

Ethnomedicinal Plants Used by the Populations of the Central High Atlas of Morocco for the Prevention and Relief of the Main Symptoms Similar to Coronavirus Diseases

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ABSTRACT

In Morocco, the population has used several medicinal plants to relieve and prevent against covid-19. The data were collected through questionnaires and other means (Telephone, WhatsApp, Facebook). The information collected from the survey also showed that the inhabitants of the Central High Atlas of Azilal use during covid-19 a total of 50 species of medicinal plants belonging to 18 families. Based on the ICF value the five symptoms treated were the fever (ICF = 0.90), followed by cough (ICF = 0.79), headache with (ICF = 0.68), breathing difficulties (ICF = 0.61), diarrhea (ICF=0.31), and fatigue (ICF = 0.22). The results showed that medicinal plants in the study area occupy an important place in the treatment of the principles similar to those of the coronavirus.

INTRODUCTION

Coronavirus disease (covid-19) is a respiratory syndrome coronavirus 2 (SARS-COV2) infection that began in Wuhan, China, and quickly spread throughout the country and around the world. On March 11, the World Health Organization (WHO) classified Covid-19 as a pandemic. The symptoms noted in infected patients are fever, cough, fatigue, abdominal pain, headache, nausea, and other gastrointestinal problems. Currently, this new coronavirus is constituted as one of the major pathogens that mainly target the human respiratory system and poses a significant threat to public health. Until today, more than 11 million cases of COVID 19 have been reported worldwide, with more than 2 million deaths. In the present, although modern medicine is available, the use of plants are still widely used to treat ancient diseases or those that have emerged in recent years. Indeed, approximately 80% of the population in developing countries depend on traditional medicine for their primary health care needs.

The Moroccan flora is the second most diverse in the Mediterranean region and the richest in North Africa, with about 6552 species of which the number of medicinal plants is estimated at about 800 species. This richness and diversity of flora have allowed the inhabitants of Morocco for a long time to use a large number of plants to fight against diseases and epidemics. In addition, previous studies have shown that several medicinal plants have been used to treat and remedy many respiratory diseases and signs of symptoms similar to those of COVID 19.

Despite the importance of medicinal plants to remedy the main symptoms of the new coronavirus such as fever, influenza, and headache, diarrhea and respiratory disorders, in Morocco until today, no in vitro studies and clinical trials to examine the effect of these plants on SARS-COV2 have been done. On the other hand, in some countries, traditional Medicine and herbal Medicine have tried to provide solutions to covid-19. For example, in China, a recent study has shown that *Artemisia annua* contains four molecules having an inhibitory effect on SARS-COV2. In the same country, trials on herbal products such as Qing Fei Pai Du Tang have shown its effectiveness in improving the condition of 98% of patients affected by covid-19. Another recent study also reviewed a database on medicinal plants containing photochemical substances that can inhibit the enzymatic activity of SARS-COV-2 3Clpro.

It is important to note that there are similarities in symptoms between COVID-19 and the earlier beta coronaviruses, such as influenza, fever, cough, dyspnea, and headache. As a result, the Moroccan population has been using herbal remedies for protection and prevention against diseases with symptoms similar to those of coronavirus disease. The Azilal region, which is part of the central High Atlas, includes vast forest areas where the natural vegetation is still more preserved. This richness and diversity of medicinal flora offer the local population a rich knowledge of traditional phytotherapy. The choice of this study area is justified by its richness in medicinal plants as well as its strong use by the population of the region. The objective of this research work is to make a diagnosis of plants used by the population of the study area and their effect on health and this based on field surveys.

THEORETICAL REVIEW

Presentation of Study Area

The study area corresponds to the Eastern mountain area of Azilal Province, and lies between 32°28'-31°58'N and 6°34' W with a total area of 10 758 ha. The climate of this region is the Mediterranean, characterized by a very cold winter and a very hot summer. It varies from a humid climate towards the tops of the high mountains to a sub-arid climate under the mountain ranges. Annual rainfall varies between 300 and 750 mm. Economically, agriculture and livestock are the fundamental component of the rural economy throughout the region. In most cases, these are a traditional farming and extensive livestock herding. According to the General Census of Population and Housing 2014, this region has 504 501 inhabitants 89.86 % of whom are rural. The total human population in 2014 was about 86869,70 whom are rural.

The study area includes very diverse mountainous areas with very different natural characteristics (geographical, climatic, ecological, floristic...). The study area is among the regions known for their floristic diversity with the presence of many species of medicinal plants and a particularly high rate of endemism. It is for example: *Myrtus communis*, *Pistacia lentiscus*, *Pistacia atlantica*, *Juniperus thurifera*, *Artemisia herba-alba*, *Thymus maroccanus*, *Thymus satureioides*, *Lavandula pedunculata*. Samples of 310 citizens were surveyed in seven cities and villages: Azilal, Tagleft, Anergui, Zaouiat Ahansal, Tabant, Ouaouizaght and Demnate. The dialogue was done in Amazigh or in Arabic depending on the case (Figure 1).

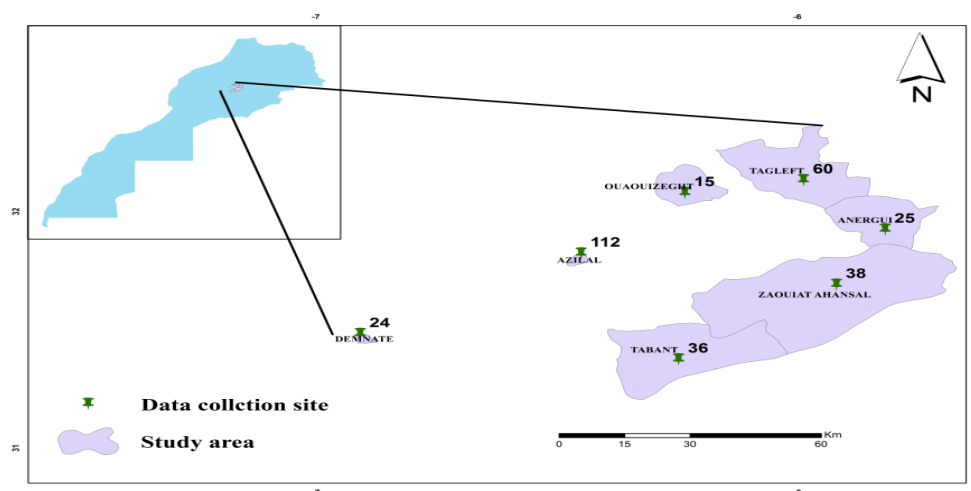


Figure 1. Geographical Location of the Study Area

The State of Spread of Covid-19

To date (March 27, 2021), Morocco has recorded 494 849 cases of infection with covid-19, including 8 804 deaths and 482,084 people cured, while the number of cases excluded after negative results amounts to 59 861. In the region of Azilal, the number of cases infected with this virus was relatively low compared to other regions of the kingdom. Figures 2 and 3 show the distribution and evolution of confirmed cases in Morocco.

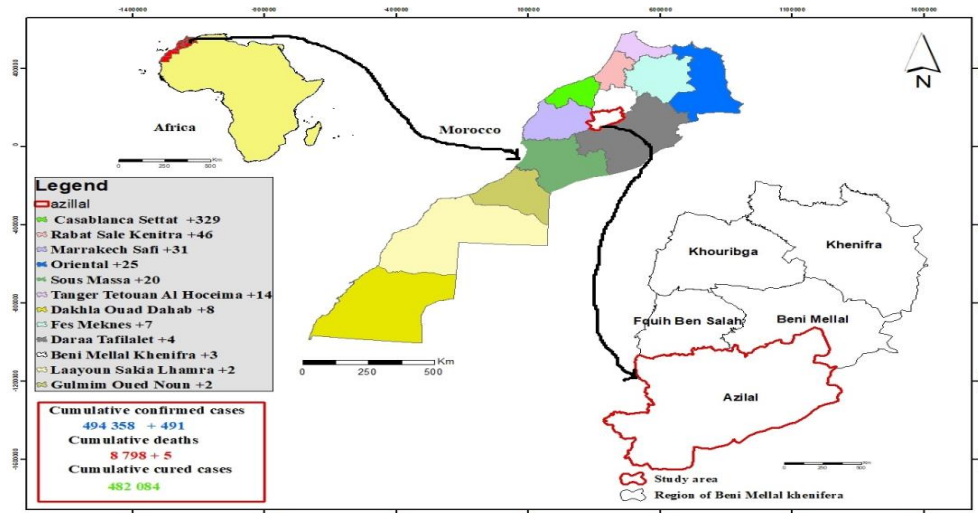


Figure 2. Distribution of Confirmed Cases of Covid-19 in the Regions of Morocco

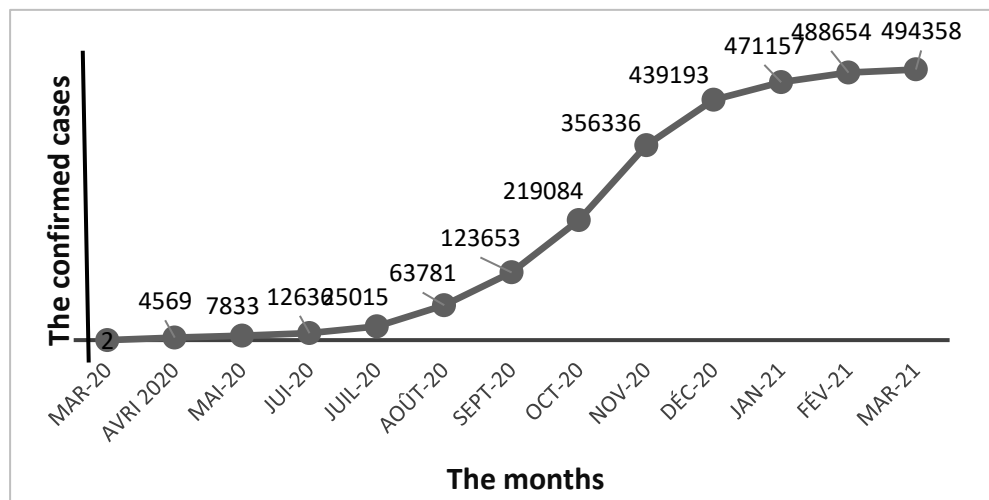


Figure 3. Evolution of the Epidemiological Situation in Morocco

METHODOLOGY

The data collection was carried out through a questionnaire that aims to collect information on the inhabitants and the plants used in the treatment and prevention against symptoms similar to those of the coronavirus (COVID-19) in the Azilal region. The survey of the local population of this region was conducted between June 2020 and February 2021. During this survey, the sanitary protocol was respected in order to avoid any risk of contamination. The main questions asked are presented in Table 1.

Table 1. The Main Questions Dedicated to the Inhabitants of the Study Area

Q1: Are you male or female?
Q2: How old are you?
Q3: Do you live in a rural/urban area?
Q4: Have you experienced symptoms similar to those of covid-19? If yes, which one(s)?
Q5: Do you use any remedy(s) for the symptoms developed? If yes, is it medication/phytotherapy?
Q6: If you used the plants, what are these plants (Name of the plant) ?
Q7: How do you prepare these plants?
Q8: How often do you use medicinal plants (before and during the pandemic)?

The data obtained and collected were entered and statistically analysed by the computer software SPSS (System Package for Social Sciences, version 23). Two quantitative index values were calculated to analyse the data using the Use Value (UV) and The informant consensus factor (ICF). In addition, Arc GIS 10.8 software was used to obtain maps of the information collected in the field.

The Informant Consensus Factor (ICF)

The informant consensus factor was calculated to seek agreement among informants on the reported remedies for each disease group [20]. The ICF value ranges from 0 to 1. A high ICF indicates that there is a high degree of agreement or shared knowledge between the participants on the medicinal uses of a particular species for treating one of the main symptoms of covid-19 disease. Low ICF value indicates that the informants do not agree or do not share knowledge on the uses of specific plants used to treat a category of coronavirus disease [21]. ICF is calculated using the following formula:

$$ICF = \frac{Nur - Nt}{Nur} \dots \dots \dots (1)$$

Where "Nur" refers to the total number of use reports for each disease cluster and "Nt" refers to the total number of species used for that cluster.

The Use Value (UV)

The Use Value (UV) was calculated using the formula below:

$$UV = \frac{\sum}{N} \dots \dots \dots (2)$$

Where, " $\sum$ " the total number of use reports per plants and N is the total number of respondents interviewed. High UV values are obtained when the species with a high level of use, while a low UV value indicates while indicates fewer use reports cited by the respondent.

RESULTS AND DISCUSSIONS

Results of the present survey revealed that medicinal plants have an essential role in the treatment of ancient and new diseases, such as covid, that have emerged in recent years. The potential use of medicinal plants and species of these plants involved in the treatment of the principles signs of covid-19 are analyzed and discussed in the following section.

Impacts of Covid-19 on Dietary Habits

Of the 310 people interviewed, 247 used traditional Medicine (79%) and 63 used modern Medicine (21%). The population that uses more medicinal plants is the one in small centers and in rural areas. On the other hand, the consumption of plants by urban dwellers remains somewhat limited. Concerning the academic level of the respondents using medicinal plants, the results show that 74.19% are illiterate, while 16.12% have a primary level and 9.67% have a secondary level. Moreover, medicinal plants are used almost equally by women and men. The survey results showed that covid-19 influences the behavior of the population towards medicinal plants. Indeed, high consumption of medicinal plants was noticed during the pandemic. This is to strengthen the immune system. Figure 4 shows the outcome of the frequency of medicinal plant consumption before and during the period of covid-19.

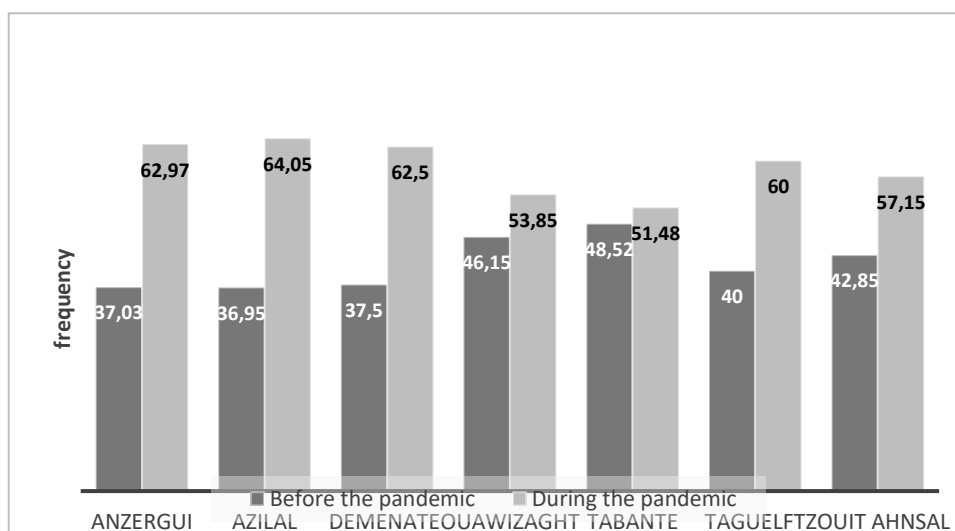


Figure 4. Potential Use and Consumption of Medicinal Plants in the Study Area

Medicinal Plants Used by the Local Population

The floristic analysis of the plants used by the population in the study area showed that respondents used a total of 50 species belonging to 18 families for the prevention and treatment of Covid-19. The most popular families are Lamiaceae and Apiaceae, which have 16 and 4 species, respectively, followed by Cupressaceae, Asteraceae, Liliaceae, Verbenaceae, Zingiberaceae, and Myrtaceae, which each have three species, and the remaining ten families have only two or one species (Table 2). These data are consistent with previous studies that reported that Lamiaceae, Apiaceae and Asteraceae are more used in the

treatment of diseases present in the three respiratory disorders similar to that of covid 19 in the High and Middle Atlas of Morocco. These botanical families are also known by their therapeutic uses in different regions in Morocco. These results may explain the observed exploitation of these plants by the population who used them not only to remedy old diseases but also emerging and new diseases like COVID-19.

Table 2. Ethnomedicinal Plants Used by the Inhabitants during the Covid-19 Pandemic

Botanica family	Species	Local name	statut	Habit	Part Used	Mode of preparation	Use value s (UV)
Amaranth aceae	<i>Chenopodium ambrosioides</i> L.	M'khinza	Wild	Herb	Leaves	Decoction /infusion	0.77
Amaryllid aceae	<i>Allium cepa</i> L.	Azalim	Cultivated	Herb	Bulbs	Decoction/ Infusion /Cataplasma	0.29
	<i>Allium Sativum</i> L.	Touma	Cultivated	Herb			0.85
Anacardi aceae	<i>Pistacia atlantica</i> Desf.	Iguie	Wild	Tree	Leaves and fruits	Decoction /Powder	0.05
	<i>Pistacia lentiscus</i> L.	Tidaete	Wild	Tree			0.17
Apiaceae	<i>Ammodaucus leucotrichus</i> Coss.& Dur.	Kamoun soufi	Wild	Herb	Leaves and Stem	Decoction/ Infusion	0.015
	<i>Coriandrum sativum</i> L.	kazbour	Cultivated	Herb	Fruits and flowers	Decoction/ Powder	0.032
	<i>Cuminum cuminum</i> L.	Kamoun	Wild	Herb	Seeds	Infusion	0.38
	<i>Petroselinum sativum</i> L.	Meadnouns	Cultivated	Herb	Leaves and Stem	Infusion	0.11
Asteraceae	<i>Artemisia absinthium</i> L.	Chiba	Wild and cultivated	shrub	Leaves and Stem	Infusion/de coction	0.20
	<i>Artemisia herba-alba</i> Asso.	Chih	Wild	herb			0.10
	<i>Matricaria camomilla</i> L.	Babounj	Wild	Herb	Flowers	Infusion/de coction	0.07
Cupressac eae	<i>Juniperus oxycedrus</i> L.	Tiqui	Wild	Tree	Leaves	Decoction/I nfusion/Ca taplasma	0.02
	<i>Juniperus thurifera</i> L.	Tawalt	Wild	Tree			0.03

	<i>Tetralinis articulata</i> (Vahl) Mast.	Aerar	Wild	Tree			0.19
Fabaceae	<i>Ceratoniasiliqua</i> L.	Tikite	Wild and cultivated	Tree	Leaves and fruits	Infusion/ cataplasm	0.02
	<i>Trigonella foenum-graecum</i> L.	Halba	Cultiverd	Herb	Seeds	Infusion/ Cataplasm	0.78
Lamiaceae	<i>Calamintha officinalis</i> (L.) kuntze	Manta	Wild	Herb	Leaves and Stem	Decoction/ Infusion	0.028
	<i>Lavandula dentata</i> L.	lkhzama	Wild	Herb			0.15
	<i>Lavandula pedunculata</i> (Mill.)Cav	Irghiolle	Wild	Herb			0.74
	<i>Lavandula stoechas</i> L.	Lhalhale	Wild	Herb			0.40
	<i>Marrubium vulgare</i> L.	Mreoua	Wild	Herb			0.21
	<i>Mentha piperita</i> L.	Naenaaebdi	Cultivated	Herb			0.012
	<i>Mentha pulegium</i> L.	Fliou	Cultivated	Herb			0.48
	<i>Mentha suaveolens</i> Ehrh.	Timija	Wild	Herb			0.42
	<i>Mentha viridis</i> L.	Naenaae	Cultivated	Herb	Leaves and Stem	Decoction/ Infusion	0.03
	<i>Ocimum basilicum</i> L.	Tafloute	Cultivate d	Herb			0.06
	<i>Origanum majorana</i> L.	Mardeidouch	Wild	Herb			0.05
	<i>Rosmarinus officinalis</i> L.	Azir	Cultivated	Herb			0.62
	<i>Salvia officinalis</i> L.	Salmia	Wild	Herb			0.29
	<i>Thymus maroccanus</i> L.	Zaatere	Wild	Herb			0.42
	<i>Thymus satureioides</i> Coss.	Azoukeni	Wild	Herb			0.72
	<i>Thymus zygis</i> L.	Zaitera	Wild	Herb			0.64
Lauraceae	<i>Cinnamomum cassia</i> J. Presl.	Lkarfa	Wild	Tree	Bark	Powder	0.30
	<i>Laurus nobilis</i> L.	WarqatMousa	wild	Tree	Leaves	Decoction/ Infusion	0.09

Lythraceae	<i>Lawsonia inermis</i> L.	Elhanna	Cultivated	Herb	Leaves	Cataplasm	0.05
	<i>Punica granatum</i> L.	Romman	Cultivated	Tree	Peel	Infusion	0.016
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	Elcalypitous	Wild and Cultivated	Tree	Leaves	fumigation	0.70
	<i>Eugenia caryophyllata</i> Thunb.	Qranfel	Wild	Tree	Flower buds	Infusion	0.37
	<i>Myrtus communis</i> L.	Rihan	Wild	Tree	Leaves	Cataplasm	0.25
Oleaceae	<i>Olea europaea</i> L.	Zitoun	Wild and Cultivated	Tree	Leaves / Fruits	Infusion/ Cataplasm	0.32
Pinaceae	<i>Pinus halepensis</i> Mill.	Tayda	Wild and Cultivated	Tree	Leaves	fumigation	0.20
Ranunculaceae	<i>Nigella sativa</i> L.	Habba Souda	Wild	Herb	Seeds	Infusion/ Cataplasm	0.23
Rosaceae	<i>Rosa canina</i> L.	Taghofert	Wild	Tree	Fruits / Flowers	fumigation	0.013
	<i>Rubus fruticosus</i> L.	Tabegha	Wild	Tree		Infusion	0.03
Verbenaceae	<i>Aloysia citriodora</i> Palau.	Louiza	Cultivated	Herb	Leaves	Infusion	0.53
Zingiberaceae	<i>Alpinia officinarum</i> Hance.	Khoudenjal	Cultivated	Herb	Rhizomes	Decoction	0.65
	<i>Curcuma xanthorrhiza</i> Roxb.	Kharkhoum	Cultivated	Herb			0.36
	<i>Zingiber officinale</i> Roscoe.	Skinjbir	Cultivated	Herb			0.67
Zygophyllaceae	<i>Peganum harmala</i> L.	Harmel	Wild	Herb	Leaves	Infusion	0.22

Figure 5 shows the different species of medicinal plants consumed during the covid-19 pandemic according to their frequency of use (number of times a plant species is cited by the 310 respondents). Moreover, the residents mostly use herbs (64%) for their remedies which are widely distributed in the Central High Atlas Mountains and can easily be harvested. Of the 50 species, 68% were wild while 32% were cultivated. This study thus highlights the dependence of traditional healers on the Central High Atlas Mountains in obtaining their ethnomedicines from the natural environment. On other Most respondents have indicated that they take herbal medicines orally using decoction or infusion. Ethnobotanical studies conducted in other parts of Morocco found that the majority of informants prepared herbal remedies by infusion and decoction. This

result corroborates the fact that there is an ongoing transfer of knowledge on the effectiveness of plant species between inhabitants of Morocco.

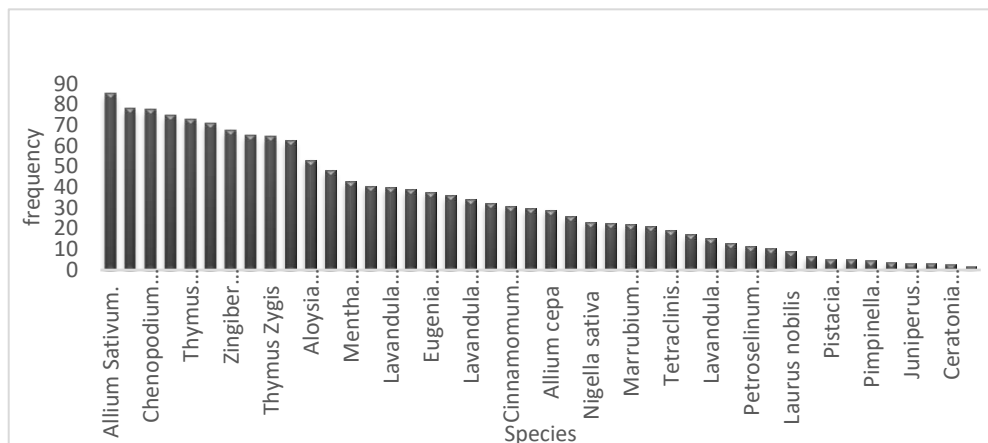


Figure 5. Frequencies of Medicinal Plants Used during Covid-19 in the Study Area

The comparison of the results of the present study with others carried out at the national level, it is found that these species are widely used in the study area and in other regions of Morocco. Moreover, the majority of these plants cited in this study have been used in Moroccan traditional Medicine to treat diseases with symptoms similar to those caused by coronavirus.

Prevention and Treatment of Covid 19 Symptoms in the Study Area

The results of the principles symptoms of covid 19 treated by ethnomedicinal plants are presented in Figure 6. According to the results of the ICF values, it was found that the inhabitants used medicinal plants to treat a number of symptoms related to covid 19, such as fever, cough, fatigue, diarrhea, headache, and breathing difficulties (Figure 6). Six symptoms were treated with medicinal plants by the population in the study area. In general, the results obtained show that the category with the highest degree of informant agreement (ICF) was fever (ICF = 0.90), followed by cough (ICF = 0.80), headache with (ICF = 0.73), breathing difficulties (ICF = 0.50), diarrhea (ICF = 0.38), and lastly fatigue (ICF = 0.25). Most of the respondents indicate that these plants have beneficial effects, including the control of fever, cough, headache and diarrhea as well as other respiratory symptoms such as asthma, rhinitis, flu, allergies, bronchitis and pneumonia (Table 3).

Table 3. ICF Values for Each of the Symptoms of Covid-19

Use categories	Number of taxa (Nt)	Number of use reports (Nur)	ICF
Fever	40	412	0.90
Cough	35	179	0.80
Headache	30	112	0.73
BreathingDifficulties	27	54	0.50
Diarrhea	14	22	0.38
Fatigue	10	13	0.25

The survey also showed that the different parts of the plant are used by the respondents to relieve from main symptoms of COVID-19. Leaves and stems (40%) or leaves only (20%) are the most frequently used part of the medicinal plants, followed by the flowers (12%), and fruit (6%). The choice of leaves can be explained by the ease of harvesting as well as their richness in bioactive components. This confirms that the leaves are the most used parts of the plant for the preparation of medicines in Morocco and Africa. Furthermore, most of the interviewees indicated that some species are used for the treatment of several diseases at the same time; this is the case for example *Chenopodium ambrosioides* which is used in case of fever and headaches. The interviews also revealed that these people took remedies based on medicinal plants in the form of fresh or dried material mixed with certain components and solutions like milk, water, oils and honey. Regarding the toxicity and the mode of preparation of these species have been reported in ethnobotanical studies of medicinal plants in Morocco.

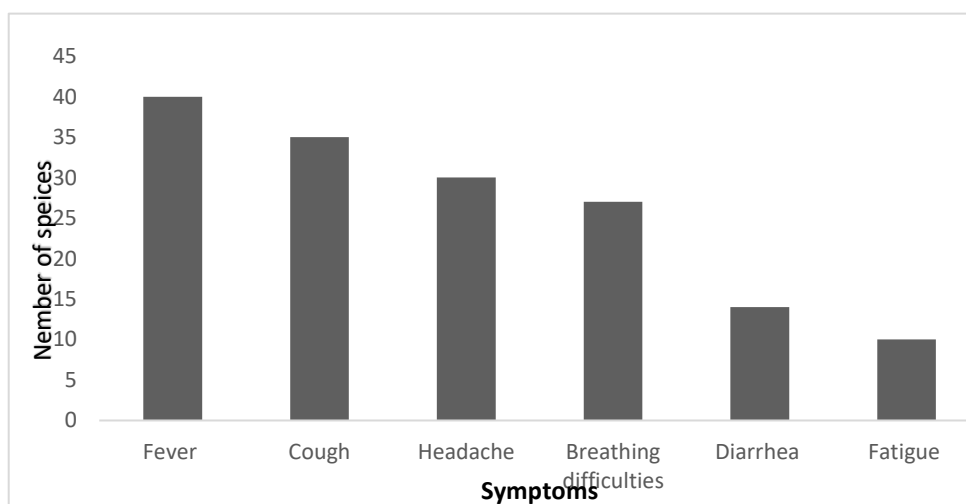


Figure 6. Distribution of Ethnobotanical MP Use Rates for the Six Covid-19 Symptoms in the Study Area

According to several studies, the majority of the plants used in covid19 contain many bioactive components including essential oils, flavonoids, phenolics, carotenoids, steroids, glycosides and alkaloids. These compounds have properties such as antimicrobial, antifungal, antiviral, antioxidant, muscle

relaxant, and analgesic, as well as various effects on the respiratory system, have been reported [41-45]. Due to the lack of in vitro studies and clinical trials of these plants on SARS-COV2 activity. However, some compounds of these plants could be responsible for the disappearance of the characteristic symptoms of covid-19.

CONCLUSIONS AND RECOMMENDATIONS

The present work has allowed us to shed light on the ethnomedicinal plant species used by the inhabitants of the Central High Atlas in Morocco for the prevention or treatment of the main symptoms of covid-19. According to the ethnobotanical survey, the use of medicinal plants during covid-19 is widespread in the study area. This study shows that 50 species are used in traditional Medicine during the covid-19 pandemic for protective purposes. The most commonly used medicinal plant species were: *Allium sativum*, *Trigonella foenum-graecum*, *Chenopodium ambrosioides*, *Lavandula pedunculata*, *Thymus satureioides*, *Eucalyptus globulus*, *Zingiber officinale*, *Alpinia officinarum*, *Thymus Zygis*, *Rosmarinus officinalis*, *Aloysiacitriodora*, *Mentha pulegium*. Of all the symptoms treated, fever, cough, fatigue, diarrhea, headache and breathing difficulties were the most frequently cited by the respondents. Leaves and stems or leaves only are the most used part in treatment of these symptoms, while the most common methods of preparation include decoction, infusion and maceration. It is difficult to conclude that medicinal plants have a beneficial effect of minimizing and preventing against SARS-COV2. However, the results could serve as a basis for conducting more precise studies to assess the safety and value clinical of the main crude and bioactive compounds derived from these plants and to clarify their mechanisms of action in the fight against Covid-19.

FURTHER STUDY

Furthermore, most of the interviewees indicated that some species are used for the treatment of several diseases at the same time; this is the case for example *Chenopodium ambrosioides* which is used in case of fever and headaches. The interviews also revealed that these people took remedies based on medicinal plants in the form of fresh or dried material mixed with certain components and solutions like milk, water, oils and honey. Regarding the toxicity and the mode of preparation of these species have been reported in ethnobotanical studies of medicinal plants in Morocco.

REFERENCES

- Lai CC, Shih TP, Ko WC, Tang HJ, Hsueh PR. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19) : The epidemic and the challenges . J antimicrobial agents. 2020; 55: 105924.
- Wang XL, Huang CY, Ren LJ, Zhao YH. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. J the Lancet. 2020; 395: 497-506.

- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J. A novel coronavirus from patients with pneumonia in China .New England journal of medicine.2019; 382:727-733.
- Ren LL, Wang YM, Wu ZQ, Xiang ZC, Guo L, Xu T. Identification of a novel coronavirus causing severe pneumonia in human a descriptive study. Chinese Med.2020; 134: 655.
- Carlos WG, Cruz CS, Cao B, Pasnick S, Jamil S. Novel wuhan (2019-nCoV) coronavirus. J of Respi and Critical Care Med.2020; 201: 7-8 .
- Wang WJ, Tang F, Wei. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan . J Chinese Med.2020; 92: 441-447.
- Ekor M.The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety . J Fron in Pharmacology.2018; 4 :177.
- Birhan W, Giday M, Teklehaymanot T. The contribution of traditional healers' clinics to public health care system in Addis Ababa, Ethiopia: a cross-sectional study. J Ethnobiol and Ethno.2011; 7 :39.
- Valdés B, Rejdali M, El-Kadmiri A, Jury SL, Montserrat M. Catalogue des plantes vasculaires du Nord du Maroc incluant des clés d'identification. Editorial CSIC-CSIC Press.2002.
- Rankou H, Culham A, Jury S, Christenhusz MJM. The endemic flora of Morocco. Phytotaxa.2013; 78:169.
- Salhi S, Fadli M, Zidane L, Douira A. 2010. Etudes floristique et ethnobotanique des plantes médicinales de la ville de Kénitra (Maroc).Lazaroa.2010; 31 :133-146.
- Benlamdini N, Elhafian M, Rochdi A, Zidane L. Étude floristique et ethnobotanique de la flore médicinale du Haut Atlas oriental (Haute Moulouya) . J Appl Biosci .2014 ; 78 :6771-6787.
- Yang Y, Islam MS, Wang J, Li Y, Chen X. Traditional Chinese Medicine in the Treatment of Patients Infected with 2019-New Coronavirus (SARS-CoV-2): A Review and Perspective . International journal of biological sciences.2020; 16 :708-1717
- Han YY, Zhao MR, Shi B, Song ZH, Zhou SP, He Y. Application of integrative 89. medicine protocols on treatment of coronavirus disease. J Chines Traditional and Herbal Drugs.2019; 878-882.

- Khaerunnisa S, Kurniawan H, Awaluddin R, Suhartati S, Soetjipto S. Potential Inhibitor of COVID-19 Main Protease (Mpro) from Several Medicinal Plant Compounds by Molecular Docking Study. Preprints.2020; 6-7.
- Riou J, Althaus CL. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. Eurosurveillance.2020; 25: 20-58.
- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J. A novel coronavirus from patients with pneumonia in China .New England journal of medicine.2019; 382:727-733.
- El Alami A, Farouk L, Chait A. Etude ethnobotanique sur les plantes médicinales spontanées poussant dans le versant nord de l'Atlas d'Azilal (Maroc) . J Nat Products .2016 ; 4 : 271-282.
- Bellakhadar J. 1997. La pharmacopée marocaine traditionnelle. Press Ibis, 764 p.
- Heinrich M. Ethnopharmacy and natural product research – Multidisciplinary opportunities for research in the metabolomic age. J Phytochemistry Letters.2008; 1-5.
- Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. Medicinal plants in Mexico: healers' consensus and cultural importance.J Social science & medicine.1988 ; 47 : 1859-1871.
- Phillips O, Gentry AH, Reynel C, Wilkin P, Galvez-Durand B. Quantitative ethnobotany and amazonian; conservation etnobotánica cuantitativa y la onservación de la amazonia. J Conservation Biology. 1994; 8: 225- 248.
- Calder PC, Carr AC, Gombart AF, Eggersdorfer M. Optimal nutritional status for a well functioning immune system is an important factor to protect against viral infections. Journal of Nutrients.2020; 12: 1182-1191.
- Gasmi A, Noor S, Tippairote T, Dadar M, Menzel A, Bjørklund G. Individual risk management strategy and potential therapeutic options for the COVID-19 pandemic. J Clinical immunology.2020; 215: 1-9
- Jayawardena R, Sooriyaarachchi P, Chourdakis M, Jeewandara C, Ranasinghe P. Enhancing immunity in viral infections, with special emphasis on COVID-19: A review. Diabetes & Metabolic Syndrome 2020; 14: 367-382.
- El Alami A, Chait A. Enquête ethnopharmacologique et ethnobotanique sur les plantes médicinales dans le Haut Atlas central du Maroc .J Nat Products.2017; 5 : 427-445.

- Hamamouch N. Use of Ethnomedicinal Plants by the People Living in the Middle Atlas Mountains in Morocco. *Journal of Med and Aromat Plants*.2020; 9: 349.
- El-Midaoui M, Maataoui A, Benbella M, Ait Houssa A, Labazi N. Ethnobotanical study of some aromatic and medicinal plants in the Middle Atlas Mountains of Morocco. *J Nat Produits*.2011; 6: 1455-1458.
- Benkhniq O, Zidane L, Fadli M, Elyacoubi H, Rochdi A, Douira A. Etude ethnobotanique des plantes médicinales dans la région de Mechraâ Bel Ksiri (Région du Gharb du Maroc). *J Acta botánica barcinonensia* .2010; 53 :191-21.
- Islam k. Anethnobotanical study of medicinal plants used bytribal and native people of Madhupur forest area,Bangladesh. *J Ethnopharm*.2014 ; 151: 921.
- Chaachouay N, Benkhniq O, Fadli M, Ellbaoui H, ElAyadi R , Zidane L. 2019. Ethnobotanical and ethnopharmacological study of medicinal and aromatic plants used in the treatment of respiratory system disorders in the Moroccan Rif. *J Ethnobot*.2019; 18: 1-6.
- Bouiamrine E, Bachiri L, Ibijbijen J, Nassiri L .Fresh medicinal plants in the middle atlas of Morocco: Trade and threats to the sustainable harvesting. *J Med Plants Studies*.2017; 5:123-128
- Hmamouchi M. Les plantes médicinales et aromatiques marocaines, utilisation, biologie, écologie, Wang 387p.
- Ben Akka F, Salhi S, Benkhniq O, Dahmani J, Douira A, Lahcen Z. Ethnobotanical study of medicinal plants used in the region of middle OumRbia (Morocco). *J Plant Archives* 2019; 19 : 2005-2017.
- Daoudi A, Bammou M, Zarkani S, Slimani L, Ibijbijen J, Nassiri L. 2016. Étude ethnobotanique de la flore médicinale dans la commune rurale d'Aguelmouss province de Khénifra (Maroc). *Phytothérapie*. 2016 ; 14: 220-228.
- Chaachouay O, Benkhniq M, Fadli E, Ayadi R, Zidane L. Ethnobotanical study of medicinal plants used to treat osteo articular diseases in the Moroccan Rif, Morocco. *J Pharm and pharmacol*.2019; 7 : 545-470.
- Mukungu N, Abuga K, Okalebo F, Ingwela R, Mwangi J. Medicinal plants used for management o fmalaria among the Luhya community of Kakamega East sub-County, Kenya. *J Ethnopharmacol*.2016;194 : 194.98.

- Asase A, Akwetey A, Achel G. Ethnopharmacological use of herbal remedies for the treatment of malaria in the Dangme West District of Ghana. *J ethnopharmacol.* 2010; 129: 367-376
- El Hassani M, Douiri E, Bammi J, Zidane L, Badoc A, Douira A. Plantes médicinales de la Moyenne Moulouya (Nord-Est du Maroc). *J Ethnopharmacol.* 2013 ; 50.
- El Hilah F, Ben Akka F, Dahmani J, Belahbib N, Zidane L. Étude ethnobotanique des plantes médicinales utilisées dans le traitement des infections du système respiratoire dans le plateau central marocain. *J Animal & Plant Sciences.* 2005 ; 25 : 3886-3897.
- Fredotović Z. Chemical composition and biological activity of *allium cepa* L. And *Allium cornutum* (Clementi ex Visiani 1842) methanolic extracts. *Molecules.* 2017; 22.
- Mohamed N, Maideen P. Prophetic Medicine-*Nigella Sativa* (Black Cumin Seeds). Potential Herb for COVID-19. *J pharmacopunct.* 2020; 23 : 62.
- Unlu M, Ergene E, Unlu GV, Zeytinoglu HS, Vural N. Composition, antimicrobial activity and in vitro cytotoxicity of essential oil from *Cinnamomum zeylanicum* Blume (Lauraceae). *J Food and Chemical Toxicol.* 2010; 48 : 3274-3280.
- Mulyaningsih S, Sporer F, Reichling J, Wink M. Antibacterial activity of essential oils from *Eucalyptus* and of selected components against multidrug-resistant bacterial pathogens. *J Pharmaceutical Biology.* 2011; 49: 893-899.
- Damjanović-Vratnica B, Dakov T, Šuković D, Damjanović J. Antimicrobial effect Of essential oil isolated from *eucalyptus globulus* Labill. from Montenegro. *Food Sci.* 2011; 29: 277-284.