The status and perception of medicinal plants by local population of Talassemtane National Park (Northern Morocco)

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ABSTRACT

The humans have the capacity to transmit knowledge to other individuals remote in space and time by verbal and written means. Ethno-pharmacology is based on approaches from the sociocultural and natural sciences. Ethnobotanical research in the Talassemtane National Park was undertaken following a perspective to establish the base of comparative study with Andalusian and Sicilian regions. The aim of these studies was to analyze the data regarding interviewees (socio-demographic), status, perception of inhabitants of the Northern Morocco, confidence in the healing properties of medicinal plants, and conserving the traditional medicinal heritage of the Talassemtane National Park (TLSNP). This study was conducted in the National Park of Talassemtane for a three-year survey (2014-2017). In total, 200 local traditional informers were interviewed to explore the traditional ethnobotanical and ethno-pharmacological knowledge of the local population. Information was collected using open-ended and semi-structured interviews, followed by the analysis of data regarding the interviewees (socio-demographic) and the ethnobotanical or ethno-pharmacological data. In this study, we have identified a total of 152 medicinal plant species belonging to 44 botanical families. The most important family is that of the Apiaceae represented by 31 species. We identified 567 symptoms and diseases for the 152 taxa belonging to 44 included families, with a total of 9402 use reports (UR). They are used to treat up to 123 conditions or symptoms classified into 15 pathological groups according to the ICPC-2 classification of diseases. Concerning the diseases, the main pathological group treated is the one for digestive symptoms (D, 24%). The results show that 50% of the local population still prefer to use traditional medicine for daily healthcare, and a few of them support these traditional medicines along with conventional drugs. The analysis of data obtained in this ethnobotanical study allowed us to identify the most commonly used medicinal plants in the TLSNP. The knowledge reported in this study is a very original source of information on the local traditional medical flora and provide an additional value to the emblematic Talassemtane National Park.

Keywords: Ethnobotanical approach; Medicinal plants; traditional medicine; Talassemtane National Park; North of Morocco.

INTRODUCTION

Relationship between human food and medicines are integral part of human life (Ford 1979; Harshberger 1986; Jhons 1990; Berlin 1992; Balick & Cox 1996; Johns 1996; Endicott & Welsch 2003; Etkin 2006; Heinrich et al. 2006; Totelin 2009; Benítez et al. 2010; Leonti 2011; Nolan & Turner 2011; Mandal et al. 2012). There are societies that use plants to cure diseases and traditional medicine still taking a very important position in the life...
of many people around the world (Matu & Van Staden 2003; Ahmad et al. 2015; Datir & Bhore 2017). Over 25,000 plants are used in traditional medicine for the discovery of new drugs in pharmacology around the world (Van Wyk et al. 1997; Diallo 2000; Hamilton 2003; Limem-Ben Amor et al. 2009; Huang 2011; Raffieian-Kopaei 2012). From the 20th century the plants has been revalued by ethnobotanists and the field of ethnobotany has changed with the compilation of raw data (Jhons 1996; Guerrera 2003). The most important ethnobotanical studies involve the dynamics between human populations, plant foods and medicines that have historic significance in maintaining human nutrition and health. The populations are known to develop social networks to aid in the procurement of plant materials needed to retain traditional medicine (Arber 1938; Corsi & Pagni 1979; Riddle 1985; Lardos 2006; Volpato et al. 2007; Weckerle et al. 2009; DeVos 2010). The population has always had resort, for centuries, to medicinal plants as a solution and the only way to solve many of their health-related problems. In fact, nowadays, many people still use herbal medicine, and popular herbal therapeutic knowledge is being passed down from generation to generation, even though this tradition is disappearing (Schultes 1994; Johns 1996; Pieroni & Price 2006; Etkin et al. 2011; Touwaide & Appetiti 2013). People who lack this tradition continue to turn to herbalists to buy plants or consult traditional healers for any type of health-related problems. The ethnobotanists consider traditional plants and medicines in their efforts to interpret health belief systems (Quave & Pieroni 2007). Ethno-ecological studies also highlight the forces that continuously shape how information is transferred from one generation to the next (Nolan 1998; Zent 1999; Zarger & Stepp 2004). The ethnobotanical knowledge is passed on verbally among generations and most of this knowledge has not been formally documented (Asase et al. 2008; Nadembega et al. 2011). The documentation of knowledge is an essential step in ethnobiology, since it provides data for further studies and evaluates indigenous pharmacopoeias (Berlin 1992; Robineau & Soejarto 1996; Frei et al. 1998; Leoniti et al. 2001; Touwaide 2010; Leoniti 2011). Notwithstanding the humanistic ideas, technological innovations and discoveries during our century, the broad perspective of ethno-pharmacology contextualizes ecology and addresses the perception of plants, plant use, and pharmacology in human communities (Ginzburg 1990). Humans have the capacity to transmit knowledge to other individuals remote in space and time by verbal and written means. Ethno-pharmacology is based on approaches from the sociocultural sciences and the natural sciences, historical aspect overview will have to be based on the development of this scientific approach (Buenz et al. 2005; Leoniti et al. 2010; Touwaide 2010; Adams et al. 2011; Lardos & Heinrich 2013; dal Cero et al. 2014). However, written document of using remedy and the medical practice are of course available from many cultures (Heinrich 2000; Rivera et al. 2006; Heinrich et al. 2006; Heinrich 2010; Leoniti et al. 2010, 2011). Today, according to the World Health Organization (WHO 2007), over 80% of the world’s population rely more often on traditional drugs, mainly plants, serving as the main source of health care (Farnsworth et al. 1995; Ganesan 2008; Jiofack et al. 2010). The most population’s diseases are currently being treated more often through medicines of synthetic origin and specifically developed in laboratories, and their definite effects on the treatment of diseases have contributed to the development of their use. The use of some medications leads to certain damages to the body. Actually, the 50% of the available drugs are basically derived from medicinal plants. The importance of medicinal plants and their products is increasingly recognized, and the public confidence in their use is constantly strengthened (Yarnell & Abascal 2002; Harvey 2008). So, the global trend of synthetic compounds has turned to herbal drugs (Fabricant & Farnsworth 2001).

Aim of the study
This study documents traditional medicinal plants that are used by the indigenous population of Talassemtane National Park, the analysis of data regarding the interviewees (socio-demographic), the status, perception of the inhabitants of the Northern Morocco, confidence in the healing properties of medicinal plants, and conserving the traditional medicinal heritage of the local population.

MATERIALS AND METHODS

Study area
The present study was conducted in Talassemtane National Park (TLSNP), Northern Morocco (Fig. 1). The TLSNP is located on the Mediterranean coast. It is limited to the north by Wadi Tissikiste, douars Amahousse, Arhiniame, and Souk El Had. To the east by Oued Kanar and douars Assimrane and Assifane, to the south by the way connecting Assifane to the main road to Bab Taza, and to the west by douar Benizid, Ain Tissiliane, Tarhzoute, Jbile Sidi Salah, and Tamalout. The study area has Mediterranean climate with maximum temperature beyond 45°C during summer (July and August) and below 0°C during winter (December and January) and annual rainfall...
is about 1000 mm. In the area, economy of the local people is very much dependent on subsistence agriculture, is generally based of cannabis cultivation (Chouvy & Afsahi 2014; Afsahi 2015; Meklach et al. 2017; Chouvy & Macfarlane 2018; Redouan et al. 2020).

Fig. 1. Situation and delimitation of PNTLS (Edited with QGIS from designed using QGIS 3.4.2.).

Data collection
Ethnobotanical survey was conducted from 2014 through 2017. Semi-structured interviews were administered, and free listings were conducted, through face-to-face interviews and focus group. The field survey is based on the previous works of our research group (Merzouki et al. 1997; 2000; 2001; El Gharbaoui et al. 2017; Redouan et al. 2020; Cheikh et al. 2020). Totally, 200 informants aged 20-40 and 40-60.

The survey consists of two parts: the first part deals with the demographic characteristics of the informants and the second one focuses on the used plants (disease and symptoms), the used parts, and the preparation of the remedies. Interviews were performed in the field individually for each informant, in Arabic local dialects (darija). The plant samples were identified in the Abdelmalek Essaâdi University Herbarium, Voucher numbers for the included plants are provided in the results. For each plant sample, a specific code was given (e.g. “TMP-B001”, since the international herbarium code for this herbarium is TMP-B). Vernacular names were included as referred by our informants in both Arabic and Roman alphabets. For the transliteration of the vernacular names from Arabic into the Roman alphabet, we followed Bellakhdar (1997).

The treated diseases were classified according to the international classifications of diseases (ICPC-2, International Classification of Primary Care, 2015) of the WHO (as suggested by Staub et al. 2015).

Statistical analysis
For the analysis of data regarding the interviewees (socio-demographic) and the ethnobotanical or ethno-pharmacological data (used parts, administration modes, etc.) we first used Excel ® sheet to introduce the transcribed data. To evaluate knowledge, use, and motivation of medicinal plants versus conventional drugs, we used the Principal Component Analysis (PCA) in SPSS ®. For this PCA analysis, we mainly include questions that refer to the use of medicinal plants (closed question: Yes/No), the knowledge or know-how of traditional medicine recipes (closed question: Yes/No), and finally the motivation to whether or not they use medicinal plants for ailments relief (open question for which answers were regrouped into appropriate clusters). The data resulted from these questions were imported into and recoded in SPSS, and then the PCA analysis was carried out by
including the socio-demographic data (gender, age, education level, and civic status). SPSS allows recording the coordinates of principal dimensions or factors in form of new variables that allow plotting the main information explained as a 2D scatter plot (Figs. 2, 3 and 4). It is important to highlight that these questions focused on the medicinal plants, rather they asked in a general manner, with the aim to establish a general perception of the local use, knowledge, and motivation toward medicinal plants.

RESULTS & DISCUSSIONS
The sample was made up of 87 females and 113 males from different socio-economic strata, the 47% of our interviewees were illiterate and their knowledge on the medicinal plants use was therefore originated from verbal transmission (Table 1).

<table>
<thead>
<tr>
<th>Categories</th>
<th>Statistics (200)</th>
<th>Percentages (%)</th>
</tr>
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<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
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<td>[20-40]</td>
<td>99</td>
<td>49.5</td>
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<tr>
<td>[40-60]</td>
<td>67</td>
<td>33.5</td>
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<tr>
<td>&gt;60</td>
<td>23</td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>M</td>
<td>113</td>
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<tr>
<td>F</td>
<td>87</td>
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<tr>
<td>Status</td>
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<td>21</td>
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<td>Widow</td>
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<td>3</td>
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<tr>
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<tr>
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<tr>
<td>University</td>
<td>18</td>
<td>9</td>
</tr>
</tbody>
</table>

Perceptions and attitudes of the Talassemtane National Park inhabitants towards medicinal plants
In order to visualize the perception and attitude of the Talassemtane National Park inhabitants regarding medicinal plants (use, knowledge, and motivation) versus conventional medicine, a principal component analysis (PCA) was conducted. The obtained KMO index, that measures the validity of both our survey and PCA analysis, is satisfactory (0.517) with a very significant Bartlett Sphericity test (Khi-2 = 422.21; p <0.001).

PCA revealed three main dimensions representing 65.56% of the total information explained in our sample, and the first two dimensions explain 47.54%. SPSS allows recording the coordinates of these three dimensions in form of new three variables or factors that allow plotting the main (47.54%) information explained in a 2D scatter plot. The variables included in this analysis are age, educational level, matrimonial status, use of medicinal plants, knowledge of medicinal plants recipes, and motivation to use medicinal plants (Figs. 2, 3, and 4). Notably, according to PCA analysis of our sample, gender (M: male; F: female) did not exhibit any significant differences regarding the use of medicinal plants.
Use of medicinal plants by the Talassemtane National Park Inhabitants

Fig. 2 shows the utilization of medicinal plants by the Talassemtane National Park inhabitants. The scatter plot highlights two distinct groups following the first dimension that describes 25.41% of total information embedded in our sample. It highlights the use of medicinal plants as well. The first group (■) represents the individuals that integrate the utilization of medicinal plants in their tradition and costumes for healing purposes. This group inherited these habits from their grandparents. While the second group (●) represents the individuals that are not used to consume medicinal plants for several motivations (see Fig. 4). These observations show plausible information erosion that threatens the high value of traditional medicine in Talassemtane National Park.

![Fig. 2](image-url)

**Fig. 2.** Utilization of medicinal plants by TLSNP inhabitants, Dimension 1 represents the utilization of medicinal plants, and Dimension 2 represents age, education, and matrimonial status; M: males; F: females.

Knowledge of Medicinal Plants by Talassemtane National Park Inhabitants

Fig. 3 presents the analysis of TLSNP inhabitants’ medicinal plant knowledge. It shows three main groups: the first group (■) has sufficient traditional knowledge of healing and therapeutic practices, likewise, the second group (■ bordered) shows enough traditional knowledge of healing and therapeutic practices, nevertheless, these individuals do not use medicinal plants as shown in Fig. 2. Finally, the third group (●) does not have any traditional knowledge of healing and therapeutic practices, and therefore does not use medicinal plants (see Fig. 3). The fact that we obtained through the PCA analysis a group of people which have the knowledge on the use of medicinal plants for healing purposes but they do not currently use neither medicinal plants nor their inherited knowledge, show a scary trend in TLSNP toward losing confidence on the high valued heritage of traditional medicine in this region.

Motivations to use medicinal plants by the Talassemtane National Park inhabitants

The motivations and perception analysis of TLSNP inhabitants to use medicinal plants can be analyzed according to two main groups representing the data plotted in Fig. 4. In order to analyze the motivation of the first group (◇◇□), i.e. individuals who use medicinal plants and got enough traditional knowledge of therapeutic practices, one can easily identify three subsets. The first subset (◇) uses medicinal plants because they are accessible and affordable, the second (◇) says that medicinal plants are effective, and the third (□) uses medicinal plants in synergy with conventional drugs.

Thus, we can confirm this previously mentioned trend of losing confidence toward medicinal plants as we move from first subset to third one (from right to left on the 1st dimension), even though this later is less represented.
On the other hand, the motivations of the second group (▼●▼) i.e. individuals who do not use medicinal plants, are divided into 4 subsets. The first subset (▼) represents individuals who are not used to consume medicinal plants or it is not a tradition in their families. The second (●) seems indifferent regarding the use of medicinal plants, while the third (▼) believes that medicinal plants are not efficient to use for daily care. Finally, the fourth (■) undoubtedly relies on conventional medicine to treat symptoms and diseases. All the individuals of the second groups argue that their confidence towards the use of medicinal plants for therapeutic purposes is deteriorating in recent decades. According to our finding, this trend is mostly related to changing lifestyle and access to commodities such as electricity, health care campaigns, and satellite TV channels.
Medicinal plants and groups of diseases

Medicinal plants used to treat 15 groups of diseases are the biological material for this study. A total of 152 ethnomedicinal species in 44 families were recorded as being used by the TLSNP in treating different types of diseases and symptoms (Table 2). The list of the species, sorted in alphabetical order of groups of diseases (with the ICPC-2 code).

Table 2. Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

<table>
<thead>
<tr>
<th>Species (Vouchers)</th>
<th>Pathological groups</th>
<th>Treated diseases &amp; symptoms codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agave americana L. (TMP-B170); Atriplex repens (Jacq.) Lag. (TMP-B005); Athamanta sicula L. (TMP-B047); Daucus muricatus (L.) L. (TMP-B021); Eryngium bourgattii Gouan (TMP-B023); Eryngium caespitiferum Font Quer &amp; Pau (TMP-B023); Eryngium triquetrum Vahl (TMP-B030); Kundmannia sicula (L.) DC. (TMP-B032); Smyrnium olausmatum L. (TMP-B044); Centaurea calcitrapa L. (TMP-B010); Cynara cardunculus L. (TMP-B068); Matricaria chamomilla L. (TMP-B074); Silybum marianum L. (TMP-B078); Sonchus oleraceus L. (TMP-B079); Alkanna tinctoria L. (TMP-B080); Trachelium caeruleum L. (TMP-B084); Chenocephalis acuminatam Wild. (TMP-B088); Euphorbia helioscopia L.(TMP-B092); Lathyris tingitanus L. (TMP-B099); Scorpiurus muricatus L. (TMP-B101); Centaurea erythraea Rafn. (TMP-B107); Ajuga iva (L.) Schreb. (TMP-B112); Clinopodium nepeta (L.) Kunze (TMP-B114); Lavandula angustifolia Mill. (TMP-B115); Lavandula dentata L. (TMP-B116); Lavandula stoechas L. (TMP-B117); Marrubium vulgare L. (TMP-B118); Mentha piperita L. (TMP-B119); Mentha pulegium L. (TMP-B120); Mentha rotundifolia (L.) Huds. (TMP-B121); Ocimum basilicum L. (TMP-B124); Origanum majorana L.(TMP-B126); Origanum elongatum (Bonnet) Emn. &amp; Maire (TMP-B127); Origanum vulgare L. (TMP-B128); Salvia officinalis L. (TMP-B130); Teucrium polium L. (TMP-B132); Thymbra capitata L. (TMP-B133); Thymus wildenowii Boiss. (TMP-B135); Allium cepa L. (TMP-B168); Allium sativum L. (TMP-B169); Phillyrea latifolia L. (TMP-B143); Citrus limon (L.) Burm. fil. (TMP-B160); Aloysia citrodora Palau (TMP-B165); Zingiber officinale Roscoe (TMP-B167)</td>
<td>A. General and Unspecified</td>
<td>Sweating problem A09 ; Leprosy A78 ; Intoxication A86 ; Swelling A08 ; Chills A02 ; Fever A03 ; Tiredness general A04 ; Pain general A01 ; Tuberculosis A70</td>
</tr>
<tr>
<td>Adiantum capillus-veneris L. (TMP-B172); Pisonia tectius L. (TMP-B034); Ammi majus L. (TMP-B001); Ammi visnaga (L.) Lam. (TMP-B002); Daucus muricatus (L.) L. (TMP-B021); Eryngium bourgattii Gouan (TMP-B023); Eryngium glaciare Boiss. (TMP-B025); Eryngium hateri Porta (TMP-B026); Foeniculum vulgare Mill. (TMP-B031); Kundmannia sicula (L.) DC. (TMP-B032); Rilolofia segetum (L.) Moris (TMP-B042); Smyrnium olausmatum L. (TMP-B044); Stibonax pomelianus (Maire) B.L. Britt (TMP-B006); Nerium oleander L. (TMP-B055); Chamaerops humilis L. (TMP-B057); Anacyclus pyrethrum (L.) Link (TMP-B059); Artemisia absinthium L. (TMP-B060); Seriphidium herba-alba (Asso) J. Sojak (TMP-B061); Carthamus tinctorius L. (TMP-B063); Centaurea acutis L. (TMP-B064); Centaurea pallata L. (TMP-B065); Cichorium intybus L. (TMP-B067); Dittrichia viscosa (L.) Greuter (TMP-B069); Echinops glaberrimus DC. (TMP-B070); Lactuca sativa L. (TMP-B038); Matricaria chamomilla L. (TMP-B074); Scopolymus hispanicus L. (TMP-B076); Scopolymus maculatus L. (TMP-B077); Alkanna tinctoria L. (TMP-B080); Opuntia ficus-indica (L.) Mill. (TMP-B083); Chenocephalis acuminatam Wild. (TMP-B088); Cistus albidus L. (TMP-B089); Tetraclinis articulata (Vahl) Mast. (TMP-B090); Arbutus unedo L. (TMP-B091); Mercurialis annua L. (TMP-B093); Riczus communis L. (TMP-B094); Anagryris foetida L. (TMP-B095); Ceratonia siliqua L. (TMP-B096); Lupinus angustifolius L. (TMP-B098); Glycyrhiza glabra L. (TMP-B100); Scorpiurus muricatus L. (TMP-B101); Trigonella foenam-graeum L. (TMP-B102); Vicia faba L. (TMP-B103); Vicia sativa L. (TMP-B104); Quercus rotundifolia Lam.(TMP-B105); Quercus suber L. (TMP-B106); Centaurea erythraea Rafn. (TMP-B107); Crocus sativus L. (TMP-B108); Juglans regia L.(TMP-B109); Ajuga chamaepitys L. Schreb. (TMP-B111); Ajuga iva (L.) Schreb. (TMP-B112); Lavandula angustifolia Mill. (TMP-B115); Lavandula dentata L. (TMP-B116); Lavandula stoechas L. (TMP-B117); Marrubium vulgare L. (TMP-B118); Melissa officinalis L. (TMP-B039); Mentha piperita L. (TMP-B119); Mentha pulegium L. (TMP-B120); Mentha rotundifolia (L.) Huds. (TMP-B121); Mentha suaveolens Ethr. (TMP-B122); Mentha viridis (L.) L. (TMP-B123); Ocimum A. General and Unspecified</td>
<td>Abdominal pain epigastric D02; Dyspepsia/indigestion D07; Teeth/gum symptom/complaint D19; Diarrhoea D11; Constipation D12; Abdominal pain/cramps general D01; Gastrointestinal infection D70; Flatulence/gas/belching D08; Liver disease NOS D97; Mouth/tongue/lip symptom/compl. D20; Irritable bowel syndrome D93; Mouth/tongue/lip disease D83; Jaundice D13; Stomach function disorder D87; Worms/other parasites D96; Swallowing problem D21; Rectal/anal pain D04 ; Mumps D71; Vomiting D10; Duodenal ulcer D85</td>
<td>D. Digestive</td>
</tr>
</tbody>
</table>

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Article type: Research
Table 2 (continued). Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

<table>
<thead>
<tr>
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<th>Pathological groups</th>
<th>Treated diseases &amp; symptoms codes</th>
</tr>
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<tbody>
<tr>
<td>basilicum L. (TMP-B124); Origanum compactum Benth. (TMP-B125); Origanum majorana L. (TMP-B126); Origanum elongatum (Bonnet) Emb. &amp; Maire (TMP-B127); Origanum vulgare L. (TMP-B128); Rosmarinus officinalis L. (TMP-B129); Salvia officinalis L. (TMP-B130); Teucrium polium L. (TMP-B132); Thymbra capitata L. (TMP-B133); Thymus capitellatus Hoffmanns. &amp; Link. (TMP-B134); Thymus wildeodowi Boiss. (TMP-B135); Thymus algeriensis Boiss. &amp; Reut (TMP-B136); Laurus nobilis L. (TMP-B137); Allium cepa L. (TMP-B168); Allium sativum L. (TMP-B169); Sicygium aromaticum (L.) Merr. &amp; Perry (TMP-B139); Myrtus communis L. (TMP-B140); Fraxinus angustifolia Vahl, nom. cons. (TMP-B141); Olea europaea L. (TMP-B142); Phillyrea latifolia L. (TMP-B143); Rumex acetosus L. (TMP-B145); Rumex pulcher L. (TMP-B146); Rumex spinosus L. (TMP-B147); Rumex bicepsaphorius L. (TMP-B148); Panicum granatum L. (TMP-B149); Clematis flammula L. (TMP-B150); Crataegus monogyna Jacq. (TMP-B155); Cydonia oblonga Mill. (TMP-B156); Prunus dulcis (Mill.) D. A. Webb (TMP-B157); Citrus limon (L.) Burm. fil. (TMP-B160); Daphne gnidium L. (TMP-B162); Celtis australis L. (TMP-B163); Aloysia citrodora Benth. (TMP-B166); Zingiber officinale Roscoe (TMP-B167)</td>
<td>F. Eye</td>
<td>Eye infection/inflammation F73; Weakness of vision F28; Eye pain F01</td>
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<td>Daucus carota L. (TMP-B021); Torilis arvensis (Huds.) Link subsp. neglecta (Schult.) Thell. (TMP-B048); Torilis japonica (Houtt.) DC. (TMP-B053); Arum maculatum L. (TMP-B056); Artemisia absinthium L. (TMP-B060); Lactuca sativa L. (TMP-B038); Matricaria chamomilla L. (TMP-B074); Allium sativum L. (TMP-B080); Cannabis sativa L. (TMP-B085); Arbutus unedo L. (TMP-B091); Trigonella foenum-graecum L. (TMP-B102); Crocus sativus L. (TMP-B108); Melissa officinalis L. (TMP-B039); Mentha suaveolens Ehrh. (TMP-B122); Ocimum basilicum L. (TMP-B124); Origanum compactum Benth. (TMP-B125); Thymus capitellatus Hoffmanns. &amp; Link. (TMP-B134); Allium cepa L. (TMP-B168); Allium sativum L. (TMP-B169); Fraxinus angustifolia Vahl, nom. cons. (TMP-B141); Prunus dulcis (Mill.) D. A. Webb (TMP-B157); Zingiber officinale Roscoe (TMP-B167)</td>
<td>P. Psychological</td>
<td>Sexual fulfilment reduced P08; Sleep disturbance P06; Feeling anxious/nervous P01; Sexual desire reduced P07; Anorexia P86; Feeling Anxiety disorder P74</td>
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<td>Strobis pellifera (Maire) B.L. Burtt (TMP-B006); Marrubium vulgare L. (TMP-B118)</td>
<td>H. Ear</td>
<td>Ear pain H01</td>
</tr>
<tr>
<td>Pistacia lentiscus L. (TMP-B054); Ammi visnaga (L.) Lam. (TMP-B002); Elaeocistum foetidum (L.) Boiss. (TMP-B022); Nerium oleander L. (TMP-B055); Chamaeleon gummiifer (L.) Cass. (TMP-B066); Matricaria chamomilla L. (TMP-B074); Pulicaria odora (L.) Richh. (TMP-B075); Chenopodium acuminatum Willd. (TMP-B088); Lavandula angustifolia Mill. (TMP-B115); Lavandula dentata L. (TMP-B116); Lavandula stoechas L. (TMP-B117); Origanum majorana L.(TMP-B126); Thymbra capitata L. (TMP-B133); Nigella damascena L. (TMP-B152); Nigella sativa L. (TMP-B153); Ruta graveolens L. (TMP-B161)</td>
<td>N. Neurological</td>
<td>Vertigo/Dizziness N17; Cluster headache N90; Migraine N89; Trigeminal neuralgia N92; Weakness N18; Neurological symptom N29; Headache N01; Epilepsy N88</td>
</tr>
<tr>
<td>Agave americana L. (TMP-B170); Cachrys libanotis L. (TMP-B016); Thapsia villosa L. (TMP-B046); Arum maculatum L. (TMP-B056); Anacystis pyrethrum (L.) Link (TMP-B059); Seriphidium herba-alba (Asso) J. Sojak (TMP-B061); Cynara cardunculus L. (TMP-B068); Ricianus communis L. (TMP-B094); Erophaca baetica (L.) Boiss. (TMP-B097); Juncus acutus L. (TMP-B110); Lavandula angustifolia Mill. (TMP-B115); Lavandula dentata L. (TMP-B116); Lavandula stoechas L. (TMP-B117); Mentha suaveolens Ehrh. (TMP-B122); Thymbra capitellatus Hoffmanns &amp; Link. (TMP-B134); Allium sativum L. (TMP-B169); Olea europaea L. (TMP-B142)</td>
<td>L. Musculoskeletal</td>
<td>Joint symptom L20; Elbow symptom L10; Knee symptom L15</td>
</tr>
<tr>
<td>Ammi visnaga (L.) Lam. (TMP-B002); Magnolias pastinacea (Lam.) Paol (TMP-B033); Aristolochia baetica L. (TMP-B058); Seriphidium herba-alba (Asso) J. Sojak (TMP-B061); Centaurea calcitrapa L. (TMP-B100); Opuntia ficus-indica (L.) Mill. (TMP-B083); Lathyrus tingitanus L. (TMP-B099); Trigonella foenum-graecum L. (TMP-B110); Centaurea erythroaera Rafn. (TMP-B107); Ajuga chamaepitys L. Schreb. (TMP-B111); Clinopodium nepeta (L.) Kuntze (TMP-B114); Mentha piperita L. (TMP-B119); Mentha rotundifolia (L.) Huds. (TMP-B121); Mentha viridis (L.) L. (TMP-B123); Origanum compactum Benth. (TMP-B125); Allium cepa L. (TMP-B168); Myrtus communis L. (TMP-B140); Nigella sativa L. (TMP-B153); Citrus limon (L.) Burm. fil. (TMP-B160)</td>
<td>K. Cardiovascular</td>
<td>Palpitations K04; Head pain K01; Haemorrhoids K96; hypotension K88; Hypertension K86</td>
</tr>
</tbody>
</table>
Table 2 (continued). Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

<table>
<thead>
<tr>
<th>Species (Vouchers)</th>
<th>Pathological groups</th>
<th>Treated diseases &amp; symptoms codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiantum capillus-veneris L. (TMP-B172); Agave americana L. TMP-B170; Ammi majus L. (TMP-B001); Apium nodiflorum (L.) Lag. (TMP-B004); Baniun alpinum Waldst. &amp; Kit. (TMP-B007); Baniun bulbocastanum L. (TMP-B008); Daucus muricatus (L.) L. (TMP-B021); Magydaris pastinacea (Lam.) Poul (TMP-B033); Thapsia villosa L. (TMP-B046); Nerium oleander L. (TMP-B055); Aristolochia baetica L. (TMP-B058); Anacyclus pyrethrum (L.) Link (TMP-B059); Calendula officinalis L. (TMP-B062); Carthamus tinctorius L. (TMP-B063); Centaurea calcitrapa L. TMP-B100; Centaurea acaulis L. (TMP-B064); Chamaeleon gymnifer (L.) Cass. (TMP-B066); Cichorium intybus L. (TMP-B067); Cynara cardunculus L. (TMP-B068); Dittrichia viscosa (L.) Greuter (TMP-B069); Glebionis coronaria (L.) N.N. Tzvel. (TMP-B071); Helianthus annuus L. (TMP-B072); Lactuca virosa L. (TMP-B073); Matricaria chamomilla L. (TMP-B074); Anchusa ochroleuca M. Bieb. (Anchusa officinalis L.) (TMP-B081); Borago officinalis L. (TMP-B082); Opruntia ficus-indica (L) Mill. (TMP-B083); Cannabis sativa L. (TMP-B085); Silene vulgaris (Moench.) Garck (TMP-B086); Anagrysis foetida L. (TMP-B095); Trigonella foenum-graecum L. (TMP-B102); Vicia faba L. (TMP-B103); Quercus suber L. (TMP-B106); Gentianella erythraea Rafn. (TMP-B107); Ajuga chamaepitys L. Schreb. (TMP-B111); Ajuga iva (L.) Schreb. (TMP-B112); Lavandula angustifolia Mill. (TMP-B115); Lavandula dentata L. (TMP-B116); Lavandula stoechas L. (TMP-B117); Mentha pulegium L. (TMP-B120); Mentha rotundifolia (L.) Huds. (TMP-B121); Ocimum basilicum L. (TMP-B124); Origanum compactum Benth. (TMP-B125); Rosmarinus officinalis L. (TMP-B129); Salvia officinalis L. (TMP-B130); Teucrium polium L. (TMP-B132); Thymus wildenowii Boiss. (TMP-B135); Laurus nobilis L. (TMP-B137); Allium cepa L. (TMP-B168); Allium sativum L. (TMP-B169); Lawsonia inermis L. (TMP-B138); Myrtus communis L. (TMP-B140); Olea europaea L. (TMP-B142); Plantago rugelii Decone. (TMP-B144); Clematis flammula L. (TMP-B150); Delphinium staphisagria L. (TMP-B151); Nigella damascena L. (TMP-B152); Zea pachystachya L. (TMP-B154); Prunus dulcis (Mill.) D.A. Webb (TMP-B157); Rosa canina L. (TMP-B158); Rubus ulmfolius Schott (TMP-B159); Daphne gnidium L. (TMP-B162); Viola tricolor L. (TMP-B166)</td>
<td>S. Skin</td>
<td>Laceration S18; Contusion S16; Eczema S87; Warts S03; Contusion S16; Pediculosis S73; Skin injury S19; Pruritus S02; Pain of skin S01; Burn S14; Acne S96; Hair loss S23; Eczema S87; Scabies S72; Insect bite S12; Animal bite S13; Hair symptom S24; Wart S03; Skin inflammation S11; Skin symptom S29; Dermatitis contact/allergic S88; Skin colour change S08; Mouth symptom S20</td>
</tr>
<tr>
<td>Adiantum capillus-veneris L. (TMP-B172); Ammi visnaga (L.) Lam. (TMP-B002); Foeniculum vulgare Mill. (TMP-B031); Thapsia tragantha Brot. (TMP-B045); Thapsia villosa L. (TMP-B046); Artemisia absinthium L. Artemisia arboreascens L. (TMP-B060); Glebionis coronaria (L.) N.N. Tzvel. (TMP-B071); Helianthus annuus L. (TMP-B072); Pulicaria odora (L.) Rchb. (TMP-B075); Borago officinalis L. (TMP-B082); Glycyrrhiza glabra L. (TMP-B100); Clinopodium nepeta (L.) Kuntze (TMP-B114); Lavandula angustifolia Mill. (TMP-B115); Lavandula stoechas L. (TMP-B117); Marrubium vulgare L. (TMP-B118); Mentha pulegium L. (TMP-B120); Mentha suaveolens Ehrl. (TMP-B122); Origanum compactum Benth. (TMP-B125); Origanum majorana L. (TMP-B126); Origanum elatum (Bonnet) Emb. &amp; Maire (TMP-B127); Origanum vulgare L. (TMP-B128); Salvia officinalis L. (TMP-B130); Teucrium polium L. (TMP-B132); Thymus capitatus L. (TMP-B133); Thymus capitellatus Hoffmanns. &amp; Link. (TMP-B134); Thymus wildenowii Boiss. (TMP-B135); Laurus nobilis L. (TMP-B137); Allium cepa L. (TMP-B168); Allium sativum L. (TMP-B169); Olea europaea L. (TMP-B142); Clematis flammula L. (TMP-B150); Nigella sativa L. (TMP-B153); Citrus limon (L) Burn. fil. (TMP-B160); Zingiber officinale Roscoe (TMP-B167)</td>
<td>R. Respiratory</td>
<td>Sputum/phlegm abnormal R25; Asthma R96; Bronchitis R78; Cough R05; Influenza R80; Breathing problem R04; Sinus symptom R09; Pain respiratory system R01; Throat symptom R21; Pneumonia R81; Respiratory infection R74; Shortness of breath R02; Gripe R80; Respiratory infection R83; Hypertrophy tonsils/adenoids R90; Voice symptom R23</td>
</tr>
<tr>
<td>Ammi visnaga (L.) Lam. (TMP-B002); Apium inundatum (L.) Rchb. f. (TMP-B003); Daucus carota L. (TMP-B020); Eryngium tricuspidatum L. (TMP-B029); Strobrax pomeliana (Maire) B.L. Burtt (TMP-B006); Aristolochia baetica L. (TMP-B058); Artemisia absinthium L. Artemisia arboreescens L. (TMP-B060); Cynara cardunculus L. (TMP-B068); Borago officinalis L. (TMP-B082); Herniaria hirsuta L. (TMP-B087); Anagrysis foetida L. (TMP-B095); Crocus sativus L. (TMP-B108); Juncus acutus L. (TMP-B110); Lavandula angustifolia Mill. (TMP-B115); Lavandula dentata L. (TMP-B116); Lavandula stoechas L. (TMP-B117); Marrubium vulgare L. (TMP-B118); Origanum vulgare L. (TMP-B128); Rosmarinus officinalis L. (TMP-B131); Salvia officinalis L. (TMP-B130); Salvia argentea L. (TMP-B131); Allium cepa L. (TMP-B168); Allium sativum L. (TMP-B169); Strychnos aromaticus (L.) Mert. &amp; Pery (TMP-B139); Myrtus communis L. (TMP-B140); Urtica dioica L. (TMP-B164)</td>
<td>U. Urological</td>
<td>Kidney symptom U14; Bladder pain U13; Urine retention U08; Urinary infection U71; Urinary calculus U95</td>
</tr>
</tbody>
</table>
Family contribution
The most dominant botanical family with respect to the number of species used was Apiaceae (31 species) followed by Lamiaeae (27 species) Asteraceae (23 species) and Fabaceae (10 species). Rosaceae (5 species), Polygonaceae and Ranunculaceae (4 species each), Boraginaceae, Euphorbiaceae, and Oleaceae (3 species each), Fagaceae, Amaryllidaceae, Myrtaceae, Caryophyllaceae and Rutaceae (2 species each), while all other families shared one species each (Fig. 5). The high number of species presented by these families reflects that the study area has rich biodiversity and the inhabitants have sound knowledge of the use of these plants in locally prepared medicines. In fact, the total amount of species in these 4 families reaches the 59% of total ones.

Table 2 (continued). Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

<table>
<thead>
<tr>
<th>Species (Vouchers)</th>
<th>Pathological groups</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Ammi majus L. (TMP-B001); Eryngium ilicifolium Lam. (TMP-B027); Artemisia absinthium L. Artemisia arborescens L. (TMP-B060); Seriphidium herba-alba (Asso) J. Sojak (TMP-B061); Matricaria chamomilla L. (TMP-B074); Ricinus communis L. (TMP-B094); Lavandula angustifolia Mill. (TMP-B115); Lavandula dentata L. (TMP-B116); Marrubium vulgare L. (TMP-B118); Origanum majorana L.(TMP-B126); Origanum vulgare L. (TMP-B128); Rosmarinus officinalis L. (TMP-B129); Salvia officinalis L. (TMP-B130); Salvia argentea L. (TMP-B131); Allium sativum L. (TMP-B169); Punica granatum L. (TMP-B149); Nigella sativa L. (TMP-B153)</td>
<td>X. Female Genital</td>
<td>Menstrual pain X02; Menstruation absent X05; Vaginal infections X14; Menstruation Excessive X06; Menstrual irregular X07; Genital pain female X01; Vaginal symptom X15</td>
</tr>
<tr>
<td>Ammi visnaga (L.) Lam. (TMP-B002); Daucus muricatus (L.) L. (TMP-B021); Nerium oleander L. (TMP-B055); Artemisia absinthium L. Artemisia arborescens L. (TMP-B060); Oponia ficas-indica (L.) Mill. (TMP-B083); Tetraclinis articulata (Vahl) Mast. (TMP-B090); Lathyrus tingitanus L. (TMP-B099); Trigonella foenum-graecum L. (TMP-B102); Quercus rotundifolia Lam. (TMP-B105); Juglans regia L.(TMP-B109); Ajuga chamaepepita L. Schreb. (TMP-B111); Ajuga iva (L.) Schreb. (TMP-B112); Ballota hirsuta Benth.(TMP-B113); Lavandula angustifolia Mill. (TMP-B115); Lavandula stoechas L. (TMP-B117); Marrubium vulgare L. (TMP-B118); Origanum compactum Benth. (TMP-B125); Origanum vulgare L. (TMP-B128); Rosmarinus officinalis L. (TMP-B129); Salvia officinalis L. (TMP-B130); Teucrium polium L. (TMP-B132); Allium cepa L. (TMP-B168); Allium sativum L. (TMP-B169)</td>
<td>W, Pregnancy, Childbearing, Family Planning</td>
<td>Abortion induced W83; Post-partum symptom W18; Antepartum bleeding W03; Infertility W15; Post-partum bleeding W17; Lactation symptom W19</td>
</tr>
<tr>
<td>Ammi visnaga (L.) Lam. (TMP-B002)</td>
<td>T. Endocrine/Metabol ic and Nutritional</td>
<td>Diabetes non-insulin dependent T90; Hypoglycaemia T87; Lose of appetite T03; Weight gain T07</td>
</tr>
<tr>
<td></td>
<td>Y. Male Genital</td>
<td>Prostate symptom Y06</td>
</tr>
</tbody>
</table>

Fig. 5. Number of species per botanical family.
In this study, we identified 567 symptoms and diseases for the 152 taxa belonging to 44 included botanical families, with a total of 9402 use reports (UR). Among the five most representative families in this survey, TLSNP therapists prepare 186 remedies from 27 taxa that belong to the Lamiaceae family which have been found to treat 57 diseases from 13 disease groups (Fig. 6).

However, Lamiaceae have considerable economic importance, many species of horticultural value, many used as culinary herbs or in perfumery and many are used in medicine. In particular, many species of Lamiaceae are known for their aromatic oils, and many are of commercial or cultural importance, such as: Salvia officinalis L., Rosmarinus officinalis L., Mentha L. spp., Thymus vulgaris L., Origanum L. spp., Melissa officinalis L., Lavandula L. spp., Ocimum spp., (Harley et al. 2010).

**Fig. 6.** Number of species, use frequency, diseases number, and number of disease groups, for the five botanical families most represented in TLSNP.

### Conditions, symptoms and pathological groups

A total of 567 medicinal uses have been reported for the included plants. They are used to treat up to 123 conditions or symptoms classified into 15 pathological groups according to the ICPC-2 classification of diseases (Fig. 7). The main pathological group treated is the one for digestive symptoms (D, with 174 use, 24%), with 20 mentioned conditions, and for which 96 plants can be used. As several ethno-pharmacological studies has pointed out (e.g. in nearby territories Merzouki et al. 2000; González-Tejero et al. 2008; Benítez 2009; Benítez et al. 2010; Benlamdini et al. 2014; El Haouari et al. 2018). This situation is the most typical one because digestive conditions used to be frequent and not medically important (i.e., not complicated and frequently fleeting). In our case, the explanation is because of, on one hand, it is the group (D, 24%) with the higher number of conditions cited in our interviews. Most of them with a high number of UR (abdominal pains, diarrhea, tooth age and constipations), being also conditions with a high prevalence in the studied area; on the other hand, because these conditions can be threatened with a high number of local resources (Table 3). This high UR for digestive conditions can also be explained because of the lack of domestic hygiene in some houses, and the frequent consumption of non-well treated water. Skin symptoms (S, 103 UR, 16%) are also important in this territory, including 10 different conditions and 26 medicinal uses for their treatment.

### Use report of medicinal plants in Talassmtane National Park

In this study, we identified 567 medicinal uses for the 152 taxa belonging to 44 included families, with a total of 9402 use reports (UR). In general, we have obtained very high use ratios for most uses. Most of the reported cases are Lawsonia inermis leaf powder as a poultice against eczema (120 UR), as well as fennel root decoction (Foeniculum vulgare) against colon pain (87 UR) or its fruits to treat abdominal pain (78 UR) and indigestion (62 UR) (Table 2). Plants are used in the study area to treat 123 conditions or symptoms classified into 15 disease groups according to the disease classification used (International Classification of Primary Care, 2015).
CONCLUSIONS
The inhabitants express the ethnobotanical interest of TLSNP plants in terms of the rate of their use. Results of data analysis obtained in this ethnobotanical study allowed us to identify the most commonly used medicinal plants in the studied Park.

Our fieldwork provided ethnobotanical information on 152 species from 44 botanical families. For the latter, 567 different medicinal uses were collected to treat 114 diseases from 15 different disease groups. The Apiaceae family was the most represented, with 31 species, followed by Lamiaceae 27 species, Asteraceae 23 species, Fabaceae 10 species, and Rosaceae with 5 species. Families with lower than 5 species together account for 40.13% of the total.

The results show as well that the local population has accumulated a rich traditional knowledge regarding the use of medicinal plants. 50% of them still prefer to use traditional medicine for daily healthcare, and a few of them support these traditional medicines along with conventional drugs. Furthermore, inhabitants of TLSNP rely solely on the experience of others (elders) to access information. This reflects the image of the relative transmission of traditional practices from one generation to the next one. Nevertheless, the perception and attitude of TLSNP inhabitants revealed a serious threat towards the trend of losing confidence on healing properties of medicinal plants, which call for urgent need for the transcription, and conservation of the traditional medicinal heritage of TLSNP.

ACKNOWLEDGEMENTS
The authors are indebted to the informants, healers and local communities for cooperating and sharing their indigenous knowledge, Mr. Abdelatif EL OUAHRANI for his help in the statistical analysis of our data, and the director of the TLSNP (Anouar JAOUI) for their time and effort dedicated to our interviews and field trips.

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وضعیت و پذیرش گیاهان دارویی توسط جمعیت محلی پارک ملی تالاسمان (شمال مراکش)

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(تاریخ دریافت: ۲۰۱۸/۱۲/۸، تاریخ پذیرش: ۹۸/۱۴/۰۹)

چکیده

انسان این توانایی را دارد که دانش را به دیگران در طی زمان و مکان از طریق گفتگوی با نوشته‌دار منتقل کند. فارماکولوژی قومی بر پایه‌های‌های یادگیری از علوم اجتماعی فرهنگی و طبیعی است. تحقیق قومی بوستنی در پارک ملی تالاسمان انجام شد تا چشم‌انداز برای یادگیری و استفاده مطالعات مقایسه‌ای با مناطق آندوسی و سیبیلی ایجاد شود. هدف از این مطالعه تجزیه و تحلیل اطلاعات با توجه به نظیر مصاحبه نشان‌گر (اجتماعی-جمعي) و وضعیت گیاهان دارویی، پذیرش اینها توسط ساکنان شمال مراکش، اطلاعات به خواص این گیاهان، حفظ گیاهان دارویی سنتی در پارک ملی تالاسمان بود. این مطالعه طی سال‌های ۲۰۱۲ و ۲۰۱۴ آماده شد. در مجموع ۲۰۰ مصاحبه شدن داشته و اطلاعات بوستنی قومی و داروسلیمی قومی جمعیت مخلی منتشر شد. اطلاعات با استفاده از مصاحبه‌های پیام‌بردار زندگی‌نامه‌خوان‌ها، جمعیت و با دنبال آن تجزیه و تحلیل اطلاعات مربوط به مصاحبه شونده‌ها (اجتماعی-جمعي)، اطلاعات بوستنی قومی و داروسلیمی قومی صورت گرفت. در این مطالعه ۱۵۲ گیاه دارویی متعلق به ۴۴ خانواده شناسایی شد، مهم‌ترین خانواده آنها به گونه‌ای آورد و ۲۱ گونه را در بر می‌گرفت. ما ۵۴۷ علائم و بیماری را از ۱۵۲ نام‌خانواده شناسایی کردیم و در مجموع ۹۴۰ گزارش استفاده به دست آمده‌انه برای درمان ۱۳۲ بیماری با علائم متعلق به ۱۵ گروه اسپیتال (با توجه به طبقه‌بندی بیماری ICPC-2) مصرف می‌شده‌اند. با توجه به بیماری‌ها مهم‌ترین گروه اسپیتال‌های مورد درمان بیماری‌های قله‌گذری (دی.۲۴%) بود. نتایج نشان داد که ۵۰% مصاحبه شونده‌ها هنوز استفاده از داروهای سنتی را برای مراقبت بهداشتی روزانه خود ترجیح می‌دهند و بخشی از آنها هم در اینچند را به همراه داروهای ممنوع مصرف می‌کنند. تجزیه و تحلیل داده‌ها به ما امکان داد که نتایج مسئله تصفیه‌کننده‌ی دارویی در پارک ملی شناسایی کنیم. اطلاعات گزارش شده در این مطالعه پایه‌ای است در خصوص فلور گیاهان دارویی سنتی و همچنین ارزش اضافی دیگری برای به تصویر کشیدن پارک ملی تالاسمان فراهم می‌کند.  

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