Ethnobotanical survey of medicinal plants consumed during holy month of Ramadan in the Chlef region, Algeria

Abdelaziz Merouane, Sara Fellag, Moufida Touaibia and Abdelmalek Beldi

Correspondence

Abdelaziz Merouane[1,2,*] , Sara Fellag[3], Moufida Touaibia[4], Abdelmalek Beldi[4]

[1]Laboratory of Natural Bioressources, Hassiba Benbouali University of Chlef, Algeria.
[2]Faculty of Life and Natural Sciences, Hassiba Benbouali University of Chlef, Algeria, Department of Agricultural Sciences, Faculty of Life and Natural Sciences, Hassiba Benbouali University of Chlef, Algeria.
[3]Department of Pharmacy, Faculty of Medicine, Ahmed Benbella University, Oran, Algeria.
[4]Department of Nutrition Sciences and human Nutrition, Faculty of Life and Natural Sciences, Hassiba Benbouali University of Chlef, Algeria.

[*]Corresponding Author: a.merouane@univ-chlef.dz

Research

Abstract

Background: The fasting month of Ramadan is the fourth pillar of Islam. This religious practice is characterized by a specific style of life, culinary and phytotherapeutic habits in Muslim societies. The aim of this research is to document information about the traditional medicinal knowledge of herbal species used during the holy month of Ramadan in the region of Chlef, north-west Algeria.

Methods: This ethnobotanical survey was conducted during the holy month of Ramadan in 1442 Hijrah, corresponding to 13 April–12 Mai 2021. The information was gathered through semi-structured interviews with 100 fasting Muslim informants ranging in age from 18 to 71 years. The obtained data were analyzed using the following indices: Use Value (UV), Family Use Value (FUV) and Informant Consensus Factor (ICF).

Results: In the current and first Ramadanian ethnobotanical survey, 38 herbal species distributed into 22 families were recorded in the Chlef region, north-west Algeria. *Lamiaceae* was the dominant botanical family explored in phyto-folk medicine, with 8 species. Leaves and aerial parts (22.22% each) represent the main plant parts valorized. Decoction (32.35%) and infusion (27.94%) were the principal preparation methods adopted for making remedies from medicinal herbs. Species supported by Quran verses and prophetic orientation are widely consumed during the month of Ramadan and record UVs indexes superior to 0.5. The highest UV values were assigned to *Phoenix dactylifera* L. (0.98), *Hordeum vulgare* L. (0.92) and *Citrus limon* (L.) Osbeck (0.89). The analyses revealed a high and common ICF among the local population during the month of Ramadan for 14 disease categories due to the religious guidance of informants.

Conclusions: The month of Ramadan is characterized by a rich patrimony of herbal medicine and harmonious knowledge among informants based essentially on religious orientation. Further investigations into possible interactions between the health benefits of fasting and the therapeutic virtues of medicinal herbs are suggested in the future.

Keywords: Ethnomedicine, Iftar, Suhur, Ramadan, Prophetic medicine.

Background

Therapeutic use of medicinal plants is rooted deep in the history of ancient civilizations. Knowledge of various preparations and remedies was transmitted among generations through oral traditions and/or transcribed manuscripts, such as the antique references Sumerian clay tables (4000 BC), Egyptian papyri (1500 BC), Chinese Pun-tsao (2500 BC), De Materia Medica by Dioscorides (Levetin & McMahon 2003), Canon of Medicine by Avicenna, and Sum of simples by Ibn Al-Baytar (d'Hennezel-Whitechurch 2007) that illustrate ancient preparations of medicinal herbs, most of them still in-service. This biocultural diversity became a common humanitarian patrimony and offered evidence for the cultural persistence of communities.

Phytotherapy is regarded as both an art and a science (Hoffmann 2003). As a result, ethnobotanical knowledge of populations varies and is strongly related to their environment, geographical location, climate conditions, culture, and religion (Eddouks *et al.* 2017). On the other hand, the variety of medicinal species, ranging from 35,000 to 70,000 species (Jütte *et al.* 2017), explored since antiquity still results in a great variability of traditional medicines throughout the world.

Religious practices are one of the factors affecting the ethnomedicinal knowledge of societies. Ramadan fasting is one of the practices influencing habitual culinary behavior, implying the adaptation of specific phytotherapeutic habits in Muslim societies, mainly dominated by the consumption of wild edible plants.

The holy month of Ramadan is the ninth month of the Islamic calendar, accounting for 29 or 30 days according to the lunar calendar (Hijri calendar). The fasting of this month represents the fourth pillar of Islam (Islamic faith based on five pillars) and means abstaining absolutely from taking foods and drinks from dawn to sunset (Husain *et al.* 2020) conformably to the holy Quran *"Fasting is prescribed for you as it was prescribed for those before you, that you may become Al-Muttaqun (the pious). (Fasting) for a fixed number of days, but if any of you is ill or on a journey, the same number (should be made up) from other days. And as for those who can fast with difficulty, (i.e., an old man, etc.), they have (a choice either to fast or) to feed a poor person (for every day). But whoever does good of his own accord, it is better for him. And that you fast, it is better for you if only you know."* (Quran 2:183–184 in Khan 1997).

The local community of the Chlef region is conservative with valuable ancestral knowledge regarding folkloric medicine collected from its long history mingled with different Mediterranean civilizations (Arabs, Berbers, Vandals, Greeks, Romans, Spanish, Turks, and French). Herbalism figures as the dominant part of this medicine and is strongly related to meals that characterize the Ramadan days, Iftar at the sunset and Suhur before the dawn. An ethnopharmacological survey of herbal recipes during Ramadan can constitute a promising strategy to find effective treatments and/or prevention for insolvable ailments by modern medicine (Palabaş Uzun & Koca 2020), especially those related to modern lifestyles such as obesity, diabetes and colonic disorders. In addition, documentation of ancestral knowledge through scientific ethnopharmacological research is a practical procedure for the conservation and promotion of plant biodiversity and its valorization (Heywood 2011).

As far as our literature survey could ascertain, there is no data published on the ethnopharmacological investigation during the holy month of Ramadan. This study was undertaken to share information about medicinal plants consumed during the holy month of Ramadan and their associated knowledge in Chlef province, northwest Algeria. This paper seems to be the first data to document an ethnomedicinal survey shaped by religious practice.

Material and Methods

Study area

The research was carried out in Chlef province (Fig.1), which is located in the northwestern part of Algeria between 36° 10′ 0″ N and 1° 20′ 0″ E and has a surface area of 4,791 Km^2. According to the last census (2008), there were 1,002,088 Arab and Berber inhabitants, embracing mainly Islam, and descended principally from two nomadic tribes, namely Zenata and Maghraoua. The Chlef province is limited in the north by the Mediterranean Sea, in the south by the province of Tissemsilt, in the east by Tipaza and Ain-Defla provinces, and in the west by the provinces of Relizane and Mostaganem. This region has a semi-arid climate characterized by an annual average rainfall of 458 mm, temperature and humidity ranges of 9.7°C (January) to 28.5 °C (July-August) and 43(July) to76% (January), respectively.

Ethnobotanical data collection

The ethnobotanical survey was conducted during the holy month of Ramadan 1442 Hijrah (13 April-12 May 2021). Information was obtained through semi-structured interviews using the local Arabic dialect. In total, 100 (75 females and 25 males) informants aged between 18 and 71 years were questioned. Information on culinary and therapeutic uses of plants was recorded after recognizing the species through photos (on mobile) and/or live samples of voucher species. The interview includes socio-demographic details (age, gender, study level) that were recorded and presented in Table 1.

The vouchers were deposited in the herbarium of the Department of Nutrition Sciences and Human Nutrition. The medicinal plants were identified by comparison with voucher specimens deposited in the herbarium of the Oran Museum. The binomial names were confirmed at http://www.theplantlist.org.
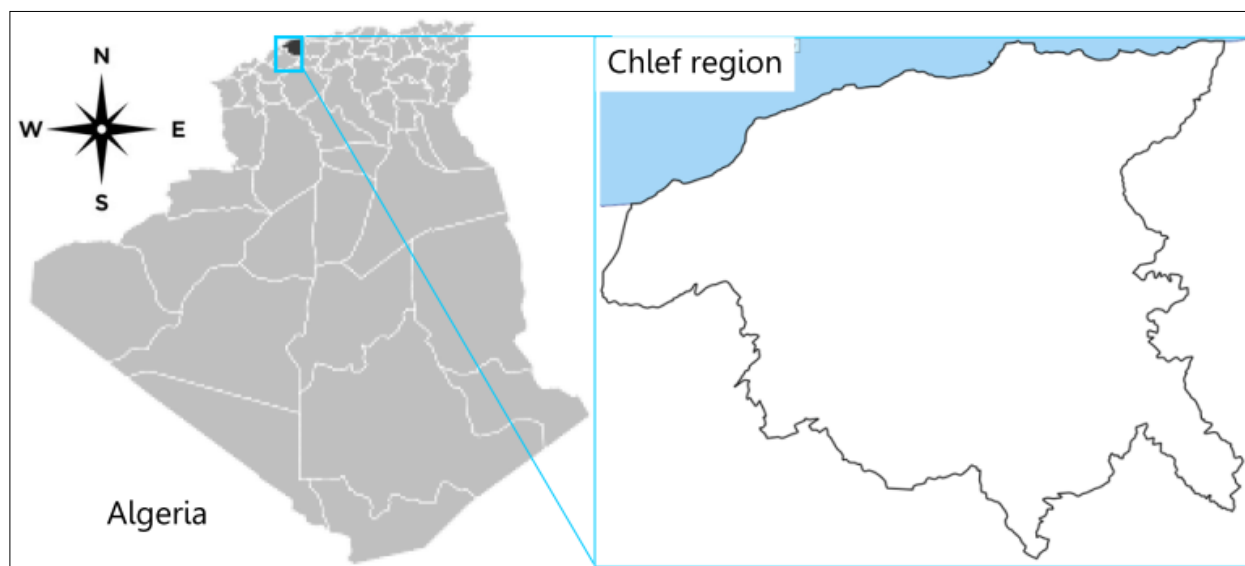

Figure 1. Location of the study area

Data analysis

The medicinal herbs used in the Chlef region during holy Ramadan were listed with the following data: Binomial name, family, local name (Berber and/or Arab), part used, method of preparation, medicinal use, and use value. The survey data was converted into quantitative value indices to better interpret our results.

Use-value (UV)

The UV is a quantitative index that can be used to estimate the relative importance of a medicinal species based on its use by autochthonous population. This index is calculated using the following formula given by Phillips *et al.* (1994):

$$UV = U/N$$

Where U represents the number of all uses mentioned per species, N is the number of informants that used this species.

Family Use-Value (FUV)

The FUV is the average total UV of species members for a given family and demonstrates the relative importance of botanical family. This parameter is calculated using the following formula:

$$FUV = \Sigma UV/n$$

Where ΣUV: represents to the sum of UV for species belonging to the same botanical family, n: is the number of species belonging to the same botanical family.

Informant Consensus Factor (ICF)

The ICF is employed to verify homogeneity in medicinal plants use in ailment categories between informants interviewed. The ICF was calculated using the formula reported by Trotter & Logan (2019):

$$FIC = (Nur - Nt)/(Nur - 1$$

Where, Nur: represents the number of use reports for each ailment category, Nt: is the number of species used as a treatment for a given ailment category by interviewed informants.

ICF values vary in the interval [0–1]; the ailment category with a value close to 0 signifies low homogeneity of informant agreement on medicinal species explored in the treatment of this category, whereas values close to 1 signify high homogeneity between informants interviewed.

Results and Discussion

Socio-demographic details

The informants are the pivotal element in the success of ethnobotanical studies. Their socio-demographic details, such as age, gender, study level, occupation, religion, etc. offer a good look at the survey and help in the interpretation and analysis of furnished data in their real social context (Eddouks *et al.* 2017).

In this study, 100 Muslim faithful informants from Chlef province were interviewed. In Algerian society, women are assiduous in the preparation of different food plates during Ramadan and are more attached to the traditional knowledge and phytotherapy than men. For this reason, women dominate the panelists (75%). Additionally, women are more attached to traditional knowledge than men in the North African community (Jouad 2001) and stay more at home, especially during the holy month of Ramadan (period of the survey) due to the religious and traditional rules. The majority of informants ranges in age between 20 and 30 years (59.14%) and most of them are students (66.6%) (Table 1). This result may be attributed to the reduction of attendance studies in universities during the study year 2020/2021 due to the COVID-19 pandemic which coincided with the period of the survey.

Table 1. Socio-demographic details of the interviewed informants.

Variables	Category	Percentage (%)
Age (years)	< 20	8.60
	[20-30]	59.14
	[31-40]	16.13
	[41-50]	4.30
	[51-60]	6.45
	[61-70]	3.23
	> 71	2.15
Gender	Male	25
	Female	75
Study level	Primary	5.4
	Middle	5.4
	Secondary	22.6
	University	66.6

The inhabitants of the Chlef region are mostly related to folkloric medicine due to the traditions and cultural patrimony of the community, especially during holy Ramadan, when the majority adopts a traditional style of life. Furthermore, the country's socioeconomic conditions, the fragility of the public health system (lack of health infrastructure, weakness of health insurance and pharmaceutical industry), the interruption of imported drugs supplies (including necessary drugs for diabetes, cancer, heart disease, and so on), the low efficacy of local generic drugs, the high cost of medication, and corruption, forced the population to rely on herbal medicine as primary healthcare. In addition, the availability of medicinal plants with immense therapeutic potential compared to Western medicine at a low price supported the use of plant-based remedies.

Medicinal flora of Ramadan

In the current survey, a total of 38 species, distributed into 22 botanical families (Table 2), were reported by the informants as medicinal sources used during the holy month of Ramadan in the Chlef region. *Lamiaceae* and *Apiaceae* were the most represented botanical families, with 8 and 6 species, respectively (Fig. 2).
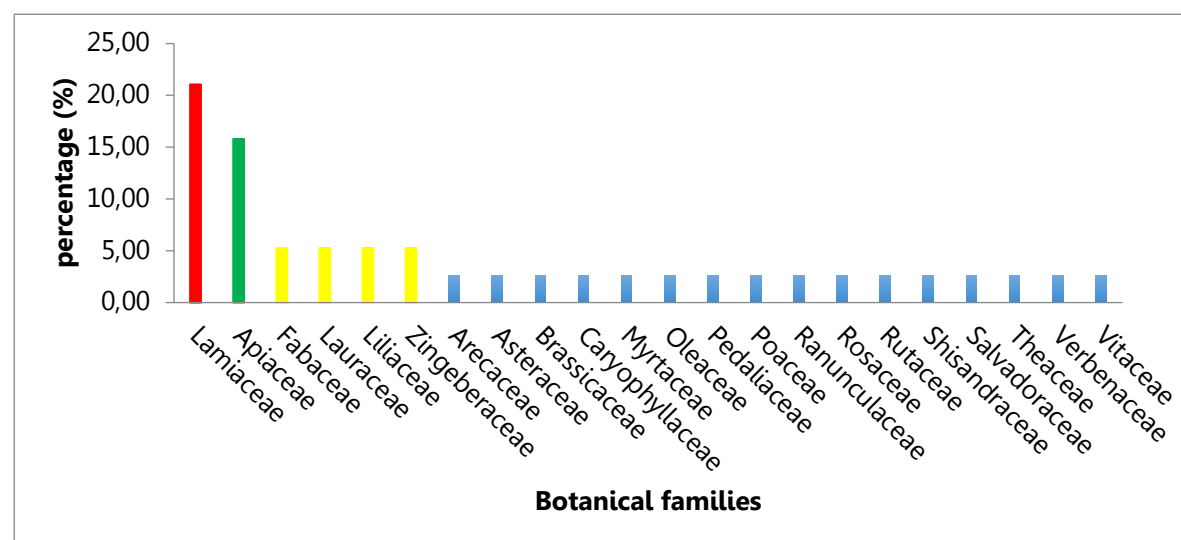

Figure 2. Distribution of cited plants in percent among botanical families.

Table 2. Medicinal species used among the local community of Chlef region during holy Ramadan.

Family	Scientific name	Local name (Arabic/Berber)	Parts used	Method of preparation	Medicinal uses	UV
Apiaceae	*Petroselinum sativum* Hook. & Gillies	Maâdnous	Aerial parts	Raw (in soup)	Appetite stimulation, liver problems, stomachache, hypertension, hyperglycemia	0.67
Apiaceae	*Coriandrum sativum* L.	El-qosber	Aerial parts	Raw (in soup)	Intestinal infections, constipation	0.67
Apiaceae	*Apium graveolens* L.	El-krafs	Seeds, leaves	Raw (in soup)	Urinary inflammation	0.35
Apiaceae	*Cuminum cyminum* L.	El-kemmoun	Seeds	Powder (spice in diverse dishes)	Migraine, stomach gas	0.84
Apiaceae	*Foeniculum vulgare* Mill.	El-besbas	Seeds, Tuber	Decoction, Infusion (seeds)	Gastrointestinal disorders, colic, stomach spasms, gas troubles	0.27
Apiaceae	*Ptychotis verticillata* Duby	Nunkha	Aerial parts, seeds	Decoction, Infusion, Powder	Angina, asthma, kidney stones	0.05
Arecaceae	*Phoenix dactylifera* L.	Tmer	Fruit	Raw, Syrup	Hypoglycemia, sterility treatment, facilitation of childbirth	0.98
Asteraceae	*Matricaria chamomilla* L.	El-babonej	Flowers	Decoction, Infusion	Stress, insomnia, skin diseases, hair lightening, halitosis	0.07
Brassicaceae	*Lepidium sativum* L.	Hab rchad	Seeds	Decoction, Infusion, Powder	Rheumatism, migraine, galactogogue, dandruff	0.05
Caryophyllaceae	*Silene vulgaris* (Moench) Garcke	Tighigheyth	Leaves, stem	Decoction (with omelette)	Inflammation, nervous disorders, sedative, bronchitis	0.01
Fabaceae	*Cassia senna* L.	Sana el-mekki	Leaves	Decoction	Constipation, hemorrhoids, sore tooth, weight loss	0.06
Fabaceae	*Trigonella foenum-graecum* L.	El-halba	Seeds	Decoction, Infusion, Powder	Appetite stimulation, obesity, gastrointestinal disorders	0.13
Lamiaceae	*Origanum vulgare* L.	Ezzaâter	Aerial parts	Infusion, Decoction	Influenza, gynecological disorders, respiratory disorders, ulcer, anemia, halitosis	0.45
Lamiaceae	*Mentha spicata* L.	Ennânaâ	Aerial parts	Infusion, Decoction	Headache, sedative, analgesic, menstruation, cold, halitosis	0.55
Lamiaceae	*Rosmarinus officinalis* L.	Iklil el-jebel / leklil	Leaves	infusion, Decoction (with meat)	Gastrointestinal disorders, inflammation, respiratory disorders, asthma, fever, hypertension	0.16
Lamiaceae	*Mentha pulegium* L.	Fliyo	Aerial parts	Infusion, Decoction (with potatoes)	Influenza, Inflammation, stomachache, cold, halitosis	0.09

Lamiaceae	*Ocimum basilicum* L.	Lehbeq	Aerial parts	Infusion, decoction	Halitosis, abdominal pains	0.07
Lamiaceae	*Thymus vulgaris* L.	Zâitra	Aerial parts	Decoction (with tomato sauce)	Cough, respiratory disorders, obesity, urinary infection	0.08
Lamiaceae	*Calamintha nepeta* (L.) Savi	Ennabta / Tis'hethrine	Aerial parts	Infusion, Steam (saturation of Couscous)	Halitosis, inflammation, relaxation	0.01
Lamiaceae	*Salvia officinalis* L.	El-marimya	Aerial parts	Infusion, Decoction, powder	Gynecological disorders, hypertension, gastrointestinal disorders, skin diseases (canker sore), inflammation	0.11
Lauraceae	*Cinnamomum verum* J.Presl	El-qerfa	Peel	Powder (spice in diverse dishes)	Bloodstream activator, respiratory disorders, antiseptic, vomiting, diarrhea	0.54
Lauraceae	*Laurus nobilis* L.	Waraq el-ghar / Errand	Leaves	Decoction (with meat and vegetables)	Carminative, migraine, urological problems	0.48
Liliaceae	*Allium cepa* L.	Bassal	Leaves, bulb	Raw (in salad), Juice, decoction (with vegetables and meat)	Eye diseases, skin diseases	0.67
Liliaceae	*Allium sativum* L.	Thoum / Icherth	Leaves, bulb	Decoction, Infusion, Powder	Eye diseases, Influenza, hypertension, intestinal parasites, acne	0.65
Myrtaceae	*Syzygium aromaticum* (L.) Merr. & L.M.Perry	El-qronfel	Flower buds	Infusion	Halitosis, tooth diseases, Hair loss	0.23
Oleaceae	*Olea europea* L.	Zaytoun / Azemmour	Fruit, leaves	Oil (for frying and salad), infusion, decoction (olives with vegetables and meat), fermentation (olives in salad)	Skin diseases, cough, hypertension, Abdominal pains, gynecological disorders, trichoschisis	0.59
Pedaliaceae	*Sesamum indicum* L.	El-semsem	Seeds	Oil, powder	Hair loss, skin diseases, galactogogue	0.07
Poaceae	*Hordeum vulgare* L.	Chaâir / Imzin	Fruit	Decoction, powder (bread)	Digestive troubles	0.92
Ranunculaceae	*Nigella sativa* L.	Essanouj	Seeds	Raw (with bread)	Gastrointestinal problems, hyperglycemia, intestinal parasites, hypocholesterolemia, toothache	0.74
Rosaceae	*Prunus domestica* L.	Berqouq	fruit	Raw, decoction (with honey and meat)	Hypoglycemia, digestive problems	0.46
Rutaceae	*Citrus limon* (L.) Osbeck	Leymoun / Lim	fruit	Juice (as beverage and acidifiant for soup), decoction (peel)	Kidney stones, hypertension, obesity, acne, inflammation, liver diseases	0.87
Salvadoraceae	*Salvadora persica* L.	Siwak, Arak	Branch	Chewing young branches	Tooth brushing	0.09

Shisandraceae	*Illicium verum* Hook.f.	El-yansoune	seeds	Infusion	Appetite stimulation, galactogogue, menstruation, asthma, gastrointestinal troubles	0.04
Theaceae	*Camellia sinensis* (L.) Kuntze	Chay / Latay	Leaves	Infusion	Diuretic, obesity	0.44
Verbenaceae	*Verbena officinalis* L.	Louiza / Tisana	Leaves	Infusion	influenza, abdominal pains	0.39
Vitaceae	*Vitis vinifera* L.	Zebib / Izourine	fruit (dehydrated)	Raw, decoction (with honey and meat)	Hypoglycemia, anemia, digestive problems	0.46
Zingeberaceae	*Zingiber officinale* Roscoe	Zenjabil	Rhizome	Powder (spice in diverse dishes), Infusion	Sexual disorders, influenza, cold, obesity, digestive problems	0.24
Zingeberaceae	*Curcuma aromatic* Salisb.	El-kerkem	Rhizome	Powder (spice in diverse dishes)	Digestive troubles, Inflammation, stomachache	0.54

Previous ethnobotanical studies from north Algeria indicated *Lamiaceae* as the family with the most medicinal plants cited (Benarba *et al.* 2015; Boudjelal *et al.* 2013; Chermat & Gharzouli 2015; Meddour & Meddour-Sahar 2015; Miara *et al.* 2013). Based on these reports and the current one, *Lamiaceae* could be considered the most botanical family explored in phyto-folk medicine in north Algeria. Species of this family cited in the current survey (*Origanum vulgare* L.; *Mentha spicata* L.; *Rosmarinus officinalis* L.; *Mentha pulegium* L.; *Ocimum basilicum* L.; *Thymus vulgaris* L.; *Calamintha nepeta* (L.) Savi and *Salvia officinalis* L.) are daily used by the population of the Chlef region during Ramadan as herbal beverages, flavors in different food plates and therapeutic drugs.

Comparison of indices
UV index
The UV is a metric index that shows the valuable medicinal herbs in a given region that merit possible valorization in drug discovery (Sadeghi *et al.* 2014). In the current survey, this index was quite variable and varied between 0.01-0.98. 13 species from the total of 38 recorded a UV superior to 0.5. The top three medicinal species were *Phoenix dactylifera* L. (0.98), *Hordeum vulgare* L. (0.92), and *Citrus limon* L. (0.89) (Table 2). These medicinal species characterize the iftar table of most Algerian families during Ramadan due to the prophetic motivation of their consumption for their wide health benefits. The prophet Muhammed ﷺ (PBUH: peace be upon him) encourages the consumption of date palm fruits (*Phoenix dactylifera* L.) when he says [in SunanTirmidhi]: "*When one of you breaks his fast, let him break it with dates for they are blessed. If they are not found, let him break it with water for it is pure."* and said [in Sahih Muslim: 2048] *"Indeed in dates there is a cure".* The Quran mentioned also that eating dates can help with the pains of pregnancy and facilitate childbirth in Surat Maryam: *"The pains of labour drove her to the trunk of a date-palm. She [Maryam] said, "Oh if only I had died before this time and was something discarded and forgotten!" A voice called out to her from under her, "Do not grieve! Your Lord has placed a small stream at your feet. Shake the trunk of the palm towards you and fresh, ripe dates will drop down onto you. Eat and drink and delight your eyes."* [Quran, 19:23]. This ayah (Quran verse) is the fundamental argument for the traditional use of the *Phoenix dactylifera* L. fruit for childbirth facilitation.

The date palm (*Phoenix dactylifera* L.) fruit has been deeply entrenched in the lives of populations and tribes of the Middle East and North African (MENA) region as food and medicinal material. In Iraqi Kurdistan, the dates are entered as ingredients in various therapeutic mixtures described traditionally for the treatment of cervical inflammation and other ailments (Mati & de Boer 2011). In Saudi Arabia, it is prepared in hot milk or honey to increase women's fertility and as a cure for digestive disorders (Alqethami *et al.* 2017).

Barley, reported as the second important UV, is viewed to be nutritious and beneficial for digestive troubles and the elimination of toxins from the body. In addition, this medicinal source is used in the local preparation of "Mermez" (soup of barley), which is present in the Iftar of all Algerian families during the holy month of Ramadan as the first dish. More than twenty-one hadiths (prophetic sayings) recommend the consumption of barley preparations such as "Satto" (powdered barley) and "Talbina" (Satto, milk, and honey). For instance, the prophet Muhammed (ﷺ) stated [in Sahih Bukhari: 593]: *"At-talbina gives rest to the heart of the patient and makes it active and relieves some of his sorrow and grief"* (Hwaa 2021). This medicinal cereal is used traditionally in MENA countries. It is reported for urological and digestive troubles in Saudi Arabia (Alqethami *et al.* 2017), for the treatment of diabetes and gout (UV=0.14) in Iran (Sadat-Hosseini *et al.* 2017), and for the prevention of various cancer types (colorectal, liver, stomach, uterus, and prostate) in West Algeria (Taïbi *et al.* 2020). Barley is also indicated as a valuable medicinal food (frequency of citation = 0.17) by the Gorani ethnic population in Kosovo (Pieroni *et al.* 2017).

Citrus limon L. was assigned the third most important UV (0.87) in the current survey; this medicinal citrus is widely consumed during Ramadan as a beverage locally known as "Charbat" and acidifier of soups. Lemon juice is widely used by the local population to treat and/or prevent COVID-19, resulting in market scarcity and a price increase for the lemon fruit during the month of Ramadan 1442 corresponding to 2021.

Therapeutic uses of lemon have been commonly known in Arabic civilization since antiquity. The Arabs introduced *C. limon* L. into Spain (second lemon-producer) (Klimek-Szczykutowicz *et al.* 2020), where it has been used traditionally as a treatment for colds, sore throats, stomach pain, and diarrhea (Alarcón *et al.* 2015). In Romania, the essential oil of this citrus plant (administered with sugar) was reported as an efficient treatment for coughs (Papp *et al.* 2011). In India, women use lemon juice for the treatment of menstrual disorders (Bhatia *et al.* 2015). Lemon was traditionally used to treat fevers, sore throats, chest pain, rheumatism, scurvy, and high blood pressure in South African cultures (Balogun & Ashafa 2019). Trinidad traditional medicine targets similar ailments (coughs, fever, common cold, and high blood pressure) as Romania and South Africa, with slight differences in preparation method (Clement *et al.* 2015).

Cuminum cyminum L. (UV = 0.84), is a medicinal spice with a long history of use as a condiment and a traditional drug. It is recommended for diarrhea in Morocco (Eddouks *et al.* 2017), abdominal pains, wounds, and flatulence in Iraqi Kurdistan (Mati & de Boer 2011), and digestive and gynecological disorders in Saudi Arabia (Alqethami *et al.* 2017).

In Algeria, most bread types (baguette, matloue, ftir, mchaouat) consumed during holy Ramadan were decorated with *Nigella sativa* L. (UV=0.74) seeds, also called black seeds. This widespread use can be attributed to its use in prophetic medicine as a herb with tremendous therapeutic properties, as stated by the prophet Muhammed (ﷺ) [in Sahih Bukhari: 5687/5688]: "*Use this black seed regularly, because it has a cure for every disease except death.*". In Turkey, this medicinal plant has a long history of use against asthma, urinary diseases, and flu (Palabaş Uzun & Koca 2020). In Morocco (Eddouks *et al.* 2017) and Iraq (Mati & de Boer 2011), it is used for treating diabetes. Additionally, the black seed is traditionally indicated as a miracle treatment for hypertension, digestive troubles, diarrhea, appetite stimulation, skin diseases, and as an efficient analgesic and antibacterial herb (Ahmad *et al.* 2013).

The above-mentioned species, as well as *Allium cepa* L. (UV = 0.67), *Petroselinum sativum* Hook. & Gillies (UV = 0.67), *Coriandrum sativum* L. (UV = 0.67), *Allium sativum* L. (UV = 0.65) and *Olea europea* L. (UV = 0.59), comprise the top ten group of medicinal herbs used during holy Ramadan in the Chlef region. This plant collection is widely consumed by Algerian families during holy Ramadan for its nutritional and therapeutic qualities, and it is rare to find a home without these therapeutic herbs.

Salvadora persica L. (UV = 0.09) is frequently used by Muslims as a traditional remedy to brush teeth and maintain oral hygiene. Prophet Muhammad (ﷺ) advised using this medicinal herb before and after sleep before prayers and after eating. The Siwak was reported in many hadiths when he said [in Sahih Nassai: 5] *"the Siwak is cleansing to the mouth and pleasing to the Lord"* and [in Sahih Boukhari: 887] *"if it were not that it would be difficult on my nation, then I would have ordered them to use the Siwak for each prayer."* Despite the prophetic encouragement and medicinal features of *Salvadora persica* L. (Farag *et al.* 2021), this medicinal herb didn't receive a great importance among the informants interviewed in the current survey comparatively to the edible plants commonly consumed during the month of Ramadan.

The FUV parameter
The FUV parameter represents the average UV of the species members for a given family and indicates the importance of these members in the traditional medicinal knowledge. However, this index doesn't show any information on the number of species.

In terms of numbers, the seven botanical families *Arecaceae* (0.98), *Poaceae* (0.89), *Rutaceae* (0.68), *Ranunculaceae* (0.74), *Liliaceae* (0.68), *Oleaceae* (0.59), *Lauraceae* (0.51) recorded the highest FUV index and surpassed 0.5. The FUV of the remaining families ranged from 0.01 (*Caryophyllaceae*) to 0.47 (*Apiaceae*). The *Lamiaceae* family was the most represented family in the traditional flora of Ramadan in the Chlef region recorded a FVU=0.19.

The *Arecaceae, Poaceae* and *Ranunculaceae* families, showing the highest FUV, were represented by one medicinal species each: *Phoenix dactylifera, Hordeum vulgare* and *Nigella sativa* respectively. These edible medicinal herbs are consumed daily during the holy Ramadan at the El-Iftar meal for their nutritional and therapeutic purposes. *Phoenix dactylifera* L. is consumed as the first food with or without milk to avoid hypoglycemia after hours of fasting. Scientific investigations classed this bioresource as a palatable source of bioactive compounds with diverse beneficial effects on human health (Ali Haimoud *et al.* 2016). In Ramadan traditions, *Hordeum vulgare* L. is prepared as a soup and combined with *Petroselinum sativum* Hook. & Gillies and *Coriandrum sativum* L. to stimulate appetite and treat digestive troubles, stomachaches, liver diseases, and more health ailments.

The *Liliaceae* family was represented by two edible species (garlic and onion). These species are deep rooted in the traditional folk medicine of humanity, their use remounting to the historical Israeli people and reported in the Quran "*O Moses, we can never endure one [kind of] food. So call upon your Lord to bring forth for us from the earth its green herbs and its cucumbers and its garlic and its lentils and its onions.*" [Quran, 1: 61]. In the Chlef region, garlic is used as an effective remedy against Influenza and hypertension, whereas onion is popularly known as a treatment for skin diseases. These *Liliaceae* members have been widely used throughout the year, including the holy month of Ramadan, and share some ailments targets such as eye diseases (applied as drops on the eye) and were recently introduced into the phytotherapeutic prevention of COVID-19 based on their efficacy against influenza and cold.

Ramadanian floristic patrimony
Plant parts used
The ethnobotanical data collected during the holy Ramadan in the Chlef region showed the use of different plant parts (Fig. 3). The used parts were ranked in the following order: leaves and aerial parts (22.22%) > seeds (20%) > fruits (13.33%) > bulbs (6.67%) > flowers and rhizomes (4.44%) > stems, peels and branches (2.22%). The dominance of leaves and aerial parts in traditional medicine has previously been reported in Algeria (Taïbi *et al.* 2020; Boudjelal *et al.* 2013), Morocco (Eddouks *et al.* 2017), Italy (Ranfa & Bodesmo 2017), Turkey (Palabaş Uzun & Koca 2020) and Iran (Sadat-Hosseini *et al.* 2017). This superiority may be attributed to their richness in bioactive compounds exhibiting diverse therapeutic virtues proved scientifically in a plethora of medicinal plants (Merouane *et al.* 2020; Choukri Beghdad *et al.* 2014).

According to previous ethnobotanical studies, leaves constitute one of the most used plant parts for the preparation of remedies in ethnomedicinal surveys carried out in Indian Himalayas (Bhat *et al.* 2013a; Malik *et al.*

2015), in west Algeria (Taïbi *et al.* 2020), Morocco (Eddouks *et al.* 2017), Saudi Arabia (Alqethami *et al.* 2017), Ethiopia (Woldemariam *et al.* 2021), China (Xing & Li, 2016), and Iran (Sadat-Hosseini *et al.* 2017).
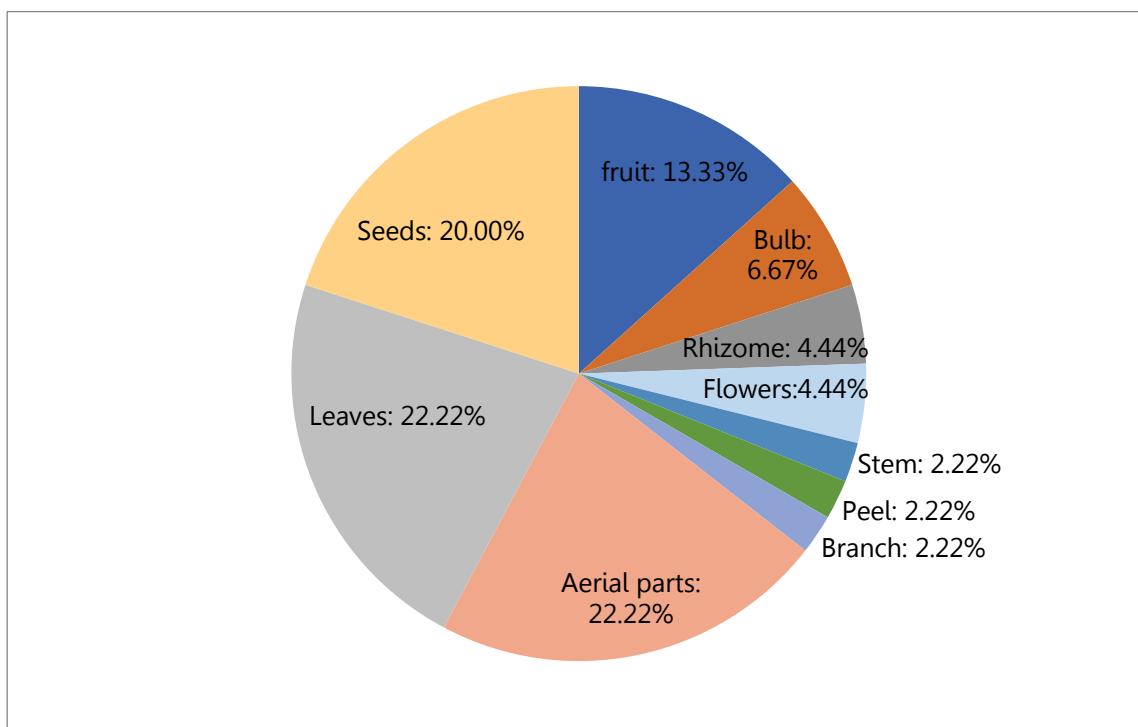

Figure 3. Percentage of plant parts used among local community of Chlef during month of Ramadan.

Mode of preparation
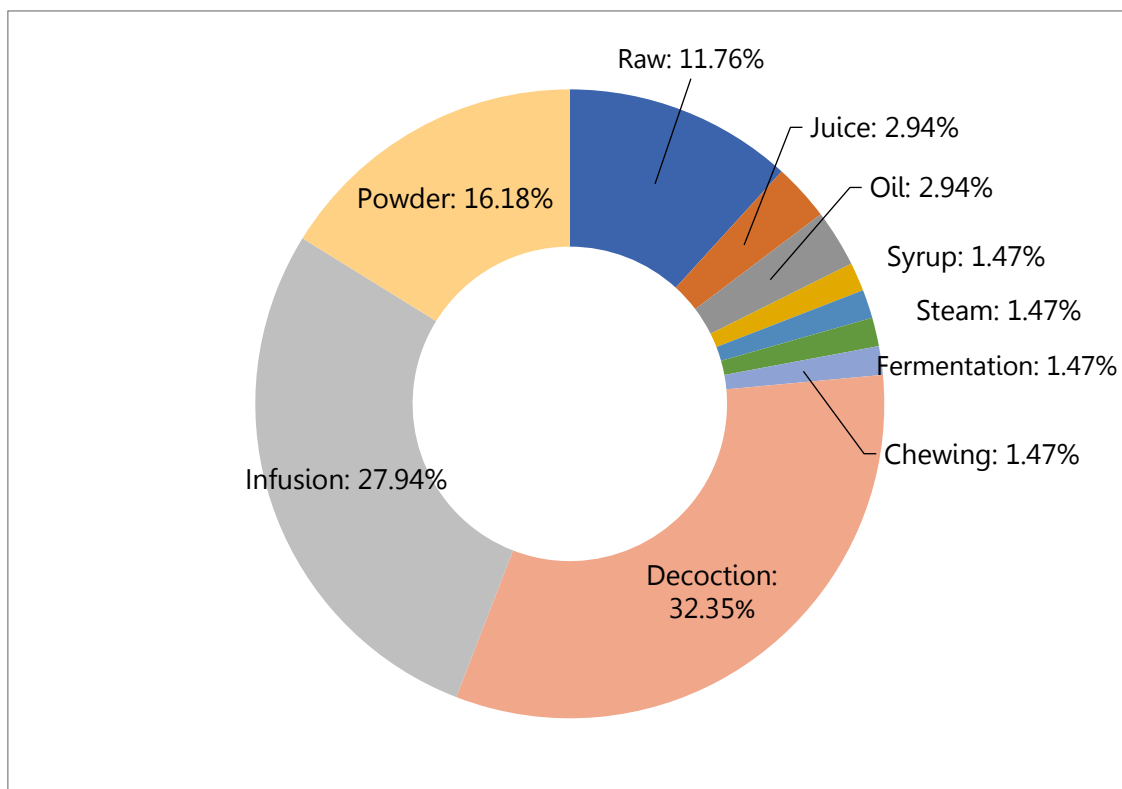Customers of medicinal plants during holy Ramadan reported nine manners of preparation (Fig. 4).

Figure 4. Percentage of preparation methods of medicinal species consumed during month of Ramadan in Chlef region.

The most frequently adopted preparation methods were decoction (32.35%) and infusion (27.94%). These methods are commonly used for the preparation of remedies from medicinal herbs in different MENA countries (Eddouks *et al.* 2017; Alqethami *et al.* 2017; Palabaş Uzun & Koca 2020; Sadat-Hosseini *et al.* 2017). During Ramadan fasting, some medicinal plants are prepared only through decoction and cooked as part of the Iftar meal such as Mermez soup, Tighigheyth dish (*Silene vulgaris* (Moench) Garcke with omelette), and spices added to different dishes. Whereas other medicinal herbs were prepared using both decoction and infusion, especially species consumed as herbal teas such as *Mentha spicata* L*., Mentha pulegium* L*., Calamintha nepeta* (L.) Savi*, Salvia officinalis* L. and *Thymus vulgaris* L. are usually consumed after Iftar at soirees. In addition, other applications are reported in this enquiry including powder, raw material, oil, syrup, fermentation, juice, and steam.

ICF index

In the current survey, 38 medicinal species were documented during the holy month of Ramadan as remedies for 71 ailments classified into 14 categories shown in Table 3. The ICF values obtained range from 0.821 to 1; this result indicates a high and common consensus among the local population during the month of Ramadan on the use of herbs to treat a given category. The consensus is justified by the religious guidance generally based on the Quran verses and Sunnah (prophetic orientation).

Table 3. Informant Consensus Factor (FIC) values for categories ailments.

Ailment Category	Diseases/treatments	Nur[a]	Nt[b]	FIC[c]
Digestive system problems	Stomachache, constipation, stomach gas, gastrointestinal disorders, colic, stomach spasms, gas troubles, ulcer, abdominal pains, vomiting, diarrhea, carminative, digestive troubles, appetite stimulation	484	24	0.952
Respiratory system diseases	Asthma, halitosis, bronchitis, influenza, respiratory disorders, cold, cough	379	18	0.954
Nervous system disorders	Migraine, stress, nervous disorders, sedative, headache, analgesic, relaxation	125	7	0.952
Cardiovascular system problems	Hypertension, angina	121	7	0.950
Urogenital and gynecological disorders	Urological problems, kidney stones, sterility treatment, facilitation of childbirth, gynecological disorders, menstruation, urinary infection, urinary inflammation, diuretic, sexual disorders	247	12	0.955
Endocrine problems	Liver problems, hyperglycemia, hypoglycemia	194	6	0.974
Skin and hair	Skin diseases, hair lightening, dandruff, antiseptic, acne, hair loss, trichoschisis	88	10	0.897
Blood and nutritional problems	Appetite stimulation, anemia, Bloodstream activator, cholesterolemia	104	5	0.961
Microbial infections	Intestinal infections/parasites	81	4	0.963
Symptoms and signs	Inflammation, hemorrhoids, fever	92	10	0.901
Tooth problems	Sore tooth, tooth diseases, toothache, tooth brushing	18	4	0.824
Eye diseases	Eye diseases	31	2	0.967
Musculoskeletal disorders	Rheumatism	2	1	1.000
Others	Galactogogue, weight loss, obesity, insomnia	40	8	0.821

a: Number of use mentions.
b: Number of species.
c: Informant Consensus Factor.

Bhat *et al.* (2013b) while carrying out an ethnomedicinal survey in the Indian Himalayas reported that the inhabitants have a high level of consensus, where the ICF index ranged from 0.85 (general medicines: fever, cough, wounds, antiseptic) to 1.00 (hematological illnesses). In another study conducted in lower belts of Himalayas, Kumar *et al.* (2011) reported a high consensus among inhabitants reaching 1.00 for warts, vomiting, carminative, pain, boils and antiseptic utilizations.

This study showed the influence of religious practices on the traditional medical knowledge of the population, where the informants interviewed are all Muslims and practice Ramadan fasting. In contrast to other months, Ramadan is distinguished by nocturnal application and consumption of medicinal species, as well as a boycott of Haram (forbidden) foods and beverages (tabac, alcohol, dopes) that have a negative impact on human health and are associated with physical activity (specific evening prayer known as Tarawih), which may promote the beneficial therapeutic virtues of medicinal species.

Conclusion
This survey inventoried medicinal plants used for food and/or medicinal purposes during the holy month of Ramadan in the Chlef region, Algeria. This inquiry documented 38 species distributed across 12 botanical families and used to treat 71 ailments. Most of the medicinal plants use is based on the Quran verses and prophetic hadiths (prophetic sayings) citing these herbs or indicating their beneficial effects, as well as traditions related to the mixing of races and civilizations such as Arabs, Berbers, Romans, Vandals, and Africans. The medicinal herbs represent the preferred prevention line to protect organisms and the first trial to treat ailments before visiting healthcare units. The efficiency of medicinal herbs against some diseases is debatable and requires the conduction of clinical trials. Further investigations into possible interactions between the health benefits of fasting and therapeutic virtues of medicinal herbs are suggested in the future.

In conclusion, it is very important to perform a general screening to update the Algerian flora list, including the Sahara region, which was excluded from the last flora done in the 1960s (Quézel & Santa 1963), and to collaborate with local communities to conserve biodiversity and promote indigenous knowledge.

Declarations

Acknowledgements

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