Ethnobotanical study on the different use forms of *Cannabis sativa* L. in the provinces of Al-Hoceima and Chefchaouen (Northern Morocco)

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Research

Abstract

Background: Cannabis sativa L. was among the first plants used by humans for fiber, food, medicine, and in sociocultural settings. This study aimed to identify the local uses of *Cannabis sativa* L. and its socio-cultural importance in the provinces of Al-Hoceima and Chefchaouen in Northern Morocco.

Methods: The survey was conducted between September 2023 and May 2024 using semi-structured questionnaires in the provinces of Al-Hoceima and Chefchaouen.

Results: The values of the diversity and equitability knowledge indices are high (ID>5 and IE>0.5) indicating an equal distribution of knowledge among the respondents about *Cannabis sativa* L. Five types of use of the species were identified: economic, psychoactive, traditional medicine, cosmetics and fodder. The most commonly used plant parts are leaves, flowers and seeds. Chi-square and ANOVA tests using SPSS software revealed a slight variation in knowledge of the use of the species according to sex and age. The plant part uses values calculated by age category and gender were subjected to multiple correspondence analysis (MCA).

Conclusion: The population of the provinces of Al-Hoceima and Chefchaouen is mainly dependent on cannabis cultivation for their livelihood, with the majority of men using the plant for psychoactive purposes. One of the goals of legalizing Cannabis in Morocco is to increase the value of the plant by diversifying its legal uses.

Keywords: Ethnobotanical knowledge, survey, Cannabis sativa L., Northern Morocco, semi-structured questionnaires.

Background

Hamp (*Cannabis sativa* L.) is one of the most versatile plants known to humans and is used in various fields such as medicine, food, textiles and as a psychoactive substance (Barguil 2011, Chaachouay *et al.* 2022, Conrad 1997, Haddou *et al.* 2023, Kaushal 2012, Small 2016, Ranalli & Venturi 2004, Ross 2005) which has also become a sub-cosmopolitan plant (Chouvy

2019, Amico 2016, Small *et al.* 2003). However, even though people have been using it for thousands of years, the origin of Cannabis is still poorly understood. The oldest archaeological remains are seeds discovered in Japan around 10,000 years ago (McPartland 2018, Wills 1998). Thus, theories of multi-regional domestication have also been suggested (Clarke & Merlin 2016, Long *et al.* 2017, McPartland *et al*. 2020, Merzouki *et al.* 1996). Cannabis has enormous structural diversity, with a wide cultivar of forms and environments on every continent. Moreover, its pharmacological effects are manifold, acting as an antiemetic and appetite stimulant in debilitating diseases (Cancer and AIDS), analgesic, as well as in the treatment of multiple sclerosis, spinal cord injury, Tourette's syndrome, epilepsy and glaucoma (Andreoli *et al*. 2020, Chas *et al*. 2019, Miyake 2009). Further clinical research is required (Hourfane *et al*. 2023).

The taxonomic classification of the plant has given rise to controversial debate, with the genus Cannabis, belonging to the family Cannabaceae, consisting of either: three species (*Cannabis sativa* L., *Cannabis indica* Lam., *Cannabis ruderalis*) (Hillig 2005, Sawler *et al.* 2015), two species (*Cannabis indica* and *Cannabis sativa* L.) (Clarke & Merlin 2016) or one species (*Cannabis sativa* L.) (McPartland 2018, Small & Cronquist 1976). Currently, the most widely accepted theory is that the genus consists of a single species, *Cannabis sativa* L., with several subspecies and varieties. Depending on its purpose and chemical composition, it is mainly divided into fiber-type plants (hemp; < 0.3% Δ9-tetrahydrocannabinol (THC)) or drug-type plants (marijuana or medical cannabis; > 0.3% THC) (Hurgobin *et al.* 2021). Is an annual herbaceous plant, which can sometimes be perennial, with an upright, simple, hollow, fluted stem. Its height varies from 60 centimeters to 4 meters, depending on whether the environment is favorable or not. The stem is round in cross-section, and the surface is ringed and pubescent (Amico 2016). The root system is highly developed around a taproot. The leaves are compound and palmate and are opposite on either side of the stem, becoming alternate at the apex (Amico 2016). All parts of the plant are covered with hairs, also called trichomes, which are of two types: Resin-secreting mahogany-orange glandular hairs are multi-celled and non-secreting hairs are single-celled (Chandra *et al*. 2017). Resin secretion is maximal between the flowering period and full seed maturity (Punja *et al.* 2023) the resin is produced naturally by the plant; on the one hand to protect it from desiccation, and on the other, the strong characteristic odor it gives off defends it against herbivores, The distribution between the sexes is almost equal.

At germination, young male plants cannot be distinguished from women, and it is only during the last phase of growth, when flower formation begins, that sex determination becomes possible (Hazekamp 2009, Paczesny 2014, Schilling 2020). The male plant develops small pollen sacs that are used to fertilize the female plant, which has a hairy, resinous stigma (Anwar 2006, Richard 2010). The male plant dies after flowering. Male plants are spindlier and less leafy than female plants, and their flowers are inconspicuous, defined by a main axis whose tip ends in a flower and not a bud, unlike indefinite axes, the flower is distinguished by five stamens welded to the five tepals (Bouloc 2006), Pollination is anemophilous, reflecting the ancestral nature of the Cannabaceae. The female inflorescence is characterized by a compact biparous cyme and is also a defined inflorescence with a main flowering axis and secondary axes arranged in opposite directions from the main axis (Rana 2010). *Cannabis sativa* L. flowers are regular or actinomorphic and radially symmetrical (Gaborit 2014). Like all angiosperms, there is double fertilization, with the ovule transforming into a seed with an embryo inside, which will become the future seedling, and albumen, which is the "nutrient tissue" for the embryo and integument. Cannabis seeds are among the most nutritious, containing the highest quantity and best-balanced mix of essential fatty acids and proteins (Barguil 2011). The structure surrounding the ovule, which defines the ovary, is transformed into a fruit (Gaborit 2014), called a "hemp seed", which is a smooth, dry, indehiscent, greyish, shiny ovoid achene with mottling, 2.5 to 3.5 mm long and 2.5 to 3 mm in diameter (Paczesny 2014).

In Morocco, the plant is thought to have first appeared in the 7th century AD during the Arab invasions, before cultivation took root around Ketama, in Sanhaja Tribe in the heart of the Rif, in the 15th century (Bordes 2004). It was not until much later, in the 19th century, that Sultan Moulay Hassan I (1873-1894) officially authorized the cultivation of cannabis for local consumption in five douars, or villages, of the Ketama, Beni Seddate and Beni Khaled tribes, presumably to help pacify the region (Bachir *et al.* 2022, Chouvy 2008, Ouhtit *et al*. 2024). Cultivation reached its peak in the 1980s, and the local population's dependence on the plant is genuine (Chouvy 2018). This culture proliferated in surrounding areas with a subsequent transfer of traditional knowledge about its various uses to the local population (Afsahi 2020, Blickman 2017).
In the 1960s, the number of Indian hemp smokers worldwide, including in Morocco, increased considerably, leading to a surge in global demand for the plant (Afsahi 2017). On the other hand, there has been a decline in other beneficial and legitimate uses for the plant, all of which have combined to make Cannabis an economically profitable, socially shunned and legally prohibited plant, but in recent years many countries have tended to legalize its cultivation for medical or industrial purposes (Baratta 2022, Morgan 2023, Sorrentino 2021). Morocco is among them, but it remains informal in the country despite the new law 13-21 regulating the legal use of cannabis in 2021 (Bulletin official 2021).

Beldiya, is the most widely grown cultivar in the region, but it is now facing stiff competition from hybrid varieties, commonly known as Romia. The most important of these hybrids is Critical (Chouvy 2018). The growing conditions of these different varieties are very different (El Bakali 2024): Beldiya is grown fallow, while hybrid varieties require large amounts of water, but their yield is very high compared to Beldiya (Afsahi 2017). In terms of essential oil content, that extracted from the Beldiya strain was found to be particularly rich in antioxidants, making it a potentially useful ingredient in medical applications. The Critical strain has a high oil content with good germination, which could be of interest in the fields of nutrition and cosmetics (Chergui 2024).

In this article, we examine, using a survey, the impact of Cannabis uses as a drug on other uses among the inhabitants of the provinces of Al-Hoceima where, to our knowledge, few ethnobotanical surveys have been carried out, and of Chefchaouen (Northern Morocco), considered a historical area of Cannabis cultivation in Morocco.

The main objectives of the present work were to explore the extent of Cannabis use in these two provinces and to study the determining relationships between this local knowledge and various socio-demographic characteristics (age, gender, level of education and occupation) using statistical tools. This work is also in line with the recent legalization of *Cannabis sativa* L. in Morocco, where it had been banned since 1953 (Bellakhdar 1997) and the growing importance of this plant worldwide.

Materials and Methods

Study area

In order to achieve the objectives of the study, the field survey included the historical Cannabis-growing areas of Al Hoceima and Chefchaouen (Bouhlal 2024), which belong to the Tangier-Tetouan region in Northern Morocco, on the Rif mountain range, which is characterized by difficult terrain and a modern geological structure with calcareous, chalky and clayey rocks, and very rugged paths, including Mount Tidirhine, which is the highest mountain in the Rif mountain range in Northern Morocco, reaching a height of 2,456 meters above sea level. This region is known for its cold climate, with mild summers and very cold winters in general. Rainfall in these areas is high, averaging between 500 and 1,800 m. In terms of vegetation, the region is characterized by the presence of cedar and oak trees. The local economy is dependent on Cannabis cultivation. The province of Al Hoceima comprises four urban communes and 31 rural communes, including the research areas of Ketama, Issaguène, Abdel Ghaya Al-Sawahel and Moulay Ahmed Cherif (Provincial Monograph Al Hoceima 2017).

Chefchaouen province comprises one urban commune and 25 rural communes, including Tamorot, the research area (Provincial Monograph Chefchaoun 2018) (Fig. 1). These communes were chosen for a number of reasons. These include the presence of the species, the originality of the ethnic groups and the commercial circuit for the species. The development of Cannabis requires a good knowledge of these morphogenetic characteristics. For example, according to the flora of Morocco, it is much more widely recognized in the central Rif community (Chouvy 2018, El-Ommal 2024). So, the choice of socio-cultural groups in the heart of the Rif enables us to gather relevant information on the uses of the species.

Ethnobotanical data collection

Field studies were carried outbetween September 2023 and May 2024. Individual interviews were conducted with the three main ethnic groups (Bni sadat, Ghmara and Ketama) in the six administrative villages (Issaguene, Ketama, Molay ahmed cherif, Tamsawte, Abd lraya swahel and Tammorot). These villages are considered to be pioneering areas for cannabis cultivation in Morocco, which has become the population's main, if not only, source of income (Blickman 2017, Pratiwi 2023, Tingman 2019). A total of 261 informants were interviewed, their ages ranging from 18 to 76. This age limit was set so that the informant would have sufficient information on the research topic. Both sexes were interviewed in order to compare their knowledge of *Cannabis sativa* L. The number of respondents was proportional to the population size of each village. The survey forms were sent to the respondents mainly in Arabic. The questionnaire was divided into two parts: the first dealt with socio-demographic characteristics (age, sex, level of education, profession, name of commune, tribe and douar), while the second included questions on the uses of the plant, vernacular names, parts of the plant used, preparation mode, and diseases treated. These questionnaires were supplemented by direct observations in the field.

Data analysis is done using Excel and SPSS: SPSS is one of the pioneering software packages for statistical data analysis, introduced in the late 1960s and marketed by SPSS Inc. SPSS stands for "Statistical Package for Social Sciences" and can be used to process data in a number of fields, including economics, health sciences, marketing, etc. The version of SPSS we used in our study: IBM SPSS Statistics 27.0. (Carricano 2010, Zheng 2019).

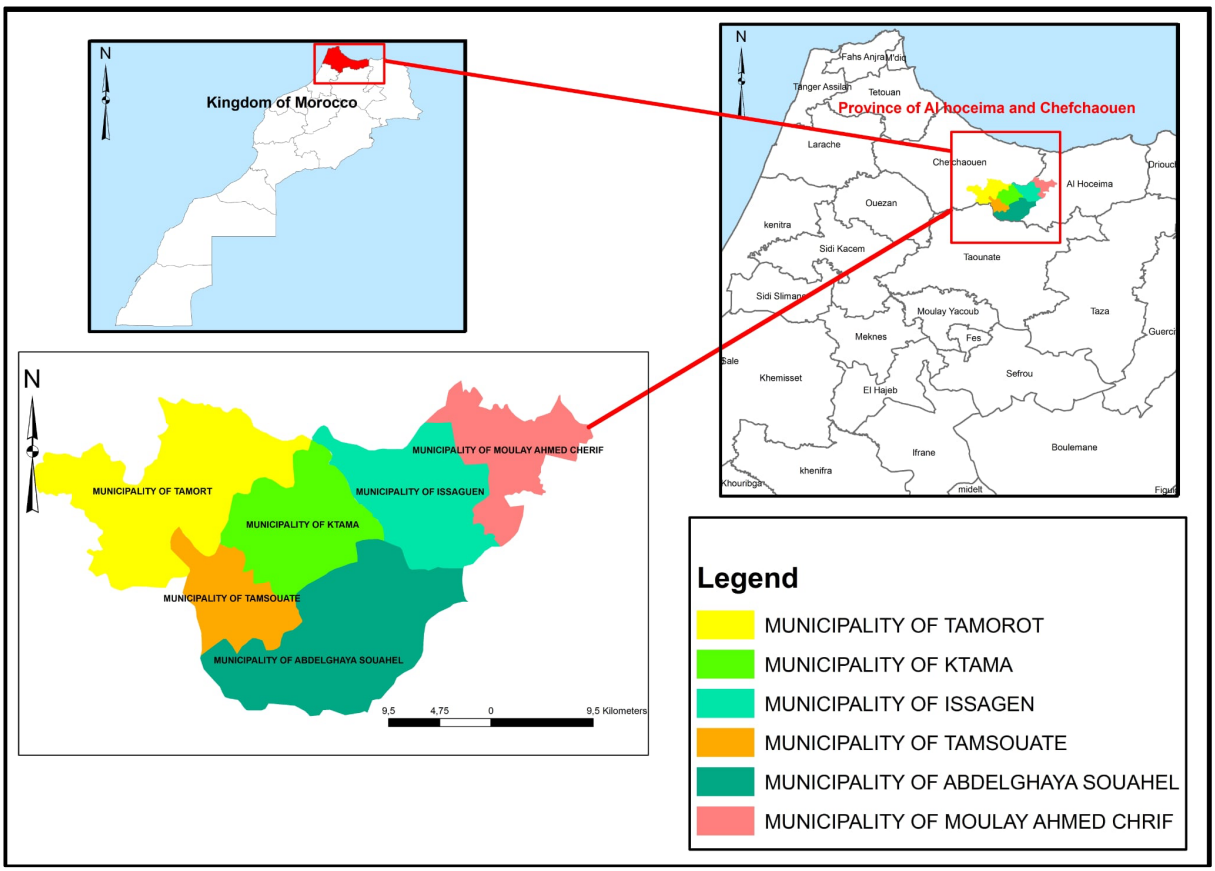

Figure 1. Map of Northern Morocco showing the location of the study area, Provinces of Al-Hoceima and Chefchaouen

The ethnobotanical data collected were analysed quantitatively using usage ratios (UR) and frequency of citation (FRC) using Excel software (Whitney 2022).

Data Analysis

To assess the uses and importance of Cannabis various types of parameters were calculated:

Relative frequency of citation (RFC)

The RFC (Relative Frequency of Citation) index has been used to assess the importance of plant use within a specific population (Tardío & Pardo-de-santayana 2008). It is measured on a scale from 0 to 1, where values closer to 0 indicate a lower frequency of citation and, therefore, less cultural importance. Conversely, values closer to 1 indicate a higher frequency of citation and, consequently, greater cultural importance within the population. The RFC index is calculated according to the following formula:

$$RFC = FC/N \quad (1)$$

where FC: Number of informants mentioning the use of species X And N: Total number of informants.

Usage value (UV)

The use value defined by (Albuquerque *et al*. 2006, Phillips & Gentry 1993, Sop *et al.* 2012) is a way of expressing the relative importance of a given species for the population in provisioning services; Use Value (UV).

$$UVs = \Sigma Us/N \quad (2)$$

Where: U is the total number of citations of uses of species s mentioned; N is the number of informants.

Value of the plant part (PPV)

The plant part value (PPV) is a value given for a specific part of the plant. It is equal to the ratio between the number of uses declared for each part of the plant and the total number of uses declared for this plant (Gomez-Beloz 2002).
The value of the plant part (VPP) was calculated using the following formula:

PPV = RUP plant part / RU (3)

Where RU is the number of reported uses of all plant parts and RU plant part is the sum of reported uses per plant part. The part with the highest PPV is the one most used by respondents.

Index of diversity of knowledge (ID) of respondents

The diversity value of ID knowledge measures the diversity of categories of use of the species and shows how this knowledge is distributed among the respondents (Byg & Baslev 2001). However, Shannon's diversity index (Hutchins 1999) was used instead of Simpson's index to calculate the diversity value. It is low if the species is widely used in one or two categories of use, and high when the species has multiple uses. It lies between [0 and n]. It is given by the formula:

$$\mathrm{ID} = -\sum(\mathrm{N_t}/\mathrm{N})\log(\mathrm{N_t}\mathrm{N}) \text{ (4)}$$

With N_t the number of uses cited by the respondent and N the total number of uses recorded: if ID≤3 diversity is low; if 3≤ ID≤4 diversity is average; if ID≥4 diversity is high. A low value of the index means that a small group of respondents holds most of the knowledge about *Cannabis sativa* L.

Equitability index of respondents' knowledge (EI)

The equitability index is the ratio of actual diversity to maximum theoretical diversity (Byg & Balslev 2001). This index is given by the relationship:

$$IE = ID/\ IDmax \text{ (5)}$$

Where ID is the Respondent Diversity Index and

$$ID_{max} = \log_2 n \text{ (6)}$$

The maximum value of the Survey Diversity Index obtained. (n: the total number of respondents).

The advantage of the Respondent Equitability Index is that it measures the degree of homogeneity of respondents' knowledge. Its value is between 0 and 1.
If IE < 0.5, the diversity of the respondents' knowledge is not homogeneous, that is, information about the plant is not evenly distributed across surveys (very few people know many uses of the species and a minority use the species a lot).
If IE = 0.5, equitability is average.
If IE > 0.5 the diversity is homogeneous, which means that the information is well distributed among the respondents. These indices were calculated by gender and age.

Consensus value for types of use (Cs)

It measures the degree of agreement between respondents regarding the uses made of the species (Albuquerque *et al.* 2006, Byg 2001). It is expressed as:

$$C_s = (2n_i/n) - 1 \text{ (7)}$$

Where n_i is the number of people using *Cannabis sativa* L in a given use category and n is the total number of people interviewed? It is between [-1 and 1]. If n_i = 0; Cs = -1 and if n_i = n; Cs = 1. This reflects the degree of consensus among respondents on a given use.

Bivariate analysis (chi-square): This method was used to examine the associations between the categories of *Cannabis sativa* L. use and each of the socio-demographic variables, the analysis of variance (ANOVA) test was also carried out, and when the conditions for applying ANOVA were not met (normality, homogeneity of variances), Welch's non-parametric test was performed. In addition, multiple correspondence analysis (MCA) was used to understand the typology of *Cannabis sativa* L. users, taking into account all socio-demographic factors.

Results

This ethnobotanical study provided a wealth of information on the use of the plant in the study area.

Socio-demographic characteristics of informants

Data was collected from questionnaires sent to 261 informants, the ages of the respondents ranged from 18 to 76, and the most common age groups were 25 to 44 (58.4%) and 45 to 60 (23.5%) (Table 1). Of these, 51% were women and the remaining 49,0% were men. This disparity in favor of women is due to the fact that a significant number of men had either been arrested for cannabis cultivation or were on the run from the law for the same reason. The informants were born in the study area, Regarding the level of education, those with no schooling accounted for 53.9% (41.3% illiterate and 12.6% Koranic school), which is more than half of the participants, while higher levels of education had very low percentages (secondary (3.6%), university (4.9%)). The majority of respondents were farmers, and the rest of the group was divided between shopkeepers, students, the unemployed and employees.

Table 1. Socio-demographic characteristics of informants

Categories		Numbers	Percentage
Gender of informants	Male	125	49.0%
	Female	130	51.0%
Age category of informants	18_24	25	9.8%
	25_44	149	58.4%
	45_60	60	23.5%
	61_76	21	8.2%
Informant'level of education	Illiterate	102	41.3%
	Koranic school	31	12.6%
	Primary	67	27.1%
	Junior secondary	26	10.5%
	High school	9	3.6%
	University	12	4.9%
Marital status of informant	Single	66	26.4%
	Married	165	66.0%
	Divorced	10	4.0%
	Widowed	9	3.6%
Profession of the informant	Farmer	101	40.4%
	Housewife	116	46.4%
	Trade	12	4.8%
	Student	6	2.4%
	Other	8	3.2%
	Unemployment	7	2.8%

Ethnobotanical knowledge of populations

Use value (UV)

Information gathered on local uses of *Cannabis sativa* L revealed the following results:

Table 2 shows that the frequency of use is very high (RFC =1) and (UV=2.93).

A descriptive analysis of frequencies using SPSS shows two aspects:

- The percentage of responses: The percentage of uses of each category in relation to the total number of uses of all the categories studied;
- The percentage of observations: The percentage of uses of each category in relation to the total number of informants. The sum of the observations often exceeds 100% because an informant can use cannabis in several categories.

With 765 use reports (UR), of which 261 (34.1) correspond to economic use (resin), 128 (16.8) recreational use, 152 (19.9%) fodder use, 124 (16.2%) cosmetic use, and 100 (13.1%) medicinal use.

Table 2. Different forms of cannabis use in the study area

Multiple use of cannabis	Response		Percentage observations
	N	Percentage	
Sale	261	34.1%	100.0%
Consumption	128	16.7%	49.0%
Forage	152	19.9%	58.2%
Cosmetics	124	16.2%	47.5%
Therapeutics	100	13.1%	38.3%
Total	765	100.0%	293.1%

Diversity and equitability of uses of *Cannabis sativa* L.

Table 3 shows the values of the diversity of use and equitability indices for *Cannabis sativa* L.

The table shows that the diversity of use index values is of the same order of magnitude for all the socio-cultural groups surveyed and are high (IDU > 4), with mature young people and adults being more likely to use Cannabis. These results confirm the use of cannabis in various categories of use (commercial, reagent, fodder, cosmetic, traditional therapeutic). However, the respondent's equitability index values are very high, indicating that knowledge about the use of this plant is evenly distributed among the respondents (IE > 0.5).

Table 3. Diversity and distribution of knowledge of the uses of *Cannabis sativa* L. by sex and age of respondents

	Age			
	18-24	25-44	45-60	61-76
ID	4.5118711	7.21916852	5.8263188	4.2571111
IE	0.9715786	0.966428	0.9863597	0.9692176
	Gender			
	Woman		**Men**	
ID	6.9424458		6.9374693	
IE	0.9810127		0.9942943	

Consensus value of types of use (Cs)

Table 4 shows the degree of consensus given by respondents to each type of use.

Analysis of Table 5 shows that trade is always in the lead compared with other types of use, whatever the socio-demographic characteristics (sex, age) considered. Smoking is mainly carried out by men (0.89). As for the other categories of use, their consensus values differ according to sex and age, proving that there is heterogeneity regarding knowledge of these types of use. These results also show that the consensus values (Cs) for cosmetic use are low among adults and the elderly compared with the other age categories and among men compared with women, while the consensus values for therapeutic use are very low among the young and the mature, and among both sexes.

Table 4. Consensus value of types of use of *Cannabis sativa* L.

	Sale	Smoke	Forage	Cosmetics	Therapeutics
			Age		
18-24	1	-0.2	-0.6	0.28	-0.76
25-44	1	-0.06	0.06	0.046	-0.489
45-60	1	0.3	0.6	-0.366	0.366
61-76	1	-0.238	0.809	-0.14	0.619
			Gender		
Woman	1	-0.86	0.33	0.24	-0.40
Men	1	0.888	-0.01	-0.36	-0.047

Box-and-whisker plot, chi-square test and ANOVA test

In order to study the relationship between cannabis use and social characteristics, we carried out a number of tests and analyses, including the box-and-whisker plot, the chi-square test and the ANOVA test (Fig. 2).

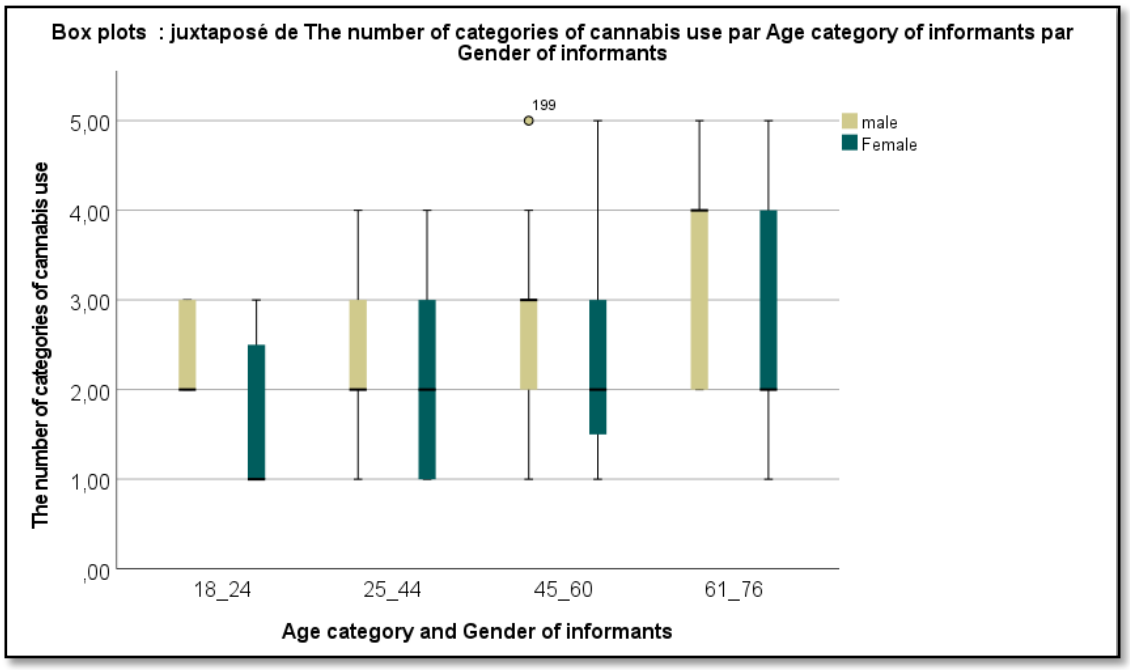

Figure 2. Box plots illustrating the variation in knowledge of *cannabis sativa* L. by age group and gender.

Analysis of the graph shows that knowledge of cannabis use appears to be high among both sexes. In addition, older people of both sexes have a high level of knowledge about the uses of *cannabis sativa*, whereas young women have very little knowledge.

The results of the Chi-square test analysis revealed that age and gender had a significant association effect on cannabis use categories, as shown by the results ($p<0.05$) except for cosmetics and age categories where there was no relationship ($p=0.34$) (Table 5).

Table 5. Chi-square test

Categories uses	Socio-demographic characteristic	Chi-2 tests		Symmetric Phi measurements	
		Khi-2	P-value	Value	Approximate meaning
Smoking	Gender	195,059[a]	.000	.875	.000
Fodder	Gender	8,973[a]	.003	-.188	.003
	Age category	38,825[a]	.000	.391	.000
Cosmetic	Gender	22,974[a]	.000	-.301	.000
	Age category	8,684[a]	.034	.185	.034
Therapeutic	Gender	8,693[a]	.003	.185	.003
	Age category	56,396[a]	.000	.470	.000

In addition, the results of the statistical test analysis (ANOVA one way) revealed the following associations:

➢ Regarding the relationship between gender and different forms of cannabis use, we obtained the following statistical results:

- Between consumption and gender: f=823.315 >>>1; there is a highly significant difference with a p-value<0.001 in favor of men.
- Between cosmetic use and gender: f=25>>; there is a significant difference with p-value<0.001 in favor of women.
- For other uses, dependence was assessed using the Which test, which showed a weak association between therapeutic use and sex (st=8.9 > 1; p=0.03) in favor of women, and feed use and sex (st=9.2 > 1; p=0.03) in favor of women.

➢ Regarding the age factor: statistical tests (ANOVA one-way) indicate that there is no significant variation in the consumption of the species according to age (p=0.43 >0.05). For other uses, the Welch test confirmed the dependence between use as fodder, traditional medicine and age category ((st=24.8 >>1; p<0.001) ;(st=20.9>>1; p<0.001)), while the variation between age category and cosmetic use was not significant (p=0.33>0.005).

Use value of organs: Value of the plant part (PPV)

Table 6 shows that almost all the organs of *Cannabis sativa* L. are of socio-economic importance and are used by the people of the Rif in northern Morocco. The most widely used parts are the leaves and flowers, with almost equal percentages of 96% each. The last reported use values for the other organs are 5.7% for the stem and 1.5% for the roots.

Table 6. Plant parts used

Plant part used	Response		Percentage of observations
	N	Percentage	
Flowers	252	34.8%	96.6%
Leaves	256	35.4%	98.1%
Stem	16	2.2%	6.1%
Seeds	196	27.1%	75.1%
Roots	4	0.6%	1.5%
Total	724	100.0%	277.4%

The different varieties used in the region

According to Table 7, several varieties of *Cannabis sativa* L. are used in the study area, with the absolute dominance of the cultivar Beldiya, where 100% of respondents reported its use, representing 40.5% of the total varieties used, followed by Khardala with a percentage of use of 86.2%, while Criticale comes third with a percentage of use of 40.6%. Since the question is multiple choice, the percentage of observations is 246.7%, which is more than 100%, since an informant can mention several varieties.

Table 7. The different varieties used in the region

The different varieties	Response		Percentage of observations
	N	Percentage	
Beldiya	261	40.5%	100.0%
Khardala	225	34.9%	86.2%
Critical Plus	106	16.5%	40.6%
Limonia	17	2.6%	6.5%
Pakistana	18	2.8%	6.9%
Other varieties	17	2.6%	6.5%
Total	644	100.0%	246.7%

State of the plant used

90.3% of informants indicated the use of cannabis in a dry state, compared to a minority of 9.7% who used it in a fresh state.

Table 8. Condition of the plant used

	Response		Percentage of observations
	N	Percentage	
Dry state	242	90.3%	95.3%
Fresh state	26	9.7%	10.2%
Total	268	100.0%	105.5%

Diseases treated

The study revealed that cannabis would be used as a treatment for eight different diseases. These treatments were mainly based on recommendations from acquaintances or family members. Despits its versatility in terms of use for medical

purposes, the percentages obtained remain low: 9% mentioned to treat oral thrush, this is a disease that affects young children and is characterized by symptoms such as pain and burning sensation in the mouth and difficulty swallowing, 6% each treats wounds, soothe tooth pain and treat warts, 5% each to treat burns and insomnia, finally 3% each for anxiety and appetite (Fig. 3).

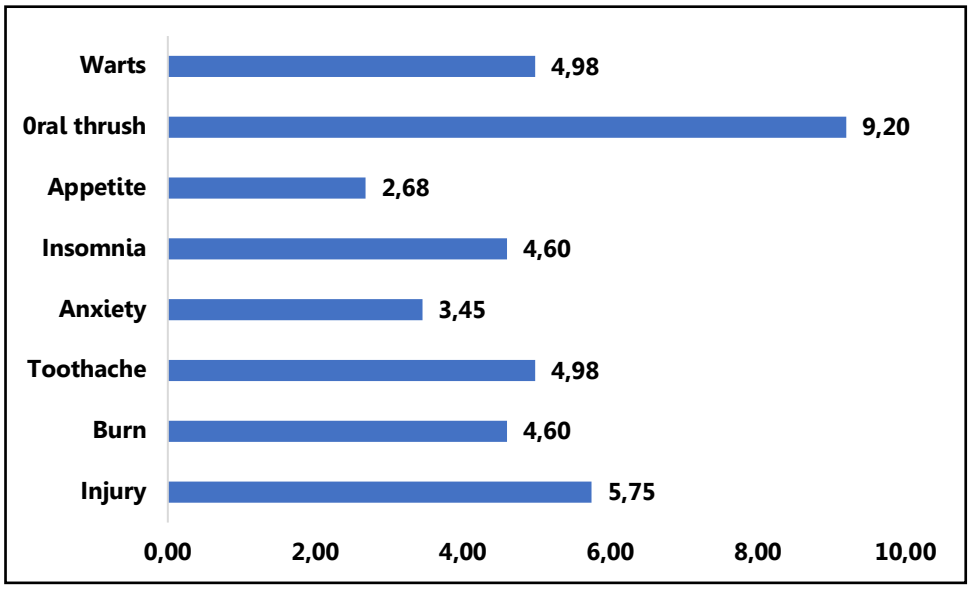

Figure 3. Diseases treated by informants using *Cannabis sativa* L. as a medicinal plant

Fidelity Level

Our results (Table 9) demonstrate that the cannabis plant would treat eight different categories of symptoms and diseases with fairly low levels of fidelity indicating significant gaps in the transmission of knowledge and applications of traditional practices associated with the plant, the treatment of oral thrush was associated with a fidelity level of wounds came in second place with a fidelity level of 15%, followed by toothache and warts with 13% each, insomnia and burns 12% each, anxiety 9% and finally loss of appetite7%.

In this study the symptoms and their classification in pathological group were included according to the ICPC-2 international classification of primary care (Staub et *al*. 2015).

Table 9. Percentage of Fidelity level of diseases treated by *Cannabis sativa* L.

Pathological group	Diseases treated	Mode of preparation/ administration	Numbers of citation	Fidelity Level (FL)
Skin (S)	Injury (S19)	Apply resin to the damaged area	15	15
Skin (S)	Burn (S14)		12	12
Digestive (D)	Toothache (D19)		13	13
Psychological (P)	Anxiety (P74)	Smoking cannabis	9	9
Psychological (P)	Insomnia (P06)		12	12
Skin (S)	Loss of Appetite (S03)		7	7
Digestive (D)	Oral thrush (D20)	Smoking "sepsis" and blowing on the affected child's mouth	23	23
Skin (S)	Warts (S03)	Put out a cigarette butt where the pill is located	13	13

Multiple component analysis

Multiple Correspondence Analysis (MCA) is a multidimensional exploratory method that creates a synthetic representation of categories derived from various qualitative criteria in a survey. In our analysis, we used MCA to explore the interrelationships between the variables Gender, Age, Marital status, Education, Occupation, Cannabis use, Cannabis varieties, without imposing specific hypotheses concerning their associations. MCA was applied to the dataset comprising

these variables, resulting in a scatterplot of individuals positioned along two factorial axes (Fig. 4). The first two axes collectively captured 44 ;4% of the dataset's total inertia, a significantly high percentage. From the factor map obtained we can therefore visualize 3 fairly clear groups: The first group is made up of women aged 61 to 76 who are illiterate housewives, either married, divorced or widowed, who don't want to leave their region and use cannabis as a cosmetic product or chicken feed.

The second group is made up of men aged between 45 and 60 who are farmers or shopkeepers, have no more than a primary school education, want to stay in their region, and use cannabis as a psychoactive, therapeutic substance or fodder. The third group consists of young people aged 18 to 24, who are either studying or unemployed, whose educational level ranges from secondary school to university, who want to leave the region, and who have not mentioned any uses for cannabis.

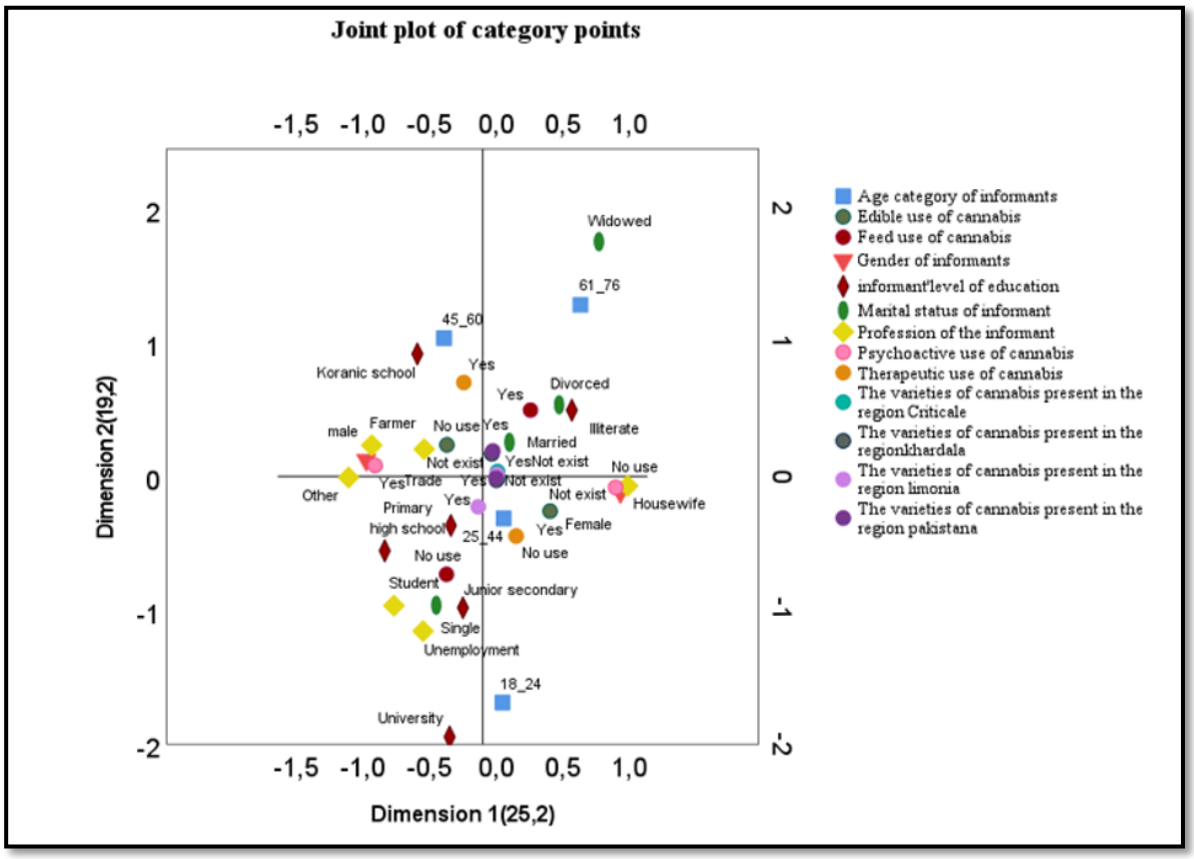

Figure 4. Multiple correspondence diagram of studied data

The figure 5 allows us to see the correlations between the variables:

There is a strong correlation between occupation, gender and use of cannabis as a psychoactive substance. These variables are highly significant and related to dimension 1. Similarly, there is a strong correlation between choice of residence and age category, and a correlation between age category, educational level, family situation and use of cannabis as a stimulant, which are related to dimension 1. For cosmetic use, therapeutic use and choice of stay, they are not very significant.

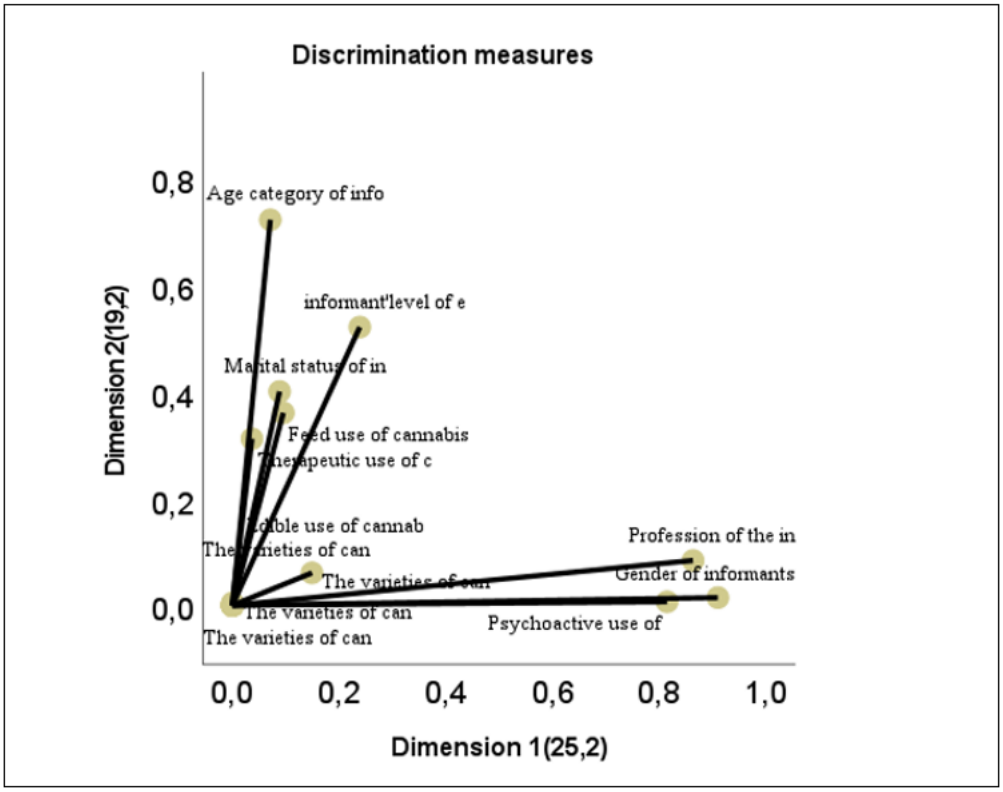

Figure 5. Discrimination measures

Discussion

All informants live in rural areas and are therefore farmers (81% men) economically dependent on *Cannabis sativa*, which is the only subsistence agricultural product (Afsahi 2017, Bordes & Labrousse 2004, Chouvy 2008, Meklach *et al.* 2019).

The socio-demographic results of our survey showed that the age of all participants was between 18 and 76, and that the age group with the highest response rate was between 25 and 444 (58.4%), followed by the 45-60 age group (23.5%). Older people seem to have better knowledge than other age groups, as Balafrej 2024 shows. The illiteracy rate is very high, at over 53.9%, compared with 16.3% (Balafrej 2024) and 4.17% (Bouarfa 2020). This increase is attributed to several causes:

- Socio-economic factors, such as poverty, limited needs, and limited financial resources for children's education. In addition to child labor in the agricultural sector (Meklach & Merzouki 2021) and girls in domestic work.
- Geographical, manifested by a very difficult topography, poor facilities, lack of infrastructure, distance of educational establishments from student accommodation, scattered housing, difficulty and lack of footpaths at times, as well as a lack of school transport, not to mention the region's climate, which is characterized by wet and very cold winters.

Girls, for them, add other factors for which they abandon school, notably economic and social, such as poverty, where they spend their time either fetching firewood, water and pasture, or marrying early and consequently having multiple pregnancies So young girls are forced to carry their children on their backs instead of carrying their schoolbags. This can be seen in the propagation of patriarchal thinking and the lack of awareness that if a woman obtains her right to education, she will be a good mother and will contribute to the development of her society.

The high marriage rate is due to the early marriage of girls in residential areas and to the fact that marriage conditions are inferior to those in urban areas. As the region is mountainous, most of its inhabitants are farmers and even cannabis growers. Women, even if they were content to declare their roles as housewives only, are in reality actively involved in the various stages of cannabis cultivation (Afsahi 2015, Meklach *et al.* 2010). All informants live in rural areas and are therefore farmers (81% men) economically dependent on *Cannabis sativa*, which is the only subsistence agricultural product (Afsahi 2017, Bordes & Labrousse 2004, Chouvy 2008, Meklach *et al*. 2019) and the exploitation of forest plant resources (Chouvy 2022, Dan Guimbo 2011). This study has shown that *Cannabis sativa* L. is a multiple-use species, with six use categories identified

for the species. The results obtained are in line with those of previous studies reporting various uses of *Cannabis sativa* L. (Barguil 2011). Analysis of the ethnobotanical indices made it possible to collect and explain a set of results linked to local people's knowledge of how the plant is used. Our results showed that the relative frequency of quotation is at a maximum, which suggests that the level of knowledge of *Cannabis sativa* L. among the population is very high, and has even reached a ceiling (Robert *et al.* 2008). The index of diversity of knowledge (ID) and the index of equitability of knowledge of the respondents (IE).

Revealed a sharing of information on the uses of the plant, with a slight disparity in favor of men compared to women, while other studies show a large difference, older people compared to younger people, as reported in (Balafrej 2024, Bouarfa 2020), this knowledge is distributed in a homogeneous and balanced way between all members of the population. All respondents declared at least one use for the plant. Its economic use is the most dominant, given that it represents the main source of subsistence for the population (Bordes & Labrousse 2004). For the majority of respondents, the plant is life, "the plant is our life", "without hashish, we would die of hunger".

The habit of smoking cannabis has become very common among men in the region (Merzouki & Molero Mesa 2002), and this consumption covers all age groups and levels of education as long as hashish is available (El Omari *et al.* 2013) and the use of cannabis by Moroccans dates back to 1800, mainly for its psychoactive and therapeutic properties (Bellakhdar 1997). Analysis of the relationship between socio-demographic characteristics and the nature of cannabis use using the chi-square test, ANOVA and Welch showed that older people have more knowledge than other age groups, particularly younger people. Some of them recall its use in the manufacture of bags and ropes, or in the construction of terracotta houses and its important role as a thermal insulator. These uses have disappeared and, as a result, the current generation does not know of them (Hourfane *et al.* 2023) On the other hand, when the RFC value of cannabis in the provinces of Al-Hoceima and Chefchaoun was 1, meaning that the entire local population had knowledge of the traditional uses of cannabis, "therapeutic use" was represented by a cultural IC value of 38%, in line with the province of Taounate with 40% (Balafrej 2024). On the other hand, the local population uses cannabis therapeutically to treat a number of illnesses (Amico 2016, Chaachouay *et al.* 2023, Merzouki & Molero Mesa 1999, Merzouki *et al.* 2000, Grotenhermen 2009). The use of cannabis by the elderly for medical purposes is due to their eternal relationship with the plant and therefore to the accumulation of experience concerning the effect of the plant on their state of health. The younger generations, on the other hand, are turning to modern medicine as living conditions improve. Young informants have doubts about the therapeutic uses of the plant, employing typical interpretations: "We only hear that cannabis has beneficial effects", "Cannabis can be used for therapeutic purposes as they say". Since men are more aware of the therapeutic uses of cannabis (Merzouki & Molero Mesa 1999), this disparity in use between the sexes is to some extent due to men's use of cannabis for psychoactive purposes. On the other hand, some women who grow cannabis show their hatred for the plant, which they consider to be grown solely for the purpose of selling its harvest, and are completely unaware of its therapeutic uses.

Cannabis has no interest it only destroys health. In contrast to other species, therapeutic knowledge is accumulated more by women (Montanari & Bergh 2019). The therapeutic use of cannabis remains below expectations (Bouarfa *et al*. 2020). Although most of our informants were cannabis growers, they were nevertheless unaware of the history of cannabis growing in their region, and each generation indicated that it existed before they were born. This is part of the dialectic of the history of the introduction of this plant in Morocco. The use of Indian cannabis in the cosmetic field, which includes only hair oil, is limited to women, particularly young women, an inevitable outcome of rural women's immersion in the arduous tasks they perform every day, as they no longer have time to rest or take care of themselves. Our results showed that almost all the parts (leaves, flowers, seeds) of the species are of great importance to people. The leaves and flowers are used for their psychoactive properties; the leaves and seeds are often more important in traditional medicine than the inflorescences for the treatment of certain ailments. (Balant *et al.* 2021), the seeds are used in cosmetics or as chicken fodder (Merzouki & Mesa 1997), given the high fatty acid content of akenes. The use of stems in the manufacture of houses represents only 6.1%, given the change in furniture construction methods.

As far as the spread varieties are concerned, despite the fact that the region has been flooded with the latest hybrid species, which exert strong competition on the local cultivar or 'Beldiya', the latter is still the most widely used, followed by Khardala and critical, Beldiya is considered to be soothing and harmless to health, unlike the other varieties known as 'Romanian'. (Afsahi 2022, Chergui et al. 2024).

Although there are different varieties of Cannabis sativa L. in the region, they all have the same uses, except in the medical field, where the population prefers Beldiya, which is considered calming and safe, to the other varieties. Most of the people

interviewed said that there was no difference between the varieties: "The varieties are all similar, they only differ in yield; similar except that the hybrids (Romia) grow faster; similar except that the hybrids are irrigated and the Beldiya is fallow" (Afsahi 2022, Chergui *et al*. 2024).

Conclusion

This study, devoted to the use of *Cannabis sativa* L. among the population of the provinces of Al Hoceima and Chefchaouen, was able to answer questions concerning the relationship between forms of use and socio-economic variables of the population. The use of cannabis as a psychoactive substance is strongly gendered, with the majority of men using it.

The seeds are used as fodder for poultry because of their high nutritional value. Research has also highlighted the cosmetic and medical uses of cannabis. It is used to treat diseases of the digestive system, psychological and skin diseases. Given the widespread use of the plant in the region, its use in the textile and food industries has been conspicuously absent.

The high prestige of *Cannabis sativa* L. is due to its economic importance as a source of livelihood for most informants. Therefore, if legalization aims to redress the injustice suffered by farmers in the region by improving agricultural conditions, it will also promote the various uses of the plant, particularly its medicinal uses.

This study has highlighted the traditional medicinal knowledge of *Cannabis sativa* L. among the population of the provinces of Al-Hoceïma and Chefchaouen, thus reducing the marginalization of the plant. In addition, these results may serve as a basis for future phytochemical and pharmacological research. Further studies are needed.

The problem with this study lies in a number of difficulties encountered during the fieldwork. Despite the legalization of cannabis cultivation, I sometimes encountered communication problems with residents that prevented me from gathering as much information as possible that could have enriched the research. Many avoided answering questions for fear of being arrested, for hesitation, or for fear of exaggerating their answers. In addition, the difficulty of access to the field meant that I was unable to visit remote areas where people make greater use of alternative medicines.

Declarations

List of abbreviations: RFC: Relative frequency of citation, UV: Usage value, PPV: Value of the plant part, ID: Index of diversity of knowledge of respondents, EI: Equitability index of respondents' knowledge, Cs: Consensus value for types of use.

Ethics approval and consent to participate: All the informants were informed about the aim of this study. The data were collected with respect to confidentiality and consent.

Consent for publication: Not applicable.

Availability of data and materials: All the data are presented in figures, tables and appendix in the manuscript and are available with the corresponding author.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: Maria Hourmate Allah: Conducting field surveys of the work, Drafting the work, Analysis and interpretation of data for the work. Fatima Zahrae Redouan: Drafting the work, Analysis and interpretation of data for the work, Corresponding author and submission. Ghizlane Merzouki: Drafting the work, Analysis and interpretation of data for the work. Abderrahmane Merzouki: Drafting and conception and design of the work, Revising and critically of the content; Final approval of the version to be published.

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Literature cited

Afsahi K. 2015. Pas de culture de cannabis sans les femmes. Le cas du Rif au Maroc. Déviance et Société 1:73-97.

Afsahi K. 2017. La construction socio-économique du cannabis au Maroc : le kif comme produit traditionnel, produit manufacturé et produit de contrebande. Tempo Social 29:99-114.

Afsahi K. 2020. The Rif and California: Environmental Violence in the Era of New Cannabis Markets. In Drug Policies and Development. Brill Nijhoff.

Albuquerque UP, Lucena RF, Monteiro JM, Florentino AT, Cecília de Fátima CBR. 2006. Evaluating two quantitative ethnobotanical techniques. Ethnobotany Research and Applications 4:51-60.

Amico A. 2016. Utilisation thérapeutique du cannabis (Sativex®) : de la sclérose en plaques aux innovations médicales. PhD dissertation, Université de Lorraine.

Andreoli MJ, Nascimento GR, Colquhoun A. 2020. Gamma-Linolenic acid alters migration, proliferation and apoptosis in human and rat glioblastoma cells, Prostaglandins Other Lipid Mediat 150:106452.

Anwar F, Latif S, Ashraf M. 2006. Analytical characterization of hemp (Cannabis sativa) seed oil from different agro-ecological zones of Pakistan. Journal of the American Oil Chemists' Society 83(4):323-329.

Argueta DA, Aich A, Muqolli F, Cherukury H, Sagi V, DiPatrizio N V, Gupta K. 2020. Considerations for cannabis use to treat pain in sickle cell disease. Journal of clinical medicine 9(12):3902.

Bachir F, Eddouks M, Arahou M, Fekhaoui M. 2022. Origin, Early History, Cultivation, and Characteristics of the Traditional Varieties of Moroccan *Cannabis sativa* L. Cannabis and cannabinoid research 7(5):603-615.

Balafrej T, Skalli S, Benaich S, Bessi A, El Mekkaoui A, Boukour B, Hassikou R. 2024. An ethnobotanical survey on the therapeutic use of *Cannabis sativa* L. in the province of Taounate, Morocco. Ethnobotany Research and Applications 28:1-14.

Balant M, Gras A, Ruz M, Valles J, Vitales D, Garnatje T. 2021. Traditional uses of Cannabis: An analysis of the CANNUSE database. Journal of Ethnopharmacology 279:114362.

Baratta F, Pignata I, Ravetto Enri L, Brusa P. 2022. Cannabis for medical use: Analysis of recent clinical trials in view of current legislation. Frontiers in Pharmacology 13: 888903.

Barguil Y. 2011. Etude de trois plantes psychotropes consommées en Nouvelle-Calédonie : kava, cannabis et datura : aspects médicaux et médico-légaux, PhD dissertation, Université de la Nouvelle-Calédonie.

Bellakhdar J. 1997. Contribution à l'étude de la pharmacopée traditionnelle au Maroc : la situation actuelle, les produits, les sources du savoir (enquête ethnopharmacologie de terrain réalisée de 1969 à 1992), PhD dissertation, Université Paul Verlaine-Metz.

Blickman T. 2017. Morocco and cannabis: Reduction, containment or acceptance. Amsterdam, Netherlands: Transnational Institute.

Bordes P, Labrousse A. 2004. Économie de la drogue et réseaux de corruption au Maroc. Politique africaine 93(1):63-81.

Bouarfa M, Lebtar S, Boukhira S, Bousta D. 2020. An Ethnobotanical and Ethnopharmacological Survey of *Cannabis sativa* of Taounate Region in Northern Morocco. International Journal of Pharmaceutical Sciences Review and Research 7 (12).

Bouhlal I, Ben-adim A, Benssi H, Sadik A. 2024. Transforming Cannabis Cultivation in Northern Morocco: A Geographical Analysis from Prohibition to Legitimization.

Bouloc P. 2006. Le chanvre industriel : production et utilisations. France Agricole Editions.

Bulletin officiel 2021. Dahir n° 1-21-59 du 3 hija 1442 (14 juillet 2021), portant promulgation de la loi n° 13-21 relative aux usages licites du cannabis. http://www.sgg.gov.ma/BO/bo_fr/2021/BO_7010_fr.pdf

Byg A, Balslev H. 2001. Diversity and use of palms in Zahamena, eastern Madagascar. Biodiversity and Conservation 10:951-970.

Carricano M, Poujol F, Bertrandias L. 2010. Analyse de données avec SPSS®. Pearson Education France.

Chaachouay N, Azeroual A, Bencharki B, Douira A, Zidane L. 2023. *Cannabis sativa* L.: a review on traditional uses, botany, phytochemistry, and pharmacological aspects. Traditional and Integrative Medicine 97-116.

Chaachouay N, Douira A, Zidane L. 2022. Herbal medicine used in the treatment of human diseases in the Rif, Northern Morocco. Arabian Journal for Science and Engineering 47(1):131-153.

Chandra S, Lata H, ElSohly MA. 2017. *Cannabis sativa* L.-botany and biotechnology. Springer.

Chas M, Goupille C, Arbion F, Bougnoux P, Pinault M, Jourdan ML, Chevalier S, Ouldamer L. 2019. Low eicosapentaenoic acid and gamma-linolenic acid levels in breast adipose tissue are associated with inflammatory breast cancer. Breast 45:113-117. doi: 10.1016/j.breast.2019.04.001

Chergui A, Ajal EA, Zakaria I, Nejjari R. 2024. A Comparative Study of the Biometric, Germinative, and Physicochemical Characteristics of Fruits and Oils of Three *Cannabis* Strains (*Cannabis sativa* L. var indica) Cultivated in the Rif Region of Morocco. Pharmacognosy Journal 16(1).

Chouvy PA, Afsahi K. 2014. Hashish revival in Morocco. International Journal of Drug Policy 25(3):416-423.

Chouvy PA, Macfarlane J. 2018. Agricultural innovations in Morocco's cannabis industry. International Journal of Drug Policy 58: 85-91.

Chouvy PA. 2008. Production de cannabis et de haschich au Maroc : contexte et enjeux. L'Espace Politique. Revue en ligne de géographie politique et de géopolitique 4.

Chouvy PA. 2019. Illegal cannabis cultivation in the world, and as a subject in academic research. Introduction. EchoGéo 48.

Chouvy PA. 2022. Le cannabis marocain, du territoire au terroir. Les Cahiers d'EMAM. Études sur le Monde Arabe et la Méditerranée 34.

Clarke RC, Merlin MD. 2016. Cannabis domestication, breeding history, present-day genetic diversity, and future prospects. Critical reviews in plant sciences 35(5-6):293-327.

Conrad C. 1997. Hemp for health: The medicinal and nutritional uses of *Cannabis sativa*. Inner Traditions/Bear & Co.

Dan Guimbo I. 2011. Fonction, dynamique et productivité des parcs à *Vitellaria paradoxa* C.F. Gaertn. et à *Neocarya macrophylla* (Sabine) Prance dans le sud-ouest du Niger. Thèse de doctorat, Université Abdou Moumouni, Niamey.

El Bakali I, Hassoun M, Boutahar A, El Bakali S, Sakar EH, Kadiri M, Merzouki A. 2024. A comparative evaluation of biomass and resin by-products attributes of six hemp (*Cannabis sativa* L.) cultivars grown in Rif Mountains (northern Morocco). Vegetos 1-13.

El Omari F, Sabir M, Toufiq J. 2013. L'usage de drogues auprès des élèves marocains. Rapport MedSPAD.

El-Ommal M, Tribak A, Amhani Z, Arari K. 2024. Culture du *Cannabis* et dégradation des sols dans les montagnes du Rif Central (Maroc) : cas du bassin de l'Oued Sra. Revista de Estudios Andaluces (48):93-109.

Fordjour E, Manful CF, Sey AA, Javed R, Pham TH, Thomas R, Cheema M. 2023. *Cannabis*: a multifaceted plant with endless potentials. Frontiers in Pharmacology 14:1200269.

Gaborit F. 2014. *Cannabis sativa*, état des lieux en 2014 : controverses sur la réglementation du cannabis dans le monde : frontière étroite entre l'usage récréatif et thérapeutique. PhD dissertation.

Gomez-Beloz A. 2002. Plant use knowledge of the Winikina Warao: the case for questionnaires in ethnobotany. Economic Botany 56(3):231-241.

Grotenhermen F. 2009. Cannabis en médecine : un guide pratique des applications médicales du cannabis et du THC. Editions Indica.

Haddou S, Hassania Loukili E, Hbika A, Chahine A, Hammouti B. 2023. Phytochemical study using HPLC-UV/GC-MS of different of *Cannabis sativa* L. seeds extracts from Morocco, Materials Today: Proceedings 72:3896-3903. doi: 10.1016/j.matpr.2022.10.215

Hazekamp A. 2009. Cannabis review. Department Of Plant Metobolomics, Leiden University.

Hillig KW. 2005. Genetic evidence for speciation in Cannabis (Cannabaceae). Genetic Resources and Crop Evolution 52:161-180.

Hourfane S, Mechqoq H, Bekkali AY, Rocha JM, El Aouad N. 2023. A comprehensive review on *Cannabis sativa* ethnobotany, phytochemistry, molecular docking and biological activities. Plants 12(6):1245.

Hurgobin B, Tamiru-Oli M, Welling MT, Doblin MS, Bacic A, Whelan J, Lewsey MG. 2021. Recent advances in *Cannabis sativa* genomics research. New Phytologist 230(1):73-89.

Hutchins WJ. 1999. Warren weaver memorandum, July 1949. MT News International (99).

Kaushal S. 2012. Ethnobotanical study and socioeconomic survey of *Cannabis sativa*. Indian Journal of Plant Sciences 1(1):114-119.

Long T, Wagner M, Demske D, Leipe C, Tarasov PE. 2017. Cannabis in Eurasia: origin of human use and Bronze Age trans-continental connections. Vegetation History and Archaeobotany 26,:245-258.

McPartland JM, Small E. 2020. A classification of endangered high-THC cannabis (*Cannabis sativa* subsp. indica) domesticates and their wild relatives. PhytoKeys 144:81.

McPartland JM. 2018. Cannabis systematics at the levels of family, genus, and species. Cannabis and cannabinoid research 3(1):203-212.

Meklach Y, Haluza-Delay R, Kadiri M, Ouahrani AE, Mesa JM, Merzouki A. 2019. Cannabis cultivation within a religious context: A case study of Ghomara in the Rif Mountain (Northern Morocco). Journal of ethnicity in substance abuse 18(1):45-66.

Meklach Y, Merzouki A. 2021. Cannabis cultivation as a factor influencing scholastic performance: The case study of Ghomara's secondary school students (Chefchaouen province, north-western Morocco). Journal of Quality in Education 11(18):20-46.

Meklach Y, Sánchez Alhama J, Molero Mesa J, Martos AV, Ouahrani A, Merzouki A. 2010. Cannabis and sustainable development in Ghomara's mountains (western coastal part of Rif-North of Morocco): The gender makes the difference? Journal of Sustainable Development in Africa 12(3):286-303.

Merzouki A, Casares M, Molero J. 1996. Etude morphologique des akènes de 4" variétés climatiques" du cannabis du rif Nord du Maroc. Ars Pharmaceutica 37(2), 239-251.

Merzouki A, Ed-Derfoufi F, Mesa JM. 2000. Hemp (*Cannabis sativa* L.) and abortion. Journal of ethnopharmacology 73(3):501-503.

Merzouki A, Mesa JM, Louktibi A, Kadiri M, Urbano GV. 2008. Assessing changes in pupillary size in Rifian smokers of kif (*Cannabis sativa* L.). Journal of forensic and Legal Medicine 15(5):335-338.

Merzouki A, Molero Mesa J. 1997. Fatty acid composition of Achene oils from five Moroccan climatic cultivars of Cannabis. Grasas y aceites 48(3):144-147.

Merzouki A, Molero Mesa J. 2002. Concerning kif, a *Cannabis sativa* L. preparation smoked in the Rif mountains of northern Morocco. Journal of Ethnopharmacology 81(3):403-406.

Merzouki A, Molero Mesa J. 1999. La Chanvre (*Cannabis sativa* L.) dans la pharmacopée traditionnelle du Rif (Nord du Maroc). Ars Pharmaceutica 40(4):233-240.

Miyake JA. 2009. Gamma-linolenic acid inhibits both tumour cell cycle progression and angiogenesis in the orthotopic C6 glioma model through changes in VEGF, Flt1, ERK1/2, MMP2, cyclin D1, pRb, p53 and p27 protein expression. Lipids Health Dis., 8:8. doi: 10.1186/1476-511X-8-8

Montanari B, Bergh SI. 2019. Why women's traditional knowledge matters in the production processes of natural product development: The case of the Green Morocco Plan. In Women's Studies International Forum. Pergamon.

Morgan GW. 2023. Effects of drought stress on floral hemp (Cannabis sativa L.) agricultural systems (Master's thesis, Auburn University).

Munch G. 2015. Le cannabis, les deux versants : drogue et médicament. PhD dissertation, Université de Lorraine.

Ouhtit R, Ouhtit A, Redouan FZ, Lamrani Z, Merzouki A. 2024. Morphometry, Oil Yield and Fatty Acid Profile of Cannabis Achenes from the Chefchaouen Region. Moroccan Journal of Chemistry 12 (1):43-60. doi: 10.48317/IMIST.PRSM/morjchem-v12i1.42058

Paczesny M. 2014. *Cannabis sativa* L. : étude botanique et chimique : propriétés médicales et état des lieux sur la réglementation. Université Joseph Fourier-Grenoble.

Phillips O, Gentry AH. 1993. The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. Economic Botany 15-32.

Pratiwi YI, Cengiz MK, Mouhin A. 2023. Cannabis Regulation: A Comparative Study in Indonesia, Turkey, and Morocco. Kosmik Hukum 23(1):103-114.

Provincial Monograph Al Hoceima. Direction Provinciale D'al Hoceima, haut-commissariat au plan. 2017. Main Report. https://www.hcp.ma/region-tanger/attachment/954564/

Provincial Monograph Chefchaoun. Direction Provinciale D'al Hoceima, haut-commissariat au plan. 2018. https://www.hcp.ma/region-tanger/attachment/1044497/

Punja ZK, Sutton DB, Kim T. 2023. Glandular trichome development, morphology, and maturation are influenced by plant age and genotype in high THC-containing cannabis (*Cannabis sativa* L.) inflorescences. Journal of Cannabis Research 5(1):12.

Rana A, Choudhary N. 2010. Floral biology and pollination biology of *Cannabis sativa* L. International Journal of Plant Reproductive Biology 2(2):191-195.

Ranalli P, Venturi G. 2004. Hemp as a raw material for industrial applications. Euphytica 140(1):1-6.

Richard D, Senon J. L. 2010. Le cannabis dans l'histoire. Que sais-je?, 5:28-44.

Ross IA. 2005. *Cannabis Sativa*. In Medicinal Plants of the World, Volume 3: Chemical Constituents, Traditional and Modern Medicinal Uses, Totowa.

Sawler J, Stout JM, Gardner KM, Hudson D, Vidmar J, Butler L, Myles S. 2015. The genetic structure of marijuana and hemp. PloS one 10(8):e0133292.

Schilling S, Melzer R, McCabe PF. 2020. *Cannabis sativa*. Current Biology, 30(1):R8-R9.

Schrauf RW, Julia Sanchez J. 2008. Using Freelisting to Identify, Assess, and Characterize Age Differences in Shared Cultural Domains, Journals of Gerontology B(63).

Small E, Cronquist A. 1976. A practical and natural taxonomy for *Cannabis*. Taxon 405-435.

Small E, Pocock T, Cavers PB. 2003. The biology of Canadian weeds. 119. *Cannabis sativa* L. Canadian Journal of Plant Science 83(1):217-237.

Small E. 2016. Cannabis: a complete guide. CRC Press.

Sop TK, Oldeland J, Bognounou F, Schmiedel U, Thiombiano A. 2012. Ethnobotanical knowledge and valuation of woody plants species: a comparative analysis of three ethnic groups from the sub-Sahel of Burkina Faso. Environment, Development and Sustainability 14:627-649.

Sorrentino G. 2021. Introduction to emerging industrial applications of cannabis (*Cannabis sativa* L.). Rendiconti Lincei. Scienze fisiche e naturali 32(2):233-243.

Staub PO, Geck MS, Weckerle CS, Casu L, Leonti M. 2015. Classifying diseases and remedies in ethnomedicine and ethnopharmacology. Journal of Ethnopharmacology 174:514-519

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Economic Botany 62:24-39.

Tingman S. 2019. Local Perceptions of Cannabis and Cannabis Laws in Morocco: Unpacking Past Laws, Moroccans' Perceptions, and Exploring Organizational Efforts.

Thomas E, Vandebroek I, Sanca S, Van Damme P. 2009. Cultural significance of medicinal plant families and species among Quechua farmers in Apillapampa, Bolivia. Journal of Ethnopharmacology 122:60-67.

Wills S. 1998. *Cannabis* use and abuse by man: an historical perspective. In *Cannabis*, CRC Press.

Whitney, C. 2022. Quantitative ethnobotany analysis with ethnobotany R.

Zheng L, Plaisent M, Zuccaro C, Bernard P, Daghfous N, Favreau S. 2019. L'analyse des données de sondage avec SPSS: un guide d'introduction. PUQ.