

Ethnopharmacological study of the mixtures of *Rass El Hanout* and *Lmssakhn* used for therapeutic purposes in the region of Souk Sebt, Morocco

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Abstract

In Morocco, medicinal plants have been used for a long time against diseases. In the great majority of cases, plants are part of a more complex preparation. Traditional herbal mixtures could well yield new clues to the treatment of a wide variety of disease. Several preparations are commercially available with no indication at the species, the quantities, composition or the date of use. The current work focuses on the study of the mixtures of *Rass El Hanout* and *Lmssakhn* used for therapeutic purposes in the region of Souk Sebt, Morocco. Information on the two mixtures was obtained through interviews with inhabitants in the study region. We identified frequencies of use of each mixture. Then, we obtained four samples of each mixture from different vendors. Results showed that the mixtures of *Rass El Hanout* and *Lmssakhn* are used mainly against colds, sexual and reproductive dysfunctions, to treat many digestive disorders and they are used as an aphrodisiac. Plant composition of each mixture differs among vendors and the sampling results show that there is not a standard composition for these mixtures. The total weight of the four samples and the percentage of each plant in each mixture varies among vendors. This article retains a written record of the mixtures *Rass El Hanout* and *Lmssakhn* whose transmission is based on the oral tradition. This work can also be exploited in scientific research in the field of pharmacology, phytochemistry and biochemistry.

Keywords: Ethnopharmacology, medicinal plant mixtures, *Rass El Hanout*, *Lmssakhn*, traditional uses, Morocco.

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1. Introduction

In Morocco, medicinal plants have been used for a long time against diseases. The floristic diversity of this country is a source of many plant species used in herbal medicine. The Moroccan flora has about 6 552 species: 500 species of algae, 820 fungi, 700 lichens, 619 bryophytes, 64 pteridophytes, 17 gymnosperms, 3 832 angiosperms (Fougrach *et al.*, 2007; Fennane and Ibn Tattou, 2012; Ahayoun *et al.*, 2013). The researchers counted more than 600 plants used in herbal medicine in Morocco (Rejdali, 1996; Hmamouchi, 1999; Hmamouchi, 2016). This richness and diversity of medicinal flora is accompanied by the acquisition of important knowledge on the treatment of diseases by plants over millennia. Local people have been able to identify plants that can cure each disease categories. This knowledge has been perfected through experimentation and exchange of information on medicinal plants with other peoples, particularly around the Mediterranean, the Middle East and other African countries. In Morocco several studies have been carried out on plants traditionally used to fight diseases. But the majority of these studies have been conducted on the traditional use of medicinal plants by local populations. However in the great majority of cases, plants are part of a more complex preparation. Although inhabitants use several plant mixtures to treat and prevent many different diseases, studies documenting the use of the plant mixtures are rare.

Since 2012, we started collecting data on herbal medicine in the High Atlas of Morocco. The results of ethnobotanical and ethnopharmacological surveys have been published (El Alami *et al.*, 2016; El Alami 2017a; El Alami 2017b; El Alami and Chait 2017). The current work focuses on the study of the mixtures of *Rass El Hanout* and *Lmssakhn* in the region of Souk Sebt, a Moroccan locality of Fkih Ben Salah province. Information on the main traditional mixtures was obtained through interviews with residents and vendors of medicinal plants in the study region. This study is important because it keeps written records of herbal medicine practices whose transmission is based on the oral tradition. In addition, it can be exploited in the field of pharmacology to search for new drugs.

2. Material and Methods

2.1. Study region

The study was conducted in Souk Sebt region, a Moroccan locality of Fkih Ben Salah province (Fig. 1). Souk Sebt region contains one of the largest traditional markets of Morocco. The name of this city comes from the name of this market. Souk means in Arabic

the traditional market and Sebt means Saturday, which is the day of the weekly market. This region belongs to the plain of Tadla which covers an area of approximately 3 600 km². This plain is crossed by the river of Oued Oum Rbiaâ. The region of Souk Sebt belongs to the zone of Beni Moussa which is located on the left of this river. Beni Moussa is a vast irrigated agricultural area covering an area of 96 500 ha. The study region is characterized by a very cold winter and a hot summer. According to the 2014 general population and housing census, the region has about 60 000 inhabitants. The large fraction of the population comes from the Arabs tribes of Beni Moussa (Arab population), but a considerable number of the inhabitants come from the regions of the central High Atlas Mountains (Amazigh population).

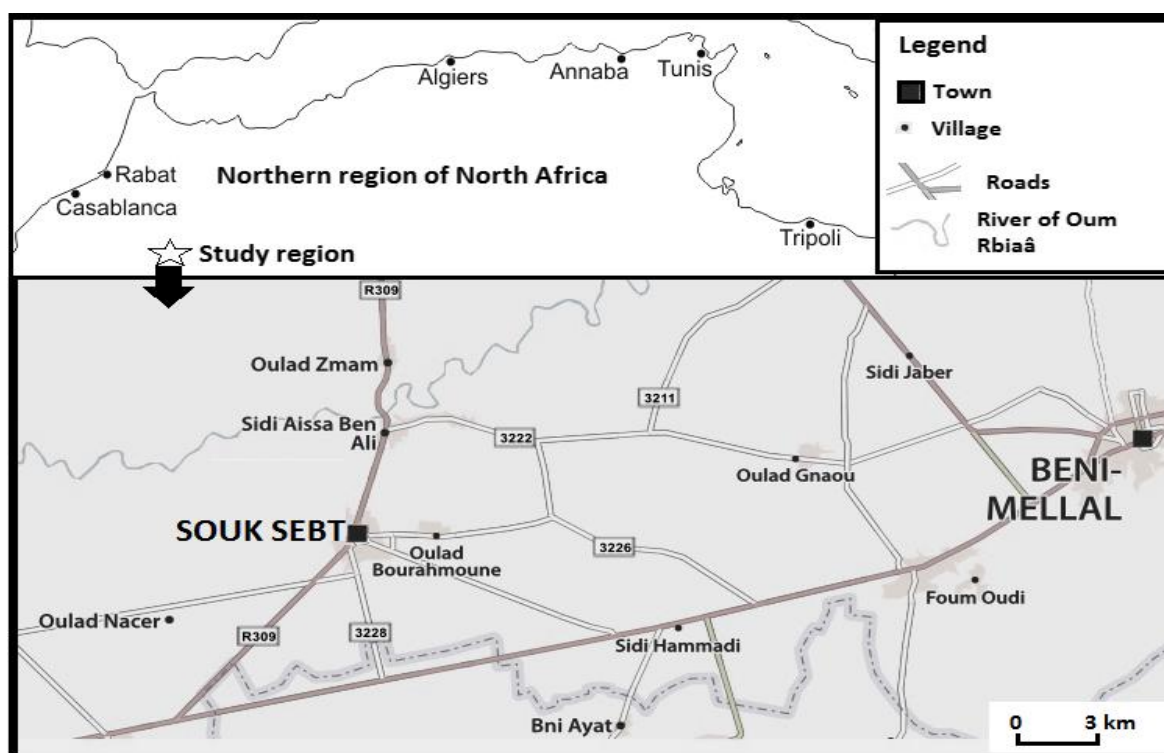


Fig. 1. Map of the study region showing the river of Oued Oum Rbiaâ and the main roads and localities. The rectangle on the inset indicates the location of the study region in the northern region of North Africa.

2.2. Data collection

This study was conducted between February 2014 and December 2018. Preliminary information on the mixtures of *Rass El Hanout* and *Lmssakhn* used for therapeutic purposes was obtained through interviews with 150 inhabitants in the study region. Simple random sampling was carried out in six locations corresponding to the main communes: the city of Souk Sebt and the villages of Oulad Bourahmoune, Sidi Aissa Ben Ali, Oulad Zmam, Sidi

Hammadi and Oulad Nacer (Fig. 1). The interviewees consist of 69 % of women and 31 % of men; 64 % are over 40 years old; and 59 % of the interviewees are illiterate. The number of women is higher than that of men because men are generally reluctant to participate in the interviews. During the interviews, we asked each interviewee if she/he uses the two mixtures. Then, we asked the interviewees about where and how they obtained each mixture, about preparation methods, the therapeutic uses and intoxication cases related to the use of each mixture.

After having identified the main mixtures used in the region of Souk Sebt, we contacted the herbalists and the traditional grocers to obtain these mixtures. We bought each mixture from four different vendors (two herbalists and two traditional grocers). We asked each vendor to give the names of plants constituting each mixture. Then, we separated plants constituting each mixture and noted their local, common and scientific names. The method of determination of the scientific names of plant species was described in our previous publications (El Alami *et al.*, 2016; El Alami and Chait, 2017). Using a digital scale, the weight of each part of plants was determined in each mixture. Data were organized in an Excel table showing local, common and scientific names, used parts and the percentage of plant weight constituting each mixture.

3. Results and Discussion

3.1 Frequencies of use of the mixtures of *Rass El Hanout* and *Lmssakhn* in the study region

Survey results showed that women, especially the older women, have valuable knowledge about traditional mixtures used by inhabitants in the region of Souk Sebt. In this region, the two mixtures were commonly used for therapeutic purposes. Inhabitants get these mixtures from herbalists and traditional grocers, especially in the weekly souk day, which takes place every Saturday. *Lmssakhn* is confused with *Rass El Hanout* by some users, but the majority of inhabitants, traditional grocers and herbalists confirm that they are two different mixtures. The frequencies of use of each mixture are given in figure 1. In the region of Souk Sebt, these mixtures are mainly prepared by women.

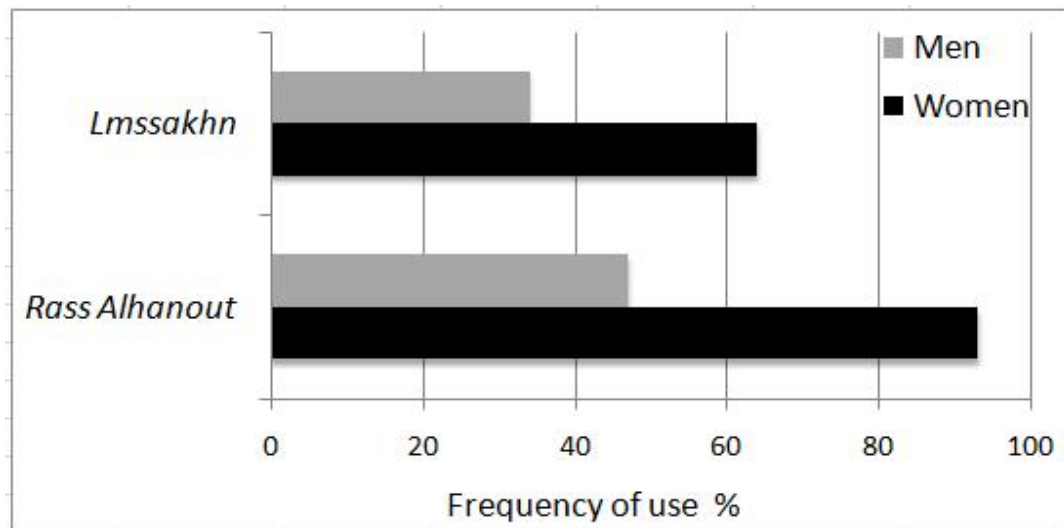


Fig. 2. Frequencies of use of the mixtures of *Rass El Hanout* and *Lmssakhn* in the region of Souk Sebt, Morocco.

3.2. The *Rass El Hanout* mixture

Rass El Hanout in Arabic dialect of Morocco means "head of the shop", and it takes this name from its composition. It contains the most popular spices and medicinal plants used in Moroccan cooking. The mixture of *Rass El Hanout* is widely used for therapeutic and preventive purposes in the Souk Sebt region. Results of interviews showed that this mixture is generally used against colds (82 % of interviewees using this mixture) and to treat many digestive disorders (41 % of interviewees using this mixture). It is also used to treat and prevent several diseases especially in cases when women have just given birth and breastfeeding women (36 % of interviewees using this mixture). In many cases, it is used as an aphrodisiac (24 % of interviewees using this mixture). According to vendors and inhabitants, this mixture is forbidden during pregnancy. In general, the users buy the parts of plants constituting this mixture from herbalists and traditional grocers. The mixture needed to be dried, usually in the shade, sieved and cleaned. Then the mixture is mixed manually using the traditional wooden grinder. But in some cases, inhabitants buy ready-to-use preparations of this mixture. The preparation of *Rass El Hanout* is used as an additive to some Moroccan cooking meals including couscous, traditional soup (*Harira*), lentils, *Rfissa*, *Tride* and *Tagine*. Adults can consume up to six teaspoons in a single meal, while young people consume only a small quantity. In the region of Souk Sebt, *Rass El Hanout* consists essentially of 39 different plants (Table 1). Sampling results are detailed in table 1. The plant composition of this mixture differs among vendors and the sampling results show that there is not a standard composition for this mixture. The mixtures obtained from traditional grocers consist mainly

of 21 plants, whereas the mixtures obtained from herbalists consist mainly of 29 plants (Table 1). In addition, the percentage of each plant in the mixture varies between vendors (Table 1). The total weight of the four samples of this mixture, bought at the same price, varies between vendors. In general, the weights of mixtures obtained from herbalists (134 g and 155 g) are higher than those obtained from traditional grocers (117 g and 118 g).

Rass El Hanout is a well-known mixture in Morocco, Algeria and Tunisia (Audibert, 1997; Meziane, 2003; Atti, 2014; Boukri, 2014; Yezza and Djedai, 2016). Its composition varies between vendors. This mixture can contain up to 50 plants of which about 20 spices are very often selected to prepare this mixture (Barouda and Kherfi, 2015). Comparison with other mixtures of *Rass El Hanout* in the Maghreb shows that in the study region, many medicinal plants as *Laurus nobilis* L., *Punica granatum* L., *Aizoon canariense* L., *Ammodaucus leucotrichus* Coss. and Dur., *Ziziphus lotus* L., *Rosmarinus officinalis* L., *Corrigiola telephiifolia* Pourr. and *Rubia tinctorum* L. are added to the spices usually constituting this mixture. The richness of this mixture in plants is due to the floristic diversity and the richness of the herbal medicine practices in the study region. This study shows that *Rass El Hanout* is generally a spice mixture as it is known among inhabitants of the North Africa, but in the study region, many medicinal plants, growing spontaneously in the mountains of the High and Middle Atlas, are added to the spices constituting this mixture.

The majority of medicinal plants constituting *Rass El Hanout* are used by Moroccans in traditional herbal medicine to treat several categories of diseases (El Alami and Chait, 2017). The majority of these plants have anti-inflammatory, antimicrobial, antioxidant, antiseptic, anticarcinogenic, antiallergic, antiatherogenic, hepatoprotective, cardioprotective, vasodilator and analgesic activities (Barouda and Kherfi, 2015). Although this mixture is used against colds, to treat many digestive disorders and in cases when women have just given birth and breastfeeding women, the constitutive plants of *Rass El Hanout* have innumerable benefits because of the diversity of the secondary metabolites which they contain. Boukri (2014) and Barouda and Kherfi (2015) have shown that the spices constituting this mixture are rich in polyphenols (flavonoids, tannins, coumarins), terpenoids, steroids and many other compounds beneficial to health. The medicinal plants of this mixture include also a very large number of essential oils: anethol, coriandrol, limonene, carvone, cuminaldehyde, eugenol, cinnamic acid, salicylic acid, benzylbenzoate, caryophyllene, geraniol, -pinene, sabinene, terpinene, phellandrene, actinodaphnine, myristicin, citronellol, nigelline, zingiberene, xanthorrhizol,

etc. (Nabih, 1992; Hmamouchi, 1999; IUCN Centre for Mediterranean Cooperation, 2005; Portes, 2008; Talla, 2009; Boukri, 2014; Barouda and Kherfi, 2015).

Table 1: Percentages (%) of the constituent plant parts of four *Rass El Hanout* samples obtained from two herbalists (H1 and H2) and two traditional grocers (TG1 and TG2) in the region of Souk Sebt, Morocco (The weight in gram “g” of each mixture is given in brackets).

Local name	Common name	Scientific name	Used part	H1 (134 g)	H2 (155 g)	TG1 (117 g)	TG2 (118 g)
Lkarwia	Caraway	<i>Carum carvi</i> L.	Seeds	2,98	5,16	11,96	7,62
Skinjbir	Ginger	<i>Zingiber officinale</i> Rosc.	Rhizome	5,22	7,74	6,83	10,17
Nafaâ	Fennel	<i>Foeniculum vulgare</i> Mill.	Seeds	3,73	5,81	5,98	8,47
Zriât alkattane	Flax	<i>Linum usitatissimum</i> L.	Seeds	3,73	5,16	3,42	7,62
Hbat Lhlawa	Anise	<i>Pimpinella anisum</i> L.	Seeds	4,48	1,94	9,40	5,93
Lbzar	Black pepper	<i>Piper nigrum</i> L.	Seeds	3,73	5,16	6,83	5,08
Kharkhoum	Java ginger	<i>Curcuma xanthorrhiza</i> Roxb.	Rhizome	2,98	1,94	11,96	5,08
Lgouza	Nutmeg	<i>Myristica fragrans</i> Houtt.	Nut	4,48	2,58	3,42	4,24
kaâkala	Green Cardamom	<i>Elettaria cardamomum</i> (L.) Maton	Seeds	2,24	4,52	1,71	4,24
Lkamoun	Cumin	<i>Cuminum cyminum</i> L.	Seeds	1,49	2,58	4,27	3,39
Lkarfa	Chinese cassia	<i>Cinnamomum cassia</i> (Nees & T. Nees) J. Presl.	Bark	2,24	1,29	5,13	2,54
Chounia	Chili pepper	<i>Capsicum frutescens</i> L.	Fruits	1,49	0,65	0,85	2,54
Khoudnjal	Lesser Galangal	<i>Alpinia officinarum</i> Hance	Rhizome	2,98	7,74	2,56	1,69
Asayt Sidna Moussa	Bay Laurel	<i>Laurus nobilis</i> L.	Leaves	2,24	5,81	3,42	5,08
Lkazbour	Coriander	<i>Coriandrum sativum</i> L.	Seeds	1,49	3,23	3,42	1,69
Taghassoult	Aizoon	<i>Aizoon canariense</i> L.	Fruits	4,48	1,94	3,42	2,54
Illane	Pearl millet	<i>Pennisetum typhoides</i> (Burm.) Stapf et Hubb.	Seeds	4,48	1,29	1,71	1,69
Lgouza Sahraouia	Maniguette	<i>Aframomum melegueta</i> K. Schum.	Seeds	5,97	2,58	1,71	4,24
Rman	Pomegranate	<i>Punica granatum</i> L.	Flowers	5,22	3,23	6,83	5,08
Lkamoune Soufi	Wooly cumin	<i>Ammodaucus leucotrichus</i> Coss. et Dur.	Fruits	0,75	0,65	0,00	0,85
Zâafran	Saffron crocus	<i>Crocus sativus</i> L.	Stigmas	0,04	0,00	0,04	0,04
Nbag	Jujube	<i>Ziziphus lotus</i> L.	Fruits	2,24	0,00	3,42	5,93
Lhalba	Fenugreek	<i>Trigonella foenum-graecum</i> L.	Seeds	2,98	4,52	0,00	0,00
Lyazir	Rosemary	<i>Rosmarinus officinalis</i> L.	Leaves	2,98	3,87	0,00	0,00
Habrchat	Garden cress	<i>Lepidium sativum</i> L.	Seeds	2,98	1,94	0,85	0,00

Tasrghinte	Corrigiola	<i>Corrigiola telephiifolia</i> Pourr.	Root	3,73	1,94	0,00	0,00
Kharroub	Carob	<i>Ceratonia siliqua</i> L.	Fruits	2,24	2,58	0,00	2,54
Nwiwira	Jamaica Pimenta	<i>Pimenta officinalis</i> (L.) Merr.	Seeds	1,49	2,58	0,00	0,00
Sanouge	Black Seed	<i>Nigella sativa</i> L.	Seeds	1,49	1,94	0,00	0,00
Lfoua	Common Madder	<i>Rubia tinctorum</i> L.	Root	1,49	1,29	0,00	0,00
Lkbbaba	Cubeb	<i>Piper cubeba</i> L.f.	Seeds	1,49	1,94	0,00	1,69
Wdan Alhalouf	Autumn Buttercup	<i>Ranunculus bullatus</i> L.	Root	5,22	0,00	0,00	0,00
Souja	Soybean	<i>Glycine max</i> (L.) Merr.	Seeds	0,00	3,23	0,00	0,00
Kebbar	Caper bush	<i>Capparis spinosa</i> L.	Caper	2,24	0,00	0,00	0,00
Bakbouka	Autumn Crocus	<i>Colchicum autumnale</i> L.	Bulbs	0,00	1,94	0,00	0,00
Zenjlane	Sesame	<i>Sesamum indicum</i> L.	Seeds	1,49	0,00	0,00	0,00
Lsan Attir	Common ash	<i>Fraxinus excelsior</i>	Seeds	0,00	1,29	0,00	0,00
Krounfal	Clove	<i>Eugenia caryophyllata</i> Thumb.	Floral buttons	0,75	0,00	0,85	0,00
Lbadyana	Badiane	<i>Illicium verum</i> Hook. F.	Fruits	0,75	0,00	0,00	0,00
Total	39 plant species			100 %	100 %	100 %	100 %

3.3 The *Lmssakhn* mixture

In the study region, the *Lmssakhn* mixture is generally considered as an aphrodisiac. Its name in Arabic dialect of Morocco comes from its traditional use and its effects on sexual desire and fertility. Results of interviews showed that this mixture is used mainly against male and female infertility and to treat many sexual dysfunctions including disorder and decrease in sexual desire, orgasm, erection and ejaculation disorder (77 % of interviewees using this mixture). But a fraction of user employs it to treat women who have just given birth and lactating women (18 % of interviewees using this mixture). The methods of preparation and use are identical to the *Rass El Hanout* mixture. In the region of Souk Sebt, *Lmssakhn* consists of 22 different plants (Table 2). The sampling results are detailed in table 2. Results show that only 13 plants are included in the mixtures obtained from the four vendors (Table 2), and they also show that each vendor adds one or more plants to this basic composition. The percentage of each plant in the mixture varies among vendors. The weights of the mixtures obtained from the traditional grocers (76 and 94 g) are higher than those bought at the herbalists (52 and 71 g). The sampling results show that with the exception of *Vitex agnus-castus* L., *Euphorbia falcata* L., *Lavandula officinalis* Mill. and *Thymus satureioides*

Coss. Et Ball., all plants that exist in the *Lmssakhn* mixture also exist in the *Rass El Hanout* mixture (Tables 1 and 2). But the percentage of the weight of each plant differs very significantly between the two mixtures. In *Lmssakhn*, the percentages of *Myristica fragrans* Houtt., *Aframomum melegueta* K. Schum., *Coriandrum sativum* L., *Cinnamomum cassia* (Nees & T. Nees) J. Presl., *Alpinia officinarum* Hance, *Carum carvi* L., *Capparis spinosa* L. and *Curcuma xanthorrhiza* Roxb. are higher than those in *Rass El Hanout*.

Lmssakhn is a mixture containing high quantities of aphrodisiac plants. The majority of these plants are well known in ancient traditions for their ability to improve sexual functions and have been used worldwide to treat sexual and reproductive disorders (Talla, 2009). The plant constituting this mixture contains various aphrodisiac compounds. They also have high nutritional values, and they contain alkaloids, essential oils, tannins, flavonoids, coumarins, carotenoids, phenolic compounds, saponins, lactones, anthraquinones, franic compounds, quinones, in addition to other compounds (Nabih, 1992; Hmamouchi, 1999; Talla, 2009; Mohammedi, 2013; Boukri, 2014; Barouda and Kherfi, 2015). The essential oils potentially present in *Lmssakhn* are diversified, including anethole, limonene, -pinene, coriandrol, foeniculine, carvone, cuminaldehyde, p-cymene, -terpinene, -pinene, limonene, myristicin, cinnamic aldehyde, eugenol, cinnamic acid, salicylic acid, 1,8-cineol, terpenyl acetate, sabinene, terpinene, caryophyllene, phellandrene, actinodaphnine, myrcene, chavicol, -bisabolene, -terpineol, zingiberene, xanthorrhizol, curcumene, geraniol and zingiberol (Hmamouchi, 1999; IUCN Centre for Mediterranean Cooperation, 2005; Portes, 2008 ; Talla, 2009; Boukri, 2014). The extract of certain plants constituting this mixture has positive effects on sexual functions in humans and in experimental animals. For example, extracts of *Aframomum melegueta* K. Schum. stimulate erection, intromission and ejaculation in male rats (Kamtchouing *et al.*, 2002). *Eugenia caryophyllata* Thumb., *Cinnamomum cassia* (Nees & T. Nees) J. Presl. and *Pimenta officinalis* (L.) Merr. are rich in eugenol which has a stimulating effect on the erection in humans (Tajuddin *et al.*, 2004).

Table 2: Percentages (%) of the constituent plant parts of four *Lmssakhn* samples obtained from two herbalists (H1 and H2) and two traditional grocers (TG1 and TG2) in the region of Souk Sebt, Morocco (The weight in gram “g” of each mixture is given in brackets).

Local name	Common name	Scientific name	Used part	H1 (52 g)	H2 (71 g)	TG1 (76 g)	TG2 (94 g)
Skinjbir	Ginger	<i>Zingiber officinale</i> Rosc.	Rhizome	6,56	7,79	13,64	7,84
Lkarfa	Chinese Cassia	<i>Cinnamomum cassia</i> (Nees & T. Nees) J. Presl.	Bark	4,92	10,39	7,95	4,90
Khoudnjâl	Lesser Galangal	<i>Alpinia officinarum</i> Hance	Rhizome	4,92	9,09	15,91	10,78
Sanouge	Black Seed	<i>Nigella sativa</i> L.	Seeds	1,64	5,19	2,27	4,90
Lgouza Sahraouia	Maniguette	<i>Aframomum melegueta</i> K. Schum.	Seeds	6,56	6,49	2,27	6,86
Lkarwia	Caraway	<i>Carum carvi</i> L.	Seeds	3,28	6,49	10,23	11,76
Lgouza	Nutmeg	<i>Myristica fragrans</i> Houtt.	Nut	3,28	6,49	7,95	3,92
kharkhoum	Java ginger	<i>Curcuma xanthorrhiza</i> Roxb.	Rhizome	6,56	9,09	7,95	9,80
Lkazbour	Coriander	<i>Coriandrum sativum</i> L.	Seeds	4,92	7,79	6,82	1,96
Kharwaâ dyaï lma	Chaste tree	<i>Vitex agnus-castus</i> L.	Fruits	11,48	6,49	2,27	5,88
Nwiwira	Jamaica Pimenta	<i>Pimenta officinalis</i> (L.) Merr.	Seeds	3,28	3,90	2,27	4,90
Kebbar	Caper bush	<i>Capparis spinosa</i> L.	Caper	8,20	3,90	6,82	3,92
Lyazir	Rosemary	<i>Rosmarinus officinalis</i> L.	Leaves	1,64	2,60	2,27	0,98
Hayat Noufous	Sickle Spurge	<i>Euphorbia falcata</i> L.	Leaves	6,56	2,60	0,00	2,94
Lfoua	Common Madder	<i>Rubia tinctorum</i> L.	Root	3,28	6,49	0,00	5,88
Habrchat	Garden Cress	<i>Lepidium sativum</i> L.	Seeds	0,00	1,30	2,27	0,98
Krounfal	Clove	<i>Eugenia caryophyllata</i> Thumb.	Floral buttons	0,00	2,60	2,27	2,94
Lbadyana	Badiane	<i>Illicium verum</i> Hook. F.	Fruits	3,28	0,00	0,00	2,94
Lakhzama baldia	Lavender	<i>Lavandula officinalis</i> Mill.	Aerial parts	0,00	1,30	0,00	3,92
Tasrghinte	Corrigiola	<i>Corrigiola telephiifolia</i> Pourr	Root	6,56	0,00	0,00	1,96
Illane	Pearl millet	<i>Pennisetum typhoides</i> (Burm.) Stapf et Hubb.	Seeds	6,56	0,00	4,55	0,00
Zaâtar	Thyme	<i>Thymus satureioides</i> Coss. Et Ball.	Aerial parts	6,56	0,00	2,27	0,00
Total	22 plant species			100 %	100 %	100 %	100

3.4. Toxicity of plants constituting the *Rass El Hanout* and *Lmssakhn* mixtures

The uses of spices have been known since long time, and the interest in the potential of spices is remarkable due to the chemical composition. The species used are parts of plants that due to their properties are used as colorants, flavor, preservatives or medicine. Several bioactive compounds present in the plants constituting the *Rass El Hanout* and *Lmssakhn* mixtures show a wide pharmacological and medicinal property. However, the two mixtures may contain bioactive substances which can cause various disorders and intoxication in overdose. According to vendors and inhabitants, the *Rass El Hanout* and *Lmssakhn* mixtures are forbidden during pregnancy. According to the surveys, no case of toxicity by the mixture of *Rass El Hanout* has been reported. Contrariwise, seven interviewees mentioned that the use of *Lmssakhn* mixture caused various symptoms including tachycardia, insomnia, nausea, headaches, vertigo, diarrhea and abdominal pains. Three among them are brought to the hospital via ambulance to be treated. The results of the surveys show that users consume large quantities of this mixture preparation when treating sexual and reproductive disorders.

Although the mixtures of *Rass El Hanout* and *Lmssakhn* are widely used in Morocco and other countries, data on the toxicity of the plants constituting them are not well known. The *Rass El Hanout* mixture may contain compounds such as carvone, anethole, cyanogenic glycosides, myristicin, safrole, elemicine and nigelline which can cause various disorders and intoxication in overdose (Zekkour, 2008; Hammiche *et al.*, 2013; Boukri, 2014; Yezza and Djedai, 2016). The *Lmssakhn* mixture may contain toxic substances such as colchicine, carvone, anisatin, neoanisatin, anethole, sesquiterpene lactones, cyanogenic glycosides, myristicin, safrole, elemicine and nigelline which in overdose can cause a wide variety of disorders and intoxications (Zekkour, 2008; Hammiche *et al.*, 2013; Boukri, 2014; Yezza and Djedai, 2016; Hmamouchi, 2016). Intoxication may be caused by the consumption of large quantities of the two mixtures or by the ingestion of a preparation which contains high amounts of plants rich in toxic or potentially toxic substances or of plants known for their toxic effects (Table 3). In addition, the poisoning by these mixtures can be caused by ingestion of a preparation infected with pathogens or toxic products.

Table 3: Some toxic or potentially toxic substances and some toxic effects of plant constituting the *Rass El Hanout* and *Lmssakhn* mixtures.

Scientific name	Bioactive substances	Some effects in overdose	References
<i>Aframomum melegueta</i> K. Schum.	Gingerol, shogaols, paradols and related compounds	Liver enlargement	(Llic <i>et al.</i> , 2010)
<i>Aizoon canariense</i> L.	Poisonous alkaloids	Irritations of mucous membranes, cramps and paralysis.	(Kingsbury, 1964)
<i>Cinnamomum cassia</i> (Nees & T. Nees) J. Presl.	Essential oil, tannins, mucilage, coumarin	Convulsions	(Talla, 2009)
<i>Colchicum autumnale</i> L.	Tropolonic alkaloids and colchicine	Digestive disorders, extracellular dehydration, Cardiac circulatory collapse and respiratory distress	(Hammiche <i>et al.</i> , 2013)
<i>Coriandrum sativum</i> L.	Essential oil, tannins, terpenoids, reducing sugars, alkaloids, phenolics, flavonoids, fatty acids, sterols and glycosides	Sleep-prolonging action without major neurotoxic effect	(Al-Snafi, 2016)
<i>Crocus sativus</i> L.	Safranal and glucoside	Hemorrhage, diarrhea and dizziness	(Talla, 2009)
<i>Eugenia caryophyllata</i> Thumb.	Essential oils with hepatotoxic phenols	Hepatotoxicity	(Desramaux, 2018)
<i>Foeniculum vulgare</i> Mill.	Anethole, aldehyde, ketones and pinene	Convulsions	(Talla, 2009)
<i>Lavandula officinalis</i> Mill.	Ketones	Neurological toxicity and abortion	(Desramaux, 2018)
<i>Myristica fragrans</i> Houtt.	Myristicin, eugenol, safrole, pinene, camphene and camphor	Hepatotoxicity, abortion, psychostimulant and hallucinogenic effects	(Zekkour, 2008; Talla, 2009)
<i>Nigella sativa</i> L.	Nigelline and connigelline	Vomiting and abortion	(Zekkour, 2008)
<i>Pimpinella anisum</i> L.	Anethole, ketones, coumarin and choline	Neurotoxic effects and convulsions	(Talla, 2009)
<i>Rosmarinus officinalis</i> L.	Essential oil, tannins, mucilage, organic acids, sterols and choline	Gastroenteritis and renal toxicity	(Talla, 2009)
<i>Thymus satureioides</i> Coss. Et Ball.	Essential oils with hepatotoxic phenols	Hepatotoxicity	(Desramaux, 2018)
<i>Trigonella foenum-graecum</i> L.	Alkaloid, ketone, aldehyde and steroid	Abortion, Ingestion in pregnancy can cause birth defects	(Zekkour, 2008 ; Kumaravel <i>et</i>

			<i>al.</i> , 2017)
<i>Vitex agnus-castus</i> L.	Casticin, apigenin, vitexin, isovitexin, luteolin, orientin, isoorientin and santin	Nausea, menstrual disorders, headache, gastrointestinal disturbances, weight gain, acne, dizziness, and allergic reactions	(Dugoua <i>et al.</i> , 2008; Ho <i>et al.</i> , 2011)
<i>Zingiber officinale</i> Rosc.	Gingerols, zingibain, bisabolene, oleoresins, starch, essential oil and mucilage	Hypotension and bradycardia	(Awwad and Elkhishin, 2009)

4. Conclusion

The region of Souk Sebt is an ethnically diverse region. The population living in this region consists mainly of the Arab population of Beni Moussa, the Amazigh of the central High Atlas Mountains and of a large number of people from several Moroccan provinces. This is reflected in the diversity of traditional medicinal practices and especially herbal medicine. In this region, the mixtures of *Rass El Hanout* and *Lmssakhn* are frequently used for the treatment and the prevention of several diseases. These mixtures are used mainly against colds and sexual and reproductive dysfunctions. The results of this study show that there is not a standard composition for the two mixtures in the study region. Generally, the plant composition, the weight and the percentage of each plant in mixtures differ among vendors. All the medicinal plants constituting these mixtures are known throughout North Africa for their therapeutic virtues. These plants have innumerable benefits because of the diversity of secondary metabolites they contain. Several bioactive compounds present in the plants constituting the *Rass El Hanout* and *Lmssakhn* mixtures show a wide pharmacological and medicinal property. However, the two mixtures may contain bioactive substances which can cause various disorders and intoxication in overdose. This article retains a written record of the two therapeutic mixtures whose transmission is based on the oral tradition. This will help to keep the local people's knowledge of the traditional medicine practices which is disappearing. This work can also be exploited in scientific research in the field of pharmacology, phytochemistry and biochemistry.

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