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Therapeutic Potential of Traditional Medicinal Plants from the Central Algerian Steppe for Treating Common Digestive Disorders

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ABSTRACT

In the central Algerian steppe, digestive system disorders are a common affliction that the majority of the population treats using medicinal plants. This study aims to evaluate the therapeutic potential of the medicinal plants used for treating four common disorders: colopathy, gastric ulcers, acute diarrhea, and chronic constipation. To achieve this, a survey was conducted using a semi-structured questionnaire, involving a total of 75 traditional phytotherapy practitioners. The questionnaire comprised two sections: socio-demographic information about the practitioners and details regarding the cited plants. Data were collected through field survey forms, categorizing participants by gender, age, education level, and professional experience. Detailed botanical information about the identified plants was carefully collected and analyzed. The diversity of medicinal plants used for digestive disorders was inventoried and assessed using adequate statistics. The survey identified 57 plant species across 32 botanical families, with a predominance of Lamiaceae (9 species) and Asteraceae (7 species). Infusion was the most common preparation method (44%) followed by decoction (38%). These findings emphasize the importance of medicinal plants in traditional treatment of gastric disorders in the region and provide a foundation for future studies on their biological and chemical potentials. The study identified a wide variety of medicinal plants used to treat conditions such as colopathy, gastric ulcers, acute diarrhea, and chronic constipation, with key plants like *Cuminum cyminum*, *Teucrium polium*, *Artemisia campestris*, and *Senna alexandrina* noted for their high efficacy. The use of single plants (8 species) for multiple disorders was observed, reflecting the interconnected nature of these conditions and the broad medicinal properties of the plants. This investigation underscores the extensive traditional knowledge and rich diversity of medicinal plants used in the central Algerian steppe for treating digestive disorders. The findings highlight the importance of these plants and suggest potential areas for further pharmacological research to validate their efficacy and safety.

Keywords: Therapeutic potential, digestive disorders, medicinal plants, central Algerian steppe, traditional medicine.

1. INTRODUCTION

The World Health Organization (WHO) estimates that the use of traditional medicine, particularly those based on medicinal plants, is on the rise, highlighting its critical role as a resource for the pharmaceutical industry. Between 20,000 and 25,000 plant species are utilized in traditional medicine, with over 50% of modern medications deriving from natural sources[1]. This widespread application underscores the essential role of medicinal plants in both traditional healthcare and the development of new

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pharmacological treatments. However, despite the increasing reliance on these plants, there remains a notable deficiency in research data within this field[2].

Due to its geographical position, the central Algerian steppe is noted for its significant floristic richness[3]. The flora of this region includes 170 taxa across 34 families and 111 genera. Dominant families in the region are Asteraceae, Poaceae, Fabaceae, Brassicaceae, and Cistaceae, which together account for approximately 59% of the species. The biogeographic spectrum reveals a predominance of Mediterranean species, with 80 taxa representing 47% of the recorded flora. Additionally, 27 endemic species, constituting 16% of the total, have been identified, with 16 of these being endemic to North Africa[4].

Digestive system disorders are common and have a substantial impact on global morbidity and mortality rates, being fifth leading cause of global mortality[5]. Individuals affected by these conditions are frequently diagnosed with colopathy, gastric ulcers, acute diarrhea, and chronic constipation[6,7]. These disorders represent one of the main reasons for medical consultation. The prevalence of this condition in the global population is estimated to be between 15 and 20%[8].Digestive system disorders are among the most frequently treated conditions with medicinal plants[9,10]. Considering the interconnected nature of these disorders, medicinal plants used for treatment often have multifunctional properties, addressing a range of digestive symptoms and conditions[8]. Despite this, most scientific organizations underestimate the significance of digestive system-related issues in health discussions[11].

In developing countries, medicinal plants remain a vital source of medication. Approximately 88% of people in these regions depends primarily on traditional medicine for their primary healthcare needs[12,13,14]. In the absence of a reference molecule, managing digestive system disorders presents significant challenges[15]. Given the limitations of current treatments, there was a strong need to explore new therapeutic approaches that are both effective and non-toxic. Medicinal plants offer a promising alternative, as they are generally more compatible with human physiology and tend to have fewer side effects. Additionally, given the significant economic impact and substantial social costs associated with digestive disorders[16], the collected data are crucial for identifying and researching new phytomolecules that could aid in the treatment and prevention of various digestive issues.

Therefore, this study aims to evaluatethe therapeutic potential of traditional medicinal plants used by the population of the central Algerian steppe for treating common digestive disorders, including colopathy, gastric ulcer, acute diarrhea, and chronic constipation.

2. MATERIALS AND METHODS

2.1. Study area

The study area was situated in the central Algerian steppe, situated in the central part of Algeria. This region serves as a transitional zone between the high steppic plains of the Tellian Atlas and the arid beginnings of the Saharian Atlas[17]. It spans between 2° and 5° east longitude and between 33° and 35° north latitude, covering an area of 32,280.41 km², which constitutes 1.36% of Algeria's total land area [3].The altitude varies from 1,613 meters in the east to 150 meters in the extreme south[18]. The number of inhabitants in the studied area was 1,491,370, served by approximately 260 phytotherapy practitioners. The inventory was conducted across 9 municipalities, gathering information from many traditional health practitioners based on their experiences. The investigation was performed in the following municipalities: Aïn Oussara, Had-Sahary, Hassi Bahbah, Zaafrane, Dar Chioukh, Djelfa, Charef, Faidh El Botma, and Messaad, as illustrated in **Figure 1**.

2.2. Climate

The climate of the study area is characterized by a semi-arid steppe environment. Summers are hot and dry, while winters are cold, with temperatures occasionally dropping below freezing. Precipitation is scarce and

irregular, with most rainfall occurring between November and April, although the annual totals remain low. The region is also notable for its strong winds, particularly in the spring, which often exacerbate the dry conditions and lead to dust storms.

2.3. Data collection

To document the medicinal plants used for treating digestive disorders, a traditional plant use survey was conducted using a semi-structured questionnaire. The study targeted four specific digestive conditions: colopathy, gastric ulcers, acute diarrhea, and chronic constipation. Conducted over one month in March 2024, the survey involved a representative sample of 75 herbalists. The semi-structured questionnaire was designed to gather comprehensive information in two main areas. The first section focused on the demographic and professional background (socio-demographic) of the herbalists, including their sex, age, education level, and years of professional experience. The second section detailed the plant materials used, documenting the local names of the plants, the specific parts utilized, the preparation methods, and the herbalists' perceptions of the plants' effects. This dual approach ensured a thorough understanding of both the practitioners' profiles and the traditional knowledge they possess.

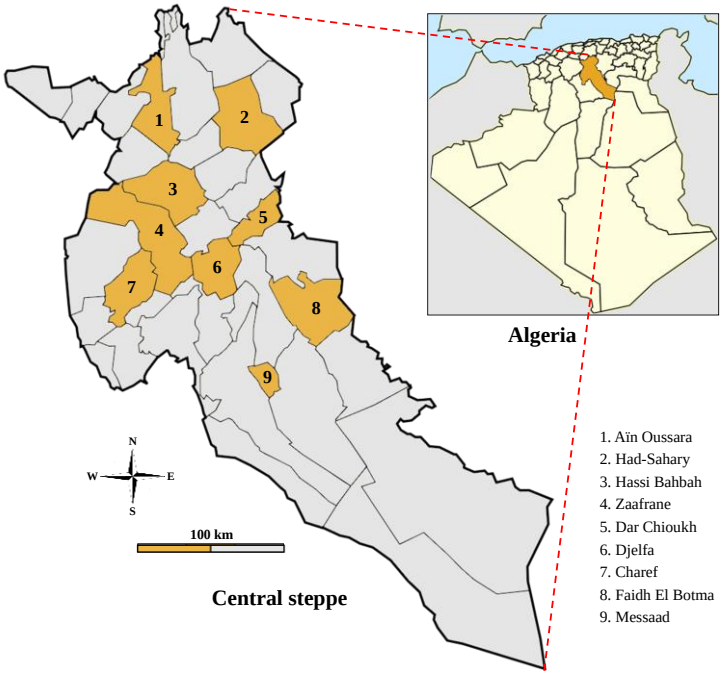

Figure 1. Geographical representation of the study area. The study sites are marked with a number corresponding to their geographic location.

The identification of plant species was conducted using several reference botanical sources on the vegetation and medicinal plants of the Algerian and North Africa, including the "Nouvelle Flore de l'Algérie" (New Flora of Algeria, the "Flore de l'Afrique du Nord" (Flora of North Africa), and the "Flore du Sahara" (Flora of the Sahara). The scientific name of each reported plant was verified using international botanical databases, such as The Plant List (https://www.theplantlist.org/) and Encyclopedia of Life (https://eol.org/).

2.4. Data analysis

The data collected from survey forms were manually entered into a database, processed, and analyzed using Microsoft Office 2016 Excel. Descriptive statistics, specifically percentages and frequencies, were used to evaluate the data. The Relative Frequency of Citation (RFC) was calculated as a percentage to assess the importance of each species for treating digestive disorders. The RFC was determined according to this formula: RFC = FC/N ($0<RFC<1$). FC was the number of informants citing the given species for a considered digestive disorder and N was the total number of informants for the same digestive disorder[19].The Family Importance Value (FIV) emphasizes the relevance of medicinal plant families. It was determined by dividing the relative frequency of citations for a particular family (RFC_{family}) by the total number of species belonging to that family (Ns). FIV = RFC_{Family}/Ns ($0<FIV\leq1$).

2.5. Data processing

The analysis of collected data involved various methods, such as the Number of Citations and the Relative Frequency of Citation and Family Importance Value. Data analysis employed simple descriptive statistical methods using Microsoft Office 2016 Excel. Quantitative variables were described using means, while qualitative variables were presented as frequencies and percentages. Graphical presentations were performed using OriginPro 2024 SR1 and Microsoft Office 2016 Excel. The statistical analysis was performed by XLSTAT (version 2018.1) and the level of significance was set at $p<0.05$.

3. RESULTS AND DISCUSSION

The general analysis of the results from this study showed that the use of plants in traditional medicine for treatingdigestive diseases was common among the population in the studied region.

3.1. Socio-demography of phytotherapy practitioners

A total of 75 phytotherapy practitioners were interviewed, representing approximately 28.8% of the 260 practitioners in the study area. This sample ensures a broad and diverse range of practices, experience levels, and regional representation. The participants, totaling 75, were categorized based on four socio-demographic characteristics: gender, age, education level, and professional experience, in accordance with the criteria defined byUmair *et al.*[20]. These characteristics were significant factors influencing the transmission of knowledge regarding the therapeutic uses of medicinal plants[21].

Regarding gender, 96% of the phytotherapy practitioners were men and 4% were women (**Figure2**), indicating a male predominance in this field. This observation was consistent with the findings of some other researches[22,23,24]. These results differ notably from those reported by Orch *et al.*[25], where the majority of phytotherapy users were women. This gender disparity could be attributed to various factors such as culture and traditions. The age distribution reveals that the majority of phytotherapy practitioners (56.19%) was in the 40 to 60-year age range. This was followed by those aged 20 to 40, who constitute 37% of the practitioners. Those aged over 60 and those 20 years or younger represent a smaller proportion of the total (**Figure2**). These results indicate a particular interest in phytotherapy among middle-aged individuals. Similar findings have been observed in other studies conducted worldwide[21,26,27].

Among phytotherapy practitioners, the highest proportion have a secondary school education (54.67%), followed by those with a middle school education (22.67%). Practitioners with a university-level education, or primary education, and those who were illiterate represent smaller proportions (**Figure2**). This study reveals that interest in traditional medicine spans all educational levels within the population. These results contrast with several studies that have shown that traditional knowledge in phytotherapy was primarily spread among individuals with low educational levels[28,29].

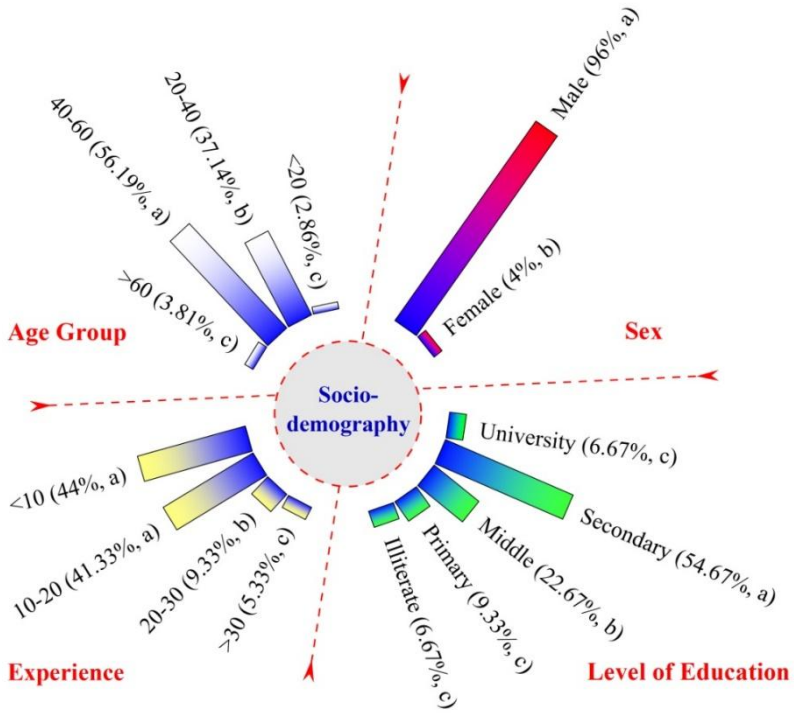

Figure 2. Socio-demographic characteristics of practitioners of traditional herbal medicine interviewed in the central Algerian steppe. ***For each socio-demographic parameter, percentage values with different letters indicate statistically significant differences (p<0.05; a>b>c).***

The distribution of practitioners based on professional experience was shown in **Figure 2**. A significant proportion of phytotherapy practitioners have less than 10 years of experience (44.00%), indicating a recent surge of interest in the field. A similar proportion, 41.33%, have between 10 and 20 years of experience, reflecting a stable and committed presence in the profession. In contrast, only 9.33% have between 20 and 30 years of experience, while just 5.33% have over 30 years, which may suggest a temporary decline in popularity or shifts in career focus. These results were comparable to those of Dey *et al.*[30], who found that a significant proportion of practitioners have less than 20 years of experience.

3.2. Diversity of medicinal plants used for the treatment of digestive disorders

The inventory of medicinal plants traditionally used in the treatment of digestive disorders in the central Algerian steppe includes a wide variety of species across different plant families. The **Table 1** categorizes these plants based on the specific digestive disorders, including colopathy, gastric ulcers, acute diarrhea, and chronic constipation.

The treatment of colopathy involves 23 species from 15 families such as Apiaceae, Lamiaceae, and Asteraceae. Notably, species like *Cuminum cyminum*, *Foeniculum vulgare*, and *Pimpinella anisum*from the Apiaceae family were commonly used, indicating a strong traditional preference for plants with carminative and anti-inflammatory properties. These plants were known to alleviate symptoms such as bloating, gas, and stomach cramps. The Asteraceae family was also well-represented, with *Matricaria chamomilla* being a commonly cited plant due to its calming and anti-inflammatory effects on the

digestive system. Studies have shown that the carminative effects of Apiaceae species were supported by their high essential oil content, which has been proven to relieve gastrointestinal discomfort[31]. Similarly, *Matricaria chamomilla*'s efficacy was attributed to its flavonoid content, which provides significant anti-inflammatory benefits[32]. The frequent use of these families indicates a strong traditional preference for plants with soothing and digestive-enhancing properties.

A total of 12 families and 16 species were used in the treatment of gastric ulcers. The Lamiaceae family was notably represented in the treatment of gastric ulcers, with plants like *Teucrium polium* and *Origanum majorana* being commonly cited. These results were consistent with those of Brahmi *et al.*[33], who indicated that digestive disorders are the primary therapeutic indications for plants in the Lamiaceae family. These plants were valued for their anti-inflammatory and protective effects on the gastric mucosa[34,35]. The Cupressaceae family, including *Juniperus phoenicea* and *Juniperus oxycedrus*, was also important in this category. These species were traditionally used for their antiseptic and anti-inflammatory properties, which help manage ulcer symptoms. The inclusion of *Punica granatum* from the Punicaceae family highlights the use of antioxidant-rich plants in preventing and treating ulcers[28].

For acute diarrhea, the inventory lists 10 families and 12 species. The Asteraceae family features prominently in the treatment of this disorder, with plants like *Artemisia campestris* being frequently mentioned. This family was known for its antimicrobial and anti-inflammatory properties, which were beneficial in managing diarrhea[36]. The Cupressaceae family also appears in this category, with species such as *Juniperus phoenicea* being used for their astringent and antimicrobial effects[37]. Additionally, *Zingiber officinale* from the Zingiberaceae family was highlighted for its digestive benefits and anti-inflammatory properties[38]. The reliance on these families underscores the importance of plants with antimicrobial and soothing effects in treating acute gastrointestinal issues.

The treatment of chronic constipation involves 8 families and 11 species. The plants from the Fabaceae and Euphorbiaceae families were particularly significant. *Senna alexandrina* from the Fabaceae family was a key plant known for its potent laxative properties[39], widely used to stimulate bowel movements[40]. *Ricinus communis* from the Euphorbiaceae family was another frequently cited plant, commonly used for its strong purgative effects[41]. The Apiaceae family, represented by *Foeniculum vulgare*, also plays a role in this constipation, valued for its mild laxative and carminative properties[42]. The presence of these families highlights the diverse botanical resources utilized in traditional medicine to manage chronic constipation through natural laxatives and digestive aids.

Table 1. Inventory of medicinal plants traditionally used in the treatment of digestive disorders in the central Algerian steppe

Family	Scientific name	Common name	Plant origin	Part used	Method of use	FC	RFC
Colopathy							
Aloaceae	*Aloe vera* L.	Aloe Vera	Spontaneous	Leaves	Mac/Inf/Dec	14	0.187
Anacardiaceae	*Pistacia lentis*us L.	Mastic Tree	Spontaneous	Fruits	Mac/Inf/Dec	68	0.907
Apiaceae	*Cuminum cyminum* L.	Cumin	Cultivated	Seeds	Mac/Inf/Dec	63	0.840
Apiaceae	*Pimpinellaanisum* L.	Anise	Cultivated	Seeds	Mac/Inf/Dec	53	0.707
Apiaceae	*Foeniculum vulgare* Mill.	Fennel	Cultivated	Roots	Mac/Inf/Dec	29	0.387
Apiaceae	*Thapsia garganica* L.	Deadly Carrot	Spontaneous	Leaves	Mac/Inf/Dec	19	0.253
Apiaceae	*Carum carvi* L.	Caraway	Cultivated	Seeds	Mac/Inf/Dec	16	0.213

Family	Scientific name	Common name	Plant origin	Part used	Method of use	FC	RFC
Asteraceae	*Matricaria chamomilla* L.	Chamomile	Spontaneous	Flowers	Mac/Inf/Dec	51	0.680
Asteraceae	*Cotula cinerea* Del.	Cotula	Spontaneous	Leaves	Mac/Inf/Dec	26	0.347
Fabaceae	*Trigonella foenum-graecum* L.	Fenugreek	Cultivated	Seeds	Mac/Inf/Dec	56	0.747
Lamiaceae	*Salvia officinalis* L.	Sage	Spontaneous	Leaves	Mac/Inf/Dec	59	0.787
Lamiaceae	*Mentha spicata* L.	Spearmint	Cultivated	Aerial part	Mac/Inf/Dec	24	0.320
Lamiaceae	*Origanum vulgare* L.	Oregano	Spontaneous	Aerial part	Mac/Inf/Dec	21	0.280
Lamiaceae	*Lavandula angustifolia* Mill.	Lavender	Spontaneous	Aerial part	Mac/Inf/Dec	7	0.093
Lauraceae	*Cinnamomum camphora* L.	Camphor Tree	Imported	Leaves	Mac/Inf/Dec	8	0.107
Linaceae	*Linum usitatissimum* L.	Flax	Spontaneous	Seeds	Mac/Inf/Dec	11	0.147
Myrtaceae	*Myrtus communis* L.	Myrtle	Spontaneous	Leaves	Mac/Inf/Dec	13	0.173
Rosaceae	*Rosa × damascena* Mill.	Damask Rose	Cultivated	Flowers	Inf/Dec	15	0.200
Rubiaceae	*Rubia tinctorum* L.	Madder	Imported	Seeds	Inf/Dec	12	0.160
Rutaceae	*Ruta montana* L.	Mountain Rue	Spontaneous	Aerial part	Mac/Inf/Dec	9	0.120
Simaroubaceae	*Ailanthus altissima* Mill. Swingle	Tree of Heaven	Spontaneous	Flowers	Mac/Inf/Dec	31	0.413
Verbenaceae	*Aloysia citrodora* Palau.	Lemon Verbena	Cultivated	Leaves	Mac/Inf/Dec	41	0.547
Zingiberaceae	*Curcuma longa* L.	Turmeric	Imported	Roots	Mac/Inf/Dec	37	0.493
Gastric ulcer							
Aloaceae	*Aloe vera* L.	Aloe Vera	Spontaneous	Leaves	Mac/Inf/Dec	26	0.347
Asteraceae	*Achillea millefolium* L.	Yarrow	Spontaneous	Leaves	Mac/Inf/Dec	17	0.227
Cupressaceae	*Juniperus phoenicea* L.	Phoenician Juniper	Spontaneous	Aerial part	Mac/Inf/Dec	62	0.827
Cupressaceae	*Juniperus oxycedrus* L.	Prickly Juniper	Spontaneous	Leaves	Mac/Inf/Dec	22	0.293
Fabaceae	*Glycyrrhiza glabra* L.	Licorice	Cultivated	Tree bark	Mac/Inf/Dec	14	0.187
Lamiaceae	*Teucrium polium* L.	Felty Germander	Spontaneous	Aerial part	Mac/Inf/Dec	69	0.920
Lamiaceae	*Origanum majorana* L.	Marjoram	Spontaneous	Leaves	Mac/Inf/Dec	20	0.267
Lamiaceae	*Ziziphora hispanica* L.	Spanish Hyssop	Spontaneous	Aerial part	Mac/Inf/Dec	18	0.240
Liliaceae	*Asparagus officinalis* L.	Asparagus	Imported	Leaves	Mac/Inf/Dec	15	0.200
Liliaceae	*Origanum vulgare* L.	Oregano	Spontaneous	Aerial part	Mac/Inf/Dec	12	0.160
Myrtaceae	*Myrtus communis* L.	Myrtle	Spontaneous	Fruits	Mac/Inf/Dec	21	0.280
Oleaceae	*Olea europaea* L.	Olive	Cultivated	Leaves	Mac/Inf/Dec	37	0.493
Pinaceae	*Pinus pinaster* Aiton	Maritime Pine	Spontaneous	Tree bark	Mac/Inf/Dec	16	0.213
Punicaceae	*Punica granatum* L.	Pomegranate	Cultivated	Fruit bark	Mac/Inf/Dec	46	0.613
Rosaceae	*Rosa × damascena* Mill.	Damask Rose	Cultivated	Flowers	Mac/Inf/Dec	24	0.320
Violaceae	*Viola abyssinica* Steud.	Abyssinian Violet	Spontaneous	Flowers	Mac/Inf/Dec	13	0.173
Acute diarrhea							
Asteraceae	*Artemisia campestris* L.	Field Wormwood	Spontaneous	Aerial part	Mac/Inf/Dec	46	0.613
Asteraceae	*Achillea moschata* Wulfen	Musk Yarrow	Spontaneous	Leaves	Mac/Inf/Dec	21	0.280
Cupressaceae	*Juniperus phoenicea* L.	Phoenician Juniper	Spontaneous	Aerial part	Mac/Inf/Dec	29	0.387
Cupressaceae	*Juniperus oxycedrus* L.	Prickly Juniper	Spontaneous	Leaves	Mac/Inf/Dec	25	0.333

Family	Scientific name	Common name	Plant origin	Part used	Method of use	FC	RFC
Fabaceae	*Ceratonia siliqua* L.	Carob Tree	Spontaneous	Fruits	Mac/Inf/Dec	23	0.307
Fagaceae	*Quercus ilex* L.	Holm Oak	Spontaneous	Fruits	Mac/Inf/Dec	27	0.360
Lamiaceae	*Rosmarinus tournefortii* de Noe	Turnefort's Rosemary	Spontaneous	Aerial part	Mac/Inf/Dec	34	0.453
Lauraceae	*Cinnamomum verum* J.Presl	Ceylon Cinnamon	Imported	Tree bark	Mac/Inf/Dec	41	0.547
Plantaginaceae	*Plantago ovata* Forssk.	Psyllium	Spontaneous	Leaves	Mac/Inf/Dec	15	0.200
Rhamnaceae	*Ziziphus spina-christi* L. Desf.	Christ's Thorn Jujube	Spontaneous	Fruits	Mac/Inf/Dec	19	0.253
Rhamnaceae	*Ziziphus juju*ba Mill.	Jujube	Spontaneous	Fruits	Mac/Inf/Dec	17	0.227
Zingiberaceae	*Zingiber officinale* Roscoe	Ginger	Cultivated	Stem	Mac/Inf/Dec	37	0.493
Chronic constipation							
Apiaceae	*Foeniculum vulgare* Mill.	Fennel	Cultivated	Seeds	Mac/Inf/Dec	39	0.520
Asteraceae	*Aucklandia costus* Falc.	Saussurea Costus	Cultivated	Tree bark	Mac/Inf/Dec	11	0.147
Asteraceae	*Artemisia herba-alba* Asso	White Wormwood	Spontaneous	Leaves	Mac/Inf/Dec	32	0.427
Euphorbiaceae	*Ricinus communis* L.	Castor Bean	Spontaneous	Fruits	Mac/Inf/Dec	25	0.333
Euphorbiaceae	*Croton tiglium* L.	Purging Croton	Cultivated	Seeds	Mac/Inf/Dec	61	0.813
Fabaceae	*Senna alexandrina* Mill.	Alexandrian Senna	Imported	Leaves	Mac/Inf/Dec	28	0.373
Fabaceae	*Ceratonia siliqua* L.	Carob Tree	Spontaneous	Fruits	Mac/Inf/Dec	13	0.173
Gentianaceae	*Centaurium erythraea* Rafn	Common Centaury	Spontaneous	Leaves	Mac/Inf/Dec	7	0.093
Lamiaceae	*Salvia hispanica* L.	Chia	Spontaneous	Seeds	Mac/Inf/Dec	16	0.213
Lauraceae	*Laurus nobilis* L.	Bay Laurel	Spontaneous	Leaves	Mac/Inf/Dec	15	0.200
Liliaceae	*Linum usitatissimum* L.	Flax	Spontaneous	Seeds	Mac/Inf/Dec	21	0.280
Malvaceae	*Malva parviflora* L.	Cheeseweed	Spontaneous	Leaves	Mac/Inf/Dec	19	0.253
Polygonaceae	*Rheum palmatum* L.	Chinese Rhubarb	Imported	Leaves	Mac/Inf/Dec	30	0.400
Zygophyllaceae	*Zygophyllum cornutum* Coss	Horned Zygophyllum	Spontaneous	Leaves	Mac/Inf/Dec	9	0.120

Mac: Maceration; Inf: Infusion; Dec: Decoction; FC: Frequence of citation; RFC: Relative frequence of citation;Total number of phytotherapy practitioners (N) is 75.

This data underscores the rich diversity of plant families used in traditional Algerian medicine for digestive disorders. The cultural knowledge embedded in the use of these plants was not only vital for preserving traditional plant uses but also offers potential avenues for pharmacological research into natural remedies for gastrointestinal health.

The data shows that Spontaneous plants were the most prevalent, comprising 42 (64.62%) of the total entries, indicating a strong reliance on locally available or naturally occurring plants. Cultivated plants follow with 16 plants (24.62%), suggesting a notable but secondary use of plants intentionally grown. Imported plants make up the smallest proportion at 10.77% (7 plants), reflecting their minor role in managing the studied digestive disorder.

3.3. Family importance and frequency of medicinal plant species

The distribution of Family Importance Values highlights a diverse range of plant families utilized for medicinal purposes. The FIV analysis provides significant insights into the cultural relevance of these families **(Figure 3)**. The families with the highest FIV values, including Punicaceae (0.61), Apiaceae (0.55), and Verbenaceae (0.55), were shown to play a prominent role in traditional medicinal

practices. Conversely, families such as Gentianaceae (0.09) and Zygophyllaceae (0.12) have the lowest FIV values, suggesting they were less emphasized in medicinal applications or used less frequently. Families like Lamiaceae and Asteraceae show moderate importance, indicating that while some families dominate medicinal use, others contribute to a broader spectrum of traditional remedies, particularly for digestive disorders.

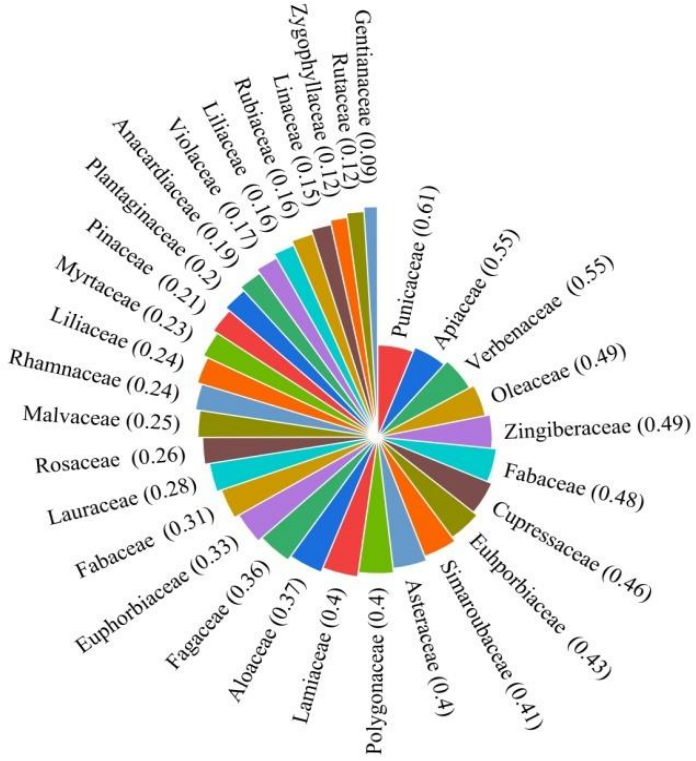

Figure 3. Importance of plant families used in treating digestive disorders in the central Algerian steppe.

The importance of plant families used for digestive disorders can vary significantly across traditional medicine surveys conducted in different regions[30,43]. This variation was due to differences in local knowledge and traditions, biodiversity, environmental conditions, and cultural practices. Each region has unique plant species and traditional uses influenced by local climate, soil, and cultural preferences, which affect the selection of plants for medicinal purposes. Additionally, factors such as plant availability, economic conditions, and the focus of ethnobotanical research further contribute to these variations[44].

The Relative Frequency of Citation, shown in **Figure 4**, underscores the significance of the plants used in local therapeutic practices and highlights the critical role of traditional medicine in treating digestive disorders.

The RFC for *Cuminum cyminum* was 0.91, highlighting its prominent use for colopathy. This high citation frequency was attributed to its well-known benefits for digestive health, primarily due to its carminative and anti-inflammatory properties[45]. *Pimpinella anisum* and *Salvia officinalis* were also frequently mentioned. *Pimpinella anisum* was particularly valued for relieving digestive bloating[46], while sage was recognized for its anti-inflammatory effects[47].

For gastric ulcers, *Teucrium polium* stands out with the highest RFC of 0.92, indicating its potential in protecting against ulcers through its anti-inflammatory and

antioxidant properties, which help reduce damage and promote healing of the gastric mucosa[48]. *Juniperus phoenicea* and *Punica granatum* were also notable, with contributions of 0.84 and 0.61, respectively. *Juniperus phoenicea* shows potential for antiulcer and antioxidant activity, suggesting it could be beneficial in protecting and healing the gastric mucosa[49]. *Punica granatum* was recognized for its anti-inflammatory, antioxidant, and mucosal protective properties, which may reduce damage and promote healing of the stomach lining[50].

In treating acute diarrhea, *Artemisia campestris* (RFC 0.61) and *Cinnamomum verum* (RFC 0.55) were frequently used. Research supports Artemisia's antimicrobial and antidiarrheal properties[51,52], while the benefits of cinnamon for digestive health, including diarrhea, were also supported[53]. For chronic constipation, *Senna alexandrina* was the leading plant with an RFC of 0.81, reflecting its potent laxative and purgative effects[54]. *Aucklandiacostus* (RFC 0.52) and *Ricinus communis* (RFC 0.40) also demonstrate significant effects.

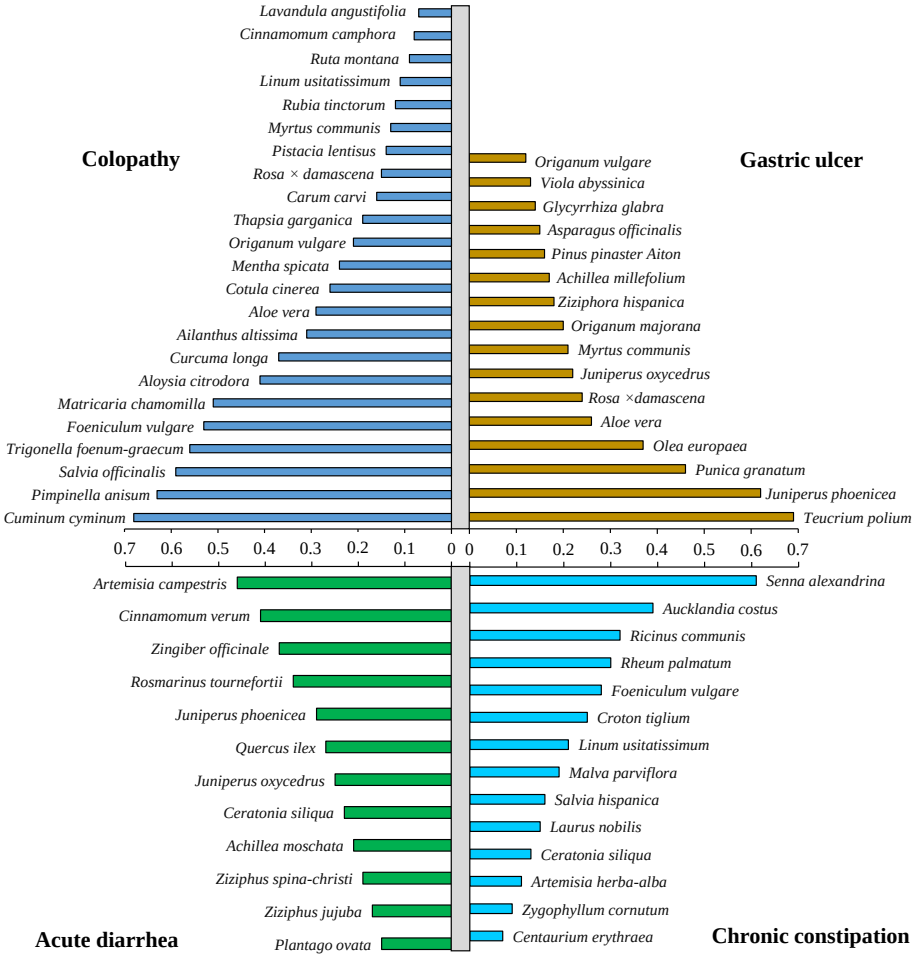

Figure4. Frequency of medicinal plant use in treating digestive disorders in the central Algerian steppe.

It has been observed that the use of a single plant for various disorders can be attributed to the interconnected nature of these conditions. When one digestive issue occurs, it was common for additional related disorders to manifest simultaneously. Additionally, the same plant can treat other disorders, showcasing its broad medicinal properties.

3.4. Relationship between medicinal plant parts used and preparation methods

The traditional medicinal use of different plant parts for treating digestive disorders was explored, with results summarized in **Figure5**. The preparation methods, including infusion, decoction, and maceration, were examined in relation to the most commonly used plant parts across various digestive disorders.

In the treatment of colopathy, seeds were the most commonly used plant part, with infusion (15.08%) and decoction (15.23%) being the preferred methods, while maceration was less used. Leaves were also prominently used, with a preference for decoction (11.57%), followed by infusion (8.93%), and then maceration. For flowers, infusion was the primary method, while maceration and decoction were less common. The aerial part of plants was least used, with decoction and infusion being more preferred. The use of fruit bark, tree bark, and stems was not observed in the treatment of colopathy.

For gastric ulcer, the aerial part and leaves were the most utilized plant parts, with infusion being the most popular method at 20.14% and 15.97%, respectively. Decoction follows for both the aerial part and leaves, around 12%, while maceration was less common for these parts. Flowers were primarily used through infusion and decoction. The use of fruits and fruit bark was minimal, while roots, seeds, and stems were not used for this digestive disorder.

In treating acute diarrhea, the aerial part was frequently utilized, with infusion as the preferred method at 14.67%, followed closely by decoction at 13.47%, while maceration was rarely adopted. Fruits also show significant usage, with infusion being the most chosen method (14.67%), followed by decoction and maceration, which were less popular. Leaves were prepared using decoction (7.78%) more often than infusion (6.89%) and sometimes with maceration. The use of tree bark was less common, with decoction followed by infusion being more commonly used. Flowers, roots, seeds, and fruit bark were not used in this context.

For chronic constipation, leaves were the most cited plant part, with decoction infusion being the leading method (21.47%), followed respectively by decoction and maceration. Seeds were also frequently used, with the methods used in the following order: decoction, maceration, and infusion. Fruits were primarily prepared through infusion (8%), followed by maceration and decoction. The use of tree bark was minimal, with infusion and decoction being more common. Aerial parts, flowers, roots, fruit bark, and stems were not used in treating chronic constipation.

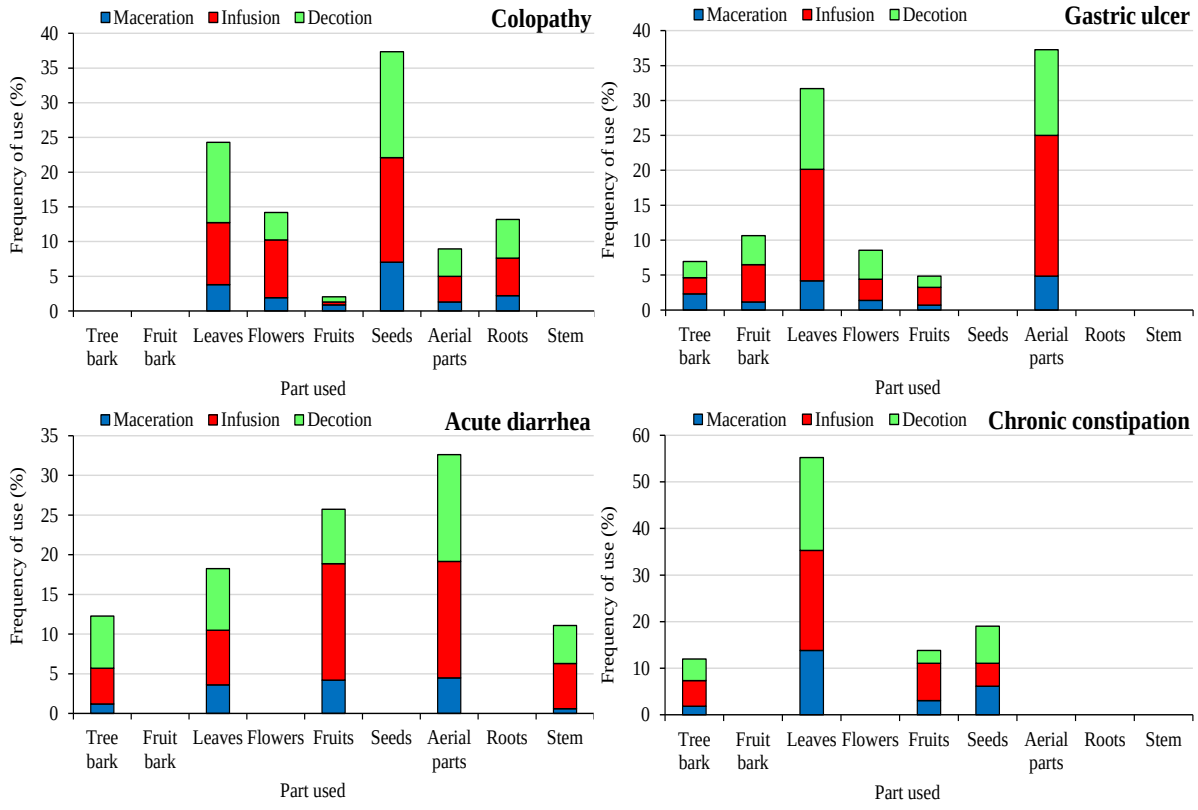

Figure5. Relationship between medicinal plant parts used and preparation methods for treating digestive disorders in the central Algerian steppe.

Overall, infusion followed by decoction were generally the most commonly employed methods across different plant parts for digestive disorders, particularly for the aerial parts and leaves. The choice of method often depends on the plant part and the specific disorder being treated, with decoction and maceration also being used frequently.

The parts of plants used in the treatment of digestive disorders play a crucial role in their therapeutic efficacy. Different parts of the plant, such as leaves, roots, fruits, and flowers, contain varying concentrations of bioactive compounds that target specific digestive issues. Leaves were commonly used for their high concentration of flavonoids, phenolic acids, and essential oils, which possess anti-inflammatory, carminative, and digestive-enhancing properties[55]. Similar compounds have been reported in leaves used for treating menstrual disorders, particularly in *Foeniculum vulgare* and *Trigonella foenum-graecum*[56]. Roots and rhizomes were valued for their high content of prebiotic compounds such as inulin, which promote healthy gut flora and improve overall digestive health[57]. Fruits were less commonly used but still play a role in the treatment of digestive disorders. Fruits were employed for their antioxidant properties, which help reduce oxidative stress in the digestive tract and protect against ulcers[58].

3.5. Efficacy of frequently cited plants in treating digestive disorders

The data detailing the efficacy of the most frequently cited plants in treating various digestive disorders provides significant insights, as shown in **Figure6**.

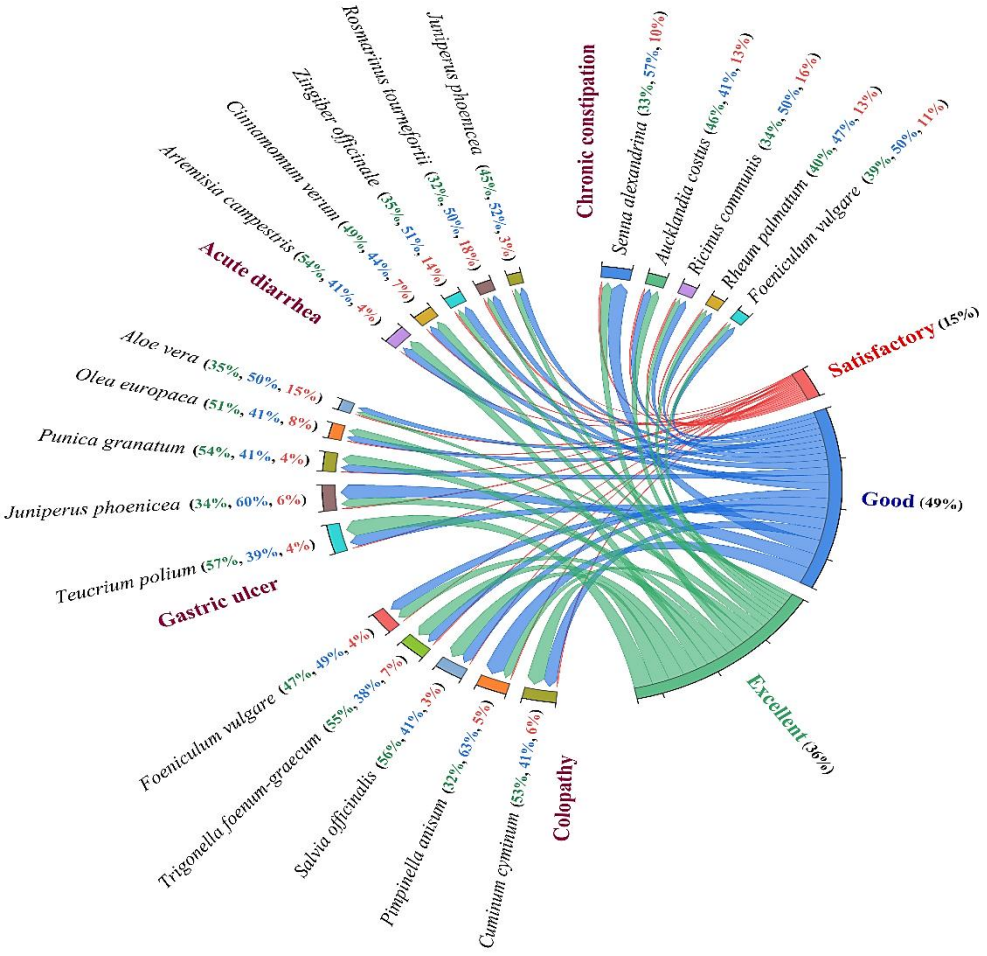

Figure6.Chord diagram showing the efficacy of the most frequently cited plants in treating digestive disorders in the central Algerian steppe. ***The values put in parenthesis for each plant represent the percentages of cited effects as satisfactory (Red), good (Bleu), and excellent (Green). The global citation percentages of the plants used are placed in parentheses next to each effect.***

For the treatment of colopathy, the most frequently cited plants with excellent effects were *Cuminum cyminum* (53%), *Salvia officinalis* (56%), and *Trigonella foenum-graecum* (55%). These plants were noted for their high efficacy, indicating that they were particularly effective in managing colopathy symptoms. On the other hand, *Pimpinella anisum* (63%) was primarily cited for its good effects, suggesting it was effective but not as potent as the others. *Foeniculum vulgare* shows a balanced efficacy, being equally cited for both good (49%) and excellent (47%) effects. Overall, the plants used for colopathy generally exhibit low frequencies of satisfactory effects, highlighting their strong therapeutic potential.

In treating gastric ulcers, *Teucrium polium* (57%) stands out with a high frequency of excellent effects, making it a key plant in traditional treatments. *Juniperus*

phoenicea also shows substantial effectiveness with a significant number of good (60%) effect. *Punica granatum* (54%) and *Olea europaea* (51%) were frequently cited for their excellent effects, indicating their role in traditional medicine for gastric ulcers. *Aloe vera* was less frequently cited for excellent effect but still plays a role in treatment. Generally, the plants used for gastric ulcers show high efficacy, with low frequencies of satisfactory effects.

For acute diarrhea, *Artemisia campestris* (54%) and *Cinnamomum verum* (49%) were frequently cited for their excellent effects, making them prominent in traditional treatments. *Zingiber officinale* and *Rosmarinus tournefortii* show moderate efficacy, with a balance of good and excellent ratings. *Juniperus phoenicea* was cited less frequently for excellent effects but still contributes to the treatment. The overall low frequency of satisfactory effects among these plants suggests their strong efficacy in managing acute diarrhea.

In the treatment of chronic constipation, *Senna alexandrina* was effective, with a significant number of good ratings (57%). *Aucklandiacostus* and *Ricinus communis* show considerable efficacy with excellent and good effects, with 46 and 50%, respectively. *Rheum palmatum* and *Foeniculum vulgare* exhibit a balanced efficacy, being cited for both good and excellent effects. The plants used for chronic constipation generally exhibit low frequencies of satisfactory effects, indicating their effectiveness in alleviating this condition.

The data highlights the significant role of various plants in traditional medicine for treating digestive disorders in the central Algerian steppe. Plants such as *Cuminum cyminum*, *Teucrium polium*, *Artemisia campestris*, and *Senna alexandrina* were particularly notable for their high efficacy across different digestive conditions. The low frequency of satisfactory effects among these plants indicates their strong therapeutic potential, emphasizing their value in traditional medicine.

The data illustrates that 49% of the citations reflect "good" effects, 36% indicate "excellent" effects, and 15% represent "satisfactory" effects. This distribution suggests that the majority of the cited plants exhibit substantial efficacy, with most evaluations falling between the "good" and "excellent" categories. These results highlight the strong reliance of the local population on traditional medicinal plants and the perceived effectiveness of these plants in the study region.

4. CONCLUSIONS

Our results reveal the richness of medicinal plant species in the central Algerian steppe for the traditional treatment of digestive disorders, highlighting the extensive traditional knowledge embedded in local practices. The socio-demographic analysis shows a predominance of middle-aged male practitioners with varying levels of education and professional experience, indicating widespread interest in phytotherapy across different social strata. The inventory of medicinal plants showcases a diverse range of species from multiple families, each valued for their therapeutic properties in treating conditions such as colopathy, gastric ulcers, acute diarrhea, and chronic constipation. Notably, plants like *Cuminum cyminum*, *Teucrium polium*, *Artemisia campestris*, and *Senna alexandrina* demonstrate high efficacy, underscoring their importance in traditional medicine. The frequent use of single plants for multiple disorders reflects the interconnected nature of these conditions and the broad medicinal properties of these plants. This study not only preserves valuable traditional practices but also suggests potential avenues for pharmacological research into natural remedies for digestive health. Further pharmacological studies should isolate and analyze active compounds in frequently cited plants to validate their efficacy and safety, while promoting conservation and sustainable use to preserve traditional knowledge and prevent resource depletion. The catalog of active plants could encourage specialized studies, potentially leading to the discovery of new products for modern therapeutics.

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Ethical Consent

The information presented in this article is derived from a questionnaire-based survey conducted with phytotherapy practitioners. The authors did not perform any experimental studies involving humans or animals.

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الإمكانات العلاجية للنباتات الطبية التقليدية في منطقة السهوب الوسطى الجزائرية لعلاج الإضطرابات الهضمية الشائعة

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ملخص

في منطقة السهوب الوسطى الجزائرية، تُعد اضطرابات الجهاز الهضمي من الأمراض الشائعة التي يعالجها غالبية السكان باستخدام النباتات الطبية. تهدف هذه الدراسة إلى تقييم الإمكانات العلاجية للنباتات الطبية المستخدمة في علاج أربعة اضطرابات شائعة، وهي: التهاب القولون، القرحة المعدية، الإسهال الحاد والإمساك المزمن. ولتحقيق هذا الهدف، أُجري مسحٌ ميداني باستخدام استبيان، شمل 75 ممارسًا في مجال النباتات الطبية. تضمن الاستبيان قسمين: معلومات اجتماعية وديموغرافية عن المشاركين، وبيانات تفصيلية حول النباتات الطبية المُستخدمة. تم جمع البيانات من خلال استمارات المسح الميداني، مع تصنيف المشاركين حسب الجنس، العمر، المستوى التعليمي والخبرة المهنية. كما جُمعت معلومات نباتية دقيقة عن الأنواع المستعملة وتم تحليلها بعناية. وقد تم جرد وتقييم تنوع النباتات الطبية المستخدمة في علاج اضطرابات الجهاز الهضمي باستخدام أدوات إحصائية دقيقة. كشفت الدراسة عن 57 نوعاً نباتياً ينتمون إلى 32 عائلة نباتية، مع هيمنة واضحة لعائلتي الشفوية (Lamiaceae) بتسعة أنواع، والنجمية (Asteraceae) بسبعة أنواع. وكانت طريقة التحضير الأكثر شيوعاً هي النقيع (44%)، تليها الغلي (38%). تؤكد هذه النتائج الدور الهام للنباتات الطبية في العلاج التقليدي لاضطرابات الجهاز الهضمي في هذه المنطقة، كما توفر قاعدة علمية للبحوث المستقبلية حول الخصائص البيولوجية لهذه الأنواع. وقد حددت الدراسة مجموعة متنوعة من النباتات الطبية المستخدمة في علاج حالات مثل التهاب القولون، القرحة المعدية، الإسهال الحاد والإمساك المزمن، مع الإشارة إلى فعالية أنواع بارزة مثل الكمون (*Cuminum cyminum*)، الجعدة (*Teucrium polium*)، الشيح الصحراوي (*Artemisia campestris*)، والسنا (*Senna alexandrina*) نظرًا لفعاليتها العالية. كما لوحظ استخدام ثمانية أنواع نباتية لعلاج اضطرابات متعددة، مما يعكس الترابط بين هذه الحالات المرضية والتنوع الواسع في الخصائص العلاجية للنباتات المستخدمة. وتُبرز هذه الدراسة الثروة المعرفية التقليدية الواسعة والتنوع الغني للنباتات الطبية المستخدمة في منطقة السهوب الوسطى الجزائرية لعلاج الاضطرابات الهضمية. كما تُسلط الضوء على أهمية هذه النباتات وتُشير إلى مجالات واعدة لأبحاث دوائية مستقبلية تهدف إلى التحقق من فعاليتها وسلامتها.

الكلمات الدالة: الإمكانات العلاجية، الاضطرابات الهضمية، النباتات الطبية، السهوب الوسطى الجزائرية، الطب التقليدي.

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