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An ethnomedicinal survey of a Tashelhit-speaking community in the High Atlas, Morocco

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ABSTRACT

Ethnopharmacological relevance

Traditional knowledge about medicinal plants from a poorly studied region, the High Atlas in Morocco, is reported here for the first time; this permits consideration of efficacy and safety of current practices whilst highlighting species previously not known to have traditional medicinal use.

Aim of the study

Our study aims to document local medicinal plant knowledge among Tashelhit speaking communities through ethnobotanical survey, identifying preferred species and new medicinal plant citations and illuminating the relationship between emic and etic ailment classifications.

Materials and methods

Ethnobotanical data were collected using standard methods and with prior informed consent obtained before all interactions, data were characterized using descriptive indices and medicinal plants and healing strategies relevant to local livelihoods were identified.

Results

151 vernacular names corresponding to 159 botanical species were found to be used to treat 36 folk ailments grouped in 14 biomedical use categories. Thirty-five (22%) are new medicinal plant records in Morocco, and 26 described as used for the first time anywhere. Fidelity levels (FL) revealed low specificity in plant use, particularly for the most commonly reported plants. Most plants are used in mixtures. Plant use is driven by local concepts of disease, including "hot" and "cold" classification and beliefs in supernatural forces.

Conclusion

Local medicinal plant knowledge is rich in the High Atlas, where local populations still rely on medicinal plants for healthcare. We found experimental evidence of safe and effective use of medicinal plants in the High Atlas; but we highlight the use of eight poisonous species.

Keywords: Ethnomedicine; traditional knowledge; medicinal plants; Informant Consensus Factor; Berber

1. INTRODUCTION

Herbal medicine is an important cultural tradition in Morocco (Bellakhdar, 1978, 1997; Bellakhdar et al., 1982; Benchâabane & Abbad, 1997) and plays central role in the daily lives of many rural and urban Moroccans (Eddouks et al., 2002; El-Hilaly et al., 2003; Fakchich & Elachouri, 2014; Hmammouchi, 1999; Jouad et al., 2001; Merzouki et al., 2003; Sijelmassi, 1993; Tahraoui et al., 2007; Ziyyat et al., 1997). Medicinal plants are often collected from the wild, both for home use and as an additional source of income for rural families across the country (El-Hilaly et al., 2003; Ouarghidi et al., 2013). As reviewed by Ouaghidi et al. (2013), efforts have been made for the last 30 years to document traditional knowledge from poorly studied areas of Morocco focusing on the northern and north-eastern provinces (El-Hilaly et al., 2003; Fakchich & Elachouri, 2014; Hmammouchi, 1999; Merzouki et al., 2003), herbalists and healers (Bellakhdar et al., 1991; Claisse, 1990) and specific ailments including hypertension, diabetes and cardiac diseases (Eddouks et al., 2002; Jouad et al., 2001; Tahraoui et al., 2007; Ziyyat et al., 1997). Elements of the Moroccan ethno-pharmacopoeia are also documented in the grey literature (Bellakhdar, 1978, 1997; Bellakhdar et al., 1982; Benchâabane & Abbad, 1997; Boulos, 1983; Sijelmassi, 1993). However, ethnobotanical local knowledge from many areas of Morocco, especially in the south, still remains poorly known (Ouarghidi et al. 2013). This is the case for medicinal plant knowledge in the High Atlas amongst Tashelhit speaking communities.

Understanding local uses of plants has social and public health implications (McDade et al., 2007; Reyes-García et al., 2008). Documenting the extent of reliance on medicinal plants is important because loss of local knowledge of medicinal plants challenges developing countries' health care systems (Quinlan and Quinlan, 2007).

In ethnopharmacology, diseases are often described in biomedical terms and, while standard classifications are necessary, they often do not reflect the local perception of disease (Staub et al., 2015). In many traditional societies plants can be used due to beliefs in supernatural forces, sorcery and magic and it is necessary that ethnobotanical field studies take these into account (Heinrich et al., 2009). In the context of Morrocan ethnobotany, there have been few attempts to report the vernacular names for diseases, or to explain the relationships between local beliefs and plant use. El Rhaffari and Zaid (2002) mention the notions of "hot" and "cold" as a basis for diagnosis as well as the belief in supernatural causes of disease, which are common in the Arabo-Muslem traditional medicine (Greenwood, 1981; Ghazanfar, 1994), but do not integrate this in the analysis of their results.

Therefore, the main aims of this study are (i) to contribute to original documentation of medicinal plant use for Ashelhi people in the High Atlas which helps preserve valuable local knowledge, (ii) to find rare medicinal plans and uses which may inform further pharmacological studies by establishing comparisons with similar studies in Morocco and assess safety of use, and (iii) to provide novel insights into the relationship between local and biomedical disease concepts in Morocco, taking into acount health-related beliefs, and their influence on medicinal plant use.

2. METHODOLOGY

2.1 Study area

The Kingdom of Morocco lies in the North-Western tip of Africa, between 21º-36ºN and 1º-17ºW. It neighbours Algeria (North-East), the Spanish cities of Ceuta and Melilla (North) and Mauritania (South, South-East) and is one of only two countries with both Atlantic and Mediterranean coastlines. Morocco has the widest plains and highest peaks in North Africa and is criss-crossed by four mountain ranges: the Rif, the Middle Atlas, the High Atlas and the Anti-Atlas (Figure 1). Broad coastal plains lay along the Atlantic Ocean, framed by the mountain ranges, which separate them from the Sahara desert. Topographic as well as climatic variability allows for great plant biodiversity: Morocco hosts more than 3913 native vascular plants species (Fennane and Ibn Tattou, 2012) of

which around 879 are endemic (Rankou et al., 2013), thus having the richest flora of any North African country and one of the most diverse of the Mediterranean region (Rankou et al., 2013).

<FIGURE 1>

Located approximately 200km south of Marrakech, the rural commune of Imegdale lies in the High Atlas (altitudes ranging from around 1000 to 2500m; Figure 1). The commune has an area of approximately 274 sq km with an approximate population of 5467 people in 1156 households (Haut Commissariat au Plan de la Statistique, 2014) dispersed in small villages. The population is almost entirely Ishelhin (Ashelhi), the southern Moroccan Amazigh ethnic group and Tashelhit is the first language spoken in the commune. At least 10% of the men are also fluent in Moroccan Arabic, whereas most have basic communication skills in this language (Haut Commissariat au Plan de la Statistique, 2014) and a proportion of younger women are also familiar with Moroccan Arabic which they learn through television and in schools established in the 1980s. The main livelihoods are subsistence agriculture and pastoralism (sheep and goats) combined with seasonal labour migration and specialized local occupations. In a neighbouring High Atlas valley, Bellaoui (1989) estimated that the agropastoral sector contributes to 75% of the local income. Temporary employment in urban centres for men, and a in local mining site, are the most important sources of monetary income for the commune after the sale of crops such as carob, apples, walnuts and other fruits, marginal crops such as orris root (*Iris germanica*) and livestock (mainly cows, sheep and goats). Barley, wheat and maize are produced and consumed locally, but not traded.

2.2 Field data collection

This study was carried out in collaboration with the Global Diversity Foundation in the context of the Darwin Initiative funded “Medicinal plant trade, conservation and local livelihoods in southern Morocco”, a community-based development and conservation project that addresses sustainable harvest of vulnerable plant resources in the High Atlas. Fieldwork was conducted between March and June 2015 and 106 adult informants were interviewed in nine of the 28 villages of Imegdale. Villages

were selected to be representative of the diversity of environments in the commune; four villages are at the top of the different watersheds that flow into the N'Fiss valley, where the other five villages are located. Eighty-five percent of the informants were women since men often referred us to their wives when we attempted to interview them. Women are known to be most knowledgeable about medicinal plants in Morocco (Fakchich and Elachouri, 2014). Since many women do not know their exact age, we classified the informants in age groups: young (<30 years old; 18%), middle aged (30-60; 55%) and older (>60; 27%). Interviews were conducted in Tashelhit with simultaneous translation to French and prior informed consent was always obtained verbally beforehand. Ethical guidelines of the American Anthropological Association (2012), the Code of Ethics of the International Society of Ethnobiology (2006) and University of Reading ethical protocols were followed. Approval from the Ethics Committee of the School of Biological Sciences, University of Reading, was obtained (Research Ethics Project Submission SBS 14-15 05). Random and snowball sampling techniques were used for selecting informants (Bernard, 2006). Interviews with herbalists about plants mixtures that locals usually acquire from them were conducted outside the commune, in the souks of Asni, Tlat N'Yakoub and Amizmiz (N=4). In addition, we interviewed nurses and doctors (N=5) working in the health centres that the villagers attend (one unattended health centre in the village of Imegdale and one health centre with a doctor and midwife in the neighbouring commune of Ouirgane).

2.3 Interviews: plant use, disease concepts, trade and plant population trends

Individual free-listing and semi-structured interviews were conducted, along with focus group discussions concerning local use of medicinal plant resources (Alexaides, 1996; Martin, 1995). Plant names were mostly given in Tashelhit, but vernacular names in Moroccan Arabic were recorded when mentioned. During discussions, focus was put on understanding local healing strategies, including the causes of sickness and their symptoms. Workers from primary health centres were asked about the correspondence of folk ailments with illnesses recognized by western medicine. The perception and preference about use of herbal remedies were evaluated for the workers of the health centres as well as lay people interviewed. Much understanding was also gained through participant observation

(Martin, 1995) when joining villagers in plant collection activities and monitoring plants being processed and used.

Nineteen structured interviews were conducted at the end of the field study using herbarium specimens as visual clues to identify local plants. Eight interviewees were men (42%) and eleven were women (58%); 21% were young, 21 % old and 58 % middle aged. The specimens used are part of the local herbarium of Imegdale, established as part of ongoing ethnofloristic documentation work by the Global Diversity Foundation. One hundred nineteen herbarium specimens were selected to represent all the available medicinal plants reported during previous interviews, as well as the most common species in the area, different plant life-forms and plants from different habitats as part of a wider study of local ecological knowledge (Teixidor-Toneu et al., *in prep.*). For each specimen, informants were asked about the plant's name, uses and parts used, plant life-form and location where it is found.

2.4 Botanical collection and plant identification

Voucher specimens were collected in the field with the collaboration of informants. Specimens from the local herbarium of Imegdale were used to identify species referred by vernacular names when collection was not possible. Vouchers have been deposited at the Marrakech Regional Herbarium (Morocco; MARK) and the University of Reading Herbarium (United Kingdom; RNG). Vouchers of the local herbarium of Imegdale are deposited in MARK and RAB (Insititut Scientifique, Rabat). Market samples were purchased in the souks of Asni and Tlat N'Yakoub and deposited in the University of Reading Herbarium. Taxonomic identification follows the *Flore Pratique du Maroc* (Fennane et al., 1999, 2007, 2015) and nomenclature follows *The Plant List* (2013). For family assignments the Angiosperm Phylogeny Group III criteria were used (APG III, 2009; Reveal & Chase, 2011). For a comprehensive list of the herbarium specimens referenced in this paper see Table 2 in Teixidor-Toneu et al. (*in press*).

2.5 Data analysis

Data were structured in use reports, which refer to each mention of one plant for one therapeutic application given by one informant. Data collected for each use report include its local name(s), part(s) used, modes(s) of administration, intended therapeutic application, origin (wild, cultivated or acquired in the souk) and socioeconomic relevance. Part(s) used and mode(s) of administration were classified and codified according to the Economic Botany Data Standard (Cook, 1995). Three ethnobotanical indices were calculated to describe the data: Use Value (UV), Fidelity Level (FL) and Informant Consensus Factor (F_{ic}; indices described in Table 1). In order to assess the agreement among informants (F_{ic}) fourteen biomedical use categories were considered. Following suggestions made by Staub et al. (2015), most categories were based on body systems: cardiovascular, dermatological, endocrinological, gastrointestinal, gynaecological, musculoskeletal, ophthalmological, otolaryngological & respiratory and urological & nephrological. To this list, we added five locally relevant categories in order to better represent the ailments mentioned during interviews: cancer, general health, paediatric, injuries and ritual & spiritual. All calculations are based on vernacular names, not on the botanical species that correspond to the name (Berlin, 1973).

<TABLE 1>

The software *anthropac* (Borgatti, 1996) was used to find a consensus model (Romney et al., 1986) of known medicinal plants listed by informants. It was also used to elucidate patterns in herbal mixtures through Johnson's Hierarchical Clustering (Johnson, 1967), based on plants that are mentioned in lists that show proximity in cluster analysis.

2.6 Identification of new or very rare medicinal plant citations and uses

A literature search was carried out in order to identify new citations and uses for medicinal plants in Morocco. Journals, edited books and other scientific databases (DOAJ, Google Scholar, PubMed, Science direct, and Scopus) were searched using combinations of the keywords "medicinal", ethnobotan*", "Morocco" and "Maroc". The studies were selected according to the following criteria:

(1) they must have been carried out in Morocco, (2) the species list must be the result of ethnobotanical fieldwork, i.e., not from bibliographical revisions, and (3) studies must explicitly state the collection of voucher specimens and deposition in recognized herbaria, since poor taxonomic practises are common in ethnopharmacology and correct botanical names linked to a vouchered specimen are indispensable (Bennet & Balick, 2014; Rivera et al., 2014). Further pharmacological literature was searched to identify uses outside Morocco and seek experimental evidence for efficacy and safe use of the new citations of traditional medicines.

3. RESULTS AND DISCUSSION

3.1 Medicinal plant diversity

In total, 151 plant vernacular names were mentioned during the interviews, corresponding to 159 botanical species. A comprehensive inventory includes vernacular and scientific names, parts used and modes of administration, local use (folk ailments) and use categories, as well as the number of use reports (UR), use values (UV) and the highest fidelity level value (FL; see Table 1 in Teixidor-Toneu et al., *in press*). Details on herbarium specimens can be retrieved from Table 2 in Teixidor-Toneu et al, *in press*. Four vernacular names corresponded to mixtures normally bought at the herbalist. Medicinal plant diversity is concentrated in five plant families: Lamiaceae (25 species), Asteraceae (11 species), Apiaceae (10 species), Fabaceae (6 species) and Rosaceae (6 species). These results are similar to those from other parts of the country (Fakchich & Elachouri, 2014) and other Mediterranean regions (Bonet & Valles, 2003; Rigat et al., 2007). A high number of use reports correspond to the Lamiaceae, as well as Asteraceae, Cupressaceae, Apiaceae, Fabaceae, Rutaceae and Amaranthaceae. The consensus model or typical medicinal plant list in Imegdale includes: *azukni* (*Thymus saturejoides*; UV 1.43), *shih* (*Artemisia herba-alba*; 1.23), *timja* (*Mentha suaveolens*; 1.23), *azuka* (*Tetraclinis articulata*; 0.88) and *timzurri* (*Lavandula dentata*; 0.74). According to UV values, *ifzi* (*Marrubium vulgare*: 0.88), *aurmi* (*Ruta chalepensis*: 0.55), *mkhinza* (*Dysphania ambroisoides*: 0.52), *tefedas* (*Trigonella foenum-graecum*: 0.46), *harmel* (*Peganum harmala*: 0.44), *tarubi* (*Rubia peregrina*: 0.41), *tlir* (*Dittrichia viscosa*: 0.39), *shanouj* (*Nigella sativa*: 0.38), *awgdmi* (*Armeria*

alliacea: 0.35), *hbrrchad* (*Lepidium sativum*: 0.35), *khzema* (*Lavandula angustifolia*: 0.34), *fliyou* (*Mentha pulegium*: 0.33), *uamsa* (*Foeniculum vulgare*: 0.32), *ijaumgar* (*Inula montana*: 0.30) and *zeet* (*Olea europaea*: 0.26) are also locally important plants (Table 2).

<TABLE 2>

Medicinal plant diversity derives from the agro-pastoralist lifestyle and the influence of Arabo-Muslim pharmacology, which includes many traded plants from Asia (Bellakhdar, 1997). The agro-pastoralist character of the Ishelhin peoples is reflected in the environments where plants are sourced. Plants are mostly harvested in the wild (59%), mostly in mountain areas (*adrar*), semi-arid slopes with little soil and sparse vegetation (*lbour*) or around the fields (*igran*), where they can also be cultivated (14%). They can also be acquired in the souks (27%), where men trade local produce for foreign goods including imported plant species. Some of the plants acquired in the markets are those from the Zingiberaceae: *skinjbir* (*Zingiber officinale*), *khoudenjal* (*Alpinia officinarum*), *khrkom* (*Curcuma longa*); but also spices from other plant families that have come to be central healing elements of Ashelhi households such as *qrfa* (*Cinnamomum* sp.), *gusa & bsibissa* (*Myristica fragrans*), *l'aamer* (*Piper nigrum*) and *jawi* (*Styrax benxoin*).

3.2 Modes of administration, plant parts used and diversity of uses

Medicinal plants are ingested orally as infusions (36% of the use reports), as reported in other regions of Morocco (Merzouki et al., 2000), or mixed with milk (12%), olive oil (20%), honey (18%) or food (38%). They can be chewed (<1%), used as ear drops (<0.5%), incense (6%) or inhaled directly (2%), applied externally in poultices (3.5%), baths (7%) and washes (<1%) or in ways not specified (5%), or carried on the body in little bundles (charms, <1%; Table 1 in Teixidor-Toneu et al, *in press*). Four species are used in *qwi* (<1%), a technique that uses dry plant stems burned at one end to make them hot and then applied to the afflicted person's skin in specific places. Incense is the preferred mode of use to treat Ritual & spiritual ailments.

For 73% of the plants, more than one plant part is used medicinally (Table 1 in Teixidor-Toneu et al, *in press*). Leaves are the part most used (55%), followed by underground parts (40%, including roots,

tubers, bulbs and rhizomes), flowers and inflorescences (18%), seeds (16%) and fruits (15%). Barks, stems, wood, galls, oils and exudates are also used from one to three species each. This widespread use of Lamiaceae explains the preponderance of leaves and inflorescences.

Fidelity Level is one of the quantitative tools used to select plants from ethnopharmacological field studies for further pharmacological screening (under the assumption that plants that are used only for one ailment are more likely to be effective; Andrade-Cetto & Heinrich, 2011), but it can also be used to interpret plant use in local contexts. High FL values indicate that the plant tends to be used to cure one ailment and low FL values show that plants are used for a wide range of ailments (Tables 2 and 3, but see Table 1 in Teixidor-Toneu et al., *in press* for comprehensive results). Only 13 species show high fidelity values (FL $\geq$ 0.60; Table 3, species with low numbers of use reports have not been included). *Mkhinza* (*Dysphania ambrosioides*) and *limoun* (*Citrus sinensis*) constitute the main remedy against fever. *Hmiku* (*Cistus laurifolius*), *tazugnit* (*Thymus marrocanus* & *Thymus willdenowii*), *asln* (*Fraxinus dimorpha*), *grnunsh* (*Nasturtium officinale*) and *khoudenjal* (*Alpinia officinarum*) are all "hot" plants used for "cold" ailments. The root bark of *tasaft* (*Quercus ilex*) and the fruits of *uamsa* (*Foeniculum vulgare*) and *tekeda* (*Ceratonia siliqua*) are used almost exclusively for stomach problems, as well as the fruit skin and flowers of *rman* (*Punica granatum*). The roots of *tarubi* (*Rubia peregrina*) are used against *fqrdem* (anaemia) due to the red coloration of its infusion, an association that could be attributed to the "doctrine of signatures". *Jawi* (*Styrax benzoin*), *harmel* (*Peganum harmala*) and *fassough* (*Ferula communis*; 1) used as incense for all ailments since it is believed to relieve negative influences from jinni and sorcery. *Zaafran* (*Crocus sativus*) was mentioned as a key plant used by local healers, *ferraggat*, to heal children's ailments which are sorcery-related. *Henna* (*Lawsonia inermis*) is used to treat dermatological problems. Finally, *touma* (*Allium sativum*) and *fliyou* (*Mentha pulegium*) are mostly used against cough and chest problems.

<TABLE 3>

Almost all the plants with high UV are used to treat wide range of ailments (FL < 0.50); only one of them has a specific therapeutic application (*mkhinza, Dysphania ambrosioides*, to treat fever). Moreover, many plants were used for all ailments (*kolshi*, which literally means "everything" in

Tashelhit) and those were also highly aromatic plants, possibly selected because of their attractive organoleptic properties (Leonti et al., 2002). Low fidelity levels of the most used plants are indicative of the popular character of Ishelhin medicine, where home remedies rather than plants prescribed by specialists are used. Similar results have also been found when comparing medicinal floras cross-culturally: families over-represented in medicinal floras as compared to the general flora tend to have a wide range of applications (Saslis-Lagoudakis et al., 2011).

3.3 New therapeutic applications of the most important local plants

The twenty most used medicinal plants in Imegdale are all known to have pharmacological activity, are also used medicinally in other regions of Morocco (Table 2). Only *ijaumgar* (*Inula montana*) had not previously been reported as a medicinal plant in Morocco, but it is a well known remedy in other Mediterranean countries (Obon et al, 2012). We report new uses for eleven of these highly reported plants. In most of the cases, we found pharmacological evidence for the new uses recorded (Table 2), however further studies should be carried out to study the therapeutic effects of *timzurri* (*Lavandula dentata*). Although pharmacological and phytochemical studies find evidence for the medicinal use of herbal remedies, locally perceived efficacy of these remedies may be influenced by cultural constructs of efficacy and the meaning response (Moerman & Jonas, 2002). Claming evidence for safe use only on experimental studies fails to integrate local perceptions of health and illness (Wayland, 2004).

<TABLE 2>

Safe use of four herbal remedies was confirmed by the literature and we identified two potentially toxic plants, but information on toxicity for most of the species is lacking. Decoctions of *mkhinza* (*Disphania ambrosoides*) may have genotoxic effects (Gadano et al, 2002). However the preferred mode of use of this plant in the High Atlas is as a poultice or bath; it is not often ingested orally. *Harmel* (*Peganum harmala*) is a well know poisonous species used to treat a wide range of ailments. Informants are aware of its toxicity and will only use small dosages or, more commonly, burn it as incense or use it externally.

3.4 Previously unreported medicinal plants in Morocco

Twenty-five ethnobotanical field studies were retrieved from our literature search, however 15 did not cite herbarium specimens, so botanical identifications may not be robust. Our medicinal plant list was compared to those in Abouri et al (2012), Eddouks et al. (2002), El-Hilaly et al. (2003), El-Rhaffari & Zaid (2002), Fakchih and Elachouri (2014), Jouad et al. (2001), Merzouki et al. (2000), Ouarghidi et al. (2013), Tahraoui et al. (2007), and Ziyyat et al. (1997) to search for new medicinal plant citations and uses in Morocco. Thirty-five medicinal plants reported in this study (22 %) have not been previously reported in the vouchered literature for medicinal plant use in Morocco, but nine have been reported as medicinal plants used in other Mediterranean countries (Table 4). Six of them are part of previously described generic complexes, used interchangeably with the other species with the same vernacular name.

<TABLE 4>

Our literature review revealed pharmacological and / or phytochemical evidence of the therapeutic effect of nine new citations in Morocco, supporting the use reported in our study: *Agrimonia eupatoria, Cistus laurifolius, Clematis flammula, Inula montana, Lavandula pedunculata, Malus domestica, Mercurialis annua, Nasturtium officinale* and *Salvia aucheri*. For six species, studies have been carried out in related taxa, suggesting possible therapeutic effects of the reported plants as well and in five cases pharmacological studies had tested different plant parts or therapeutic effects for different ailments to those reported here. Fifteen species have not been screened for pharmacological activities; importantly, several of those are widely used in the High Atlas: *Cirsium chrysacanthum, Cladanthus scariosus, Dioscorea communis, Onopordum acaulon, Polycarpon polycarpoides* and *Pterocephalus depressus*.

For most of the new citations of medicinal plants we were unable to find studies on toxicity, but literature confirms the safe use of two of them and discourages the use of six of them. Nonetheless, all of the potentially toxic species have very low use values except for *Dioscorea communis*. Poisoning can result from ingestion of related species (Bhandari and Kawabata, 2005) and external application is equally not recommended (Cogne et al, 2001). Although *Hyoscyamus niger* may be occasionally

ingested to treat musculoskeletal problems (possibly due to its sedative effects); the local population is aware of its toxicity. Many informants considered this plant dangerous, and did not use it. *Solanum nigrum* is also toxic, but the more toxic fruits are not used, and only one or two leaves are used in mixtures. *Clematis flammula* leaves are also toxic but they are only used in baths; whether seeds are toxic is not known (Chawla et al, 2012); in Imegdale seeds are chewed but not ingested. Subacute toxic effects where observed in rats when a *Retama* species was administered repeatedly, indicating possible toxicity of the species reported here (Algandaby, 2015).

3.5 Mixtures

Mixtures are frequently used as remedies in Morocco (Bellakhdar, 1997; Merzouki et al., 2000) and this is also true for the High Atlas region. Mixtures are dried plants ground and added to food, fresh leaves used in showers or baths or dried plants burned as incense. Infused dried herbs are also normally used in combinations. Mixtures can be bought from the herbalists in the souk, which is the case for *msahan* (mixture added to food to treat "cold" ailments) and *ishgaf* (mixture used as incense to clean the ambience and heal ailments believed to be caused by sorcery deeds), or prepared at home. Locally recognized mixtures are listed in Table 3, whereas plants normally used in combination, but not formally recognized as a named mixture are explained below.

<TABLE 5>

A well-known remedy for all ailments is called *tadouart nigran* or *ifskan* (literally "mixture of the fields" or "medicinal plants") and includes up to 15 plants with individual recipes varying from informant to informant. *Tadouart nigran* was described as a mixture of "all you can find on your way to the fields"; it consists of a collection of fresh leaves from plants that grow in the village environs and in agricultural fields, infused and either drunk or used in a shower. It is used especially in cases of fever and as a preventive medicinal bath for babies.

Plant mixtures can also be used as incense in a practise called *bkhorr* in which plants are sprinkled on hot coals. *Harmel* (*Peganum harmala*; FL 0.64), *jawi* (*Styrax benzoin*; 0.75) and *fassough* (*Ferula communis*; 1.00) show high FL values for the Ritual & Spiritual use category and and tend to co-occur

in plant lists. *Salaban* (*Boswellia* sp.) and *igg* (*Pistacia atlantica*) are also regularly used in *bkhorr*. These incense plants can be used together or separately, contrary to the mixture of *ishgaf* which is sold by herbalists. This mixture includes *harmel*, *sanouj* (*Nigella sativa*), *aurmi* (*Ruta chalepensis*) and *qzbor* (*Coriandrum sativum*) as well as animal parts such as sea urchin shells, crab exoskeleton and cuttlebone, not included in the present study.

Shanouj (*Nigella sativa*), *tefedas* (*Trigonella foenum-grecum*) and *hab rshad* (*Lepidium sativum*), although not considered a mixture, are regularly used together (they present high levels of clustering within lists) in food to gain strength and weight and "warm" up the body. Plants used in the recipes of traditional desserts (*slilou* and *tummit*) were mentioned for gastrointestinal problems: *cawcaw* (*Arachyis hypogaea*), *habt halawa* (*Pimpinella anisum*), *jnjlan* (*Sesamum indicum*) and *gusa* (*Myristica fragrans*). The boundary between medicinal plants and food condiments is indistinct (Etkin, 1996; Rigat et al., 2009) and especially spices have been used historically in food to preserve health in the Islamic world (García Sánchez, 2002). For example, aromatic plants are combined and used to flavour tea. As with food condiments, this blur this distinction between edible and medicinal categories.

Eye problems are treated by a mixture of *khol* (mineral galena, PbS) and medicinal plants including *bzar* (*Piper nigrum*), *tini* (*Phoenix dactylifera*), *uamsa* (*Foeniculum vulgare*) and *alili* (*Nerium oleander*). It has been argued that *khol* remedies constitute a health risk for the population, especially children, due to its high concentration of lead, but this is lowered by mixing *khol* with other products (Lekouch et al., 2001).

3.6 Folk ailments, categories of use and agreement among informants

Excluding results from herbarium specimen-based, structured interviews, 144 plants were mentioned for treating 36 folk ailments (including *kolshi*, a common answer meaning "everything" and corresponding to a "cure-all" in English; Table 3). The correspondence between folk ailments and biomedical terms is not always one-to-one; terms such as *azbar*, *kolshi* and *asumid* can refer to different use categories from a biomedical perspective since they encompass different biomedical

diseases locally defined and treated as one. For each use report, the liason between folk and biomedical terms was made depending of the context in which the folk term was used and the symptomatology explained. *Iqdi*, *taumist* and *taqait* are jointly classified as *frigg* (FR) since they are ailments treated with the same set of plants by local healers. We have included the original local terms for folk ailments as recommended by Martin (1995).

As in many other rural and mountainous communities around the world (e.g. Mexican Maya as described in Berlin & Berlin, 1996; Andean Quechua as in Thomas, 2013), medicinal plants are commonly used to treat infectious diseases including gastrointestinal disorders which are easily transmitted, perhaps due to poor hygienic conditions, proximity to livestock and high-altitude harsh weather conditions. Folk ailments are generally diagnosed among local population according to two principles, by their symptoms and according to beliefs on disease causation, which play an important role on the later therapeutic application of plants. This is the case for "cold" ailments, but also for those conditions that are believed to have a supernatural cause, showing the syncretism between Galenic humoral medicine and Prophetic medicine (Greenwood, 1981). The personalistic aspect of ethnomedicinal systems, based on the idea of extra-natural causes of illness, is present in many traditional health systems (Cosminsky, 1977). In the rural communes of the High Atlas, illness is associated with "bad luck" and whenever someone in a household is sick, a cleansing of the house is performed with incense. Potentially, any disease can have a supernatural cause, but this is especially true for ailments of children, since they are considered to be more vulnerable to sorcery. Incense is regularly burned when there is a new-born in the house as a protective measure against sorcery and illness.

In the High Atlas, cold weather is the ultimate cause of *asumid*, literally meaning "cold", a folk illness that can manifest in a range of ailments, from infertility (gyneacological), muscular and joint pains (musculoskeletal), urine infections and kidney problems (urological & nephrological) to general lack of energy and poor health (general health). People with "weak constitution" are more prone to suffer from it. Plants considered "hot" are used to treat *asumid* although not all "hot" plants are used to treat the whole range of symptoms of *asumid*, nor all "cold" diseases (Alcorn, 1984). Underground parts of

plants are considered "hot", and many of the plants used to treat *asumid* are medicinal roots included in the mixture *izoran* (Table 1 in Teixidor-Toneu et al, *in press*). Also, plants that grow in cold areas such as the alpine zone are "hot". These include *awgdmi* (*Armeria alliacea*), *arshmush* (*Onopordum acaulon*), *izoran umlil* (*Pteocephalus depressus*) and *hmiku* (*Cistus laurifolius*). The *msahan* mixture is also used for "cold" ailments, especially by women to gain weight and treat fertility problems. This mixture is composed mostly of imported spices (Table 1 in Teixidor-Toneu et al, *in press* and Table 5) and is added to specific dishes prepared to improve women's health. The distinction between "hot" and "cold" plants has been difficult to associate with specific chemical compounds (Ankli et al., 1999) but it has important symbolic meaning in medicinal plant use and is a common concept in areas as diverse as Latin America (Weller, 1983) and China (Anderson, 1987), along with cultuarly related areas such as the Arabian Peninsula (Ghazanfar, 1994). Unlike in Latin American cultures, where the "hot" and "cold" dichotomy is perceived as a balance that can destabilize to either pole (Foster, 1976), there is a marked asymmetry in Ishelhin medicine, as observed elsewhere in Morocco (Greenwood, 1981): most ailments are "cold" and most medicines are "hot". However, some plants are considered "cold" and are mostly used during summer (e.g. *timja*, *Mentha suaveolens*) whereas "hot" ones are better for winter times (e.g. *imzurri*, *Lavandula dentata*). Like *asumid*, *ado* (literally "wind") is a folk ailment due to natural causes. While *asumid* can be ultimately attributed to low environmental temperatures, *ado* is caused by exposure to sudden winds, which can produce cough (*tuhut*) or flu (*ruah*) as well as fever, ailments grouped under the otolaryngological & respiratory category.

There is little agreement between informants about plants used for musculoskeletal, urological & nephrological and cardiovascular problems. These values may be due to the use of a high diversity of "hot" species to deal with "cold" ailments in the case of the musculoskeletal and urological & nephrological use categories. The cardiovascular use category includes only one folk ailment, *boumzui*, described as palpitations in abdominal area after long periods of hard work and hunger or stress. The low agreement on which plants should be used to treat this ailment may be due to the fact that the most common remedy is rest and nourishment. The high F_{ic} values for general health and gastrointestinal are partially a consequence of high use report numbers, and the wide range of plants

used (up to two thirds and half of the total number of vernaculars mentioned, respectively). These categories also include the most common ailments in the study area, which also explains the higher agreement among informants about how to treat them.

High F_{ic} values and low numbers of plants used are found for the categories of ritual & spiritual, ophthalmological, injuries and cancer, indicating a narrower range of plants selected for those ailments. High agreement about plants used in the ritual & spiriual and ophthalmological categories is due to the use of few well-known mixtures and imported incense plants sold by herbalists. Similarly, a narrow range of plants with antiseptic properties is used to treat injuries and only two species were mentioned to treat cancer: *ifzi* (*Marrubium vulgare*) which is very bitter (in Tashelhit, *harr*) and *alili* (*Nerium oleander*) which is toxic (Langford & Boor, 1996).

4 CONCLUSION

Although Mediterranean medicinal plants have been recorded since ancient Greek times, previously unstudied rural areas still held potential of identifying previously un-cited medicinal species. The most popular remedies used in the High Atlas are also medicinal plants used elsewhere in Morocco but several new uses of these plants have been recorded here. There is pharmacological evidence for the therapeutic use of these plants as well as for most of those that are listed here for the first time as medicinal. However, a portion of the medicinal plants used in the High Atlas has potential poisonous effects and their administration is not recommended according to the literature, but the local community is only aware of the poisonous effects of some of these plants.

Ishelhin people of the High Atlas use a wide diversity of local and imported plants as medicine in ways that are culture specific. Medicinal plants used reflect both these local concepts of disease causation, including the “hot” and “cold” dichotomy, as well as the Ishelhin’s history and agro-pastoralist lifestyle. Classification of medicinal plant uses into biomedical categories is problematic since due to the local perception of disease severeal ailments are believed to have the same cause (“cold”) and are not emically differenciated, hence reported folk ailments do not always correspond to

a single biomedical disease category. Moreover, the majority of the plants are not specific to one ailment, but are used in a variety of therapeutic applications. Many species have wide application, especially plants are used for *kolshi* (lit. "everything"). Most of the time plants are used in combination, either in mixtures bought from the herbalists or prepared at home.

Our literature survey found that the vernacular names for ailments are not reported in the Morroccan ethnobotanical literature. We therefore cannot evaluate how widespread, in Morocco, are the concepts of health and disease we report here. Reporting vernacular names for disease would allow this to be evaluated, and would also facilitate comparative studies of the plant uses as well as providing the necessary cultural context for further plant selection for pharmacological tests and drug developement.

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REFERENCES

Abad, M.J., Guerra, J.A., Bermejo, P., Iruzun, A., Carrasco, L., 2000. Search for antiviral activity in higher plant extracts. Phytotherapy Research. 14, 604-607.

Abu Zarga, M.H., Hamed, E.M., Sabri, S.S., Voelter, W., Zeller, K-P., 1998. New sesquiterpenoids from the Jordanian medicinal plant *Inula viscosa*. Journal of Natural Products. 61, 798-800.

Agarwal, R., Gupta, S.K., Agrawal, S.S., Srivastava, S., Saxena, R., 2008. Oculohypotensive effects of *Foeniculum vulgare* in experimental models of glaucoma. Indian Journal of Physiology and Pharmacology. 52, 77-83.

Ahmadiani, A., Javan, M., Semnanian, S., Barat, E., Kamalinejad, M., 2001. Anti-inflammatory and antipyretic effects of *Trigonella foenum-graecum* leaves extract in the rat. Journal of Ethnopharmacology. 75, 283-286.

Alcorn, J.N., 1984. Huastec Maya Ethnobotany. University of Texas Press, Austin.

Alexaides, M.N., 1996. Selected guidelines for ethnobotanical research: a field manual. New York Botanical Garden, New York.

Algandaby, M.M., 2015. Assessment of acute and subacute toxic effects of the Saudi folk herb *Retama raetam* in rats. Journal of the Chinese Medical Association. 78, 691-701.

Al-Qura'n, S., 2009. Ethnopharmacological survey of wild medicinal plants in Showbak, Jordan. Journal of Ethnopharmacology. 123, 45-50.

Al-Said, M.S., Tariq, M., Al-Yahya, M.A., Rafatullah, S., Ginnawi, O.T., Ageel, A.M., 1990. Studies on *Ruta chalepensis*, an ancient medicinal herb still used in traditional medicine. Journal of Ethnopharmacology. 28, 305-3012.

Al-Yahya, M.A., Mossa, J.S., Ageel, A.M., Rafatullah, S., 1994. Pharmacological and safety evaluation studies on *Lepidium sativum* L., seeds. Phytomedicine. 1, 155-159.

American Anthropological Association, 2012. Statement on ethics: principles of responsibility. http://www.aaanet.org/profdev/ethics/

Anderson, E.N., 1987. Why is humoral medicine so popular. Social Science & Medicine. 25, 331-337.

Andrade-Cetto, A., Heinrich, M., 2011. From the field into the lab: useful approaches to selecting species based on local knowledge. Frontiers in Pharmacology. 2, 1-20.

Angiosperm Phylogeny Group, 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Botanical Journal of the Linnean Society. 161, 105-121.

Ankli, A., Sticher, O., Heinrich, M., 1999. Yucatec Maya Medicinal Plants Versus Nonmedicinal Plants: Indigenous Characterization and Selection. Human Ecology. 27, 557–580.

Asgarpanah, J., Ramezanloo, F., 2012. Chemistry, pharmacology and medicinal properties of *Peganum harmala* L. African Journal of Pharmacy and Pharmacology. 6, 1573-1580.

Askun, T., Baser, H.C., Tumen, G., Kurkcuoglu, M., 2010. Characterization of essential oils of some *Salvia* species and their antimycobacterial activities. Turkish Journal of Biology. 34, 89-95.

Atmani, D., Chaher, N., Berboucha, M., Ayouni, K., Lounis, H., Boudaoud, H., Debbache, N., Atmani, D., 2009. Antioxidant capacity and phenol content of selected Algerian medicinal plants. Food Chemistry. 112, 303-309.

Atmani, D., Ruiz-Larrea, M.B., Ruiz-Sanz, J.I., Lizcano, L.J., Bakkali, F., Atmani, D., 2011. Antioxidant potentical, cytotoxic activity and phenolic content of *Clematis flammula* leaf extracts. Journal of Medicinal Plants Research. 5, 589-598.

Bahramikia, S., Yazdanparast, R., 2008. Effect of hydroalcoholic extracts of *Nasturtium officinale* leaves on lipid profile in high-fat diet rats. Journal of Ethnopharmacology. 115, 116-121.

Basch, E., Ulbricht, C., Kuo, G., Szapary, P., Smith, M., 2003. Therapeutic applications of fenugreek. Alternative Medicine Review. 8, 20-27.

Bellakhdar, J., 1978. Médecine traditionnelle et toxicologie ouest-sahariennes. Contribution à l'étude de la pharmacopée marocaine. Éditions Techniques Nord-Africaines, Rabat.

Bellakhdar, J., 1997. La pharmacopée marocaine traditionnelle. Médecine arabe ancienne et savoirs populaires. Ibis Press, Paris.

Bellakhdar, J., Claisse, R., Fleurentin, J., Younos, C., 1991. Repertory of standard herbal drugs in the Moroccan pharmacopoea. Journal of Ethnopharmacology. 35, 123-143.

Bellakhdar, J., Honda, G., Miki, W., 1982. Herb drugs and herbalists in the Maghreb. Institute for the study of Languages and Cultures of Asia and Africa, Tokyo.

Bellaoui, A., 1989. Les pays de l-Adrar-n-Dern. Etude géographique du Haut Atlas de Marrakech. Ph.D dissertation, Université de Tours, Département de Géographie, Tours.

Belyagoubi-Benhammou, N., Belyagoubi, L., Bekkara, F.A., 2014. Phenolic contents and antioxidant activities in vitro of some selected Algerian plants. Journal of Medicinal Plant Research. 8, 1198-1207.

Benchâabane, A., Abbad, A., 1997. Les plantes médicinales commercialisées à Marrakech. Trace du Présent, Marrakech.

Bennett, B.C., Balick, M.J., 2014. Does the name really matter? The importance of botanical nomenclature and plant taxonomy in biomedical research. Journal of Ethnopharmacology. 152, 387-392.

Berlin, B., 1973. Folk systematics in relation to biological classification and nomenclature. Annual Review of Ecology and Systematics. 4, 259–271.

Berlin, E.A., Berlin, B., 1996. Medical ethnobiology of the highland Maya of Chiapas, Mexico: the gastrointestinal diseases. Princeton University Press, New York.

Bernard, H.R., 2006. Research methods in anthropology – qualitative and quantitative approaches. Altamira Press, New York.

Bhandari, M.R., Kawabata, J., 2005. Bitterness and toxicity in wild yam (*Dioscorea* spp.) tubers in Nepal. Plant Foods for Human Nutrition. 60, 129-135.

Bonet, M.A., Valles, J., 2003. Pharmaceutical ethnobotany in the Montseny biosphere reserve (Catalonia, Iberian Peninsula). General results and new or rarely reported medicinal plants. Journal of Pharmacy and Pharmacology. 55, 259-270.

Borgatti, S.P., 1996. ANTHROPAC 4.0. Analytic Technologies, Natick, MA.

Boulos, L., 1983. Medicinal plants of North Africa. Reference Publications, Michigan.

Cavanagh, H.M.A., Wilkinson, J.M., 2002. Biological activities of lavender essential oil. Phytotherapy research. 16, 301-308.

Chawla, R., Kumar, S., Sharma, A., 2012. The genus *Clematis* (Ranunculaceae): Chemical and pharmacological perspectives. Journal of Ethnopharmacology. 143, 116-150.

Chikhoune, A., Hazzit, M., Kerbouche, L., Baaliouamer, A., Aissat, K., 2013. *Tetraclinis articulata* (Vahl) Masters essential oils: chemical composition and biological activities. The Journal of Essential Oil Research. 25, 300-307.

Citoglu, G.S., Corban, T., Sever, B., Iscan, M., 2004. Antioxidant properties of *Ballota* species growing in Turkey. Journal of Ethnopharmacology. 92, 275-280.

Citoglu, G.D., Ozbek, H., Sever, B. Antinociceptive activity of *Ballota glandulossisima* Hub.-Mor & Patzak. Eastern Journal of Medicine. 10, 24-28.

Claisse, R., 1990. Pharmacopée traditionnelle au Maroc: marché populaire de Yacoub El Mansour. Actes du Premier Colloque Européen d'Ethnopharmacologie, Metz 22-25 Mars, pp. 448–449.

Cogne, A.-L., Marston, A., Mavi, S., Hostettmann, K., 2001. Study of two plants used in traditional medicine in Zimbabwe for skin problems and rheumatism: *Dioscorea sylvatica* and *Urginea altissima*. Journal of Ethnopharmacology. 75, 51-53.

Cook, F.E.M., 1995. Economic Botany data collection standard. Royal Botanic Gardens, Kew, London.

Cogne, A.-L., Marston, A., Mavi, S., Hostettmann, K., 2001. Study of two plants used in traditional medicine in Zimbabwe for skin problems and rheumatism: *Dioscorea sylvatica* and *Urginea altissima*. Journal of Ethnopharmacology. 75, 51-53.

Correia, H.S., Barista, M.T., Dinis, T.C.P., 2007. The activity of an extract and fraction of *Agrimonia eupatoria* L. against reactive species. BioFactors. 29, 91-104.

Cosminsky, S., 1977. The impact of methods on the analysis of illness concepts in a Guatemalan community. Social Science and Medicine. 11, 325-32.

Costa, P., Goncalves, S., Valentao, P., Andrade, P.B., Almeida, C., Nogueira, J.M.F., Romano, A., 2013. Metabolic profile and biological activities of *Lavandula pedunculata* subsp. *lusitanica* (Chaytor) Franco: Studies on the essential oil and polar extracts. Food Chemistry. 141, 2501-2506.

Dalar, A., Turker, M., Konczak, I., 2012. Antioxidant capacity and phenolic constituents of *Malva neglecta* Wallr. And *Plantago lanceolata* L. from Eastern Anatolia of Turkey. Journal of Herbal medicine. 2, 42-51.

De Jesus, R.A.P., Cechinel-Filho, V., Oliveira, A.E., Schlemper, V., 2000. Analysis of the antinociceptive properties of marrubiin isolated from *Marrubium vulgare*. Phytomedicine. 7, 111-115.

Dongare, V., Kulkarni, C., Kondawar, M., Magdum, C., Haldavnekar, V., Arvidekar, A., 2012. Inhibition of aldose reductase and anti-cataract action of transanethole isolated from *Foeniculum vulgare* Mill. fruits. Food Chemistry. 132, 385-390.

Duru, M.E., Ozturk, M., Ugur, A., Ceylan, O., 2004. The constituents of essential oil and in vitro antimicrobial activity of *Micromeria cilica* from Turkey. Journal of Ethnopharmacology. 94, 43-48.

Eddouks, M., Maghrani, M., Lemhadri, A., El Ouahidi, M., Jouad, H., 2002. Ethnopharmacological survey of some plants used for the treatment of diabetes mellitus, hypertension and cardiac diseases in the south-east region of Morocco (Tafilalet). Journal of Ethnopharmacology. 82, 97–103.

Elberry, A.A., Harraz, F.M., Ghareib, S.A., Gabr, S.A., Nagy, A.A., Abdel-Sattar, E., 2015. Methanolic extract of *Marrubium vulgare* ameliorates hyperglycemia and dyslipidemia in straptozotocin-induced diabetic rats. International Journal of Diabetes Mellitus. 3, 37-44.

El Bouzidi, L., Larhsini, M., Markouk, M., Abbad, A., Hassani, L., Bekkouch, K., 2011. Antioxidant and antimicrobial activities of *Withania frutescens*. Natural Product Communications. 6, 1447-1450.

Elhabazi, K., Ouacherif, A., Laroubi, A., Aboufatima, R., Abbad, A., Benharref, A., Zyad, A., Chait, A., Dalal, A., 2008. Analgesic activity of three thyme species, *Thymus saturejoides*, *Thymus maroccanus* and *Thymus leptobotrys*. African Journal of Microbiology Research. 2, 262-267.

El-Hilaly, J., Hmammouchi, M., Lyoussi, B., 2003. Ethnobotanical studies and economic evaluation of medicinal plants in Taounate province (Northern Morocco). Journal of Ethnopharmacology. 86, 149–158.

El Rhaffari, L., Zaid, A., 2002. Pratique de la phytothérapie dans le sud-est du Maroc (Tafilalet). Un savoir empirique pour une pharmacopée rénovée, in: Fleurentin, J., Pelt, J-M., Mazars, G. (Eds.), Des sources du savoir aux médicaments du futur. IRD Editions, Strasbourg, pp. 293-318.

Etkin, N., 1996. Medicinal cuisines: diet and ethnopharmacology. International Journal of Pharmacognosy. 34, 313-326.

Fakchich, J., Elachouri, M., 2014. Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. Journal of Ethnopharmacology. 154, 76–87.

Fennane, M., Ibn Tattou, M., Mathez, J. Ouyahya, A., El Oualidi, J. (eds.), 1999, 2007, 2015. Flore pratique du Maroc. Manuel de détermination des plantes vasculaires. Vols. 1-3. Institut Scientifique, Université Mohammed V, Rabat.

Fennane, M., Ibn Tattou, M., 2012. Statistiques et commentaires sur l'inventaire actuel de la flore vasculaire du Maroc. Bulletin de l'Institut Scientifique, Rabat. 34, 1-9.

Ferreira, A., Proenca, C., Serralheiro, L.M., Araujo, M.E.M., 2006. The in vitro screening for acetylcholinesterase inhibition and antioxidant activity of medicinal plants from Portugal. Journal of Ethnopharmacology. 108, 31-37.

Foster, G.M., 1976. Disease etiologies in non-western medical systems. Medical Anthropolgy. 78, 773-782.

Friedman, J., Yaniv, Z., Dafni, A., Palewitch, D. A., 1986. Preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. Journal of Ethnopharmacology. 16, 275-287.

Gadano, A., Gurni, A., Lopez, P., Ferraro, G., Carballo, M., 2002. In vitro genotoxic evaluation of the medicinal plant *Chenopodium ambrosoides* L. Journal of Ethnopharmacology. 81, 11-16.

García Sánchez, E., 2002. Dietic aspects of food in al-Andalus (the formation of the classical Islamic world, Vol. 10). In: Waines, D. (Ed.), Patterns of everyday life. Ashgate Variorum, Aldershot, pp. 275-288.

Gilani, A.H., Jabeen, Q., Khan, M.A.U., 2004. A review of medicinal uses and pharmacological activities of *Nigella sativa*. Pakistan Journal of Biological Sciences. 7, 441-451.

Gilani, A., Khan, A., Raoof, M., Ghayur, M., Siddiqui, B., Vohra, W., Begum, S., 2008. Gastrointestinal, selective airways and urinary bladder relaxant effects of *Hyoscyamus niger* are mediated through dual blockade of muscarinic receptors and Ca (2+) channels. Fundamental & Clinical Pharmacology. 22, 87-99.

Ghazanfar, S.A., 1994. Handbook of Arabian medicinal plants. CRC Press, Boca Raton, Florida – London – Tokyo.

Greenwood, B., 1981. Cold or spirits? Choice and ambiguity in Morocco's pluralistic medical system. Social Science and Medicine. 15B, 219-235.

Hajhashemi, V., Ghannadi, A., Sharif, B., 2003. Anti-inflammatory and analgesic properties of the leaf extracts and essential oil of *Lavandula angustifolia* Mill. Journal of Ethnopharmacology. 89, 67-71.

Hajlaoui, H., Trabelsi, N., Noumi, E., Snoussi, M., Fallah, H., Ksouri, R., Bakhouf, A., 2009. Biological activities of the essential oils and methanol extract of two cultivated mint species (*Mentha longifolia* and *Mentha pulegium*) used in the Tunisian folkloric medicine. World Journal of Microbiology and Biotechnology. 25, 2227-2238.

Hallal, A., Benali, S., Markouk, M., Bekkouche, K., Larhsini, M., Chair, A., Romane, A., Abbad, A., El-Abdouni, M.K., 2010. Evaluation of the analgesic and antipyretic activities of *Chenopodium ambrosoides* L. Asian Journal of Experimental Biological Sciences. 1, 189-192.

Haut Commissariat au Plan de la Statistique, 2014. Recensement général de la population et de l'habitat. Rabat, Morocco.

Heinrich, M., Ankli, A., Frei, B., Weimann, C., Sticher, O., 1998. Medicinal plants in Mexico: healers' consensus and cultural importance. Social Science and Medicine. 47, 91-112.

Heinrich, M., Edwards, S., Moerman, D.E., Leonti, M., 2009. Ethnopharmacological field studies: a critical assessment of their conceptual basis and methods. Journal of Ethnopharmacology. 124, 1-17.

Herzi, N., Bouajila, J., Camy, S., Romdhane, M., Condoret, J-S., 2013. Comparison of different methods for extraction from *Tetraclinis articulata*: Yield, chemical composition and antioxidant activity. Food Chemistry. 141, 3537-3534.

Hmammouchi, M., 1999. Les plantes médicinales et aromatiques marocaines. Utilisations, biologie, écologie, chimie, pharmacologie, toxicologie et lexiques. Imprimerie Fédala, Rabat.

Imelouane, B., Elbachiri, A., Ankit, M., Benzeid, H., Khedid, K., 2009. Physico-chemical compositions and antimicrobial activity of essential oil of eastern Moroccan *Lavandula dentata*. International Journal of Agriculture and Biology. 11, 113-118.

International Society of Ethnobiology (2006). ISE Code of Ethics (with 2008 additions). (http://www.ethnobiology.net/code-of-ethics /) [Accessed: 10/09/2014]

Ismaili, H., Tortora, S., Sosa, S., Fkih-Tetouani, S., Ilidrissi, A., Della Loggia, R., Tubaro, A., Aquino, R., 2001. Topical anti-inflammatory activity of *Thymus willdenowii*. Journal of Pharmacy and Pharmacolgy. 53, 1645-1652.

Ivanova, D., Gerova, D., Chervenkov, T., Yankova, T., 2005. Polyphenols and antioxidant capacity of Bulgarian medicinal plants. Journal of Ethnopharmacology. 96, 145-150.

Jaspen-Schib, R., Theus, L., Guirguis-Oescher, M., Gossweiler, B., Meier, P.J., 1996. Serious plant poisonings in Switzerland 1966-1994. Case analysis from the Swiss Toxicology Information Center. Schweizerische Medizinische Wochenschrift. 126, 1085-1098.

Johnson, S.C., 1967. Hierarchical clustering schemes. Psychometrika. 32, 242-254.

Jouad, H., Haloui, M., Rhiouani, H., El Hilaly, J., Eddouks, M., 2001. Ethnobotanical survey of medicinal plants used for the treatment of diabetes, cardiac and renal diseases in the North centre region of Morocco (Fez-Boulemane). Journal of Ethnopharmacology. 77, 175–182.

Kupeli, E., Yesilada, E., 2007. Flavonoids with anti-inflamatory and antinociceptive activity from *Cistus laurifolius* L. leaves through bioassay-guided procedures. Journal of Ethnopharmacology. 112, 524-530.

Langford, S.D., Boor, P.J., 1996. Oleander toxicity: an examination of human and animal toxic exposures. Toxicology. 109, 1-13.

Lekouch, N., Sedki, A., Nejmeddine, A., Gamon, S., 2001. Lead and traditional Moroccan pharmacopoeia. The Science of the Total Environment. 280, 39-43.

Leonti, M., Sticher, O., Heinrich, M., 2002. Medicinal plants of the Popoluca, México: organoleptic properties as indigenous selection criteria. Journal of Ethnopharmacology. 81, 307-315.

Ljubunicic, P., Azaizeh, H., Portnaya, I., Cogan, U., Said, O., Abu Saleh, K., Bomzon, A., 2005. Antioxidant activiy and cytotoxicy of eight plants used in traditional Arab medicine in Israel. Journal of Ethnopharmacology. 99, 43-47.

Loi, M.C., Maxia, L., Maxia, A., 2005. Ethnobotanical comparison between the villages of Exolca and Lotzorai (Sardinia, Italy). Journal of Herbs, Spices & Medicinal Plants. 11, 67-84.

Mahmoudian, M., Jalipour, H., Dardashti, P.S., 2002. Toxicity of *Peganum harmala*: review and a case report. Iranian Journal of Pharmacology & Therapeutics. 4, 1-4.

Marrif, H.I., Ali, B.H., Hassan, K.M., 1995. Some pharmacological studies on *Artemisia herba-alba* (Asso.) in rabbits and mice. Journal of Ethnopharmacology. 49, 51-55.

Martin, G.J., 1995. Ethnobotany: a methods manual. Chapman & Hall, London.

Martin, T., Villaescusa, L., Gasquet, M., Delmas, F., Bartolome, C., Diaz-Lanza, A.M., Ollivier, E., Balansard, G., 1998. Screening for protozoocidal activity of Spanish plants. Pharmaceutical Biology. 36, 56-62.

McDade, T.W., Reyes-García, V., Blackinton, P., Tanner, S., Huanca, T., Leonard, W.R., 2007. Ethnobotanical knowledge is associated with índices of child health in the Bolivian Amazon. PNAS. 104, 6134-6139.

Merghoub, N., Benbacer, L., Amzazi, S., Morjani, H., El-Mzibri, M., 2009. Cytotoxic effect of some Moroccan medicinal plant extracts on human cervical cell lines. 3, 1045-1050.

Merzouki, A., Ed-Derfoufi, F., Molero Mesa, J., 2000. Contribution to the Knowledge of Rifian traditional medicine. II: Folk medicine in Ksar Lakbir district (NW Morocco). Fitoterapia. 71, 278–307.

Merzouki, A., Ed-Derfoufi, F., Molero Mesa, J., 2003. Contribution to the Knowledge of Rifian traditional medicine. III: Phytotherapy of Diabetes in Chefchaouen province (North of Morocco). Ars Pharmaceutica. 44, 59–67.

Moerman, D.E., Jonas, W.B., 2002. Deconstructing the placebo effect and finding the meaning response. Annals of Internal Medicine. 136, 471-476.

Moreno, L., Bello, R., Primo-Yufera, E., Esplugues, J., 2002. Pharmacological properties of the methanol extract from *Mentha suaveolens* Ehrh. Phytotherapy Research. 16, 10-13.

Moufid, A., Eddouks, M., 2012. *Artemisia herba alba*: a popular plant with potential medicinal properties. Pakistan Journal of Biological Sciences. 15, 1152-1159.

Nakamura, K., Ogasawara, Y., Endou, K., Fujimori, S., Koyama, M., Akano, H., 2010. Phenolic compounds responsible for the superoxide dismutase-like activity in high-brix apple vinegar. Journal of Agriculture and Food Chemistry. 58, 10124-10132.

Obon, C., Rivera, D., Verde, A., Fajardo, J., Valdes, A., Alcaraz., F., Cavalho, A.M., 2012. Arnica: a multivariate analysis of the botany and ethnopharmacology of a medicinal plant complex in the Iberian Peninsula and the Balearic Islands. Journal of Ethnopharmacology. 144, 44-56.

Orhan, I., Kartal, M., Naz, Q., Ejaz, A., Yilmaz, G., Kan, Y., Konuklugil, B., Sener, B., Choudhary, M.I.., 2007. Antioxidant and anticholinesterase evaluation of selected Turkish *Salvia* species. Food Chemistry. 103, 1247-1254.

Ouarghidi, A., Martin, G. J., Powell, B., Esser, G., Abbad, A., 2013. Botanical identification of medicinal roots collected and traded in Morocco and comparison to the existing literature. Journal of Ethnobiology and Ethnomedicine. 9, 59.

Oumzil, H., Ghoulami, S., Rhajaoui, M., Ilidrissi, A., Fkih-Tetouani, S., Faid, M., Benjouad, A., 2002. Antibacterial and antifungal activity of essential oils of *Mentha suaveolens*. Phytotherapy Research. 16, 727-731.

Ozgen, U., Houghton, P.J., Ogundipe, Y., Coskun, M., 2003. Antioxidant and antimicrobial activities of *Onosoma argentatum* and *Rubia peregrina*. Fitoterapia. 74, 682-685.

Perez, R.M., Perez, J.A., Garcia, L.M., Sossa, M., 1998. Neuropharmacological activity of *Solanum nigrum* fruit. Journal of Ethnopharmacology. 62, 43-48.

Phillips, O., Gentry, A.H., 1993. The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. Economic botany. 47, 15-32.

Preedy, V.R., Watson, R.R., (Eds.), 2008. Tomatoes and tomato products: Nutritional, medicinal and therapeutic properties. Science Publishers: Enfield, New Hampshire, USA.

Quave, C.L., Plano, L.R.W., Pantuso, T., Bennet, B.C., 2008. Effects of extracts from Italian medicinal plants of planktonic growth, biofilm formation and adherence of methicillin-resistant *Staphylococcus aureus*. Journal of Ethnopharmacology. 118, 418-428.

Quinlan, M.B., Quinlan, R.J., 2007. Modernization and medicinal plant knowledge in a Caribbean horticultural village. Medical Anthropology Quaterly. 21, 169-192.

Rankou, H., Culham, A., Jury, S.L., Christenhusz, M.J.M., 2013. The endemic flora of Morocco. Phytotaxa. 78, 1–69.

Reveal, J.L., Chase, M.W., 2011. APG III: Bibliographical Information and Synonymy of Magnoliidae. Phytotaxa. 19, 71–134.

Reyes-García, V., McDade, T., Vadez, V., Huanca, T., Leonard, W.R., Tanner, S., Godoy, R., 2008. Non-market returns to traditional human capital: nutritional status and traditional knowledge in a native Amazonian society. Journal of Development Studies. 44, 217–232.

Rigat, M., Bonet, M.A., Garcia, S., Garnatje, T., Valles, J., 2007. Studies on pharmaceutical ethnobotany in the high river Ter valley (Pyrenees, Catalonia, Iberian Peninsula). Journal of Ethnopharmacology. 113, 267-277.

Rigat, M., Bonet, M.A., Garcia, S., Garnatje, T., Vallès, J., 2009. Ethnobotany of food plants in the high river Ter valley (Pyrenees, Catalonia, Iberian Peninsula): non-crop food vascular plants and crop food plants with medicinal properties. Ecology of food and nutrition. 48, 303-326.

Rimbau, V., Risco, E., Canigueral, S., Iglesias, J., 1996. Anti-inflammatory activity of some extracts from plants used in traditional medicine of North-African countries. Phytotherapy Research. 10, 421-423.

Rivera, D., Allkin, R., Obón, C., Alcaraz, F., Verpoorte, R., Heinrich, M., 2014. What is in a name? The need for accurate scientific nomenclature for plants. Journal of Ethnopharmacology. 152, 393-402.

Romney, A.K., Weller, S.C., Batchelder, W.H., 1986. Culture as consensus: a theory of culture and informant accuracy. American Anthropologist. 88, 313-338.

Rossato, S., Leitao-Filho, H.F., Begossi, A., 1999. Ethnobotany of Caiçaras of the Atlantic forest coast (Brazil). Economic Botany. 53, 377-385.

Sadhu, S.K., Okuyama, E., Fujimoto, H., Ishibashi, M., Yesilada, E. Prostaglandin inhibitory and antioxidant components of *Cistus laurifolius*, a Turkish medicinal plant. Journal of Ethnopharmacology. 108, 371-378.

Sahpaz, S., Garbacki, N., Tits, M., Bailleul, F., 2002. Isolation and pharmacological activity of phenylpropanoid esters from *Marrubium vulgare*. Journal of Ethnopharmacology. 79, 389-392.

Saslis-Lagoudakis, C.H., Williamson, E.M., Savolainen, V., Hawkins, J.A., 2011. Cross-cultural comparison of three medicinal floras and implications for bioprospecting strategies. Journal of Ethnopharmacology. 135, 476-487.

Sedef, N.El., Karakaya, S., 2009. Olive tree (*Olea europea*) leaves: potential beneficial effects on human health. Nutrition reviews. 67, 632-638.

Shah, A.H., Qureshi, S., Ageel, A.M., 1991. Toxicity studies in mice of ethanol extracts of *Foeniculum vulgare* fruit and *Ruta chalepensis* aerial parts. Journal of Ethnopharmacology. 34, 167-172.

Shang, X., Pan, H., Li, M., Miao, X., Ding, H., 2011. Lonicera japonica Thunb.: Ethnopharmacology, phytochemistry and pharmacology of an important traditional Chinese medicine. Journal of Ethnopharmacology. 138, 1-21.

Sijelmassi, A., 1993. Les plantes médicinales du Maroc. Edition Fenugrec, Casablanca.

Staub, P.O., Geck, M.S., Weckerle, C.S., Casu, L., Leonti, M., 2015. Classifying diseases and remedies in ethnomedicine and ethnopharmacology. Journal of Ethnopharmacology. 174, 514-519. doi:10.1016/j.jep.2015.08.051

Tasdelen, G., Mammadov, R., 2014. The research of antioxidant activity of the endemic species of *Onopordum anatolicum*. International Journal of Secondary Metabolite. 1, 8-15.

Teixidor-Toneu, I., Martin, G.J., Ouhammou, A., Puri, R.K., Hawkins, J.A., *in press*. Medicinal plants used by a Tashelhit speaking community in the High Atlas, Morocco. Data in Brief. *In press*.

Tereschuk, M.L., Riera, M.V.Q., Castro, G.R., Abdala, L.R., 1997. Antimicrobial activity of flavonoids from leaves of *Tagetes minuta*. Journal of Ethnopharmacology. 56, 227-232.

Thanabhorn, S., Jaijoy, K., Thamaree, S., Ingkanian, K., Panthong, A., 2006. Acute and subacute toxicity study of the ethanol extract from *Lonicera japonica* Thunb. Journal of Ethnopharmacology. 107, 370-373.

Tahraoui, A., El-Hilaly, J., Israili, Z.H., Lyoussi, B., 2007. Ethnobotanical survey of plants used in the traditional treatment of hypertension and diabetes in south-eastern Morocco (Errachidia province). Journal of Ethnopharmacology. 110, 105–117.

The Plant List, 2013. The Plant List, a working list of all known plant species. Version 1.1, released in September 2013 (http://www.theplantlist.org/) [Accessed: 15/09/2015]

Thomas, E., 2013. Medicinal plant use as an adaptive strategy in the Bolivian Andes: evidence from the Quechua community of Apillapampa in: Lozny, L.R. (Ed.), Continuity and change in cultural adaptation to mountain environments. Studies in Human Ecology and Adaptation, 7. Springer Science & Business Media, New York, pp. 275-301.

Tiwari, S., 2008. Plants: a rich source of herbal medicine. Journal of Natural Products. 1, 27-35.

Tripoli, E., Gimmanco, M., Tabaccchi, G., Di Majo, D., Gimmanco, S., La Guardia, M., 2005. The phenolic compounds of olive oil: structure, biological activity and beneficial effects on human health. Nutrition Research Reviews. 18, 98-112.

Trotter, R.T., Logan, M.H., 1986. Informant consensus: a new approach for identifying potentially effective medicinal plants, in: Etkin, N.L. (Ed.), Plants in indigenous medicine and diet. Redgrave Publishing Company, Bedford Hills, New York, pp. 91-112.

Vladimir-Knezevic, S., Blazekovic, B., Kindl, M., Vladic, J., Lower-Nezda, A.D., Brantner, A.H., 2014. Acetylcholinesterase inhibitory, antioxidant and phytochemical properties of selected medicinal plants of the Lamiaceae family. Molecules. 19, 767-782.

Wayland, C., 2004. The failure of pharmaceuticals and the power of plants: medicinal discourse as a critique of modernity in the Amazon. Social Science & Medicine. 58, 2409-2419.

Weller, S.C., 1983. New data on intracultural variability – the hot-cold concept of medicine and illness. Human Organization. 42, 249-257.

Xinlu, G., Yuning, Y., Taiming, W., 2004. Anti-inflamatory effects and acture toxicity rest with *Pterocephalus hookeri*. Journal of Bejing University of Traditional Chinese Medicine.

Yazdanparast, R., Bahramikia, S., Ardestani, A., 2008. *Nasturtium officinale* reduces oxidative stress and enhances antioxidant capacity in hypercholesterolaemic rats. Chemico-Biological Interactions. 172, 176-184.

Yesilada, E., Gurbuz, I., Ergun, E., 1997. Effects of *Cistus laurifolius* L. flowers on gastric and duodenal lesions. Journal of Ethnopharmacology. 55, 201-211.

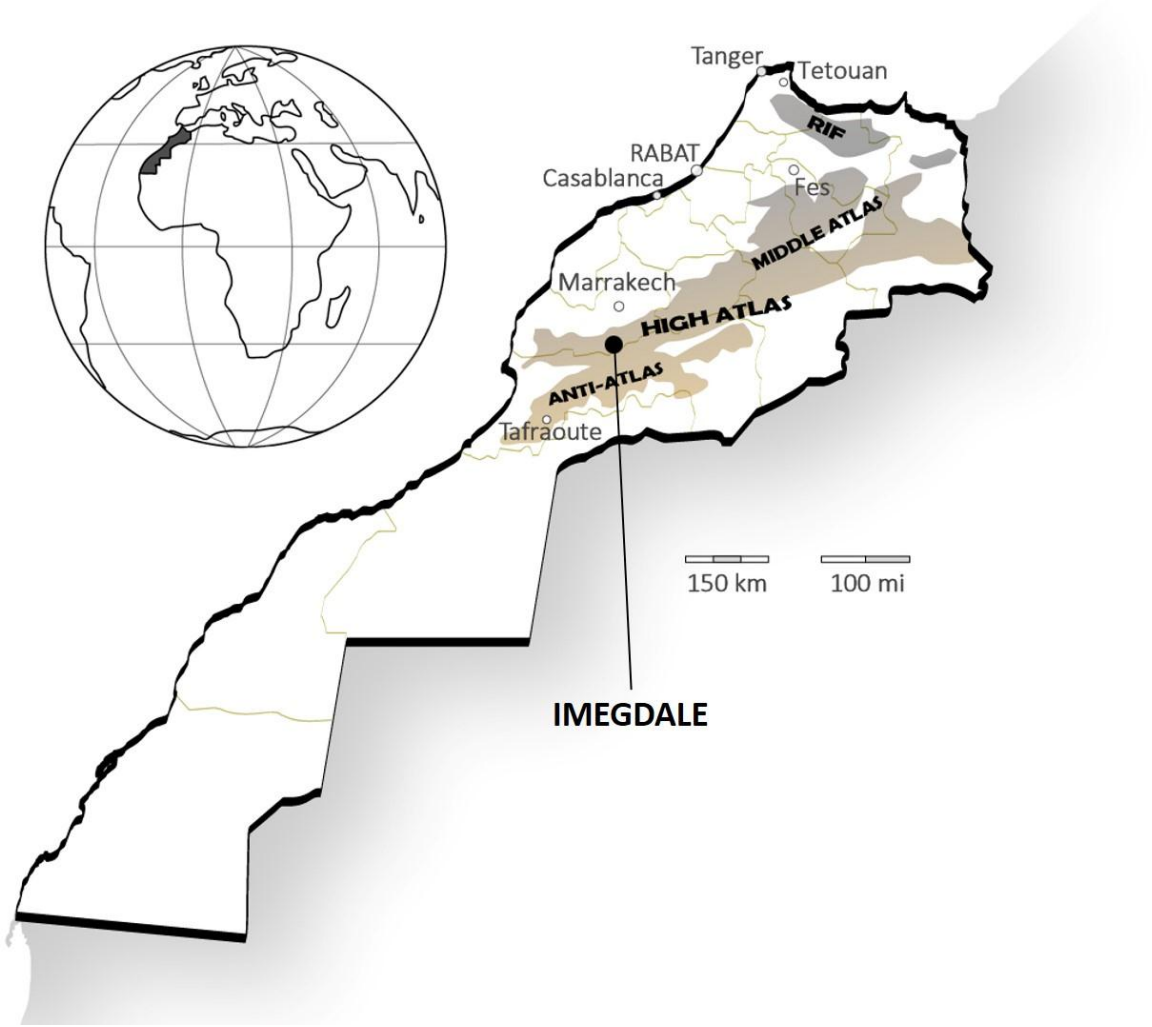
Zaoui, A., Cherrah, Y., Mahassini, N., Alaoui, K., Amarouch, H., Hassar, M., 2002. Acute and chronic toxicity of *Nigella sativa* fixed oil. Phytomedicine. 9, 69-74.

Zhang, L., Hu, J-J., Lin, J-W., Fang, W-S., Du, G-H., 2009. Anti-inflamatory and analgesic effect of ethanol and aqueous extracts of *Pterocephalus hookeri* (C.B. Clarke) Hoeck. Journal of Ethnopharmacology. 123, 510-514.

Ziyyat, A., Legssyer, A., Mekhfi, H., Dassouli, A., Serhrouchni, M., Benjelloun, W., 1997. Phytotheraphy of hypertension and diabetes in oriental Morocco. Journal of Ethnopharmacology. 58, 45–54.

LIST OF FIGURES

Figure 1. Map of Morocco; the location of the rural commune of Imegdale indicated by a black dot.



TABLES

Table 1. Indices used to describe medicinal plant knowledge.

Use Value (UV)	**Informant Consensus Factor (F_{ic})**	**Fidelity Level (FL)**
UV evaluates of the relative cultural importance of each plant based on the number of use reports. Based on Phillips and Gentry (1993), simplified by Rossato et al. (1999).	F_{ic} assesses the agreement among informants on the plants used for each use category. Based on Heinrich et al. (1998) and Trotter & Logan (1986).	FL identifies the main use of each plant, and calculates the relative importance of the number of use reports for each category of use. Based on Friedman et al. (1986).
$UV = \frac{\Sigma Uis}{N}$	$Fic = \frac{Nuc - Nt}{Nuc - 1}$	$FL = \left(\frac{Np}{N}\right) x\ 100$
$\sum Uis$ is the sum of the total number of use reports concerning a given species and *N* is the total number of informants.	*Nuc* is the total number of use reports in each use category and *Nt* is the number of plants used in that category.	*Np* is the number of use reports for one use category and *N* the total number of informants that cited the plant for any use.
The most reported plants have the highest UV values.	High *Fic* values indicate agreement among informants on which plants to use for a particular use category.	High FL values indicate that a plant is mainly used only for one use category. FL is artificially high for plants with few use reports, thus plants with less than 5 use reports were excluded from the discussion.

Table 2. Most reported medicinal plants (24 use reports or more). Uses highlighted in bold are uses not previously reported from Morocco. All vernacular plant names are in Tashelhit.

Scientific name (family, voucher specimen)	**Vernacular name**	**Part used**	**Administration**	**Use categories (folk ailments)**	**UR**	**UV**	**Ethnomedicinal use outside of Morocco; pharmacological, toxicological and phytochemical literature**
Armeria alliacea (Cav.) Hoffmanns. & Link (Plumbaginaceae, IME92)	Awgdmi	Roots	Oral ingestion, tea	General health, gynaecological, musculoskeletal, **endocrinological, paediatric** (*asumid, saht, meda, kolshi, azbar, fqrdem, adis*)	29	0.35	High anti-inflammatory effect (Rimbau et al, 1996). No reports on toxicity.
Artemisia herba-alta Asso (Asteraceae, IME17)	Shih	All aerial parts	Tea, external application, oral ingestion, washes, chewing, incense, baths	General health, gastrointestinal, **gynaecological**, endocrinological, injuries, **ophtalmological,**	101	1.23	Weak antimicrobial activities (Marrif et al, 1995). Several phytochemicals present in this

				otolaryngological & respiratory, urological & nephrological, paediatric (*kolshi, azbar, jerh, meda, asumid, okhass, skar, iurigh, frigg, atsirid, msran, klaui, jqeqa, ruah, alen*)			plant are claimed to render it with beneficial health propertis and very low degrees of toxicity have been observed (Moufid and Eddouks, 2012). No reports on toxicity.
Dittrichia viscosa (L.) Greuter (Asteraceae, IME31)	Tlir	Leaves	Tea, baths, oral ingestion, poultice, external applications	General health, gastrointestinal, **gynaecological**, **otolaryngological & respiratory,** endocrinological, **paediatric** (*kolshi, skhana, skar, meda, frigg, ruah, azbar, asumid*)	32	0.39	Antiviral activities (Abad et al, 2000). Anti-cancerous activities proven for human cervical cells (Merghoub et al, 2009). There is also evidence of anti-inflammatory, antipyretic and anthelmintic properties (Abu Zarga et al, 1998). No reports on toxicity.
Dysphania ambrosoides (L.) Mosyakin & Clemants (Amaranthaceae, IME02)	Mkhinza	Leaves	Poultice, baths, oral ingestion, tea	General health, gastrointestinal, paediatric, endocrinological (*skhana, kolshi, meda, skar*)	43	0.52	Use of this plant as a remedy for fever has been confirmed (Hallal et al, 2010), but decoctions and infusions of this plant may have a genotoxic effect (Gadano et al, 2002).
Foeniculum vulgare Mill. (Apiaceae, IME27)	Uamsa	Fruits, leaves, roots	Oral ingestion, tea, external application	General health, gastrointestinal, **ophthalmological**, urological & nephrological, endocrinological (*meda, asumid, msran,klaui, alen, adis, azbar, kolshi, skar*)	26	0.32	This plant possesses significant oculohypotensive activity (Agarwal et al, 2008) and anti-cataract activity (Dongare et al, 2012). The plant is not toxic at therapeutic doses (Shah et al, 1991).
Inula montana L. (Asteraceae, IMA08)	Ijaumgar	Leaves	Tea, oral ingestion	**General health, gastrointestinal,**	25	0.30	Used medicinally in Spain (Obon et al, 2012) and Algeria,

				otolaryngological & respiratory, ritual & spiritual (*kolshi, skhana, meda, frigg, asumid, iurigh*)			antioxidant activities have been observed (Belyagoubi-Benhammou et al, 2014). Antiparasitic activity has also been validated (Martin et al, 1998), supporting its traditional use to treat gastrointestinal disorders. No reports on toxicity.
Lavandula angustifolia Mill. (Lamiaceae, MAR5)	Khzema	Leaves, inflorescences	Tea, oral ingestion, washes, baths, poultice	General health, **gastrointestinal, gynaecological,** musculoskeletal, **otolaryngological & respiratory, paediatric,** urological & nephrological, **dermatological** (*azbar, asumid, kolshi, meda, frigg, skhana, atsirid, klaui, ch'aar, ruah*)	28	0.34	This plant has anti-inflammatory and analgesic properties (Hajhashemi et al, 2003) as well as antimicrobial, relaxant and antinociceptive activities (Cavanagh and Wilkinson, 2002). No reports on toxicity.
Lavandula dentata L. (Lamiaceae, IME03, IME53)	Timzurri	Leaves, inflorescences	Tea, oral ingestion, baths, washes, poultice	General health, **gynaecological, musculoskeletal,** otolaryngological & respiratory, **paediatric,** urological & nephrological, **dermatological,** endocrinological (*kolshi, azbar, asumid, meda, tuhut, skar, ch'aar, atsirid, iurigh, frigg, skhana*)	61	0.74	Essential oils have antimicrobial activity (Imelouane et al, 2009). No tests have been carried out to evaluate its relaxant and antinociceptive activities, but this plant is likely to have similar effects to *Lavandula angustifolia*. No reports on toxicity.
Lepidium sativum L. (Brassicaceae, MAR69_14)	Hbrrchad	Seeds	Oral ingestion, tea	General health, paediatric (*kolshi, frigg*)	29	0.35	The seeds of this plant possess antipyretic, analgesic, anti-inflammatory and

							coagulant activities, and free from side or toxic effects (Al-Yahya et al, 1994).
Marrubium vulgare L. (Lamiaceae, IME24)	Ifzi	Leaves, stems	Tea, baths, oral ingestion, *qwi*, poultice, external application, incense, inhalant, chewing, washes, ear drops	General health, gastrointestinal, gynaecological, cancer, cardiovascular, endocrinological, injuries, musculoskeletal, otolaryngological & respiratory, paediatric (*kolshi, skhana, skar, asumid, frigg, jqeqa, cancer, msran, saht, bousfer, jerh, boumzui, imezguane, okhass, toqal, frigg, adis, fqrdem, tuhut*)	72	0.88	The plant presents anti-inflammatory effects (Sahpaz et al, 2002), as well as antispasmodic and antinociceptive effects (De Jesus et al, 2000). The plant has also has antihyperglycemic and antioxidant activities (Elberry et al, 2015). No reports on toxicity.
Mentha pulegium L. (Lamiaceae, IME39)	Fliyou	Leaves	Tea, oral ingestion, external applications, inhalant	General health, gastrointestinal, otolaryngological & respiratory (*ruah, kolshi, tuhut, iurigh, asumid*)	27	0.33	Antioxidant and antimicrobial activities are present in this species (Hajlaoui et al, 2009). No reports on toxicity.
Mentha suaveolens Ehrh. (Lamiaceae, IME05, IME40, IME50)	Timja	Leaves	Tea, oral ingestion, baths, inhalant, external application, poultice, incense, washes	General health, gastrointestinal, **gynaecological,** endocrinological, **injuries, musculoskeletal, otolaryngological & respiratory, paediatric** (*kolshi, azbar, meda, adis, asumid, frigg, ruah, skhana, herh, iurigh, skar, mrrara, jqeqa, okhass, saht, asumid*)	101	1.23	Decoctions of this species has antioxidant and acetylcholinesterase inhibitory capacity (Ferreira et al, 2006). Its essential oils show antimicrobial and antifungal activity (Oumzil et al, 2002). Methanol extracts from this plant lack toxicity (Moreno et al, 2002).
Nigella sativa L. (Ranunculaceae, MAR8)	Shanouj	Seeds	Oral ingestion, inhalant	General health, gastrointestinal, gynaecological, otolaryngological & respiratory,	31	0.38	This plant has antidiabetic, anticancer and immunomodulator, analgesic,

				urological & nephrological (*asumid, saht, kolshi, klaui, azbar, meda, iurigh, ruah*)			antimicrobial, anti-inflammatory, spasmolytic, bronchodilator, hepatoprotective, antihypertensive, renal protective and antioxidant properties (Gilani et al, 2004). Mild toxicity has been observed from its fixed oil, but therapeutic doses are considred safe (Zaoui et al, 2002).
Peganum harmala L. (Nitrariaceae, IME101)	Harmel	Seeds	Incense, external applications, inhalant, poultice, tea, oral ingestion, baths, washes	General health, dermatological, injuries, muskuloskeletal, otolaryngological & respiratory, ritual & spiritual, paediatric (*'aeen, bkhor, jerh, jqeqa, kolshi, ch'aar, ruah, skhana, frigg, tuhut, asumid*)	36	0.44	This plant has antibacterial, antifungal, antiviral, antioxidant, antidiabetic, antitumor, antileishmanial, insecticidal and cytotoxic activities and hepatoprotective and antinociceptive effects (Asgarpanah and Ramezanloo, 2012). However, all plant parts are toxic and poisoning in humans has been reported (Mahmoudian et al, 2002).
Olea europaea L. (Oleaceae, IME22)	Zeet	Leaves, oil, seeds, wood	Baths, external applications, oral ingestion, incense, tea, poultice, inhalant	General health, dermatological, endocrinological, otolaryngological & respiratory, ritual & spiritual, paediatric, ophtalmological (*kolshi, ruah, alen, tuhut, imezguane, frigg, 3ain, frigg, skar, ch'aar*)	24	0.26	Leaves have antioxidant, antihypertensive, antiatherogenic, anti-inflammatory, hypoglycemic, and hypocholesterolemic properties (Sedef and Karakaya, 2009). Olive oil has a powerful antioxidant, anti-inflammatory and antimicrobial

							activity (Tripoli et al, 2005). No reports on toxicity.
Rubia peregrina L. (Rubiaceae, IME01)	Tarubi	Roots	Oral ingestion, tea	**Cardiovascular**, endocrinological, general health, gastrointestinal, **injuries** (*fqrdem, bousfer, jerh, boumzui, adis, kolshi, saht*)	34	0.41	The roots of this species have antioxidant and antimicrobial activities (Ozgen et al, 2003). No reports on toxicity.
Ruta chalepensis L. (Rutaceae, IME33)	Aurmi	All aerial parts, roots	Tea, incense, oral ingestion, inhalant, *qwi*, baths, external application	Cardiovascular**, endocrinological**, general health, gastrointestinal, **musculoskeletal**, otolaryngological & respiratory, ritual & spiritual (*adis, 'aeen, jqeqa, kolshi, asumid, meda, bkhor, frigg, msran, bousfer, boumzui, azbar, skhana, skar, ruah*)	45	0.55	Anti-inflammatory and CNS depressant activities have been observed (Al-Said et al, 1990), but no studies were found to provide evidence for endocrinological and musculoskeletal uses. The plant does not have toxic effects at therapeutic doses (Shah et al, 1991).
Tetraclinis articulata (Vahl) Mast. (Cupressaceae, IME07)	Azuka	Leaves, fruits	Oral ingestion, poultice, incense, inhalant, tea, baths, external application	Endocrinological, general health, gastrointestinal, otolaryngological & respiratory, paediatric, ritual & spiritual, urological & nephrological (*iurigh, skahana, jqeqa, kolshi, skar, ein, ruah, frigg, asumid, bkhor, meda, klaui, adis, mrrara*)	72	0.88	This plant has antioxidant activities (Herzi et al, 2013) as well as antimicrobial activities (Chikhoune et al, 2013). No reports on toxicity.
Thymus saturejoides Coss. (Lamiaceae, IME37, IME49)	Azukni	Leaves, inflorescences	Tea, oral ingestion, inhalant, baths, external application	**Cardiovascular, dermatological,** endocrinological, general health, gynaecological, musculoskeletal	117	1.43	The plant has analgesic activity (Elhabazi et al, 2008). No evidence was found on therapeutic effects for cardiovascular

				, otolaryngological & respiratory, paediatric, **ritual & spiritual**, urological & nephrological (*azbar, kolshi, asumid, meda, ruah, iurigh, boumzui, skar, frigg, mrrara, jqeqa, ein, klaui, fqrdem, tuhut, msran, saht, skhana*)			and dermatological ailments. No reports on toxicity.
Trigonella foenum-graecum L. (Fabaceae, IME60)	Tefedas	Seeds	Oral ingestion, incense, tea, inhalant, baths	Cardiovascular, endocrinological, general health, gastrointestinal, gynaecological, otolaryngological & respiratory, paediatric, ritual & spiritual (*asumid, saht, kolshi, ruah, bkhor, meda, ein, mrrara, skar*)	38	0.46	This plant is effective to treat diabetes and its safe use has been reported (Basch et al, 2003). Anti-inflammatory, analgesic and antipyretic effects are present in the leaves (Ahmadiani et al, 2001) but the seeds have not been tested. No reports on toxicity.

Table 3. Categories of use, folk ailments and informant's agreement (F_{ic}). Number of use reports (UR), number of plant vernaculars (N) and F_{ic} values per biomedical category of use (many vernacular names were used for different therapeutic applications) and plants with high FL for each category (only plants with more than 5 UR have been included). For a translation and description of the folk ailments see the glossary in Teixidor-Toneu *in press* (Table 3).

Biomedical Use Categories (folk ailments) **Species with highest Fidelity Levels (FL)**	**UR**	**N**	**F_{ic}**
General health (*azbar, skhana, kolshi, asumid, shqeqa, saht*) *Cistus laurifolius* (0.93), *Dysphania ambrosoides* (0.88), *Fraxinus dimorpha* (0.88), *Nasturtium officinale* (0.86), *Citrus sinensis* (0.85), *Alpinia officinarum* (0.83), *Thymus maroccanus and T. willdenowii* (0.77).	678	95	0,868
Gastrointestinal (*iurigh, msran, meda, azbar, mrrara, adis, touqal, zagaz*) *Quercus ilex* (0.75), *Punica granatum* (0.73), *Foeniculum vulgare* (0.62), *Ceratonia siliqua* (0.60).	317	70	0,78
Paediatric (*kolshi, iqdi, taumist, taqait, frigg*) *Crocus sativus* (0.88)	139	60	0,57

Gyneacological (*azbar, asumid*)	126	27	0,71
Otolaryngological & respiratory (*ado, ruah, imezguane, okhass, tuhut*) *Allium sativum* (0.75), *Mentha pulegium* (0.70)	109	13	0,70
Endocrinological (*bousfer, skar, fqrdem*) *Rubia peregrina* (0.82)	85	29	0,67
Ritual & spiritual (*'aeen, bkhorr, lariah*) *Ferula communis* (1), *Styrax benzoin* (0.75), *Peganum harmala* (0.64)	82	16	0,81
Ophthalmological (*alen*)	40	11	0,74
Musculoskeletal (*asumid, azbar*)	38	26	0,32
Urological & nephrological (*klaui, asumid, atsirid*)	36	25	0,31
Injuries (*jerh*)	31	9	0,73
Dermatological (*ch'aar, tafalda*) *Lawsonia inermis* (0.62)	22	11	0,52
Cardiovascular (*boumzui*)	15	10	0,36
Cancer	4	2	0,67

Table 4. New reports of medicinal plant species. Vernacular names marked with * are part of previously documented generic complexes. Moroccan Arabic names are indicated by (ary).

Species (Family, voucher specimen)	**Vernacular names**	**Part used**	**Administration**	**Use categories (folk ailments)**	**UR**	**UV**	**Evidence based uses and toxicity**
Agrimonia eupatoria L. (Rosaceae, IME144)	Touga n'lmeda	Leaves	Tea	Gastrointestinal (*meda*)	2	0.02	This plant is also used in Bulgaria and has antioxidant properties (Ivanova et al, 2005). Antioxidant capacity confirmed by further studies

							(Correia et al, 2007); the plant also has anti-inflamatory activity. No reports on toxicity.
Ballota hirsuta Benth. (Lamiaceae, IME26)	Uarimsa, touga n'ifzi, tifziguiyin	Leaves	Tea, oral ingestion, baths	General health, gastrointestinal, gyneacological, paediatric (*kolshi, skhana, frigg, meda, asumid, azbar, mrrara, msran*)	23	0.28	Antioxidant activities identified for other *Ballota* species (Citoglu et al, 2004). Antinociceptive activities have been observed for *Ballota glandulosissima* (Citoglu et al, 2005) and antimicrobial agents are present in *Ballota nigra* (Quave et al, 2008). No reports on toxicity.
Cerinthe major L. (Boraginaceae, IME75 & IME87)	Taililut	Leaves	Tea, oral ingestion	General health, gynaecological, otolaryngological & respiratory (*saht, azbar, asumid*)	7	0.09	Also used medicinally in Italy (Loi et al, 2005) and India (Tiwari, 2008). No reports on pharmacological activities or toxicity.
Cirsium chrysacanthum (Ball.) Jahand. (Asteraceae, HAM126)	Teskra*	Roots	Tea, oral ingestion	Gynaecological, (*asumid, klaui, ado, lmeda*)	8	0.10	No studies identified.
Cistus laurifolius L. (Cistaceae, IME36)	Hmiku	Seeds	Oral ingestion	General health, gastrointestinal (*asumid, kolshi*)	15	0.18	Medicinally used in Turkey; studies confirm antioxidant components in the plant (Sadhu et al, 2006). Anti-inflamatory and antinociceptive

							activities have also been shown in the plant's leaves (Kupeli and Yesilada, 2007), as well as antiulcerogenic activities in the flowers and flower buds (Yesilada et al, 1997). No studies have evaluated the pharmacological activities of the seeds. No reports on toxicity.
Cladanthus scariosus (Ball.) Oberpr. & Vogt (Asteraceae, IME34)	Itzghi, ifski n'uarras	Leaves, inflorescences	Tea, oral ingestion, baths	General health, gastrointestinal, gyneacoloical, paediatric (*kolshi, skhana, meda, frigg, asumid, iurigh*)	18	0.22	No studies identified.
Clematis flammula L. (Ranunculaceae, HAM107)	Azenzou	Leaves, seeds	Bath, chewing	Paediatric, otolaryngological & respiratory (*kolshi, okhass*)	2	0.02	This plant is also used medicinally in Algeria (Atmani et al, 2009), and antioxidant activities have been observed. Further studies also report cytotoxic activity (Atmani et al, 2011). The species in the genus Clematis present protoanemonin and aristolochic acid which have severe toxic effects (Chawla et al, 2012).
Clinopodium atlanticum (Ball.) N.Galland (Lamiacea	Tzagzaut	Leaves	Oral ingestion	Paediatric (*frigg*)	1	0.01	No studies identified.

e, IMA110)							
Corrigiola litoralis L. (Mollugina ceae, MAR15)	Tausserghi nt*	Roots	Incense, chewing, external applications	Gyneacological , otolaryngologic al & respiratory, paediatric, ritual & spiritual (*kolshi, okhass*)	4	0.0 5	No studies identified.
Dioscorea communis (L.) Caddick & Wilkin (Dioscorea ceae, IME88)	Agulz	Tubercles	Oral ingestion, external application	General health, gastrointestinal, musculoskeletal , paediatric (*saht, meda, asumid, frigg*)	12	0.1 5	Evidence for therapeutic use against rheumatism is found in *Dioscorea sylvatica*, however long term external application is not recommended (Cogne et al, 2001). Inflammatory activities and occasional toxicity can result from ingestion of other *Dioscorea* species (Bhandari and Kawabata, 2005).
Hyoscyamus niger L. (Solanacea e, HAM58)	Uaililu	Leaves	Oral ingestion, incense	Musculoskeleta l, ophtalmologica l (*asumid, alen*)	2	0.0 2	Although some terapeutic applications of this plant have been proven (Gilani et al, 2007), no studies have evaluated its effects agains rheumatism or to treat eye infections. Intoxications due to the ingestion of this plant have been reported and this plant is considered among those presenting

							high toxicological risk in Switzerland (Jaspersen-Schib et al, 1996).
Inula montana L. (Asteraceae, IMA08)	Ijaumgar	Leaves	Tea, oral ingestion	General health, gastrointestinal, otolaryngological& respiratory, paediatric (*kolshi, skhana, meda, frigg, asumid, iurigh*)	25	0.30	See table 2.
Lavandula pedunculata (Mill.) Cav. (Lamiaceae, IME85)	Khzemt*	Leaves, inflorescences	Tea, oral ingestion, poultices, washes	Dermatological, general health, gastrointestinal, gynaecological, ophtalmological, otolaryngological & respiratory, paediatric (*kolshi, azbar, atsirid, ch'aar, meda*)	18	0.22	Also used medicinally in Portugal. Active metabolites in the plant have a positive effect on human health (Costa et al, 2013) and decoctions have acetylcholinesterase inhibitory capacity (Ferreira et al, 2006). No reports on toxicity.
Lonicera biflora Desf. (Caprifoliaceae, HAS90)	Irifi	Leaves	Bath	General health, paediatric (*skhana, kolshi*)	2	0.02	Related taxa has anti-inflamatory, antibacterial, antiviral, antioxidative and hepatoprotective activities (Shang et al, 2011) and this species does not have toxicity effects (Thanabhorn et al, 2006).
Malus domestica Borkh. (Rosaceae, NA)	Khal n'tfah	Fruit (vinegar)	Oral ingestion	General health (*skhana*)	1	0.01	Therapeutic effects of apple vinegar have been shown (Nakamura et al, 2010). No reports on toxicity.
Malva neglecta Wallr.	Tibi*	Leaves	Oral ingestion	General health (*asumid, saht*)	3	0.04	Used medicinally in Turkey and Jordan.

(Malvacea e, HAS148)							Antioxidant capacity similar or higher than herbs such as rosehip, cinnamon, oregano and multiple Chinese medicinal plants found in the leaves (Dalar et al, 2012). Safe use has been confirmed (Al-Qura'n, 2009).
Mentha gattefossei Maire (Lamiacea e, IME84)	Tafleyout	Leaves	Tea	General health (*kolshi*)	2	0.02	See the closely related species, *Mentha pulegium* in Table 2.
Mercurialis annua L. (Euphorbia ceae, IME20)	Lhbaq n'ughiul, harriga melsa (ary)	Leaves	Oral ingestion	Paediatric (*frigg*)	1	0.01	This plant is also used medicinally in Israel and has antioxidant activities and no toxic effects at low administration dosages (Ljubuncic et al, 2005).
Micromeria graeca (L.) Benth. ex Rchb. (Lamiacea e, IME112)	Tatait, tiqui n'uzro	Leaves	Tea	General health, urological & nephrological (*klaui*, *kolshi*)	2	0.02	*Micromeria cirica* exhibits significant antibacterial and antifungal activities (Duru et al, 2004). Several Lamiaceae species are a rich source of acetylcholinestera se inhibitors and antioxidants (Vladimir-Knezevic et al, 2014). No reports on toxicity.
Micromeria hochreutin eri (Briq.) Maire	Tatait, tiqui n'uzro	Leaves	Tea	General health, urological & nephrological (*klaui*, *kolshi*)	2	0.02	Several Lamiaceae species are a rich source of

(Lamiaceae, FD14)							acetylcholinesterase inhibitors and antioxidants (Vladimir-Knezevic et al, 2014). No reports on toxicity.
Nasturtium officinale R.Br. (Brassicaceae, IME18 & IME107)	Grnunsh	Leaves	Oral ingestion, tea	General health, paediatric (*asumid*, *frigg*)	7	0.09	This plant is also used medicinally in Iran and has cardioprotective potential (Bahramikia and Yazdanparast, 2008) and hypolipidaemic activity due to its antioxidative potential (Yazdanparast et al, 2008). No reports on toxicity.
Onopordum acaulon L. (Asteraceae, IME91 & IME95)	Arshmush	Roots	Oral ingestion	General health, gastrointestinal, muskuloskeletal, paediatric (*asumid*, *saht*, *kolshi*, *adis*)	9	0.11	Antioxidant activities have been observed in *Onopordum anatolicum* (Tasdelen and Mammadov, 2014). No reports on toxicity.
Polycarpon polycarpoides (Biv.) Zoda (Caryophyllaceae, HAM84)	Talwurst	Fruits, roots, seeds	Oral ingestion	General health, gastrointestinal, gynaecological, musculoskeletal, urinary & nephrological (*asumid*, *azbar*, *kolshi*)	10	0.12	No studies identified.
Pterocephalus depressus Coss. & Balansa (Asteraceae, IME83)	Izoran melul, izoran umlil, igudi	Roots	Oral ingesetion, tea	General health, gastrointestinal, gyneacological, musculoskeletal (*asumid*, *saht*, *azbar*, *meda*, *kolshi*, *adis*)	21	0.26	Anti-inflamatory effects and no obvious toxicity observed in *Pterocephalus hookeri* (Xinlu et al, 2004). Further studies confirmed anti-inflamatory activities and analgesic effects in this related taxa

							(Zhang et al, 2009).
Retama dasycarpa Coss. (Fabaceae, IME102)	Algu	Seeds	Oral ingestion	Urological & nephrological (*klaui*)	1	0.01	Subacute toxic effects were observed when another *Retama* species was repeatedly administered orally to rats (Algandaby, 2015).
Salix purpurea L. (Salicaceae, HAM97)	Tishki	Leaves	Bath	General health (*skhana*, *asumid*)	1	0.01	No studies identified.
Salvia aucheri Benth. (Lamiaceae, MAR53)	Salmia n'udrar	Leaves	Tea, oral ingestion	General health, gastrointestinal, urological & nephrological (*kolshi*, *meda*, *klaui*)	3	0.04	The species has anticholinesterase inhibitory capacity and antioxidant activities (Orhan et al, 2007). It also has antimycobacterial activities (Askun et al, 2010). No reports on toxicity.
Salvia taraxicifolia Coss. ex Hook.f. (Lamiaceae, FD28)	Tzdit	Roots	Oral ingestion	General health (*asumid*)	1	0.01	Several Lamiaceae species are a rich source of acetylcholinesterase inhibitors and antioxidants (Vladimir-Knezevic et al, 2014). No reports on toxicity.
Scrophularia laevigata Vahl (Scrophulariaceae, IME66 & IME111)	Ifski n'ughiul, touga n'uifski	Leaves, flwers	Bath, oral ingestion, tea	General health, gastrointestinal (*skhana*, *kolshi*)	3	0.04	No studies identified.
Solanum nigrum L. (Solanacea	Tedalen*	Leaves	Oral ingestion	Paediatric (*frigg*)	1	0.01	The species is considered toxic (Al-Qura'n, 2009)

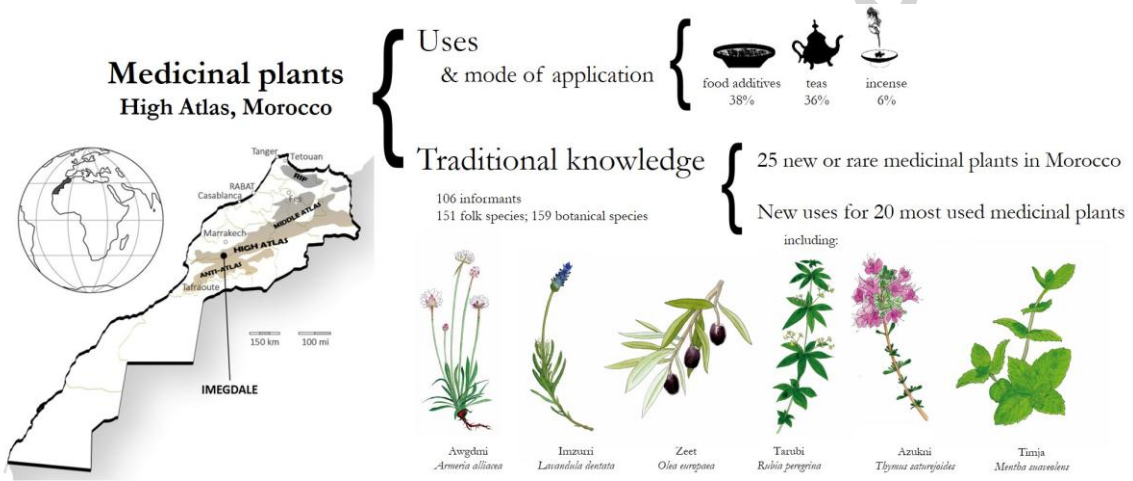
e, HAM14)							and fruits have neuropharmacological activity (Perez et al, 1998).
Solanum lycopersicum L. (Solanaceae, NA)	Matisha	Fruit	Oral ingestion	General health (*skhana*)	1	0.01	Tomatoes have antioxidant properties and a range of therapeutic effects on human health, such as prevention of some major chronic diseases, but their anti-pyrectic activity has not been yet tested (Preedy and Watson, 2008).
Tagetes minuta L, (Asteraceae, HAS133)	Lgnbes	Flowers	Tea	Musculoskeletal (*asumid*)	1	0.01	Leaves have antimicrobial activities (Tereschuk et al, 1997) but no test has been carried out from flower extracts. No reports on toxicity.
Thymus maroccanus Ball (Lamiaceae, IME51)	Tazugnit	Leaves, inflorescences	Tea, oral ingestion	General health, gastrointestinal (*asumid*, *azbar*, *meda*, *frigg*)	13	0.16	Analgesic activity (Elhabazi et al, 2008) provides evidence for its use to treat pain (*azbar*).
Thymus willdenowii Boiss. (Lamiaceae, IME93)	Tazugnit	Leaves, inflorescences	Tea, oral ingestion	General health, gastrointestinal (*asumid*, *azbar*, *meda*, *frigg*)	13	0.16	This species has been shown to have anti-inflammatory activity topically (Ismaili et al, 2001) but there are no reports that provide evidence of its therapeutic use when ingested.

							No reports on toxicity.
Withania frutescens (L.) Pauquy (Solanaceae, AS21)	Tinart	Stems	External application	Dermatological (*tafalda*)	2	0.02	This plant has antibacterial and antioxidant activities in the roots and leaves (El Bouzidi et al, 2011), but no studies have tested yet the use of this plant for dermatological problems. *Withania somnifera* is considered toxic (Al-Qura'n, 2009).

Table 5. Mixtures. Vernacular names that could not be botanically identified are indicated by NA (identification Not Available).

Mixture	**Medicinal plants included**	**Plant acquisition & mode of preparation**	**Ailments treated (use category)**
Tadouart nigran (also called *isfskan*)	*Mkhinza (Dysphania ambrosioides), igg (Pistacia atlantica), imitk (Pistacia lentiscus), louz n'uili (Searsia tripartita), itzghi (Cladanthus scariosus), lgnbes (Tagetes* sp.*), shih (Artemisia herba-alba), tlir (Dittrichia viscosa), irifi (Lonicera biflora), irgl (Cistus salviifolius, Cistus creticus), bilkam (Equisetum ramosissimum), algu (Retama dasycarpa), tekeda (Ceratonia siliqua), tswig (Juglans regia), azukni (Thymus saturejoides), afleyou (Mentha pulegium), grzguiel (Lavandula maroccana, Lavandula multifidia), ifzi (Marrubium vulgare), timzuri (Lavandula dentata), khzemt (Lavandula pedunculata, Lavandula stoechas), tatait (Micromeria graeca, Micromeria hochreutineri), tlba (Ajuga iva), timja (Mentha suaveolens), uarimsa (Ballota hirsuta), rman (Punica granatum), asln (Fraxinus dimorpha), zeet l3ud (Olea europaea), tirqa (Globularia alypum), azenzou (Clematis flammula), ashdir (Rubus ulmifolius), louz (Prunus dulcis), tarubi (Rubia peregrina), safsaf (Populus alba), ifski n'ughiul (Scrophularia laevigata), ifr tarrausht (Verbascum* sp.*), angarf (Vitex agnus-castus), adel (Vitis vinifera), azmour (*NA*) taujant (*NA*), tlanin (*NA*)*	Plants collected from the wild or the fields close to villages. Fresh leaves infused and used as a bath or wash.	General health, paediatric
Msahan	*Bqbouka (Bunium bulbocastanum), taililut (Capparis spinosa), gusa & bsibisa (Myristica fragrans), knorfel*	Mixture bought from herbalists.	General health, gyneacologycal,

	(Syzygium aromaticum), l'aamer (Piper nigrum), dar flfl (Piper longum), nuwiwira (Piper cubeba), lwrd (Rosa centrifolia), badiana (Illicium verum), blalouz (Asphodelus microcarpus), khoudenjal (Alpinia officinarum), khrkom (Curcuma longa), skinjbir (Zingiber officinale)	Dried plants ground and mixed with food.	musculoskeletal
Ishgaf	*Qzbor (Coriandrum sativum), harmel (Peganum harmala), sanouj (Nigella sativa), aurmi (Ruta chalepensis)*	Mixture bought from herbalists. Plants burned as incense.	Ritual & spiritual
Izoran	*Teskra tumlil (Eryngium tricuspidatum), arshmush (Onopordum acaulon), taddad (*NA*), tefgha (Carlina gummifera), teskra krzes (Carlina* sp.*), igudi (Pterocephalus depressus), awgdmi (Armeria alliacea)*	Plants collected from the wild. Dried plants ground and mixed with food, infused or mixed with olive oil and applied externally.	General Health, gyneacologycal, musculoskeletal



Graphical abstract