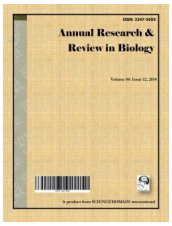

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Ethnomedicinal Evaluation of Medicinal Plants Used against Gastrointestinal Disorders in the Western Middle Atlas Region (Morocco)

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Authors' contributions

This work was carried out in collaboration between all authors. Author EAF designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ZF and AN managed the analyses of the study. Authors BO and HM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The gastrointestinal tract is one of the most important organs of the human body and is vulnerable to different diseases. Available drugs often have low efficacy or are associated with many adverse effects. Therefore, alternative drugs are necessary to treat gastrointestinal complications. This study intended to identify medicinal plants in the Western Middle Atlas, Morocco, that can affect gastrointestinal disorders.
Place and Duration of Study: Field studies were carried out approximately over a period of two years (2013-2014).
Methodology: During the field trips, the information was collected through interviews, including various data obtained from local healers and traditional medicine men, herbalists, shepherds, patients and elderly persons.

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Results: A total of 58 medicinal plants, grouped in 30 taxonomic families and 55 genera were identified. In addition, their popular uses, the part or parts employed, form of use and their biological activity are described. Lamiaceae was the most dominant family reported to be used for the treatment of gastrointestinal diseases (9 species). Among all the plant parts leaves and seeds were the most preferred plant parts used by the informants. Decoction and powder were the most popular form of treatment used. The four main disorders cured by the plants are: Stomachache/Stomach pain (39.65%), diarrhoeas (22.41%), abdominal pain (17.24%) and bowel disorders (17.24%).
Conclusion: This study aims at emphasizing the profound importance of investigating those species of plants that have not been the subject of any pharmacological study, in spite of existing reports on their traditional use.

Keywords: Medicinal plants; ethnobotany; ethnomedicine; gastrointestinal disorders; Western middle Atlas; Morocco.

1. INTRODUCTION

Medicinal plants have been used since the prehistoric period for the cure of various diseases. Human knowledge of the medicinal value of plants date back perhaps to more than five thousand years [1]. The extracts of several plants have been used as therapeutic agents. Many drugs presently prescribed by physicians are either directly isolated from plants or are artificially modified versions of natural products [2]. These medicines are safe and environmentally friendly. According to the WHO, about 80% of the world's population relies on traditional medicine for their primary health care [3]. Herbalists and indigenous healers have used botanical medicines traditionally worldwide for the prevention and treatment of different pathologies. Several research papers regarding medicinal plants have been developing in the last years; not only to preserve and have a register of traditions and uses between the population across the world [3,4], also to evaluate their biological [5,6] and toxic activities [7] for validation purposes. The focus from previous literatures was on properties and common parts of these medicinal plants, many of which were associated with the treatment of gastrointestinal ailment [8,9]. Those validation and research studies could contribute to new medicines and alternative ways to treat health problems.

Morocco, given its privileged geographical location, has attained status as one of the biologically mega diverse countries. The country possesses at least 4200 plant species [10].

Gastrointestinal disorders have a high prevalence in human societies. Functional digestive disorders are the most important ones, and about 50% of patients who refer to gastroenterology care centers suffer from them. The gastrointestinal tract is one of the most important organs in the human body, and it is vulnerable to a great diversity of diseases such as parasitic and infectious disorders, diarrhoea, reflux, gastroenteritis, constipation, and bloating [11].

This study aims to record and analyse orally transmitted traditional knowledge about treatment of digestive system diseases for the first time in Western Middle Atlas district, Morocco. As a result, new traditional therapies for digestive system diseases were recorded.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study area is located in central Morocco, covering an area of over 17,125 km^2. The region of Tadla Azilal is bounded by the provinces of Kalaat Es- sraghna and Al Haouz (west), Khouribga and Settat (north), Errachidia and Khenifra (east) and Ouarzazate (south).

Its location between two phosphate trays and Middle Atlas, with an average altitude of 400 to 700m, Tadla Azilal region is characterized by a continental climate, and the amount of rainfall varies between 300 and 750 mm depending on the year. The region includes three provinces whose capital is Beni Mellal [12].

The human population of Tadla Azilal region was established in 2012 to be 1516200 capita or about 4.65% of the total population. At the 2015 horizon, the size of the population had reached 1.53 million inhabitants.

Agriculture is the dominant activity in the region, both by available jobs (78.2% of the rural working population in 2011) and by the effects on

the regional economy. The region, with its plains (Tadla) and its important water resources, offers the possibility of developing a modern and industrializing agriculture in this part of Morocco.

Furthermore, by its geographical location, its rich natural and historical sites, this region has major assets for the development of tourism activities particularly rural and cultural tourism that could in this regard be a good niche deserving particular attention [12].

2.2 Methodology

In this study, random stratified sampling was adopted [13], where ethnobotanical interviews with the local population of Tadla-Azilal region were made during two crop years 2013-2014. This sampling technique was meant to have a floristic inventory that was as complete as possible and achieve success in various ethnobotanical surveys from one area to another in the said region. Therefore, the territory was divided into 30 strata according to the descriptors of the environment including climate, soil and vegetation. Proceeding by a stratified random sampling (Fig. 1). Samples of 30 people surveyed in each of the 30 strata were put together to form the aggregate sample (900 people). Ethnobotanical surveys were conducted with the help of 900 question sheets used to survey traditional healers, herbalists and users of medicinal plants in order to have a better representation of our sample.

During each interview, all the information about the informant (age, gender, academic level, marital status and therapeutic practice) and medicinal plants used by the latter were collected. The data collected for each plant included its vernacular name; the part used a method of preparation and the disease treated.

Similarly, spontaneous and medicinal plant species were collected and brought to the laboratory for identification and determination through the botanical books: «Flore pratique du Maroc. Manuel de détermination des plantes Vol 1 et 2» of Fennane et al. (1999 & 2007) [14,15], «La pharmacopée marocaine traditionnelle, médecine arabe ancienne et savoir populaire» of Bellakhdar (1997) [16] and «Les plantes médicinales du Maroc» of Sijelmassi (1993) [17].

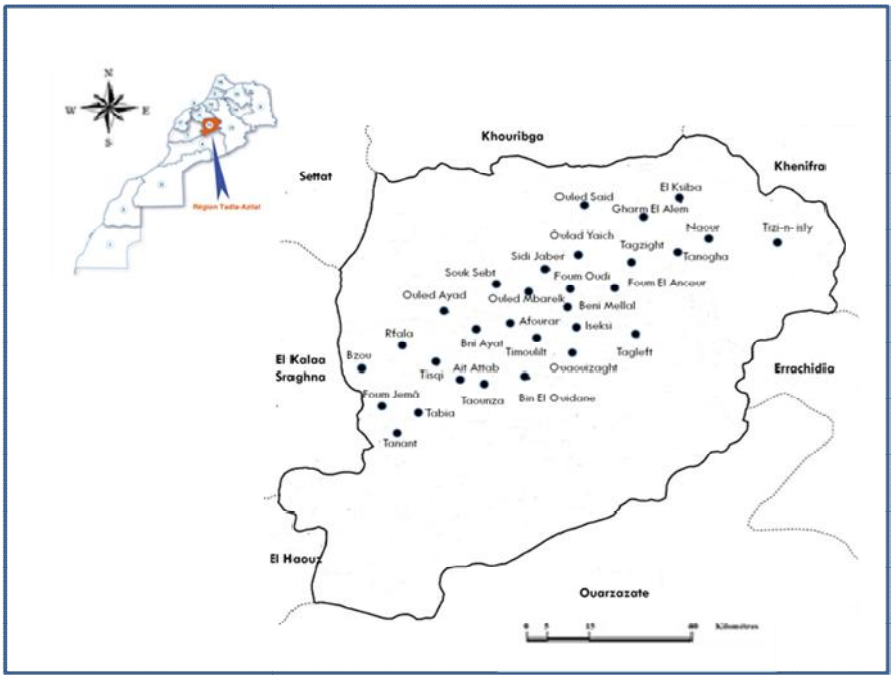

Fig. 1. Map of the study area showing the stations (black circles) where ethnobotanical surveys took place

3. RESULTS AND DISCUSSION

The present investigation reports 58 species commonly employed as remedies for gastrointestinal ailments in this region. These medicinal plants were distributed among 30 taxonomic families and 55 genera. The families with more medicinal species were: the Lamiaceae family, with 9 species (15.51 %), followed by the Asteraceae and Apiaceae families with 6 species each (10.34%) of the total, Fabaceae with 5 species (8.62%). Rosaceae and Poaceae with 3 species each. Anacardiaceae, Cupressaceae and Euphorbiaceae with 2 species each; the rest of the families were represented by one specie each (Table 1). The information of these 58 plants is compiled in Table 2, where the plant species were arranged in alphabetical order, with their scientific names, botanical family, the common names, the part of use, the popular way of use and biological activities reports.

Table 1. Principal taxonomic families with medicinal plants for the treatment of gastrointestinal problems

Family*	Number of medicinal plants	%
Lamiaceae	9	15.51
Apiaceae	6	10.34
Asteraceae	5	10.34
Fabaceae	5	8.62
Poaceae	3	5.17
Rosaceae	3	5.17
Anacardiaceae	2	3.44
Cupressaceae	2	3.44
Euphorbiaceae	2	3.44

**Only families with more than 2 species are showed.*

The most commonly used plant parts correspond to the apical section such as leaves or stems, followed by seeds, with only a few species producing useful fruits and flowers. Processing of the vegetable material varies according to the disease, but powder and decoctions are most commonly employed (Table 2).

Table 2. Synopsis of medicinal plant species for popular use in treatment of gastrointestinal disease in Western Middle Atlas, Morocco

Scientific/ popular names	Family	Part	Gastrointes-tinal disorder	Biological activity	Form of use
*Acacia gummifera willd/*Taddût	*Fabaceae*	Leaves	Stomachache, dysentery, diarrhea	_	Powder
*Allium sativum L./*Tûma	*Amaryllidaceae*	Bulb	Gastroenteritis Rumen	Antioxidant, antimicrobial [18]	Crude
*Artemisia absinthium /*Shiba	*Asteraceae*	Stem/ Leaves	Stomach pain	Antimicrobial, Antioxidant [19]	Decoction
*Artemisia herba alba/*Chih	*Asteraceae*	Leaves	Abdominal pain	Antibacterial [20]	Decoction
*Carum carvi L./*Karwiya	*Apiaceae*	Seeds	Stomach pain	Antimicrobial [21]	Decoction
*Cassia senna/*Sana haram	*Fabaceae*	Leaves	Constipation	Antimicrobial, cytotoxic, Thrombolytic [22]	Decoction
*Ceratonia siliqua/*Kharroub/ Tikida	*Fabaceae*	Seeds	Stomach pain	Antibacterial [23]	Powder
*Chamaerops humilis/*El Ghaz	*Arecaceae*	Fruit	Stomachache	Antioxidant [24]	Crude
Chenopodium ambrosioidesL./ Mkhinza	*Amaranthaceae*	Leaves	Abdominal pain, Fever, Diarrhea	Antimicrobial, antioxidant [25]	Decoction
Cicer arietinum/ Hommes	*Fabaceae*	Seeds	Bowel disorders	Antibacterial, antifungal [26]	Maceration

Scientific/ popular names	Family	Part	Gastrointes-tinal disorder	Biological activity	Form of use
Cinnamomum zeylanicum Nees./ El Qarfa	*Lauraceae*	Bark	Stomach pain	Antimicrobial, anti-cancer [27]	Powder
*Citrus limon/*El Hamed	*Rutaceae*	Fruit	Bloating	Antibacterial, antioxidant [28]	Juice
Cistus albidus/Irgel	*Cistaceae*	Seeds	Stomachache	Antimycobacte rial [29]	Powder
*Coriandrum sativum L./*Kasbûr	*Apiaceae*	Seeds	Stomachache, diarrhea	Antibacterial, antioxidant [30]	Powder
*Crocus sativus L./*Zâfran Hôr	*Iridacea*	Stigmata	Abdominal pain	Antibacterial, antioxidant [31]	Decoction
Croton tiglium/ Habbet Malk	*Euphorbiaceae*	Seeds	Gas in the stomach or bowels	Anti-inflammatory [32]	Powder
*Cuminum cyminum L./*Kamoun	*Apiaceae*	Seeds	Abdominal pain, diarrhea	Anti-inflammatory Antimicrobial [33]	Powder
*Cynara humilis L./*El hok	*Asteraceae*	Leaves	Diarrhea	_	Decoction
*Echinops spinosus L./*Taskra	*Asteraceae*	Roots	Stomach pain	Antioxidant	Powder
*Eriobotrya japonica (thunb.) Lindl./*Lamzah	*Rosaceae*	Leaves	Colics, diarrhea	Anti-inflammatory [34]	Decoction
Euphorbia resinifera/ Ssekoum	*Euphorbiaceae*	Leaves	Stomach cancer	Antioxidant, antibacterial [35]	Powder
Eryngium ilicifolium Lamk./ Zerriga	*Apiaceae*	Whole plant	Indigestion	Antimicrobial [36]	Powder
*Foeniculum vulgare/*Nafaâ	*Apiaceae*	Seeds	Stomach and intestinal pain	Antibacterial [37]	Powder
Ficus carica L./Chriha	*Moraceae*	Fruit	Large intestine pain	Antimicrobial, antioxydant [38]	Crude
*Illicium verum/*Badiana	*Schisandraceae*	Fruit	Indigestion, gas in the Stomach or bowels	Antimicrobial [39]	Powder
*Juniperus thurifera L./*Tawalt	*Cupressaceae*	Leaves	Stomachache	Antibacterial, antioxidant [40]	Decoction
*Lavandula stoechas/*Halhal	*Lamiaceae*	Leaves	Stomachache, abdominal pain	Antimicrobial, antioxidant [41]	Powder
Lepidium sativum L./ Hab-rchad	*Brassicaceae*	Seeds	Stomach pain, cancer	Antioxidant, antibacterial [42]	Crude

Scientific/ popular names	Family	Part	Gastrointes-tinal disorder	Biological activity	Form of use
Linum usitatissimum L./ Zari't-el-Kettan	*Linaceae*	Seeds	Belly fat, gas in the stomach or bowels	Antibacterial [43]	Powder
*Lippia citriodora H.B&K/*Lwiza	*Verbenaceae*	Leaves	Diarrhea	Antibacterial [44]	Infusion
*Malus domestica Borkh./*Tuffah	*Rosaceae*	Fruit	Belly fat	Antimicrobial [45]	Vinegar
Matricaria chamomilla/ Babounj	*Asteraceae*	Flowers	Colics	Antibacterial [46]	Powder
*Mentha pulegium/*Fliou	*Lamiaceae*	Leaves	Abdominal pain, fever	Anti-tumor [47]	Decoction
*Mentha rotundifolia/*Timijja	*Lamiaceae*	Leaves	Abdominal pain, constipation	Anti-tumor [47]	Decoction
Myrtus communis/ Rayhan	*Myrthaceae*	Leaves	Gastritis, bloating	Antimicrobial, antioxidant [48]	Powder
Nigella sativa/Sanuj, Habbasawda	*Ranunculaceae*	Seeds	Abdominal pain	Anti-inflammatory, Anti-cancer [49]	Crude
*Olea europaea/*Zitoun	*Oleaceae*	Leaves	Colics	Anti-diabetes, antioxidant [50]	Powder
Opuntia ficus indica/ Karmousnsara	*Cactaceae*	Flowers	Stomachache, colics	anti-inflammatory, Antiulcer [51]	Powder
Origanum majorana L./ Merdedouch	*Lamiaceae*	Leaves	Bowel ailments	Antimicrobial [52]	Infusion
*Oryza sativa L./*Ruz	*Poaceae*	Seeds	Diarrhea	Antibacterial	Cooked
Pimpinella anisum L./ Habat-halawa	*Apiaceae*	Seeds	Stomachache, bowel ailments	Antibacterial [53]	Powder
*Pistacia lentiscus L./*Drou	*Anacardiaceae*	Fruit	Gastric ulcer, diarrhea	Antibacterial, Antioxidant [54]	Powder
Punica granatum L./ Romman	*Lythraceae*	Bark	Stomach pain, bowel ailments	Antibacterial [55]	Powder
*Rosa damascena Mill/*El ward	*Rosaceae*	Flowers	Stomach pain, bowel ailments	Antibacterial, antioxidant [56]	Powder
*Rosmarinus officinalis L./*Yazir	*Lamiaceae*	Leaves	Gas in the stomach or bowels	Antimicrobial, Anti-cancer [57]	Infusion
*Rhu spentaphylla Desf./*Tizgha	*Anacardiaceae*	Roots	Stomachache	Antimicrobial, antioxidant [58]	Decoction

Scientific/ popular names	Family	Part	Gastrointes-tinal disorder	Biological activity	Form of use
Salvia officinalis L./Salmia	*Lamiaceae*	Leaves	Abdominal pain	Anti-inflammatory, Anti-cancer [59]	Decoction
Solanum sodomeum L./ El-Hdej	*Solanaceae*	Seeds	Diarrhea	Antioxidant [60]	Decoction
Taraxacumatlanticum L./Handba	*Asteraceae*	Roots	Bowel disorders	_	Powder
Terminalia chebula/Hlilij	*Combretaceae*	Fruit	Stomach pain	Antibacterial [61]	Powder
Tetraclinis articulata/El-Ârâr	*Cupressaceae*	Leaves	Stomachache, diarrhea	Antibacterial [62]	Powder
Trigonella foenum graecum/Halba	*Fabaceae*	Seeds	Stomach pain	Antimicrobial [63]	Powder
Triticum aestivum L./Zrâ	*Poaceae*	Seeds	Gastroenteritis	Antibacterial [64]	Wheat germ
Thymus satureioides/Z'itra	*Lamiaceae*	Leaves/ Stems	Bloing, diarrhea	Analgesic [65]	Infusion
Thymus zygis L./Za'tar	*Lamiaceae*	Leaves/ Stems	Abdominal pain, fever	Antibacterial [66]	Decoction
Vicia faba L./Foul	*Fabaceae*	Flowers	Colics	Antioxidant [67]	Infusion
Zea mays L./Dra	*Poaceae*	Seeds	Bowel ailments	Antimicrobial [68]	Powder
Ziziphus lotus L./Nbeg	*Rhamnaceae*	Leaves/ Fruit	Stomach pain	Antimicrobial [69]	Powder

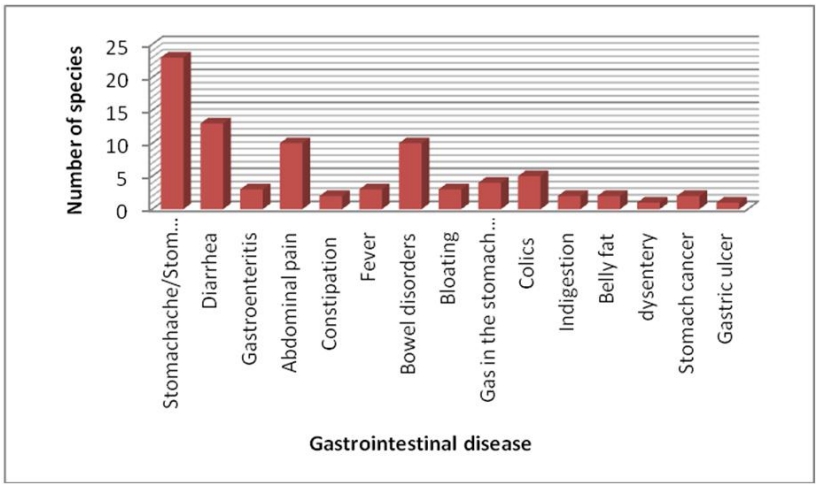

Fig. 2. Principal gastrointestinal diseases and number of species for treat them

In this study 15 gastrointestinal ailments were found to be treatable with medicinal plants. The four main disorders cured by the plants are: Stomachache/Stomach pain (39.65%), diarrheas (22.41%); abdominal pain (17.24%), bowel disorders (17.24%)(Fig. 2).The medicinal uses of 56 species (96.55%) are supported by reports that evaluate their biological activity.

4. CONCLUSION

In the scope of the present study, 58 plants belonging to 30 families were detected to be used by the local people for curative purposes. Lamiaceae was the most dominant family reported to be used for the treatment of gastrointestinal diseases (9 species). Among all the plant parts leaves and seeds were the most preferred plant parts used by the healers. Decoction and Powder were the most popular form of treatment used. The four main disorders cured by the plants are Stomachache/Stomach pain (39.65%), diarrhoeas (22.41%); abdominal pain (17.24%), bowel disorders (17.24%). Due to low-income status and lack of modern health facilities people of the region are using medicinal plants for these diseases. They have centuries old traditional knowledge to prepare different types of effective plant remedies against gastrointestinal disorders. Locals of the region are heavily dependent on these medicinal plants, therefore, causing severe threats to the abundance of these plants. There is a dire need to protect these medicinal plants before their extinction.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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