INTRODUCTION

According to the WHO statistics, about 80% of African populations use traditional medicine for their primary health care. In recent years, there has been a remarkable rise of medicinal plant’s use, probably due to their local abundance, cultural significance and inexpensive procurement [1]. An urgent need to develop national pharmacopoeia, monographs of medicinal plants, and national standards and guidelines has been emphasized [2]. It has been reported that of 121 anticancer drugs used today, 90 are derived from plants. In addition, 60% of new drugs introduced between 1981 and 2002 are plants derived [3]. Although, the development of new active natural drugs requires integration of several sciences such as botany, chemistry and pharmacology, recording how a plant is used in folk medicine by an ethnic group is the major common strategy [4]. In addition, ethnobotanical studies play an important role for the conservation and valorization of biological resources [5].

Medicinal plants have been used in Algeria for centuries to treat different ailments. Although Algeria is one of the richest Arab countries with 3164 plant species [6], few ethnobotanical studies have been carried out in the country [7,8]. In South of Algeria, the Sahara, one of the world-largest deserts, local populations still relay on traditional healers for their health care. Thus, the aim of this study was to document and analyze the local knowledge of medicinal plants’ use by traditional healers in South-west Algeria.

MATERIALS AND METHODS

Study Area

Sahara, the world’s largest non-polar desert covers 84% of the total Algerian area (2.381.741 km²). The ethnobotanical survey was conducted in two Saharian regions of South-west of Algeria: Adrar and Bechar. In total, 22 local traditional healers were interviewed using semi-structured questionnaire and open questions. Use value (UV), fidelity level (FL), and informant consensus factor (FIC) were used to analyze the obtained data. Results: Our results showed that 83 medicinal plants species belonging to 38 families are used by traditional healers from South-west of Algeria to treat several ailments. Lamiaceae, Asteraceae, Apiaceae, and Fabaceae were the most dominant families with 13, 8, 6, and 4 species, respectively. Leaves were the plant parts mostly used (36%), followed by seeds (18%), aerial parts (17%) and roots (12%). Furthermore, a decoction was the major mode of preparation (49%), and oral administration was the most preferred (80%). Thymus vulgaris L. (UV = 1.045), Zingiber officinale Roscoe (UV = 0.863), Trigonella foenum-graecum L. (UV=0.590), Rosmarinus officinalis L. (UV = 0.545), and Ruta chalepensis L. (UV = 0.5) were the most frequently species used by local healers. A great informant consensus has been demonstrated for kidney (0.727), cancer (0.687), digestive (0.603), and respiratory diseases. Conclusion: This study revealed rich ethnomedicinal knowledge in South-west Algeria. The reported species with high UV, FL, and FIC could be of great interest for further pharmacological studies.

KEY WORDS: Algeria, ethnobotanical, medicinal plants, phytotherapy, traditional healers, use-value
practicing in the study area, after obtaining their consent. Semi-structured questionnaire and open questions were used to record the use of medicinal plants (vernacular names, ailments treated, parts used, modes of preparation/administration, and ingredients). Local names were given in Arabic and/or in Amazigh or Tergui languages. Botanical identification and authentication were done by Dr. Kada Righi (Department of Agriculture, Faculty of Nature and Life sciences, Mascara University, Algeria). The voucher specimens were prepared and submitted to the LRSBG herbarium (Department of Biology, Faculty of Nature and Life Sciences, Mascara University, Algeria). All the informants were men and their age was 37 ± 11 years.

The ailments reported to be treated using the cited species were grouped into 12 categories [Table 1]. Each citation of a particular part of a particular plant was recorded as one use report. If one informant used a plant to treat more than one disease in the same category, it was considered as a single use-report [11].

Quantitative Analysis

Use-value (UV), fidelity level (FL), and informant consensus factor (FIC) were calculated using the following standard formulas [12]:

Use-value: $UV = \Sigma U/n$

$U$: Number of use reports cited by each informant for a given plant species,

$n$: Total number of informants interviewed for a given plant.

Fidelity level (FL): $FL(\%) = (Np/N)*100$

$Np$: Number of use reports for a given species reported to be used for a particular ailment category,

$N$: Total number of use reports cited for any given species.

Informant Consensus Factor: $FIC = (Nur–Nt)/(Nur–1)$

$Nur$: Number of use citations in each category,

$Nt$: Number of species reported in each category.

RESULTS

Botanical Data, Used Parts, Mode of Preparation, Routes of Administration and Ailments Treated

In this study, 83 medicinal plants species belonging to 38 families [Figure 2] were reported to be used by traditional healers from South-west of Algeria to treat several ailments [Table 2]. In consistence with most of ethnobotanical studies around the world, leaves were the plant parts mostly used (36%) by local healers in South-west of Algeria. In addition, seeds (18%), aerial parts (17%), and roots (12%) were also the most used parts [Figure 3]. We found that a decoction was the major mode of preparation (49%). In addition, different medicinal plants are used as raw (32%), infused (16%), or macerated (3%) [Figure 4]. Oral, topical, inhalation, and nasal routes were the reported ways of administration in the study area. As shown in Figure 5, most herbal remedies in South-west Algeria were...
### Table 1: Ailments grouped by different ailment categories

| Category                          | Ailments/disorders                                                                 | Abbreviation |
|-----------------------------------|-------------------------------------------------------------------------------------|--------------|
| Kidneys diseases                  | Stone, infections                                                                   | KD           |
| Gastro-intestinal diseases        | Hemorrhoids, stomach ulcer, stomach-ache, dysentery, colic, gases, constipation, colitis, parasites, hydatic cyst, liver problems, hepatitis, biliary problems, anemia, diarrhoea, toothache | Gisd         |
| Skin diseases                     | Skin diseases, fungal infections, burns                                              | SD           |
| Cancer                            | Tumors, cancers, metastases                                                         | Can          |
| Endocrine system diseases         | Diabetes, goitre, weight loss                                                       | ESD          |
| Respiratory tract diseases        | Cold, cough, asthma, bronchitis, flu, allergy                                        | RTD          |
| Skeleto-muscular system disorder  | Rheumatism, arthritis, inflammation, body pain                                      | SMD          |
| Cardiovascular system diseases    | Cholesterol, arthritis, inflammation, body pain, heart problems                     | CSD          |
| General health                    | Blood purification, body pain, tonic, psychopathic disorders, systemic healing, systemic problems | Gh           |
| Hair care                         | Hair loss, hair growth                                                              | HC           |
| Nervous system                    | Depression, anxiety, vertigo, migraine, dementia, depression                         | NS           |
| Sexual-reproductive problems      | Menstrual cramps, infertility, sexual impotence, genycological problems              | SRP          |

### Table 2: List of medicinal plants used by traditional healers in South west-Algeria

| Botanical name                      | Part used | Ailment category: N of use reports | Preparation method | Administration | UV  |
|-------------------------------------|-----------|------------------------------------|--------------------|----------------|-----|
| **Acacia gummifera** Willd. Mimosaceae | Roots     | RTSD: 6 (cough, bronchitis)        | Infusion           | Oral           | 0.318 |
| **Ajuga iva** (L.) Schreb. Lamiaceae | Aerial parts | Gisd: 2 (digestive disorders) | Raw | Oral | 0.136 |
| **Amoides pusilla** (Brot.) Breistr. Apiaceae | Fruit | CSD: 1 (hypertension) | Decoction | Oral | 0.227 |
| **Anacyclus pyrethrum** (L.) Lag. Asteraceae/Compositae | Roots | SRP: 2 (female sterility) | Decoction | Oral | 0.136 |
| **Artemisia absinthium** L. Asteraceae | Aerial parts | GISD: 2 (intestines problems) | Raw | Decoction | 0.136 |
| **Artemisia campestris** L. Asteraceae | Aerial parts | RTD: 2 (bronchitis) | Infusion | Oral | 0.139 |
| **Artemisia herba-alba** Asso Asteraceae | Aerial parts | GISD: 7 (stomachache, ulcer) | Decoction | Oral | 0.454 |
| **Atriplex halimus** L. Chenopodiaceae | Seeds | CSD: 2 (hypertension) | Decoction | Oral | 0.454 |
| **Berberis vulgaris** L. Berberidaceae | Roots | CSD: 2 (hypercholesterolemia) | Decoction | Oral | 0.318 |
| **Borago officinalis** L. Boraginaceae | Aerial parts | GISD: 2 (stomachache) | Decoction | Oral | 0.136 |
| **Carex arenaria** L. Cyperaceae | Roots | RTD: 1 (cold) | Infusion | Oral | 0.090 |
| **Carum carvi** L. Apiaceae | Seeds | GISD: 1 (digestive disorders) | Raw | Oral | 0.272 |
| **Cassia angustifolia** VahlFabaceae | Leaves | GISD: 7 (stomachache, constipation, gases) | Infusion | Oral | 0.363 |
| **Cinnamomum camphora** (L.) J.Presl Lauraceae | Leaves | GISD: 2 (hemorrhoids) | Raw | Topical | 0.136 |
| **Cinnamomum cassia** (L.) J.Presl Lauraceae | Bark | RTD: 1 (cough) | Infusion | Oral | 0.136 |

(Contd...)
| Botanical name                          | Part used | Ailment category: N of use reports | Preparation method | Administration | UV  |
|----------------------------------------|-----------|-----------------------------------|--------------------|----------------|-----|
| *Citrullus colocynthis* (L.) Schrad.   | Fruits    | GISD: 1 (haemorrhoids)            | Raw                | Topical        | 0.045 |
| Cucurbitaceae                          |           |                                   |                    |                |     |
| *Cotula cinerea* Delile                    | Whole     | RTD: 1 (pharyngitis)              | Raw                | Oral           | 0.181 |
| Asteraceae                             |           | GH: 1 (systemic healing)          |                    |                |     |
|                                       |           | NS: 3 (migraine)                  |                    |                |     |
| *Cucurbita maxima* Duchesne             | Seeds     | GISD: 1 (stomachache)             | Decoction          | Oral           | 0.045 |
| Cucurbitaceae                          |           | NS: 1 (migraine)                  | Raw                | Vapor          |     |
| *Cuminum cyminum* L. Apiaceae           | Seeds     | GISD: 4 (stomachache, gases,     | Decoction          | Oral           | 0.272 |
|                                       |           | constipation)                     | Raw                |                |     |
|                                       |           | RTD: 1 (kids cough)               | Decoction          |                |     |
|                                       |           | SRP: 1 (menstrual pain)           | Decoction          |                |     |
| *Cupressus sempervirens* L. Cupressaceae| Aerial    | GISD: 2 (bad digestion, intestine| Maceration         | Oral           | 0.090 |
|                                       | parts     | disorders)                        |                    |                |     |
| *Curcuma longa* L. Zingiberaceae        | Rizhomes  | GISD: 1 (liver diseases)          | Decoction          | Oral           | 0.067 |
| *Cyperus esculentus* L. Cyperaceae      | Tuber     | GISD: 1 (kids appetite)           | Raw                | Oral           | 0.045 |
| *Daphne gnidium* L. Thymelaeaceae       | Leaves    | HC: 1 (hair loss)                 | Raw                | Topical        | 0.046 |
| *Eucalyptus globulus* Labill. Myrtaceae | Leaves   | RTD: 3 (flu, cough)               | Vapor              | Inhalation     | 0.136 |
| *Ferula communis* L. Umbelileria/Apicalae | Aerial | SMSD: 1 (fractures)               | Decoction          | Topical        | 0.045 |
| *Foeniculum vulgare* Mill. Umbelileria/Apicalae | Seeds | GISD: 5 (stomachache, colitis, gases) | Infusion | Oral | 0.363 |
| *Fraxinus angustifolia* Vahl Oleaceae    | Leaves    | CSD: 2 (hypertension)             | Raw                |                |     |
|                                       |           | RTD: 1 (cough)                    | Decoction          |                |     |
| *Globularia alypum* L. Globulariaceae   | Leaves    | GF: 1 (appetite)                  | Infusion           | Oral           | 0.181 |
| *Glycyrrhiza glabra* L. Papilionaceae/Fabaceae | Roots | RTD: 10 (laryngitis, bronchitis, cough) | Infusion          | Oral           | 0.500 |
| *Haloxylon salicornicum* (Moq.) Bunge ex Boiss. Chenopodiaceae | Aerial parts | SMSD: 1 (fractures) | Decoction | Topical | 0.045 |
| *Hibiscus sabdariffa* L. Malvaceae      | Aerial parts | GH: 1 (body purification) | Raw | Topical | 0.181 |
| *Hyoscyamus niger* L. Solanaceae        | Leaves    | SD: 1 (eczema)                    | Raw                | Oral           | 0.045 |
| *Juglans regia* L. Juglandaceae         | Fruits    | GISD: 1 (obesity)                 | Infusion           | Oral           | 0.045 |
| *Juniperus phoenicea* L. Cupressaceae   | Leaves    | GISD: 9 (stomach pain, gases)     | Decoction          | Oral           | 0.500 |
| *Laurus nobilis* L. Lauraceae           | Leaves    | CSD: 1 (heart disease)            | Raw                |                |     |
|                                       |           | RTD: 1 (apnoea)                   | Decoction          |                |     |
| *Lavandula latifolia* Medik. Lamiaceae  | Flowers   | CSD: 2 (hypertension)             | Decoction          | Oral           | 0.045 |
|                                       |           | SRP: 3 (female sterility, lactogene) | Raw          | Oral           | 0.272 |
| *Lavandula stoechas* L. Lamiaceae       | Leaves    | RTD: 2 (kids cough)               | Decoction          | Oral           | 0.090 |
| *Lawsonia inermis* L. Lythraceae        | Leaves    | GISD: 1 (gases)                   | Infusion           | Oral           | 0.272 |
| *Lepidium sativum* L. Cruciferace/Brassicaceae | Seeds | ESD: 1 (diabetes) | Infusion | Oral | 0.363 |
|                                       |           | RSD: 2 (bronchitis)               | Raw                | Oral           |     |
|                                       |           | ESD: 1 (diabetes)                 | Raw                | Oral           |     |
|                                       |           | CSD: 1 (hypertension)             | Decoction          | Topical        |     |
| (Contd...)                             |           | SMSD: 1 (rheumatism)              |                    |                |     |
| Botanical name                  | Part used | Ailment category: N of use reports | Preparation method | Administration | UV  |
|-------------------------------|-----------|-----------------------------------|--------------------|---------------|-----|
| *Linum usitatissimum* L. Linaceae | Seeds     | GISD: 3 (digestive disorders)      | Raw                | Oral          | 0.363 |
|                               |           | CSD: 2 (hypertension)              |                    |               |     |
|                               |           | RTD: 2 (allergy)                   |                    |               |     |
|                               |           | ESD: 1 (diabetes)                  |                    |               |     |
| *Lippia citriodora* (Palau) Kunth Verbenaceae | Leaves | GISD: 1 (colitis)                   | Infusion           | Oral          | 0.045 |
|                               |           | CSD: 2 (hypertension)              |                    |               |     |
|                               |           | RTD: 2 (allergy)                   |                    |               |     |
|                               |           | ESD: 1 (diabetes)                  |                    |               |     |
| *Lupinus albus* L. Fabaceae/Leguminoseae | Seeds     | ESD: 4 (diabetes)                  | Raw                | Oral          | 0.181 |
| *Marrubium vulgare* L. Lamiaceae | Aerial parts | SMSD: 1 (arthritis)                 | Decoction          | Topical       | 0.045 |
|                               |           | RTD: 1 (cold)                      |                    |               |     |
| *Matricaria discoidea* DC. Asteraceae/compositae | Aerial parts | RTD: 3 (cough, Flu)                | Infusion           | Oral          | 0.227 |
|                               |           | GISD: 1 (appetite)                 | Decoction          | Oral          |     |
|                               |           | CSD: 1 (cardiac diseases)          |                    |               |     |
| *Myrtus communis* L.Myrtaceae | Seeds     | GISD: 4 (gases, parasites)         | Decoction          | Oral          | 0.227 |
|                               |           | RTD: 1 (flu)                       |                    |               |     |
| *Nerium oleander* L.Apocynaceae | Leaves   | SD: 1 (furuncle)                   | Raw                | Topical       | 0.045 |
| *Nigella sativa* L. Ranunculaceae | Seeds     | RTD: 4 (cough, bronchitis)         | Raw                | Oral          | 0.181 |
|                               |           | GH: 2 (systemic healing)           |                    |               |     |
| *Ocimum basilicum* L. Lamiaceae | Leaves   | RTD: 4 (allergy, cough)            | Decoction          | Oral          | 0.318 |
|                               |           | NS: 2 (sedative)                   |                    |               |     |
|                               |           | ESD: 1 (goitre)                    |                    |               |     |
| *Origanum majorana* L. Lamiaceae | Leaves   | NS: 3 (sedative, migraine)         | Decoction          | Oral          | 0.363 |
|                               |           | RTD: 2 (allergy, cough, flu)       |                    |               |     |
|                               |           | GISD: 2 (obesity)                  |                    |               |     |
| *Ormenis nobilis* (L.) J.Gay ex Coss. & Germ. Asteraceae | Flowers | SD: 3 (wounds)                     | Decoction          | Oral          | 0227 |
| *Parietaria officinalis* L. Urticaceae | Leaves | SMDS: 2 (rheumatism)               | Decoction/ Oral    |               | 0.181 |
| *Peganum harmala* L. Zygophyllaceae | Roots | NS: 2 (dementia, depression)       | Vapor/ Inhalation  |               | 0.136 |
| *Pimpinella anisum* L. Apiaceae | Seeds     | GISD: 1 (parasites)                | Decoction          | Oral          | 0.410 |
|                               | Seeds     | GISD: 4 (gases, colitis)           | Raw                | Oral          |     |
|                               |           | RTD: 3 (kids bronchitis, cough)    | Decoction          | Oral          |     |
|                               |           | CSD: 2 (hypertension)              | Raw                | Oral          |     |
| *Pinus halepensis* Mill. Pinaceae | Leaves | GISD: 2 (stomachache)              | Decoction          | Oral          | 0.093 |
|                               |           | CSD: 1 (hypertension)              | Decoction          | Oral          |     |
|                               |           | RTD: 1 (flu)                       | Raw                | Inhalation    | 0.046 |
| *Pinus martima* Mill. Pinaceae | Leaves | GISD: 5 (stomachache, colitis)     | Raw/ decocction    | Oral          | 0.363 |
| *Pistacia lentiscus* L.Anacardiaceae | Leaves | SD: 2 (skin diseases)              | Raw/ Infusion/ Oral|               | 0.227 |
|                               |           | RTD: 1 (bronchitis)                | Decoction          | Oral          |     |
| *Prunus persica* (L.) Batsch Rosaceae | Leaves | Can: 4 (cancers)                   | Raw/ decocction    | Oral          |     |
| *Quercus infectoria* G.OlivierFagaceae | Aerial parts | GISD: 1 (colon)                    | Decoction          | Oral          | 0.181 |
| *Rhamnus alaternus* L.Rhamnaceae | Leaves | GISD: 3 (hepatitis)                | Maceration/ Topical|               | 0.136 |
| *Rhamnus purshiana* DC. Rhamnaceae | Barks    | RTD: 2 (pharyngitis)               | Decoction/ Oral    |               | 0.093 |
| *Rosa canina* L.Rosaceae | Flowers | RTD: 1 (cough)                     | Decoction          | Oral          | 0.045 |
| *Rosmarinus officinalis* L.Lamiaceae | Leaves | SRP: 5 (menstrual problems)        | Decoction          | Oral          | 0.545 |
|                               |           | CSD: 3 (hypertension)              | Infusion           | Oral          |     |
|                               |           | NS: 2 (memory)                     |                    |               |     |
| *Rubia tinctoria* Salisb.Rubiaceae | Roots   | GISD: 1 (Anaemia)                  | Decoction          | Oral          | 0.045 |

(Contd...)
| Botanical name                  | Part used | Ailment category: N of use reports | Preparation method | Administration | UV  |
|--------------------------------|-----------|------------------------------------|--------------------|----------------|-----|
| *Ruta chalepensis* L. Rutaceae | Leaves    | GISD: 4 (intestine disorders, liver problems) NS: 2 (vertigo) ESD: 2 (diabetes) SMISD: 1 (gout) | Infusion | Oral | 0.409 |
| *Salvia officinalis* L. Lamiaceae | Flowers | GISD: 3 (digestive disorders) SRP: 2 (ovary inflammation, menstrual problems) CSD: 1 (hypertension) | Decoction | Oral | 0.272 |
| *Satureja calamintha* (L.) Scheele Lamiaceae | Leaves | Fev: 1 (fever) | Maceration | Oral | 0.090 |
| *Sesamum indicum* L. Pedaliaceae | Seeds    | GISD: 1 (stomachache) | Decoction | Oral | 0.045 |
| *Stipa tenacissima* L. Poaceae/ Graminaceae | Whole | NS: 1 (memory strength) GID: 1 (weight loss) ESD: 1 (diabetes) | Raw | Oral | 0.045 |
| *Teucrium polium* L. Lamiaceae | Leaves | GID: 1 (gases) SRP: 2 (female sterility) | Decoction | Oral | 0.045 |
| *Thymus vulgaris* L. Lamiaceae | Whole | RTD: 16 (bronchitis, laryngitis, allergy, flu, cough) GID: 4 (colon disorders, diarrhoea) CSD: 2 (hypertension) ESD: 1 (diabetes) | Decoction | Oral | 1.045 |
| *Thypha angustifolia* L. Typhaceae | Seeds | GID: 2 (haemorrhoids) Fev: 1 (fever) | Decoction | Oral | 0.136 |
| *Trigonella foenum-graecum* L. Fabaceae/Leguminoseae | Seeds | GID: 5 (appetite, hepatitis) GH: 4 (tonic) ESD: 2 (diabetes) CSD: 1 (increasing immunity) IS: 1 (increasing immunity) | Raw | Oral | 0.590 |
| *Triticum durum* Desf. Poaceae/ Graminaceae | Seeds | GID: 1 (colon) | Raw | Oral | 0.045 |
| *Triticum repens* L. Poaceae/ Graminaceae | Roots | KD: 3 (diuretic) | Decoction | Oral | 0.318 |
| *Urtica dioica* L. Urticaceae | Aerial parts | RTD: 1 (cough) GID: 3 (weight gain, anemia) CSD: 2 (diabetes) | Decoction | Oral | 0.045 |
| *Viscum album* L. Loranthaceae | Leaves | SRP: 2 (breast milk secretion) SMISD: 2 (fractures) | Raw | Oral | 0.181 |
| *Vitex agnus-castus* L. Lamiaceae | Leaves | SRP: 2 (internal uterine cold) | Raw | Oral | 0.090 |
| *Zingiber officinale* Roscoe Zingiberaceae | Roots | RTD: 9 (cough, flu, allergies) GH: 4 (systemic problems) GID: 2 (digestive disorders, liver diseases) CSD: 2 (cardiac diseases) SRP: 2 (aphrodisiac) | Infusion/ Macceration | Oral | 0.863 |
| *Ziziphus lotus* (L.) Lam. Rhamnaceae | Roots | ESD: 1 (diabetes) | Infusion | Oral | 0.318 |
| *Zygophyllum cornutum* Coss. Zygophylaceae | Leaves | SRP: 1 (infections) GID: 1 (stomachache) ESD: 1 (diabetes) | Decoction | Oral | 0.090 |

KD: Kidney diseases, GISD: Gastrointestinal system diseases, SD: Skin diseases, ESD: Endocrine system diseases, RTD: Respiratory tract diseases, SMISD: Skeleto-muscular system disorders, CSD: Cardiovascular system diseases, GH: General health, HC: Health care, NS: Nervous system, SRP: Sexual-reproductive problems
administered orally (80%). Furthermore, as shown in Table 3, out of the 83 cited plants, 45 species are administered with other ingredients such as other plants (66%) or non-plant-adjuvants (34%) such as olive oil, honey, milk, sugar, yogurt, or eggs. Honey is the adjuvant most added to different herbal remedies in South-west of Algeria (53%). Regarding the treated ailments, 35 species are reported to be used to treat more than one disease. According to our results, gastrointestinal disorders were the most commonly treated ailments with medicinal plants in south-west Algeria (33.6%), they were followed by respiratory diseases (23%) and cardiovascular diseases (9%).

Quantitative Analysis

UV of cited plants ranged from 0.045 to 1.045. The most commonly used species were Thymus vulgaris L. (UV = 1.045), Zingiber officinale Roscoe (UV = 0.865), Trigonella foenum-graecum L. (UV = 0.590), Rosmarinus officinalis L. (UV = 0.545), Ruta chalepensis L. (UV = 0.5), Glycyrrhiza glabra L. (UV = 0.5), A. herba-alba Asso (UV = 0.545), Atriplex halimus L. (UV = 0.545), and Pimpinella anisum L. (UV = 0.41).

The FIC reflects homogeneity of information provided by different informants regarding medicinal species used to treat a category of ailments. High FIC is correlated to species could be efficient in treating particular ailment [13]. Therefore, species with high FIC are to be prioritized for further pharmacological and phytochemical studies. As shown in Table 4, the highest FIC were found for kidney (0.727), cancer (0.687), digestive (0.605) and respiratory diseases (0.627). Four species are used to treat kidney diseases (KD) by local healers in South-west Algeria: Lawsonia inermis L. (topical use of leaves to treat cystitis), Parietaria officinalis L. (decoction of leaves is taken orally to treat kidney stones), Triticum repens L. (decoction of roots is used orally as diuretic) and Ziziphus lotus (L.) Lam. (fruits taken orally).

Cancer is ranked second regarding the FIC, demonstrating that local pharmacopeia could provide species with promising anticancer activities. Six species are used to treat different cancers: Roots of Anacyclus pyrethrum (L.) Lag., T. repens L. and Berberis vulgaris L., the whole Lepidium sativum L., seeds of A. halimus L. and leaves of Prunus persica (L.) Batsch.

To determine the most frequent species used for each ailment category, we calculated the FL. According to our results [Table 5], four species had the highest FL of 100%: Eucalyptus globulus Labill. (leave’s vapor is inhaled for a cough and
Table 3: Ingredients added for the preparation of herbal medicines by the local traditional healers

| Botanical name                | Other plants added in medicinal preparation | Other ingredients added |
|-------------------------------|--------------------------------------------|-------------------------|
| Cuminum cyminum              | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Schrad.                       |                                            |                         |
| Citrullus colocynthis J.Presl | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Ammoides pusilla (Brot.) Breistr. | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Anacyclus pyrethrum (L.) Lag. | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Aristolochia longa L.        | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Berberis vulgaris L.          | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Carex arenaria L.             | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Carum carvi L.                | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Cinnamomum camphora (L.) J.Presl | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Cinnamomum cassia (L.) J.Presl | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Citrus limon (L.) Osbeck      | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Linum usitatissimum L.        | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Prunus persica (L.) Batsch     | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Pimpinella anisum L.          | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Siccardia floribunda Willd.   | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Thymus vulgaris Bunge ex Boiss.| Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |
| Viscum album L.               | Anacyclus pyrethrum (L.) Lag. Glycyrrhiza glabra L. Lepidium sativum L. Nigella sativa L. Vitex agnus-castus L. Zingiber officinale Roscoe | Honey                    |

Table 3: (Continued)

| Botanical name                | Other plants added in medicinal preparation | Other ingredients added |
|-------------------------------|--------------------------------------------|-------------------------|
| Linum usitatissimum L.        | Lawsonia inermis L. Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Lupinus albus L.              | Lawsonia inermis L. Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Marrubium vulgare L.          | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Mentha pulegium L.            | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Nigella sativa L.             | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Origanum majorana L.          | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Parietaria officinalis L.     | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Pimpinella anisum L.          | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Pimpinella anisum L.          | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Pistacia lentiscus L.         | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Prunus persica (L.) Batsch     | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Quercus infectoria G.Olivier  | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Rhamnus alaternus L.          | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Rosa canina L.                | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Rubia tinctoria Salisb.       | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Ruta chalepensis L.           | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Satureja calamintha (L.) Scheele | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Sesamum indicum L.            | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Thymus vulgaris L.            | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Trigonella foenum-graecum L.  | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Viscum album L.               | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Vitex agnus-castus L.         | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |
| Ziziphus lotus (L.) Lam.       | Linum usitatissimum L. Zingiber officinale Roscoe | Honey                    |

(Contd...)
results, seeds of *L. albus* L. are commonly used (as raw) to treat diabetes.

**DISCUSSION**

In this study, we report the use of 85 medicinal species belonging to 38 families. These findings are in line with those we published recently [7]. Local healers in both North-west and South-West of Algeria reflect that ancestral knowledge is very important with regard to the use of medicinal plants as complementary or alternative medicine. Our results showed that the most predominant families were Lamiaceae, Asteraceae, Apiaceae, and Fabaceae. Same results were reported in oriental Morocco, a region sharing with the study area most of climatic, demographic and geographical characteristics [14]. Furthermore, the predominance of Lamiaceae and Asteraceae is well documented in most of the ethnobotanical studies carried out in North African regions such as Algeria [15,16], Morocco [17], or Egypt [18]. Recently, Ramdane et al. [8] found that Lamiaceae followed by Asteraceae were the most predominant families of medicinal species used by the *Touareg* called “blue men of the Sahara” in extreme South of Algeria. Furthermore, leaves were the most frequent used plant parts. Recently, Benderradji et al. [19] demonstrated that in South-east of Algeria, leaves were the most commonly used parts in the treatment of different ailments. The predominance of leaves in herbal therapies may be attributed to their abundance in the region, and their richness in secondary metabolites produced by photosynthesis. On the other hand, a collection of leaves would be much easier and sustainable than that of roots or flowers [20].

According to our results, the decoction was found to be the major mode of preparation of the reported medicinal species. Similar findings were recently reported in South-east of Algeria (region of Ouargla) [21]. Decoction and infusion are highly valued and often preferred by local healers in Africa [22].

### Table 4: FIC for commonly used medicinal plants

| Ailment | Nur | Nt | FIC |
|---------|-----|----|-----|
| KD      | 12  | 4  | 0.727 |
| Cancer  | 17  | 6  | 0.687 |
| RTD     | 87  | 33 | 0.627 |
| GISD    | 127 | 51 | 0.603 |
| SRP     | 24  | 12 | 0.521 |
| SD      | 11  | 6  | 0.5  |
| NS      | 15  | 9  | 0.428 |
| GH      | 20  | 12 | 0.421 |
| HC      | 6   | 4  | 0.4  |
| CSD     | 34  | 21 | 0.393 |
| ESD     | 19  | 13 | 0.333 |
| SMSD    | 6   | 5  | 0.2  |

KD: Kidney diseases, GISD: Gastro-intestinal system diseases, SD: Skin diseases, ESD: Endocrine system diseases, RTD: Respiratory tract diseases, SMSD: Skeleto-muscular system disorders, CSD: Cardiovascular system diseases, GH: General health, HC: Health care, NS: Nervous system, SRP: Sexual-reproductive problems.
formulations. The predominance of oral administration of the different medicinal plants in South-west Algeria is in total agreement with most of the carried out ethnobotanical studies in the country [25,26]. The predominance of oral administration may be explained by a high incidence of internal ailments in the region [5]. On the other hand, it’s thought that oral route is the most acceptable for the patient. 45 species are administered with other plants - (66%) or nonplants-adjuvants. Honey was added in 53% of herbal formulations. Indeed, honey is considered sacred to Muslims and occupies an important place in Islamic medicine [27]. Furthermore, honey is considered as an instant energy source and is often used in Algeria to improve the acceptability of plants having a bitter taste unbearable [7]. In addition, we found that digestive and respiratory diseases were the most commonly treated ailments with medicinal plants. Our results corroborate those reported by Meddour et al. [28] showing that digestive and respiratory diseases were the predominant ailments treated by local populations using medicinal plants of Kabylia (North-west of Algeria). Similar findings were reported in Beni-Souf (Egypt) [29].

Our quantitative analysis showed that T. vulgaris L., Z. officinale Roscoe, T. foenum-graecum L., and R. officinalis L. were the most commonly used species with the highest UVs. T. vulgaris L., Z. officinale Roscoe, and T. foenum-graecum L. were found to be the most used species in North-west Algeria [7]. Our results demonstrate that both North and South regions of West Algeria present high level of similarities regarding the ethnomedicinal knowledge. The two regions share some social and environmental characteristics. Indeed, most of the local healers working in North-west Algeria are from the South-west. Recently, Mikou et al. found that T. vulgaris L., R. officinalis L., and Artemisia herba-alba Asso were the species most commonly used by local populations in Fes (Morocco) [30]. In the current study, the decoction of T. vulgaris L. is reported to be mainly (70%) used in the treatment of respiratory diseases such as bronchitis, laryngitis, allergy, flu, and cough. The plant is considered one of the most important antitussive herbal treatments in North Algeria [31]. The pharmacological properties of the plant have been attributed to a variety of active metabolites such as apigenin, luteolin, p-cymene, borneol, carvacrol, cinmol, linalool, thymol, and triterpenic acids [32].

The high UV of Z. officinale Roscoe was reported in most of the ethnobotanical studies in muslim communities and may be explained by the influence of Islamic traditional medicine since the plant is mentioned in Holy Quran [33].

According to the calculated FIC, cancer is ranked second and is reported to be treated using six species: A. pyrethrum (L.) Lag., T. repens L., Berberis vulgaris L., L. sativum L., A. halimus L., and P. persica (L.) Batsch. Increasing incidence of different cancers in Algeria is well documented [34]. We have recently demonstrated that about 50% of Algerian cancer patients use different medicinal plants to treat and/or manage their illness [25,35].

FL is a useful indicator for identifying the informants’ most preferred species in use for treating different disorders [36]. E. globulus Labill., L. albus L., P. officinalis L., and R. alaternus L. had the highest FL values of 100%. In line with our results, E. globulus Labill. has been reported to possess higher FL for respiratory diseases [37,38]. Furthermore, seeds of L. albus L. are used to treat diabetes.

Indeed, Knecht et al. demonstrated that extracts of the whole seeds resulted in a significant increasing of tolerance to an oral glucose bolus. Furthermore, the extract exhibited a marked antihyperglycemic activity [39]. The antidiabetic effect of the plant may be attributed to the presence of an active protein: Conglutin-γ. The latter has shown in vitro insulin-mimetic effects [40,41].

CONCLUSION

In total, 83 medicinal plants species belonging to 38 families were reported to be used by traditional healers from South-west of Algeria. Our results showed important similarities with findings we previously reported from North-west of Algeria. Plants with high UV could be a promising source of active compounds against several ailments. Similarly, the plants with highest FL were identified and should be further studied regarding their phytochemicals and their biological activities. Furthermore, local healers from South-west Algeria demonstrated high consensus regarding treatment of KD and cancer.

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