Full Length Research Paper

Ethnobotanical survey of healing medicinal plants traditionally used in the main Moroccan cities

Messaoudi Moussi I.*, Filali, H., Tazi, A. and Hakkou, F.

Laboratory of Pharmacology and Toxicology, Faculty of Medicine and Pharmacy of Casablanca, University Hassan II. Morocco.

The present study is a survey conducted to indicate the healing medicinal plants, traditionally used by the Moroccan population, and especially to select the healing plants mainly used in the form of essential oils. This survey allowed an inventory of 59 species of healing plants belonging to 37 families. The results showed that the whole plant is the most commonly used part (31%), followed by the leaves (29%). Most plants are Moroccan and are used as a single powder and as essential oils. The most common frequency of use is 2 times per day and the treatment duration depends mainly, on the pathological field and the nature of the wound. Also, the results revealed that plants whose leaves are the most used as essential oils are: *Rosmarinus officinalis*, *Lavandula angustifolia* and *Artemisia tridentata.* This study showed that medicinal plants play an important role in healing practices. It's a very valuable source of information for the studied areas and for national medicinal flora. So, it could be a database for further research in the field of herbal medicine, pharmacology and in order to manufacture new drugs based on medicinal plants.

Key words: Medicinal plants, pharmacological properties, healing, traditionnal medicine, ethnobotanical survey, Morocco.

INTRODUCTION

Since ancient times, man has always used medicinal plants to treat himself; and for fifteen years, researches have increased worldwide and have sought to investigate the pharmacological activities of these plants. Indeed, it is estimated that 80% of the population of developing countries, use traditional medicine (Bousta and Ennabili, 2011). These countries include Morocco, whose knowledge of phytotherapy and traditional medicine is transmitted by the culture through generations. These knowledge are developed, and enriched, thanks to the strategic geographic position of the kingdom.

The geographical position of Morocco provides a remarkable range of bioclimates, a great biodiversity, a good wealth of medicinal and aromatic plants and a variety of traditional knowledge. Indeed, the Moroccan flora is composed of over 4200 species and subspecies belonging to a large botanical known family, with 130 families and 940 species represented by: *Ateraceae*, *Fabaceae*, *Poaceae*, *Brassicaceae*, *Caryophylaceae*, *Lamiaceae*, *Apiaceae*, *Scrophulariaceae* and other families (Bellakhdar, 1998). Medicinal plants are therefore a precious heritage for humanity and especially for Morocco.

Wounds have always had a considerable impact on

Figure 1. Map of Morocco showing the surveyed cities, Source: http://www.diplomatie.gouv.fr/fr/dossiers-pays/maroc/.

health especially those related to chronic skin wounds constitute a major health burden in developing countries (Agyarea et al., 2009). Subsequently, surgical wounds present in Morocco, a problem of drug therapy.Inflammation,swelling, pain and infection due to these wounds are closely related properties and involved in a big number of skin trauma.

To complete the partial and fragmentary studies conducted everywhere in Morocco, ethnobotanical surveys help to gather a very valuable source of information, ready to be scientifically exploited. In this context, the present study is part of the latter surveys. It aims to make a thorough inventory of medicinal plants with healing properties, traditionally used in Morocco and to choose the healing plants that are likely to be used in subsequent studies.

MATERIALS AND METHODS

Area of the study

Morocco is located at the north western tip of the African continent, separated from Spain by the 14 km of the Strait of Gibraltar. It is bathed in the west by the Atlantic Ocean and in the north by the Mediterranean Sea, both of which give it two coastlines spanning nearly 3500 km. Constituting a North-South passage area, Morocco has a surface of 710,850 km² and belongs to both the Mediterranean and the Sahara worlds (Bellakhdar, 1998). Due to its strategic location, Morocco has a rich flora. Changes in the climate and terrain are the major factors that can explain this floral wealth. Indeed, it has two coastlines and therefore receives rain streams from the Atlantic Ocean, which accumulate against the mountain

barriers of the Atlas. This leads to heavy rainfalls in the cities of Rabat, Casablanca, Fez and the formation of snow in the high peaks of the Atlas, while the south and east stay arid.Moreover, the botanical interest of Morocco is intense and contains at least 2.5 million hectares of forest (about 15% of the total area) which contains cedars, palms, date palms, fig trees, olive trees, almond trees, acacias, fruit trees, cork oaks, pines, eucalyptus, and endemic plant that is the Argan tree, which is found nowhere else in the world, but in Morocco. (Bellakhdar, 1998).

Among the big and great cities in this country, we find Casablanca, Marrakech, Agadir, Fez, Tetouan, Tangier and Oujda, in addition to the towns of Mohammedia, Salé, Kenitra and Taroudant in the Agadir area. The study chose to carry out its investigation in these cities because they belong to the most populated regions of Morocco. They are not only best known for their richness on medicinal plants, climate and biodiversity, but also for their cultural diversity. They are a home from the numerous herbalists who live there. The surveyed cities (framed in red) are illustrated in Figure 1.

METHODOLOGY

This study was conducted to establish an inventory, as complete as possible, of medicinal plants traditionally used because of their healing properties by herbalists located in the main Moroccan cities to treat their patients. The study investigation lasted about five months (from 21 September, 2014 to 16 January, 2015). The total number of herbalists contacted is 202 whose distribution is represented in Table 1.

To have an overview of the local traditional uses and the pharmacopoeia's floristic diversity of these Moroccan cities, the ethnobotanical survey was conducted using series of direct and telephonic interviews with herbalists of the cities cited in Table 1. It was carried out using a predetermined questionnaire with specific questions about the healing plant: its local name, its origin (country,

Table 1. Number of herbalists contacted per city.

Surveyed cities	Number of herbalists	Surveyed cities	Number of herbalists
Casablanca	80	Marrakech	20
Fès	20	Tanger	18
Kenitra	8	Tétouan	5
Mohammedia	5	Agadir	10
Rabat	18	Taroudant	3
Salé	12	Oujda	3
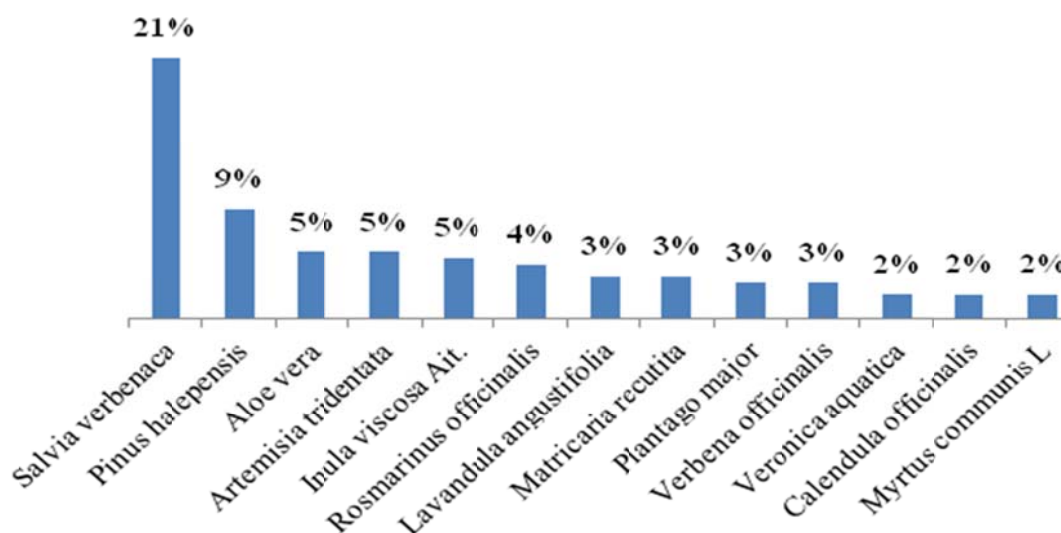
Figure 2. Distribution of collected healing plants.

region or city), its harvest season, its parts used, its form of preparation, the administration way of the plant, the frequency of use per day, the duration of the treatment, and if the plant is used alone or in combination with other plants.

Interviews were conducted in the dialect language of the country. The identification of the scientific names of the medicinal plants was carried out by a Professor Pharmacognosist at the High School of Technology (EST) in Casablanca, and with reference to the book of traditional medicinal plants (Bellakhdar, 1998). The study was able to collect 211 questionnaires in relation with the healing plants. Among the 202 herbalists contacted, 152 accepted to answer to the questions, while the others either refused to respond to our request, or were not specialized in medicinal plants or were unreachable.

The study was especially interested to find a relationship between the criteria of the plants that were collected during the investigation, in order to highlight information that will be used for the selection of healing plants for further experimental studies.

Statistical analysis

The counting of the results was carried out by an established mask on Statistical Package for the Social Sciences (SPSS) software, version 21. The relationship between the variables was evaluated by the test of independence Chi-square (χ^2) with a confidence level of 95% and by calculating the p-value. The results are considered significant when the p-value is less than 0.05.

RESULTS

Floristic screening

Scientific name of the listed plants

The survey allowed an inventory of 59 species of healing medicinal plants. So, the analysis identified several plants but the most represented are: *Salvia verbenaca* at a frequency of 21%, *Pinus halepensis (*9%), *Aloe vera* (5%), *Artemisia tridentata* (5%), *Inula viscosa ait.* (5%), *Rosmarinus officinalis* (4%) and *Lavandula angustifolia* of 3%. The classification of these species by their frequency is represented in Figure 2. All the indexed healing plants and their corresponding properties are listed in Table 6 and 7,

Families of healing plants

The recorded healing medicinal plants belong to 37 families four of which are predominant: *Lamiaceae* (34%), *Asteraceae* (18.7%), *Pinaceae* (8.9%) and
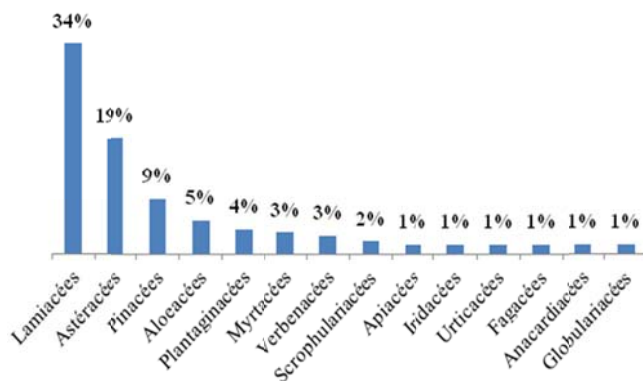
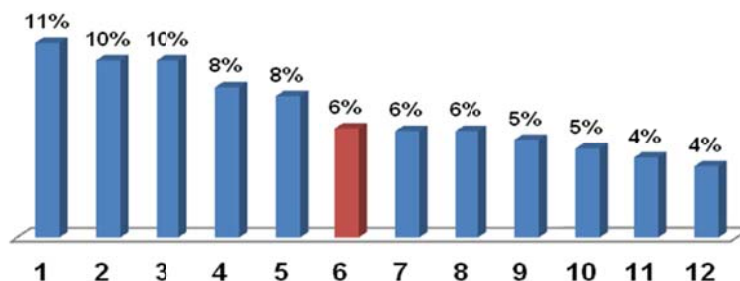**Figure 3.** Distribution of healing plants families.

Figure 4. Distribution of healing plants based on Moroccan regions, (1) Souss-Massa-Draa, (2) Marrakech-Tensift-Al Haouz, (3) Gharb-Chrarda-BeniHssen, (4) Meknes-Tafilalet, (5) Tangier- Tetouan (6) No Moroccan, (7) Taza-Al Hoceima-Taounate, (8) Fez-Boulemane, (9) Tadla-Azilal, (10) Oriental, (11) Doukkala-Abda, (12) Rabat-Sale-Zemmour- Zaër.

Aloaceae (5.4%). The rest of results are shown in Figure 3.

Origin of plants

The plants were classified according to their original area and where they are most prevalent. Most of Moroccan healing plants are distributed in the region of Souss-Massa-Draa (11%), followed by the region of Marrakech-Tensift-Al Haouz and the region of Gharb-Chrarda-Beni Hssen with 10%, while 6% of the plants are not Moroccan Figure 4.

Plants season

The availability and distribution of plants depend on the season and climate. The study obtained information on the harvest season for each plant. Spring is the season with high percentage of plants (50%), followed by summer (14%), winter (9%) and autumn (5%). Figure 5 illustrates the obtained results.

Ethnobotanical and pharmacological screening

Used parts of plant

The used parts of plants were collected and classified according to their order of importance. The whole plant is the most commonly used form with a frequency of 31%, followed by leaves with 29%, flowers (12%), bark (7%) and seeds (7%). The term "Other" refers to other parts of the plant found, as mucilage for *Aloe vera* species and stigma for *Crocus sativum* species. Figure 6 includes all these results.

Form of use

To facilitate the use of medicinal plants, herbalists recommend several types of preparations: powder, decoction, infusion and cold water, use as essential oils and many others. The most widely used form is a single powder of 57%, followed by the form of essential oils of 22% and by other forms (11%), like the application of the plant directly on the wound, or formed into a wound
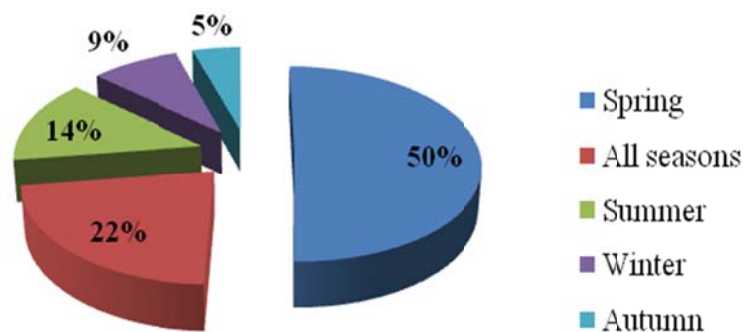
Figure 5. Distribution of healing plants by season.
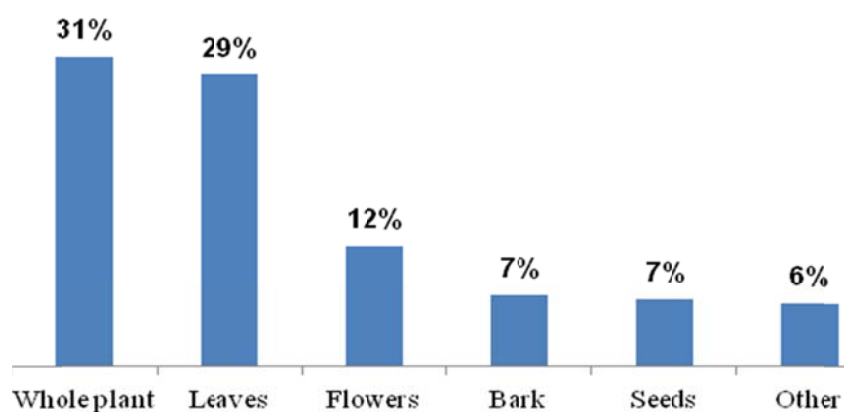
Figure 6. Distribution's frequency of used parts of healing plants.
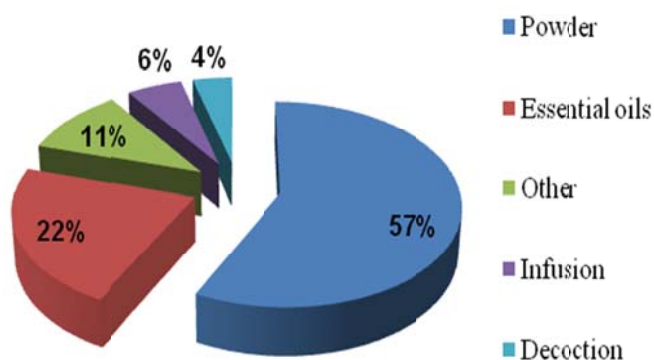
Figure 7. Dosage form of recorded healing plants.

dressing or applied as a cream Figure 7.

Way of administration

The most common ways of drugs administration are dermal and oral. In this study, the extreme majority staffs for dermal administration (90.5 %), 16% for a combi-

nation of dermal and oral administration and 2% for the oral way were found out.

Frequency and duration of use

According to each herbalist, medicinal plants are applied one to five times a day and the diagnosis may sometimes

Figure 8. Frequencies of use of healing plants.

Figure 9. Distribution's frequency of the treatment's duration.

vary depending on the wound**.** The treatment period for its part, can extend to a month, but that depends on the pathological field (case of the patient) and on the depth of the wound. In this study, 39% for a frequency use of 2 times a day (morning and evening), 32% for 1 time a day (especially at night), 19% for 3 times a day, and 9% represents the frequency that depends on the wound and the treated patient's case were obtained (Figure 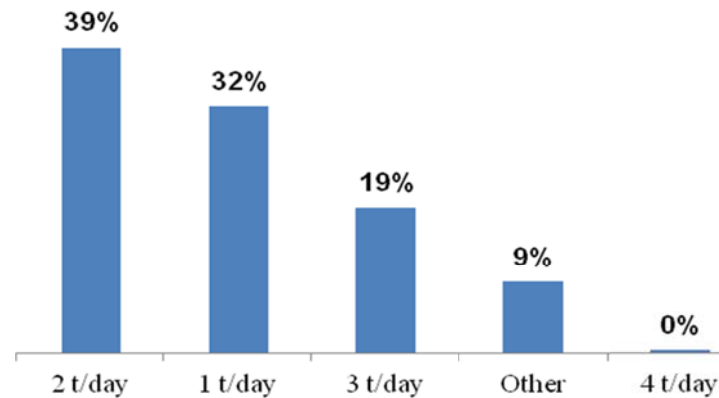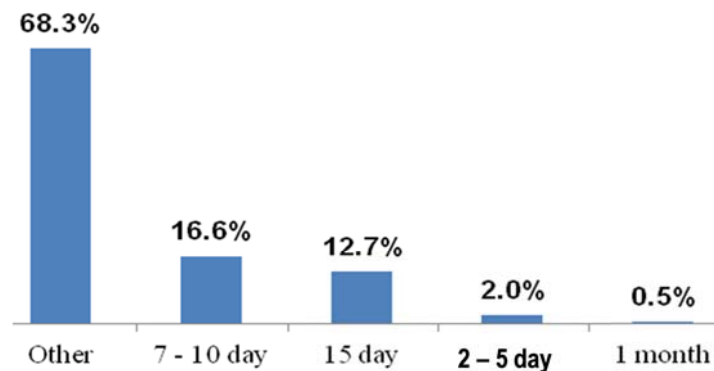8). For the duration of treatment, the majority of herbalists were unable to inform us about the exact duration of therapy because it depends on the wound, the patient's healing duration, the response to the treatment and the effectiveness of this latter. The study got a major frequency of 68.3% for the criterion "Other" (depending to the wound, to the patient's case and the response of the latter to the treatment), 16.2% for a period of 1 week to10 days and 12.7% for a period of 2 weeks (Figure 9).

Plants association

According to herbalists, there are plants that can be associated with other species or mixed with vegetable or essential oils from other plants. The study investigation revealed that the predominant part (66.4 %) is for a single use of plants without any association with other species and the rest (33.6 %) is for the association of plants with others. Names and frequencies of associated plants are listed in Table 2.

Evaluation of the independence of variables with Chi-square test

Let X and Y be two qualitative variables with l and k modalities, respectively. The study test that X and Y are independent (H_0). The Chi-square variable is associated with a number of degrees of freedom (v) calculated including: $v = (k-1)(l-1)$ (Mountassir, 2014). The study also based on the calculation of p value to test the independence of two variables. The test is significant and H_0 is rejected when the p value is less than 0.05.

Crossing between used parts and form of use

Consider X as the qualitative variable that represents the part of the plant used and Y qualitative variable that

Table 2. List and frequencies of associated plants.

Healing plant	Associated medicinal plants
Aloe vera	*Myrtus communis L.*(1)
Arnica L.	*Artemisia absinthium* (1)
Artemisia tridentata	*Lavandula angustifolia* (3)*, Myrtus communis L.* (1)*, Matricaria recutita* (1)*, Thymus vulgaris* (1)*, Artemisia absinthium* (1)*, Quercus faginea lamk* (1)*, Rhus albidum schousb.* (1)*, Tea melaleuca* (1)
Calendula officinalis	*Lavandula angustifolia (1), Rosmarinus officinalis (1)*
Inula viscosa ait.	*Argania spinosa* (2)*, Matricaria rectutita* (1)
Saponaria vaccaria L.	*Argania spinosa* (1)
Globularia alypum L.	*Salvia verbenaca* (1)
Lavandula angustifolia	*Argania spinosa* (1)
Marrubium vulgare	*Artemisia abstinthium* (1)
Rosmarinus officinalis	*Calendula officinalis* (1)*, Thymus vulgaris* (1)
Salvia verbenaca	*Plantago major* (6)*, Verbena officinalis* (9)*, Pinus halepensis* (6)*, Thymus vulgaris* (1)*, Plantago psyllium* (1)*, Inula viscosa ait.* (1)*, Argania spinosa* (1)*, Myrtus communis L* (1)*, Artemisia tridentata* (1)*, Marrubium vulgare* (2)*, Lavandula angustifolia* (1)
Thymus vulgaris	*Rosmarinus officinalis* (1)
Laurus nobilis L.	*Argania spinosa* (1)
Smilax aspera L.	*Matricaria recutita* (1)
Pinus halepensis	*Salvia verbenaca* (2)*, Verbena officinalis* (2)*, Artemisia tridentata* (2)*, Myrtus communis L.* (1)*, Marrubium vulgare* (1)*, Plantago major* (1)
Plantago major	Salvia verbenaca (1), Verbena officinalis (1)
Urtica dioica	Thymus vulgaris(1), Rosmarinus officnalis(1)
Verbena officinalis	Salvia verbenaca (1), Plantago major (1), Papaver rhoeas L. (1)
Curcuma longa.	Artemisia tridentata (1), Marrubium vulgare (1), Allium cepa (1)

(Frequency).

Table 3. Contingency table: Used parts*form of use.

Form of use/ Part	Leaf	Flower	Roots	Bark	Fruit	Seeds	Whole plant	Other	Total
Powder	2.98	0.21	0.00	2.86	0.06	0.14	4.96	0.64	11.85
Decoction	0.70	0.34	0.32	0.03	0.52	0.64	0.97	0.01	3.53
Infusion	4.70	0.51	0.19	0.94	0.59	0.07	2.71	0.47	10.18
Essential oils	1.65	1.85	0.79	1.73	0.33	0.01	1.76	0.51	8.64
Other	0.00	0.00	0.43	1.83	0.64	0.09	1.58	5.37	9.95
Total	10.05	2.91	1.74	7.40	2.14	0.95	11.97	6.99	44.15

represents the use form of the plant. The study want to test that X and Y are independent (H_0), for a significance level of 95% using a contingency table with double entry. Table 3 summarizes the results of this test. According to this table, v = 28, χ^2_{obs}=44.15 and $\chi^2_{v;\,\alpha}$=16.93 so χ^2_{obs} > $\chi^2_{v;\,\alpha}$. Therefore, H_0 is rejected.

Crossing between used parts and use form as essential oils

Let the qualitative variable X: Used parts, and Y: Use form as essential oils. According to the contingency Table 4, v=7, χ^2_{obs}=69.1 and $\chi^2_{v;\,\alpha}$=2.17 so χ^2_{obs} > $\chi^2_{v;\,\alpha}$. There-

Table 4. Contingency table: used parts*use as essential oils form.

Form of use	Leaves	Flower	Roots	Bark	Fruit	Seeds	Whole plant	Other	Total
Use as essential oils	47.81	1.36	5.88	5.88	2.91	0.98	1.36	2.91	69.10

fore H_0 is rejected.

In order to exactly know the part of the plant which is most often used in the form of essential oils, or in other words, the part of the plant which is most often used as essential oils form, the study has made the crossing between using form as essential oil and every part of the plant (leaf, flower, fruit, root, bark, seeds and whole plant) (Table 5). From Table 5, the p value of the Chi-square test of 0.003 (less than 0.05) made the study to conclude that the use in the form of essential oils depends on the leaves.

For the second crossing, the p value: 0.116 is higher than 0.05, the study doesn't reject H_0, and reached the conclusion that the use form of essential oils doesn't depend on the flowers. The p value of the third crossing (0.214) higher than 0.05 doesn't reject H_0 and conclude for an independence between the use form as essential oils and roots (at a confidence level of 95%). For the fourth crossing, the p value (0.06) is higher than 0.05; therefore study didn't reject H_0 and conclude that the use form as essential oils is independent of the barks. For the fifth crossing, the p value (0.663) is higher than 0.05, so the study didn't reject H_0 and conclude that the use form as essential oils doesn't depend on the fruit. Then, the p value (0.567) of the sixth crossing is higher than 0.05, so the study did not reject H_0 and conclude that the use form as essential oils does not depend on seeds. Finally, according to the Chi-square of the seventh crossing, the p value is less than 0.05. So the study rejects H_0 and concludes that the use in the form of essential oils depends on the whole plant.

Crossing between use form of essential oil and the healing plant

Here, the study wants to test if the use in the form of essential oils form depends on the plant species. According to Table 5, the p value is less than 0.05 (0.000). These results are significant and the H_0 hypothesis is rejected.

Crossing between use form of essential oil, leaf-part and healing plant

The study wants to show through this crossing that the use of the leaves in the form of essential oils depends on the healing plant species. Indeed, Table 5 gives a p value less than 0.05. Furthermore, plants whose leaves are

more often used in the form of essential oils are: *R. officinalis*, *L. angustifolia*, *A. tridentata*, *M. communis L* and *T. vulgaris* (Figure 10)

DISCUSSION

The phytotherapy is frequently used by the Moroccan population. In fact, according to some study, 70 to 80% of Moroccan people use medicinal plants to heal: 60% of them are female, and more than 50% are illiterate (Zeggwagh et al., 2013). 55 to 90% of people use plants to treat chronic diseases of which 16.8% are for the dermatological affections and wounds in Fez (Zeggwagh et al., 2013). Moreover, in the region of Ksar Lakbir, 11.6% of plants are employed to treat skin diseases (Merzouki et al., 2000), 15% in the region of Essaouira (Mehdioui et al., 2007), 17% in Ifran (Rhafouri et al., 2014) and 12.5% in the region of Zaêr (Lahsissene et al., 2010). On the other hand, medicinal plants are used for dermatological affections by 27% in the region of El Hajeb (EL Amri el al., 2014), by 11.80% in the region of Agadir (El Hafian et al., 2014), by 10% in Kenitra (Salhi et al., 2010), by 12% in the region of Haut Atlas Oriental (Belamdini et al., 2014) and by 16% in the region of Meknes-Tafilalet (Fadil et al., 2014).

Indexed healing medicinal plants

A number of 59 species of healing medicinal plants has been inventoried in this study, of which majority are: *S. verbenaca*, *P. halepensis*, *A. vera*, *A. tridentata*, *I. viscosa* ait , *R. officnalis*, *L. angustifolia*. In parallel, the national literature review enabled us to screen 59 Moroccan healing plants including: *S. verbenaca*, *P. halepensis, I. viscosa ait., A. tridentata* and *A. vera, in addition to 54 other healing plants* (Bellakhdar, 1998). Another national ethnobotanical study shows that *A. vera, L. officinalis, M. recutita, M.s communis, C. officinalis* and *T. vulgaris* have wound healing properties (Sijelmassi, 2011). This shows the proximity of the results of this study with those found in the literature.

On the other hand, an ethnobotanical survey confirmed that *S. verbenaca*is has been employed by the local population to facilitate the wound healing, in the region of Zaër (Lahsissene et al., 2009), Haut Atlas Oriental (Belamdini et al., 2014) and of Settat (Bammi et al., 2002). Moreover, it has been shown that *S. verbenaca* and *I. viscosa ait*. have a healing potential on wounds,

Table 5. Chi-square test: use as essential oils and used part of plants.

Parameter	Pearson Chi-square			Fisher's exact test		Interpretation
Crossing	Value	DOF	P value	Signification exacte (bilateral)	Exact significance (unilateral)	Significance
1 Use as essential oils form*Leaves	8.787	1	0.003	0.004	0.003	S
2 Use as essential oils form*Flowers	2.466	1	0.116	0.168	0.092	NS
3 Use as essential oils form*Roots	1.541	1	0.214	0.293	0.195	NS
4 Use as essential oils form*Bark	3.391	1	0.066	0.075	0.052	NS
5 Use as essential oils form*Fruit	0.190	1	0.663	0.705	0.457	NS
6 Use as essential oils form*Seeds	0.327	1	0.567	0.556	0.380	NS
7 Use as essential oils form*Whole plant.	7.204	1	0.007	0.008	0.005	S
8 Use as essential oils form*Name ofplant.	128.265	55	0.000	-	-	S
9 Use as essential oils form*Leaf-part*Name of plant.	8.787	1	0.003	0.004	.003	S

*DOF: Degree Of Freedom; NS: No Significant; S: Significant.

Table 6. Inventory of healing plants recorded in our ethnobotanical survey.

Family	Scientific name	Local name	% of plant	Used part	Usedform	Additive	Frequency of use	Treatment duration	Administration way	Content in EO	Properties	Plants association	Corresponding References
Aloeaceae	Aloevera	الصبار	5.7%	Mg (4), Pu (2), L (2), Fl (1), W (2), Ba (1)	Di (6), Cr (1), Po (1), Dr (1), EO (3)	Olive oil (2), Argan oil (2)	1t/d (4), 2t/d (6), 3t/d (2), Other (1)	2 We (4), Other (8)	Cu (10)	Yes (4), No (3)	[1]	Yes	Sijelmassi (2011), Bellakhdar (1998)
Amaryllidaceae	Allium cepa	البصلة	0.5%	F (1)	Dr (1)	Honey (1)	1t/d (1)	3 D (1)	Cu (1), Or (1)		[2]	No	El Hafian et al. (2014)
	Pistacialenticus L.	الضرو	0.5%	F (1)	Po (1), EO (1)	-	4 t/d (1)	Other (1)	Cu (1)	Yes (1)	[3]	No	Daoudi et al (2015)
Anacardiaceae	Pistaciaterebinthus L.	ايك البطم	0.5%	F (1)	Po (1)	-	3t/d (1)	2 We (1)	Cu (1)	No (1)	[4]	No	-
	Rhusalbidums chousb.	الزواية	0.5%	Ba (1)	Po (1) Dec (1)	-	2 t/d (1) 3t/d (1)	2 We (1)	Cu (1)	No (1)	[5]	No	-
	Carum carvi L.	الكروية	0.5%	S (1)	Po (1)	-	2t/d(1)	Other(1)	Cu (1) Or (1)	-	[6]	No	-
Apiaceae	Centellaasiatica	القسط الهندي	0.5%	Ba (1), R (1)	Po (2)		1 t/d (1), 2 t/d (1)	Other (2)	Cu (2)	No (1)	[7]	No	-
	Coriandrum sativum	القزبر	0.5%	L (1), R (1) S	Po (1)		3 t/d (1)	1 We (1), 2 We (1)	Cu (1), Or (1)	Yes (1)	[8]	No	-

Table 6. Contd.

Aristolochiaceae	*Aristolochia long.*	برزطم	0.5%	Ro (1), Bo (1)	Po (1)	Honey (1)	1t/d (1)	1 Mo (1), Other (1)	Cu (1)	No	[9]	No	Bellakhdar (1998)
	Arnica L.	الحلحال	0.9%	L (1), Fl (1) W (1)	Po (1), Dec (1), EO (2), Dr (1)	Salt (1)	2 t/d (1), 3 t/d (2)	Other (2)	Cu (2)	Yes (2)	[10]	Yes	-
	Artemisia tridentata	الشيح	5.2%	L (6), Fl (2), W (2), S (2), Ro (1), F (1)	Po (7), Dec (3), Inf (3), EO (5), with honey, Di (1)	Argan oil (2), Honey (2), Grease (1)	1 t/d (3), 2 t/d (7), 3 t/d (4), 4 t/day (1), Other (1)	1 We (2), 2 We (2), Other (7)	Cu (11), Or (1)	Yes (9)	[11]	Yes	Salhi et al. (2010), Fakchich and Elachouri (2014)
	Calendula officinalis	الجمرة	1.9%	Fl (4) L (1)	Po (1) Dec (1) Inf (1) EO (1) Oil (1) Mac (2)		1 t/d (2) 2 t/d (3) 3 t/d (2)	2 We (1) Other (3)	Cu (4) Or (2)	Yes (2) No (2)	[12]	Yes	Sijelmassi (2011), Bellakhdar (1998)
Asteraceae	*Chamaemelu mnobile*	البابونج	0.5%	L (1) R (1)	Po (1)	Oil (1)	1 t/d (1), 2 t/d (1)	Other (1)	Cu (1)	Yes (1)	[13]	No	Tahri et al. (2012)
	Inulaviscosa ait.	مكرمان الترهل	5.2%	L (12)	Po (11), Dec (1), Inf (1), EO (1), Di (2),	Water (1), Resin (1), Argan oil (2), Olive oil (3), Cider vinegar (1,) Propolis (1)	1 t/d (9), 2t/d (3), Other (2)	1 We (1), Other (10)	Cu (11), Or (1)	Yes (9), No (1)	[14]	Yes	Tahri et al. (2012), Salhi et al. (2010)
	Matricaria recutita	البابونج الألماني	3.3%	W (2), Fl (3), F (1), L (1), R (1),	Po (2), Inf (2), EO (5)	Vegetal oil (2)	1t/d (4), 2 t/d (4), 3 t/d (1)	2 We (1), Other (6)	Cu (7), Or (2)	Yes (7)	[15]	No	Sijelmassi (2011), Fakchich et al. (2014), Merzouki et al. (2000)
	Pulicaria arabica	العطازة	0.5%	F (1)	EO (1)	Jojoba oil (1)	1t/d (1)	Other (1)	Cu (1)	Yes (1)	[16]	No	-
	Saussurea coctus	القسط البحري	0.5%	R(1)	Po(1)		1t/d (1)	Other (1)	Cu (1)	No (1)	[17]	No	-
	Tanacetum parthenium	البابونج الكبير	0.5%	L (1) R (1)	Po (1)	Oil (1)	1 t/d (1), 2 t/d (1)	Other (1)	Cu (1)	Yes (1)	[18]	No	-

Table 6. Contd.

Family	Species	Arabic	%	Part	Prep	Adjuvant	Dose	Duration	Cu	Y/N	Ref		Source
Cactaceae	*Opuntia ficus-indica*	الكرموص الهندي	0.5%	F (2) S	EO (1), Other (1)		1t/d (2)	1 We (1), Other (1)	Cu (2)	Yes (1)	[19]	No	Fakchich et al. (2014)
Caryophyllaceae	*Saponaria vaccaria L.*	الصابونية	0.5%	L (1)	Po (1), Mac (1)	Oilve oil (1), Argan oil(1)	1t/d (1)	Other (1)	Cu (1)		[20]	Yes	Bellakhdar (1998)
Cesalpiniaceae	*Cassia absus L.*	حبة البركة	0.5%	F (1)	Po(1) EO (1)		1t/d (1)	Other (1)	Cu (1)	Yes (1)	[21]	No	-
Chenopodiaceae	*Chenopodium L.*	المخينزة	0.5%	L (1)	Di (1), EO (1)		2t/d (1)	Other (1)	Cu (1)	Yes (1)	[22]	No	Bellakhdar (1998)
Fabaceae	*Vicia sativa L.*	عين الأرنب	0.5%	L (1)	Po (1)	Honey (1)	1t/d (1)	Other (1)	Cu (1)	Yes	[23]	No	-
Fagaceae	*Quercus faginea lamk.*	العفصة	1.4%	Nu (2), F (2)	Po (3)		2 t/d (3), 3 t/d (1)	1 We (1), 2 We (1), Other (1)	Cu (3)	No (1)	[24].	No	Fakchich et al. (2014), Merzouki et al. (2000)
Geraniaceae	*Geranium L.*	لمعطرشة	0.9%	W (1), Fl (1)	Po (1), EO (1)	Oil (1)	1 t/d (1), 2t/d(1)	Other (2)	Cu (2)	Yes (2)	[25]	No	Fadil et al. (2014)
Globulariaceae	*Globularia alypum L.*	تسلغا	1.4%	L (2), Fl (1)	Po (3), EO (1)	Almond oil (1), Olive oil (1)	1 t/d (1), 2t/d (3) 3 t/d (1)	1 We (1), 2 We (1), Other (1)	Cu (3)	Yes (2), No (1)	[26]	Yes	-
Hypericaceae	*Hypericum perforatum*	يوفارقون	0.9%	Fl (2), F (1)	Po (2), EO (2)	Honey (1)	1t/d (2), 2 t/d (1)	Other (2)	Cu (2)	Yes (2)	[27]	No	Bammi and Douira (2002)
Iridaceae	*Crocus sativum*	زعفران لحر	1.4%	Sg (2), L (1)	Po (2), Dr (1), Di (1)	Honey (1), Argan oil (1)	1t/d (3)	1 We (2), Other (1)	Cu (3)	No (3)	[28]	No	-
Lamiaceae	*Lavandula angustifolia*	الخزامة	3.3%	L (4), Fl (1), W (3)	Po (4), EO (6), Dec (1)	Honey (1), Vaselin (1), Butter (1), Argan oil (1), Vegetal oil (1), Cider vinegar (1), Lavender water (1)	1 t/d (3), 2t/d (3), 3t/d (2)	1 We (1), 1 Mo (1), Other (5)	Cu (7)	Yes (7)	[29]	Yes	Sijelmassi (2011), Tahri et al. (2012)

Table 6. Contd.

Marrubium vulgare	مريوت	1.4%	W (2) L (1)	Po (1), Di (1), Dr 1)	Salt (1), Olive oil (1)	1 t/d (1), 2 t/d (1), 3 t/d (1)	2 We (1), Other (2)	Cu (3)	Yes (2)	[30]	Yes	Fakchich et al. (2014), Lahsissene et al. (2009), Daoudi et al. (2015)
Mentha x piperita L.	النعناع	0.9%	L (2)	Inf(1), EO (1), Mac (1), Dr (1)	Vaselin (1), Oil (1),Alcohol (1)	1 t/d (2), 2 t/d (1)	Other (2)	Cu (2), Or (1)	Yes (2)	[31]	No	-
Ocimum basilicum	الحبق	0.9%	L (1), Fl (2)	Po (1), EO (2)	Honey (1)	2 t/d (1), Other (1)	1 Mo (1), Other (1)	Cu (2)	Yes (2)	[32]	No	-
Origanum vulgare	زعيترة	0.5%	L (1)	Inf Dec (1), EO (1)	Castor oil (1)	2 t/d (1)	2 We (1)	Cu (1)	Yes (1)	[33]	No	-
Rosmarinus officinalis	اليازير	4.3%	L (5), Fl (1) F (1), W (3)	Po (3), Inf (2), Dec (2), EO (7)	Honey (2), Vegetal oil (3)	1 t/d (2), 2 t/d (6), 3t/d (2)	Other (5), 1 We (3)	Cu (7), Or (2)	Yes (8)	[34]	Yes	Fakchich et al. (2014), El Amri et al. (2014),Lahsissene et al. (2009), Salhi et al. (2010), Bellakhdar (1998)

and are used by the population of Settat's province (Tahri et al., 2012). Indeed, *S. verbenaca, I. viscosa ait., A. tridentata* and *R. officinalis* are recorded as healing medicinal plants by a survey in the region of Gharb of Morocco (Mechraâ Bel Ksir) (Benkhnigue et al., 2011), whereas it was found that *A. tridentata, I. viscosa, R. officinalis* and *S. verbenaca* have healing properties against wounds, in Kenitra (Salhi et al., 2010).

Families of healing plants

The study has indexed 37 families of which*Lamiaceae*, *Asteraceae*, *Pinaceae* and *Aloaceae* are predominant. In fact, several studies have confirmed the dominant presence of these families. An ethnobotanical survey in Fez (Zeggwagh et al., 2013), at Kenitra (Salhi et al., 2010) and in the region of Haut Atlas Oriental (Belamdini et al., 2014) showed that *Lamiceae*, *Asteraceae* and *Apiaceae* are the most represented. Another one, has demonstrated that *Lamiaceae*, *Fabaceae* and *Apiaceae* are the dominant families at the region of Agadir (El Hafian et al., 2014), Whereas, two other research teams found that *Lamiaceae*, *Asteraceae* and *Liliaceae* are the major families used by the local population of Ifran (Rhafouri et al., 2014) and Essaouira (Mehdioui et al., 2007). Finally, the national study of medicinal plants found that *Asteraceae, Fabaceae* and *Poaceae* are the predominant families in Morocco, which explains

this similar distribution through regions (Bellakhdar, 1998).

Origin of plants and season

The plants were found in most parts of Souss-Massa-Draa, followed by the region of Marrakech-Tensift-Al Haouz and the region of Gharb-Chrarda-Beni Hssen. This distribution can be explained by climate changes, soil and reliefs type from one region to another (Bellakhdar, 1998), and also by the cultural outcome of each region which has its own traditional use of medicinal plants. On the other hand, spring is the season of flowering aromatic plants and it's an ideal bioclimatic period for them, that is why the study

Table 6. Contd.

Family	Scientific name	Arabic	%	Used part	Prep.	Additive	Freq./day	Duration	Cu/Or	Yes/No	Ref	Yes/No	References
	Salvia verbenaca	الخياطة	21.3%	W (37), L (3), R (2), Fl (2), F (3), Ro (1)	Po (44), Inf (2), EO (1)	Olive oil (2), Honey (2), Butter (1), Cider vinegar (2), Alcohol (1), Water (1)	1t/d (19), 2 t/d(13), 3 t/d (8), 5t/d (1), Other (8)	1 We (9,) 2 We (5), Other (32)	Cu (43), Or (12)	Yes (6), No (2)	[35]	No	Fakchich et al. (2014), Lahsissene et al (2009), Merzouki et al. (2000), Daoudi et al. (2015), Belamdini et al. (2014), Bammi and Douira.(2002), Tahri et al. (2012), Salhi et al. (2010), Bellakhdar (1998)
	Thymus vulgaris	الزعتر	1.4%	L (1) W (1)	EO (2), Inf (1)	Vegetal oil (1)	2 t/d (2), 3 t/d (1)	1 We (1), Other (1)	Cu (2), Or (1)	Yes (2)	[36]	Yes	Sijelmassi (2011), Bellakhdar (1998)
Lauraceae	*Laurus nobilisL.*	ورق سيدنا موسى	0.5%	L (1)	Po (1), EO (1)	Argan oil (1)	1 t/d (1), 2 t/d(1)	Other (1)	Cu (1)	Yes (1)	[37]	Yes	-
Liliaceae	*Cinnamomumverum*	القرفة	0.5%	Ba (1)	Po (1), EO (1)	Oil (1)	2t/d (1)	1 We (1)	Cu (1), Or (1)	Yes (1)	[38]	No	-
	Smilax aspera L.	ورق العليق	0.5%	L (1)	Po(1)	Cider vinegar(1) Propolis (1)	1t/d(1)	Other(1)	Cu (1)	Yes(1)	[39]	Yes	-
Lythraceae	*Lawsonia inermis*	لحنا	0.5%	L	Po (1), Dec(1), Inf(1)	Honey (1)	2t/d (1)	2 We (1)	Cu (1)	No (1)	[40]		Fakchich et al. (2014), Semwal et al. (2014), Hseini and Kahouadji (2007), ;Zeggwagh (2013), Lahsissene and Kahouadji (2010), Bellakhdar (1998)
Myristicaceae	*Myristica fragrans*	الوردالمسكي	0.5%	Fl (2), L (1)	EO(2), Po (1)	-	1t/d (2), 2t/d (1)	Other (2)	Cu (2)	Yes (2)	[41]	No	-

found the majority of aromatic plants in spring. Also, the season of harvesting can influence the composition of the plant on several essential metabolites.

Used parts of plant

The high frequency use of the whole plant can be explained by the facility of the manipulation of the plant. In fact, another study showed that people are more likely to pick the whole plant and to use it instead of choosing a specific desired part (Tahri et al., 2012). This can probably explain the high use of the whole plant in this study. The high use of the leaves can be explained by the fact that they are the seat of several reactions (photosynthesis for example) and they contain several metabolites that are primordial for the pharmacological properties of the plant (Salhi et al., 2011). Also, their performances are better compared to other parts of the plant. Indeed, other studies have shown that essential oils yield of leaves of some plants is higher compared to flowers (Bassole et al., 2001).

Table 6. Contd.

Family	Species	Arabic	%	Part	Prep	Additive	Dosage	Period	Cu/Or	Yes/No	Ref	Tox	Other refs
Myrtaceae	*Melaleucatea*	اتاي	1.4%	S (2)	Po (3)	Castor oil (1) Almond oil (1)	1t/d (2), 2t/d (2)	Other (3)	Cu (3)	Yes (1)	[42]	No	-
	Myrtus communis L.	الريحان لحلموس	1.9%	L (2), Fl (1), W (1)	Po (1), EO (3)	Vegetal oil (1), Almond oil (1), Castor oi l(1)	1 t/d (1), 2 t/d (2), 3t/d (1), Other (1)	Other (3), 2 We (1)	Cu (4)	Yes (4)	[43]	No	Sijelmassi (2011), Wahid (2013), Tahri et al. (2010), Bellakhdar (1998)
Papaveraceae	*Papaver rhoeas L.*	بلعمان	0.5%	Fl (1)	Po (1) Di (1)		1t/d (1)	Other (1)	Cu (1)	No (1)	[44]	No	Fakchich et al. (2014)
Pédaliaceae	*Sesamum indicum*	السمسم	0.5%	S (1)	EO (1)		1t/d (1)	Other (1)	Cu (1)	Yes (1)	[45]	No	Zeggwagh et al (2013)
Pinaceae	*Pinus halepensis*	التايدة	9.0%	W (7), R (2), Ba (4), Fl (1)	Po (14), Inf (1)	Olive oil (1), Rancid butter (1), Cider vinegar (1)	1t/d (7), 2 t/d (6), Other (3)	1 We (3), 2 We (1), Other (11)	Cu (14), Or (2)	Yes (1), No (4)	[46]	Yes	Bammi and Douira. (2002)
Plantaginaceae	*Plantago major*	المصاصة	2.8%	W (1), F (1), L (1), Fl (1)	Po (2), Di (1)	-	1 t/d (1), 2 t/d (1), 3 t/d (1)	Other (3)	Cu (3), Or (1)	Yes (1), No (1)	[47]	Yes	Sijelmassi (2011), ElAmri et al. (2014), Bellakhdar (1998)
	Plantago psyllium	زرقطونة	0.9%	W (1)	Po (1)	-	1t/d (1)	Other (1)	Cu (1)	-	[48]	No	Bellakhdar (1998)
Poaceae	*Avena sativa L.*	الخرطال	0.5%	S (1)	Po (1)	Lemon juice (1)	1t/d (1)	Other (1)	Cu (1)	No (1)	[49]	No	-
Rhamnaceae	*Rhamnus alaternus L.*	مليس	0.5%	L (1)	Po (1), EO (1)		1t/d (1)	1 Mo (1)	Cu (1)	Yes (1)	[50]	No	-
Ranunculaceae	*Clematis cirrhosa L.*	ايكودي	0.5%	R (1)	Mac (1)	Milk juice (1)	1t/d (1)	Other (1)	Cu (1)	No (1)	[51]	No	-
Salicaceae	*PopulusL.*	أسفساف	0.5%	L (1)	Po (1)	-	2t/d (1)	2 We (1)	Cu (1)	Yes (1)	[52]	No	-
Sapotaceae	*Argania spinosa*	أركان	0.9%	F (3)	EO (1), Other (2)	-	1t/d (2), Other (1)	1 We (1), Other (2)	Cu (3)	-	[53]	No	Zeggwagh et al. (2013)
Solanaceae	*Capsicum annuum*	التحميرة	0.9%	W(2)	Po (2)	-	1t/d(2)	Other (2)	Cu (2)		[54]	No	

Table 6. Contd.

Family	Species	Name	Freq.	Part used	Form	Excipient	Frequency	Duration	Way	Other	Healing	Ref	Toxicity	Bibliography
Scrophulariaceae	*Veronica aquatica*	الحريكةالملسة	1.9%	W (2) L (1)	Po (2), Inf (3), EO (1), Dr (1)	-	2 t/d(2), 3 t/d (2)	1 We (1), Other (2)	Cu (3), Or (3)	Yes (2), No (1)	[55]	No	-
Urticaceae	*Urtica dioica*	الحريكة	1.4%	W (2), L (2), R (1), Bo (1)	Po (3), Inf (3), Dec (1), EO (1), Mac (1)	Alcohol (1), Cider vinegar (1)	1 t/d (1), 2 t/d (2), 3t/d (2)	1 We (1), Other (3)	Cu (4), Or (3)	Yes (4)	[56]	Yes	-
Verbenaceae	*Verbena officinalis*	بايموت	2.8%	W (3) Ro (1)	Po (4)	-	1 t/d (1), 2 t/d (1), 3 t/d (2), Other (1)	1 We (1), Other (3)	Cu (4)	-	[57]	Yes	Bellakhdar (1998)
Zingiberaceae	*Curcuma longa*	الخرقوم	0.5%	W (1)	Po (1)	Honey (1), Butter (1)	Other (1)	Other (1)	Cu (1)	-	[58]	Yes	-
Zygophyllaceae	*Peganum harmala L.*	الحرمل	0.5%	S (1)	Po (1)	-	2t/d (1)	1 We (1)	Cu (1)	Yes (1)	[59]	No	Fakchich et al. (2014), Bellakhdar (1998)

(Frequency) ; Ba: Barks; Bo: Boughts; Bu: Bulb; Cu: Cutaneous; Cr: Cream; Dec: Decoction; Di: Direct application; Dr: Dressing; D: Day; EO: Essential oils; F: Fruit; Fl: Flowers; Inf: Infusion; L: Leaves; Mac: maceration; Mo:Month; Mu: Mucilage; Nu: Nuts; Po: Powder; Pu: Pulp; Ro: Rods; R: Roots; S: Seeds; W: Whole plant; We: Week. t/d: time/day.
*Other: Depending the pathological field and to the wound.

Form of use

The high use of the plant as a powder form, according to herbalists, can be explained by the facility and the rapidity of the operation, the nature of the herbalist's profession and his experience. But it can also be explained by the effectiveness of this method on the healing of skin wounds. This was confirmed by other regional studies which found that the use of plant in powder form is frequently used by the local population of Essaouira (25%) (Mehdioui et al., 2007), Ifran (22%) (Rhafouri et al., 2014), Kenitra (25.9%) (Salhi et al., 2010), in the region of Zaêr (11.5%), Atlas Oriental (27.92%) (Belamdini and Douira, 2002) (Lahsissene et al., 2010), and in the region of Haut.

The important use of essential oils can be explained by the fact that they contain several essential compounds, and active ingredients responsible for the plant's activities and its effectiveness.

Way of administration

The important frequency of use of dermal way can be explained by the nature of the disease, which is the skin healing, and also because the effectiveness of treatment is direct and more important by dermal way.

Frequency and duration of use

The frequency and the duration of use changes from one herbalist to another because everyone has its personal diagnosis of the pathological field and of the patient's case. However, majority of herbalists recommend using the plant 2 twice a day in the morning and at the night, but they were not able to adjudicate about the treatment duration. They estimate that they have to examine thepatient before giving a diagnosis decision.

Plants association

These plant associations are explained by the fact that the efficiency of the plant increases when it associated with one or more other plants and that the wound healing time decreases. For example, consider *S. verbenaca* which is the main inventoried species. The herbalists interviewed

Table 7. Inventoried properties list of recorded healing plants.

Plant	Properties
Aloe vera	Healing, antidiabetic, anticancer, against burns, against redness, for hair and face care, against kidney problems, against stretch marks and varicose veins
Allium cepa	Healing, against cold
Pistacia lenticus L	Healing, against skin abscesses
Pistacia terebinthus L.	Healing, against abscesses, hair care
Rhusalbidumschousb.	Healing, anti diarrhea and abscesses
Carum carvi L.	Healing
Centella asiatica	Healing
Coriandrum sativum	Healing, antidiuretic, antiseptic, antispasmodic, anti diarrhea, carminative
Aristolochia long.	Healing, against pimples
Arnica L.	Healing, antiseptic, antidiabetic, antiinflammatory
Artemisia tridentata	Healing, hemostatic, anticancer, antiseptic, antidiabetic, antibiotic, draining, wormer, against sinusitis, against cold, digestive, against stomach problems, acne, eczema
Calendula officinalis	Healing, anti-hepatitis, anticancer, antifungal, assists delivery
Chamaemelum nobile	Healing
Inula viscosa ait.	Healing, against stomach ulcers, against burns, against anal fissures
Matricaria recutita	Healing, antipyretic, anti-inflammatory, antispasmodic, antiallergic, soothing, softening, black marks
Pulicaria arabica	Healing
Saussurea coctus	Healing
Tanacetumparthenium	Healing, antispasmodic, antiseptic, antiviral, for breathing and digestive apparatus, calming
Opuntia ficus-indica	Healing, against stretch marks, anti wrinkles
Saponaria vaccaria L.	Healing, against constipation
Cassia absus L.	Healing
Chenopodium L.	Healing, antipyretic, antirheumatic
Vicia sativa L.	Healing. against stomach problems
Quercus faginea lamk.	Healing, anti-haemorrhagic, anti diarrhea, blackening
Geranium L.	Healing
Globularia alypum L.	Healing, antidiabetic, against burns
Hypericum perforatum	Healing
Crocus sativum	Healing, antiseptic, against herpes, against eyes problems
Lavandula angustifolia	Healing, toning, strengthens immunity, antiseptic
Marrubium vulgare	Healing, antirheumatic, against pimples and abscesses
Mentha x piperita L.	Healing, against burns, against stomach problems, against cold, against headaches
Ocimum basilicum	Healing, antiseptic, calming
Origanum vulgare	Healing
Rosmarinus officinalis	Healing, hypertensive, antioxidant, antiseptic, anti-hepatitis, antifungal, Antibiotic, detoxifying, energizing, antioxidant, enhances memory
Salvia verbenaca	Healing, antidiabetic, antispasmodic, against pimples, against stomach problems, against bad cold, against bloating, anti acne
Thymus vulgaris	Healing, antibiotic, antiseptic, strengthens immunity, digestive, hair care
Laurus nobilisL.	Healing, against facial tasks
Cinnamomum verum	Healing, antiseptic, antirheumatic, constipating, against gases
Smilax aspera L.	Healing
Lawsonia inermis	Healing, antimycosic, antidiarrhea, against abscess, hair care
Myristica fragrans	Healing, face care
Melaleuca tea	Healing
Myrtus communis L.	Healing, antispasmodic, antiseptic, hair care

Table 7. Cont'd.

|	
Papaver rhoeas L.	Healing.
Sesamum indicum	Healing, anti tasks, against sunlight
Pinushalepensis	Healing, antiseptic, analgesic, against burns, against digestive problems
Plantago major	Healing, antiinflammatory, analgesic, against urinary and digestive problems
Plantago psyllium	Healing, antiseptic.
Avena sativa L.	Healing
Rhamnus alaternus L.	Healing, against black tasks
Clematis cirrhosa L.	Healing, against black tasks
PopulusL.	Healing
Argania spinosa	Healing, against sunburn, face care, anti wrinkles, anti tasks, anti eczema
Capsicum annuum	Healing, antiseptic
Veronica aquatica	Healing, antihemorrhagic, against pimples, anticancer, kidney problems, anemia, diarrhea, remineralizing, against anemia
Urtica dioica	Healing, anti-haemorrhagic, antirheumatic, antidiuretic, against hair loss, against hemorrhoids
Verbena officinalis	Healing, antiinflammatory, activates immune system
Curcuma longa	Healing
Peganum harmala L.	Healing
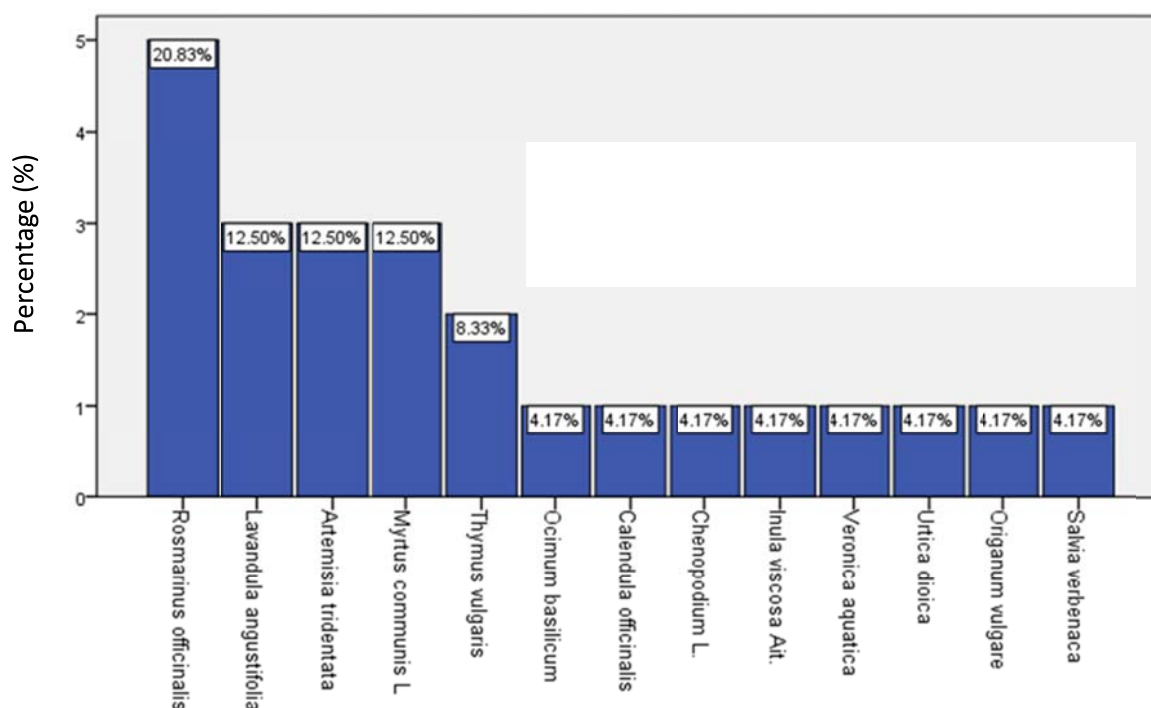
Figure 10. Workforce of healing plants whose leaves are used as essential oils.

said that *S. verbenaca* is used most often when it is associated with other plants, and its efficiency increases exceeding 80% if it is associated with *P. halepensis* or *V. officinalis*. Indeed, this result was confirmed by another ethnobotanical study, which showed that *S. verbenaca* is often associated with these plants (Bellakhdar, 1998).

Crossing between used parts and form of use

From this crossing, the study obtained that $\chi^2_{obs} > \chi^2_{v;\ \alpha}$. Therefore, H_0 is rejected. The study concluded that the used form of the plant depends on the used parts.

Crossing between used parts and use as essential oils

The study found out, through this crossing, the use in the form of essential oils depends on the leaves and on the whole plant but it is independent of the other parts like: flowers, roots, barks, fruit and seeds. The dependence of the use in essential oils to the whole plant confirms the results of the Chi-square test of Table 4. So, the study can conclude from the results, that the use of essential oils depends on part of the plant which is used and more specifically on the leaves. This can be explained by the fact that leaves contain all the essential plant metabolites including essential oils.

Crossing between use form of essential oil with healing plant

The statistical results of the crossing (Table 5) allowed us to conclude that the use of essential oils form actually depends on the healing plant species.

Crossing between use form of essential oil, leaf-part and healing plant

This crossing enabled us to conclude that the use of the leaves as essential oils depends on the nature of the healing plant. Furthermore, the study found that *R. officinalis*, *L. angustifolia*, *A. tridentata*, *M. communis L* and *T. vulgaris* are the plants whose leaves are more often used in the form of essential oils. Based on these results, the study has chosen to use these plants in subsequent experimental studies, as part of of the study research work, to develop and manufacture a phytomedicine.

CONCLUSION

The use of medicinal plants has been in existence for decades; it has been and remains until today requested by the Moroccan population. Furthermore, phytotherapy is a discipline that is changing these days, and people are more likely to go to the natural products to heal and for treatments of wounds.

Indeed, this study was conducted in order to make the most complete inventory of the healing medicinal plants used in Morocco and to gather all the necessary infor-

mation about the therapeutic uses of these plants and their specific properties. Thus, the ethnobotanical survey allowed us to reveal a large number of information. It allowed the identification of 59 species of healing plants belonging to 37 families, whose *S. verbenaca* is the major species. It is presented in this study that among these families, *Lamiaceae* is the most represented family in the surveyed citie

On the pharmacological side, the whole plant is the most used part; powder is the most common used form. There is a relationship between the form of use and the used part of the plant; especially for essential oils use form. It was also discovered that the leaves which are the most commonly used part as essential oils, and that, of course, depends on the nature of the plant. The indexed plants are distributed specifically in the Souss-Massa-Draa region and their distribution varies from one region to another. Plants are more available in spring, they are used most often 2 times per day and the duration of the use varies depending to the wound and the pathological field.

This study is the result of a series of ethnobotanical surveys made with herbalists and traditional healers in the cities of Casablanca, Mohammedia, Rabat, Salé, Kenitra, Fez, Marrakech, Agadir, Taroudant, Tangier, Tetouan and Oujda. Using direct and telephonic interviews, the survey was carried out over a period of five months, and allowed the study to know the healing medicinal plants used by the Moroccan population of the main cities of Morocco. It revealed the wealth of floral and plant heritage and much other relevant information. It is therefore, necessary to expand the field/population of this study to other regions of the Kingdom, to include all the healing medicinal plants traditionally used, and also to safeguard this precious plant heritage.

These conclusive results allowed the study to justify (as preliminary information gathered in the field) the choice of healing plants that will be used in subsequent experimental studies, to manufacture a new wound healing product.

Conflicts of interest

The authors have none to declare.

REFERENCES

Agyarea C, Asase A, Lechtenberg M, Niehues M, Deters A, Hensel A (2009). An ethnopharmacological survey and in vitro confirmation of ethnopharmacological use of medicinal plants used for wound healing in Bosomtwi-Atwima-Kwanwoma area, Ghana. J. Ethnopharmacol, 125:393-403.

Bammi J, Douira A (2002). Les plantes médicinales dans la forêt de l'Achach (Plateau central, Maroc). Acta Botanica Malacitana. 27:131-145.

Bassole IHN, Ouattara AS, Nebie R, Ouattara CAT, Kabore ZI, Traore SA (2001). Composition chimique et activités antibactériennes des huiles essentielles des feuilles et des fleurs de *Cymbopogon proximus* (stapf.) et d'*Ocimum canum* (sims). Pharm. Med. Trad. Afr. 11 : 37-51.

Belamdini N, El Hafian M, Rochdi A, Zidane L (2014). Etude floristique et ethnobotanique de la flore médicinale du Haut Atlas oriental (Haute Moulouya). J. Appl. Biosci. 78:6771-6787.

Bellakhdar J (1998). La Pharmacopée marocaine traditionnelle : Médecine arabe ancienne et savoirs populaires. Mazars Guy Revue d'histoire de la pharmacie 30:86-84.

Benkhnigue O, Zidane L, Fadli M, Elyacoubi H, Rochdi A, Douira A (2010). Etude ethnobotanique des plantes médicinales dans la région de Mechraâ Bel Ksiri (Région du Gharb du Maroc). Acta Botanica Barcinonensia *53*:191-216.

Bousta D, Ennabili A (2011). L'Institut national des plantes médicinales et aromatiques au service du développement de la phytothérapie au Maroc. Phytothérapie 9:297-303.

Daoudi A, Bammou M, Zarkani S, Slimani I, Ibijbijen J, Nassiri L (2015). Etude ethnobotanique de la flore medicinal de la commune rurale d'Aguelmouss province de Khénifra. Phytothérapie 1-9.

El Amri J, El Badaoui K, Zair T, Bouharb H, Chakir S, Alaoui TEM (2014). Ethnobotanical study of medicinal plants in the region El Hajeb (Central Morocco). J. Res. Biol. 4(8):1568-1580.

El Hafian M, Benlamdini N, El Yacoubi H, Zidane L, Rochdi A (2014). Etude floristique et ethnobotanique des plantes médicinales utilisées au niveau de la préfecture d'Agadir-Ida-Outanane (Maroc). J. Appl. Biosci. 81:7198-7213.

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

Fakchich J, Elachouri M (2004). Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. J. Ethnopharmacol. 154:76-87.

Hseini S, Kahouadji A (2007). Etude ethnobotanique de la flore médicinale dans la région de Rabat (Maroc occidental). Lazaroa 28:79-93.

Lahsissene H, Kahouadji A, Tijane M, Hseini S (2009). Catalogue des plantes médicinales utilisées dans la region de Zaër (Maroc occidental). Lejeunia 186-192.

Lahsissene H, Kahouadji A (2010). Usages traditionnels des plantes médicinales dans le Maroc occidental : cas de la région de Zaër. Phytothérapie 8(4):210-217.

Mehdioui R, Kahouadji A (2007). Etude ethnobotanique auprès de la population riveraine de la forêt d'Amsittène: cas de la Commune d'Imi n'Tlit (Province d'Essaouira). Bulletin de l'Institut scientifique, Rabat, section Sciences de la vie. 29 :11-20.

Merzouki A, Derfoufi FEd, Mesa M (2000). Contribution of the knowledge of Rifian traditional mediane: II: Folk medicine in Ksar Lakbir district (NW Morocco). Fitoterap 71:278-307.

Mountassir M (2014). Probabilités et statistique : Cours, Exercices, Etudes de cas et Modules technologiques. Afr. Orient. pp. 357-360.

Rhafouri R, Aafi A, Zair T, Strani B, El Omari M, Ghanmi M, Bentayeb A (2014). Ethnobotanical study of medicinal plants in Ifran's National Park (Morocco). J. Mater. Environ. Sci. 6 (3):619-630.

Salhi S, Fadli M, Zidane L, Douira A (2010). Etudes floristique et ethnobotanique des plantes médicinales de la ville de Kénitra (Maroc). Lazaroa 31:133-143.

Semwal RB, Semwal DK, Combrinck S, Cartwright-Jones C, Viljoen A (2014). *Lawsonia inermis L.* (henna): Ethnobotanical, phytochemical and pharmacological aspects. J. Ethnopharmacol. 155(1):80-103.

Sijelmassi A (2011). Les plantes médicinales au Maroc. Editions le Fennec. Casablanca, Morocco. p 285.

Tahri N, El Basti A, Zidane L, Rochdi A, Douira A (2012). Etude Ethnobotanique Des Plantes Medicinales Dans La Province De Settat (Maroc). Kastamonu Üniversitesi Orman Fakültesi Dergisi. 12(2):192-208.

Wahid N (2013). Perspectives de la valorisation de l'usage et de la culture du Myrtus communis L. au Maroc. Phytothérap 11:237-243.

Zeggwagh AA, Lahlou Y, Bousliman Y (2013). Enquête sur les aspects toxicologiques de la phytothérapie utilisée par un herboriste à Fès, Maroc. Pan Afr. Med. J. 14:125