but also for its therapeutic effects.

Key words: *Haloxylon scoparium*, ethnobotany, traditional medicine, steppe, Naâma, Algeria

1. Introduction

The use of herbal remedies is still one of the most prevalent forms of medicine around the world. They represent the only source of medicines for nearly 90% of the population in some African countries (Cogne 2002). Medicinal plants remain an important and decisive source for pharmacology and the development of drugs. The constituents of plants are used directly as therapeutic agents but also as raw materials for the synthesis of drugs or as models for pharmacologically active compounds (Ameenah 2006). Plant species have always been essential also for food, health care, construction, and for purification of the air and water. All of the services provided by plant biodiversity make it crucial for humanity. For centuries, plants have always cured people, empirically, guided by tradition or customs. Most of the great physicians of the past were phytotherapists (Goeb 1999). This ancestral empirical knowledge remains strongly used by current generations despite the progress of modern medicine (Koné & Kamanzi 2006). Among the scientific disciplines interested in traditional herbal medicine, ethnobotany is considered a science that enables popular knowledge to be translated into scientific knowledge (Tahri *et al.* 2012). Ethnobotany was originally defined as the study of plants used by indigenous peoples (Ritter *et al.* 2015), that is how individuals in a specific culture and area use local plants (Ebadi & Eftekharian 2019). Ethnobotany also helps to understand the role of ancient and contemporary human interventions on the plant environment and the nature of the links that result from it (Crozat 2001). An ethnobotanical survey is a type of fieldwork that consists in collecting data on the traditional use of medicinal plants. Indeed, there are about 500 000 species of plants on earth, of which about 80 000 have medicinal properties (Quyou 2003). Many studies have been carried out on the ethnobotany of steppe species (e.g. Ould el Hadj *et al.* 2003; Rebbas & Bounar 2014; Bakiri *et al.* 2016; Jaouadi *et al.* 2016). This survey, conducted among traditional healers, herbalists, and other individuals living in contact with medicinal plants, highlights an ancestral practice that is very effective in treating diseases. In this context we chose to focus this ethnobotanical study in the population of the

Naâma region on the pre-Saharan species *Haloxylon scoparium*, of therapeutic interest.

2. Material and methods

2.1. Description and choice of localities for the survey

Haloxylon scoparium (syn. *Hammada scoparia* (Pomel) Iljin) is very rich in bioactive molecules, so it is considered to be a potential source of new drugs (Ksouri *et al.* 2012). Our choice was guided by the use of the articulated and leafy branches of this shrub in folk medicine. Its effectiveness has been proven when used either alone or in combination with other species to treat various health problems. The ethnobotanical survey was carried out across 15 sites (Fig. 1), spread over all the communes of the wilaya of Naâma, to have an overview of local traditional uses.

Naâma extends over an area of 29 514.10 km^2, which represents 1.14% of the territory of Algeria. It is a wilaya with an agro-pastoral vocation, has significant steppe rangelands and groundwater resources. It is located between the Tell Atlas to the north and the Saharan Atlas to the south, in the southwest part of the high plateaus.

2.2. Ethnobotanical research

Ethnobotanical surveys were carried out in the department of Naâma during the 2017/2018 campaigns. The survey gathered information on the socio-economic and ecological importance of *Haloxylon scoparium* from 200 respondents (94 men and 106 women). They were traditional practitioners, herbalists and other people who had acquired traditional know-how based on medicinal plants. The approach of those interviewed was based on dialogue in the vernacular, taken separately within their environment.

2.3. Processing and analysis of ethnobotanical data

The ethnobotanical information gathered was recorded on raw data sheets, next transferred to a database, processed, and analysed to obtain standardized data. They covered first of all the frequency of use of *H. scoparium* in the region and the most commonly mentioned parts and methods of preparation. Then, several ethnobotanical indices were calculated.

The Cultural Importance Index (CI) is used to assess the importance of a plant in a given category of use (Tardío & Pardo-De Santayana 2008). The values reflect the quantified importance of each category of use of a species in the environment. CI is calculated by the following formula of the cited authors:

$$CI = \sum_{u=u_1}^{u_{NC}} \sum_{I=1}^{I_N} \frac{UR_{ui}}{N}$$

where N is the total number of informants and UR is the number of informants using a given species for a specific category of use.

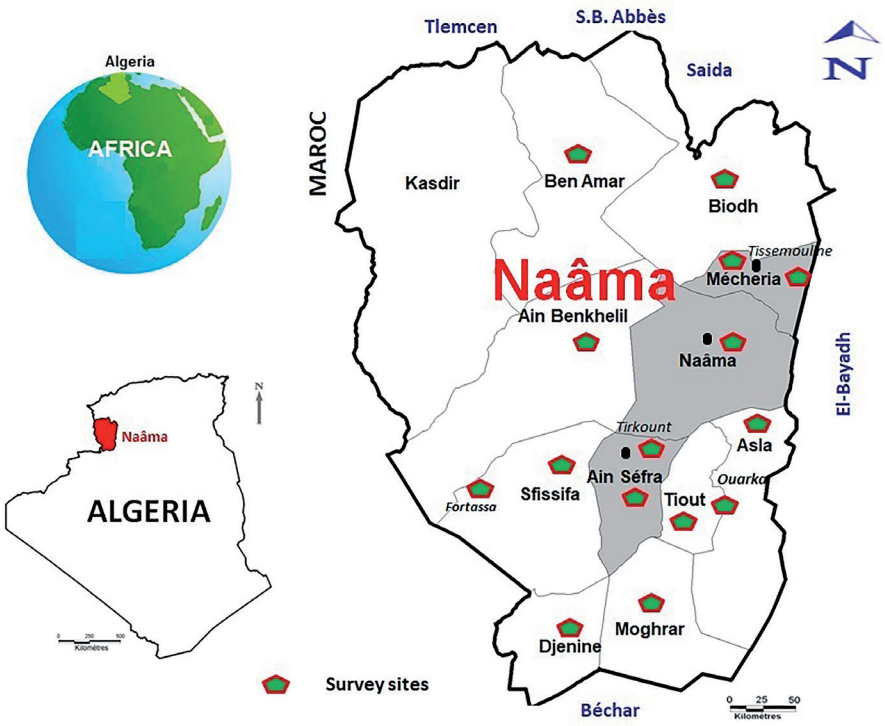

Fig. 1. Distribution of survey sites in the Naâma region

The level of knowledge (NC) index (N'guessan *et al.* 2015) is calculated as follows:

$$NC = (N/I) \times 100\%,$$

where N is the number of people recognizing the species, and I is the number of people interviewed. The following classes of species are distinguished: very well-known if NC is >75%; well-known if NC is between 50% and 75%; moderately known if NC is between 25% and 50%; little known if NC is up to 25%, and unknown if NC = 0%.

The fidelity index (IF) is calculated according to the formula (Guèye *et al.* 2012):

$$IF = (I_p/I_u) \times 100\%,$$

where I_p is the number of informants who affirmed the use of a species in a given category and I_u is the number of informants interviewed. This index makes it possible to measure the degree of relative use of each of the plants concerned.

In the formula of the intraspecific use value IUV = VU_{org} / VU_{tot} × 100% (Masharabu *et al.* 2010), organ use value VU_{org} is the number of diseases or uses cited for a given organ, and total use value VU_{tot} is the total number of diseases or uses cited for the species. This index helps to determine the organs of relatively high importance to the local communities and the use value of the various organs in medicinal recipes.

3. Results and discussion

3.1. Demographic characteristics

Out of the 200 people surveyed, 53% were female (Table 1). This corresponds to the general population and housing census (RGPH), where the number of women for the year 2016 in the age group of 20-50 years was 61472, compared to 57570 men (D.P.S.B de Naama 2020). The median age of the respondents was within the range of 41-60 years. In the department of Naâma, people over 50 years of age have a higher frequency of use of medicinal plants, compared to the age class of young people, 20-40 years old, where the percentage of use is around 29%. In the study region, educational levels of the people surveyed varied and as many as 36% of phytotherapy users were illiterate (Fig. 2). The knowledge of informants and their level of education are also a variable to be taken into account because, in traditional medicine, the statements of an illiterate or an expert are intertwined (El Rhaffari *et al.* 2002). In fact, illiteracy, limited financial means, and the traditions of local populations (especially nomads) contribute to the use of medicinal plants to treat their ailments.

Table 1. General information on the 200 people surveyed

Demographic data	Number	%
Sex		
Women	106	53.0
Men	94	47.0
Age		
20-40	59	29.5
41-60	97	48.5
61-80	40	20.0
>80	4	2.0
Educational level		
Illiterate	64	32.0
Primary	27	13.5
Secondary	68	34.0
University	41	20.5

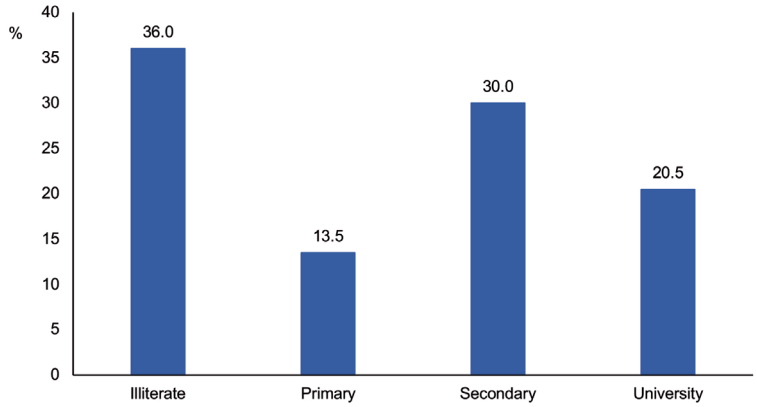

Fig. 2. Distribution of the frequency of medicinal use of *Haloxylon scoparium* according to the level of education in the Naâma region

Table 2. Frequencies and values of organ use of *Haloxylon scoparium*

Organ	Frequency of use (% of records)	No. of diseases treated	IUV(% of diseases)
Leaf	58.03	10	55.6
Leafy stem	26.36	8	44.4
Root	4.68	3	16.7
Seed	1.56	1	5.6
Whole plant	9.37	5	27.8
Total no. of diseases treated		18	

Explanations: IUV= intraspecific use value, i.e. percentage of diseases treated with the use of the given organ

3.2. Ethnobotanical characteristics

3.2.1. Plant parts used

The percentages of various plant organs used have been calculated to determine the most popular uses (Table 2). Overall, our study indicates that the leaves of *Haloxylon scoparium* are the most used by the population of Naâma (58.03% of records), followed by leafy stems (26.36%), the whole plant (9.37%), and finally roots and seeds (4.68% and 1.56%, respectively).

Our analysis shows that the different organs of *H. scoparium* (leaf, root, leafy stem, seed, etc.) are used for treatment of 18 diseases. The use value of the different organs varies according to the conditions and the respondent. Leaves represent the highest intraspecific use value of 55.6% for the species whose total use value (VU_{tot}) is 18 (Table 2).

3.2.2. Method of preparation

The average percentage of responses from respondents for the preparation methods were classified as follows: decoction (39.5%) is the most used method, followed by the powder alone or combined, others (infusion, maceration, cooked,…), and poultice: 29%; 24.5%; 4.5% and 2.5%, respectively (Fig. 3).

Most preparations (decoctions, infusions or maceration) are taken orally or with a bath. However, the powder of the dry plant material – mixed or not with butter, olive oil, henna, milk, honey, etc. – is used externally for the treatment of wounds, scabies, and other infections of the skin.

3.2.3. Therapeutic indications

Field surveys in the local population show that the plant has multiple uses, since it is applied for the treatment of many health problems: scorpion stings, stomach problems, infections, haemorrhoids, etc. (Fig. 4; Table 3). The table shows the different therapeutic indications of *Haloxylon scoparium* according to the organs used. Given its healing power, respondents use it to treat various, often fatal conditions, such as scorpion stings.

3.3. Index calculations

Various indices were calculated to reflect the level of knowledge and use of *Haloxylon scoparium* by local

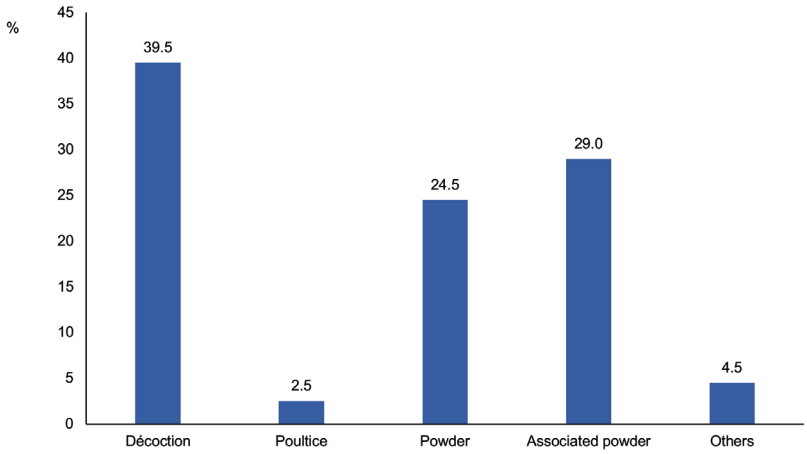

Fig. 3. Classification of the methods of preparation of *Haloxylon scoparium* in the Naâma region

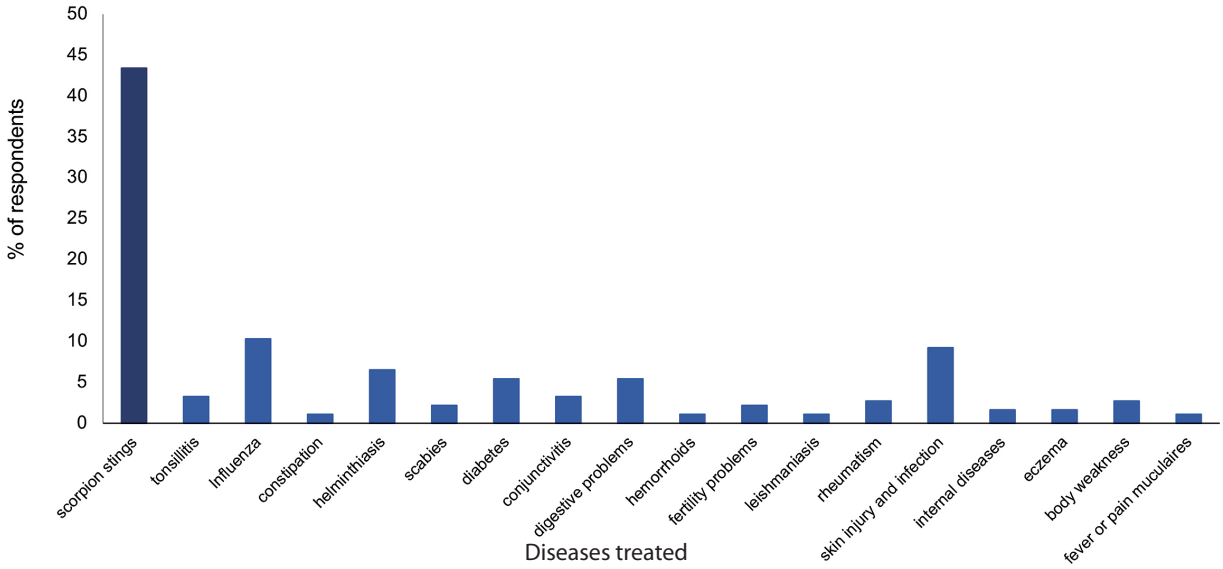

Fig. 4. Classification of health problems treated with *Haloxylon scoparium* in the Naâma region

people. These calculations are based on the number of informants using the species for therapeutic purposes.

In respect of the results of earlier work and indices analysis (Tardío & Pardo-de-Santayana 2008; Medeiros *et al*. 2011; Albuquerque *et al*. 2014), with the level of

Table 3. Presentation of the different therapeutic uses of *Haloxylon scoparium* in the Naâma region

No.	Uses	Part used	Method of preparation	Dosage
1	Bites of scorpions or snakes	leaf	powder + pure butter	1 teaspoon of powder + 1 tbsp of pure butter (heated)
2	Tonsillitis	leafy stem	decoction or infusion	1 glass in evening
3	Influenza	whole plant	decoction	1 glass/day before sleeping, or inhaling steam
4	Constipation	leaf	decoction or infusion	1 glass before meal (3 times/day)
5	Helminthiasis	leaf	decoction	1 glass with main meal
6	Scabies	whole plant	decoction	take a bath and wash well
7	Diabetes	leaf	powder + olive oil	1 teaspoon of powder + 1 tbsp of oil
8	Conjunctivitis	leafy stem	'Remth Steam' (boiling)	once a week
9	Digestive problems	leafy stem	decoction	1 glass after meal (2 times/day)
10	Haemorrhoids	leaf	powder + honey	small ball (3 times/week)
11	Fertility problems	whole plant	Take a vaginal steam bath	3 times/week
12	Leishmaniasis	leafy stem	powder + pure butter	apply to skin (3 times/week)
13	Rheumatism	whole plant	powder (poultice)	1-2 times/week
14	Skin injury and infection	leafy stem	powder + olive oil	tighten on wounds (until healing)
15	Internal diseases	leaf	decoction or infusion	1 glass/day
16	Eczema	leaf	powder + olive oil	bring to boil, then apply to skin
17	Body weakness	leafy stem	decoction	1 glass on an empty stomach
18	Fever and muscle pain	whole plant	decoction or poultice	1 glass/day

knowledge NC = 96%, the species is very well known and highly appreciated by the population for therapeutic purposes. Respondents from the region affirmed its use against scorpion stings with a high degree of consensus of 42%. The Cultural Importance Index (CI) is 0.96, corresponding to the highest number of respondents using this medicinal plant against a given health problem.

Our analysis of the results obtained from individual respondents in their own environment shows that herbal medicine is practiced by the population regardless of age, educational level or sex. We believe that group surveys would allow discussions between participants and, according to Alexiades (1996), group interviewing is a challenging exercise for individuals to provide information. In this region, the informants (men and women) are concerned with traditional medicine. According to Chippaux (2011), the frequent use of traditional healthcare is a rule in indigenous populations (75%).

People have used plants for therapeutic purposes since prehistoric times (Fleurentin *et al*. 2002). The local population uses *H. scoparium* collected directly from the study area. Few people buy the plant, whose price is about 40 Algerian Dinars for 100 g. In the region, different parts are applied for therapeutic purposes: leaves, flowers, roots, fruits, seeds, etc. This is consistent with the results reported previously (Lahsissen 2010; Benaradj *et al.* 2015, 2017, Benaradj & Boucherit 2022). Leaves of *H. scoparium* (also leafy twigs) are the most used parts in the different therapeutic preparations, with an intraspecific use value of 55.6%.They are the site of photosynthesis and storage of secondary metabolites responsible for the biological properties of the plant (Bigendako & Lejoly 1990). In addition, the use of leaves alone is better for plant survival, as the use of whole plants or roots can seriously threaten the local flora (Umair *et al.* 2017). Better use of medicinal plants can be promoted by raising awareness among users of the policy to be adopted to teach good plant harvesting practices, their management, and in situ protection (Yaici *et al.* 2020).

Our surveys of the local population revealed that as many as 192 respondents reported the use of *H. scoparium* for therapeutic purposes, with a 96% knowledge level and a 42% fidelity index. More than 18 conditions are treated with *H. scoparium*, e.g. skin diseases, digestive diseases, haemorrhoids, respiratory diseases, eye disease, gynaecological diseases, diabetes, and scorpion stings. These results corroborate those of Telli *et al.* (2016), who assert the use of this species against various health problems and especially in the traditional treatment of diabetes in the region of Ouargla (south-eastern Algeria).

Salah *et al.* (2002) have shown that the aqueous extract of *H. scoparium* has an anti-cancer activity, larvicidal effect, and is also traditionally used for scorpion bites. Despite many uses of the plant in traditional medicine, very few ethnobotanical studies have been considered to date. Our surveys conducted in the local population of Naâma indicate that *H. scoparium* is recommended against scorpion stings and other envenomations (bites of snakes and venomous insects, by 43% of respondents. A teaspoon of *H. scoparium* powder, combined with a tablespoon of pure ovine butter, slightly heated, is given to the patient immediately after the sting. As many as 50% of the interviewees are convinced that this method allows collecting the most active ingredients (Boucherit *et al.* 2017; Benaradj *et al.* 2017; Boucherit 2018; Boucherit *et al.* 2018; Benaradj & Boucherit 2022).

Other therapeutic uses of the species in the area include the treatment of gastric problems (acid indigestion, ulcer, upset stomach, gastroenteritis, food poisoning, etc.). This type of treatment was reported earlier by Adli & Yousfi (2001) in the region of Djelfa. The species is also recommended as antidiabetic, by infusion of the aerial part of the plant. The same use was described by Bnouham *et al.* (2002). Besides, the plant is indicated against inflammations and injuries, as powder mixed with olive oil for external use. Moreover, this species is applied by the Moroccan population (Eddouks *et al.* 2002) and seems to be effective for treatment of bloating, bitterness, diseases of the urinary tract, and rheumatism.

Snake bites and scorpion stings are the cause of death around the world. Obviously, the study of effects of *H. scoparium* remains to be completed by more in-depth investigations. Resorting to traditional methods and the know-how of the local population remains essentially verbal, so the approach applied in out study makes it possible to perpetuate the knowledge and scientifically improve the therapeutic use of this plant.

4. Conclusions

The ethnobotanical surveys carried out in the Naâma region have made it possible to gather practical information relating to the therapeutic use of the medicinal plant *Haloxylon scoparium*. We found that its aerial parts (stems and leaves) are the most used against scorpion envenomation, as a spoon of plant powder combined with pure sheep butter.

Our results are similar to those from Morocco and Tunisia since the frequency of use of medicinal plants is closely linked to the profile of the people surveyed. Thus, the young, compared to the elderly, generally do not know the names or the usefulness of the majority of plant species. Women and men have shared medicinal knowledge, with a slightly higher percentage of herbal medicine use by women. It should be noted that despite the drugs and all the chemical arsenal of modern medi-

cine and the large pharmaceutical groups, there is still an involvement of local communities in the Naâma region in the conservation of popular know-how in traditional herbal medicine. This popular knowledge, considered as heritage, can constitute a platform for the exchange of experiences and valuable information concerning the traditional use of medicinal plants.

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Data analysis and interpretation: H. Boucherit, A. Benaradj
Writing the article: H. Boucherit, A. Benaradj
Critical revision of the article: H. Boucherit, A. Benaradj
Final approval of article: H. Boucherit, A. Benaradj

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