Ethnobotanical investigation of herbal food additives of Morocco used as natural dyes

Aziz Drioiche, Nadia Benhlima, Amale Kchibale, Salima Boutahiri, Atika Ailli, Fatima El Hilali, Brahim Moukaid and Touriya Zair

Research

Abstract

We undertook this ethnobotanical study for identifying and valorising medicinal plants exploited as food additives, and to establish a database of aromatic and medicinal plants used as food additives in traditional phytotherapy in Morocco (Fez-Meknes, Beni-Mellal, Khenifra, Draa-Tafilalt).

Methods: An ethnobotanical investigation was carried out among 200 main actors in traditional medicine (herbalists, healers, collectors, researchers) of Meknes, El Hajeb, Taza, Azrou, Ain Leuh, Boulemane, Ifrane, Khenifra, M'rirt, and Midelt; data on the use of plants as food additives and especially those used as tinctorial plants was collected via questionnaire sheets. The data was then subjected to principal component analysis.

Results: The population surveyed use plants for three major purposes: therapeutic (39.60%), food (35.84%) and cosmetics (24.56%). Majority (33.01%) of the people surveyed use plants to provide aroma, followed by dyes (25.24%), spices (24.27%) and as food preservative (17.48%). We identified 56 plants used as dyes among the 79 species identified. From a botanical point of view, the 79 species listed are divided into 35 families. The most represented families are *Asteraceae* (16.55%), *Lamiaceae* (15.17%), *Punicaceae* (7.24%) and *Zingiberaccea* (7.24%). The survey confirmed the excessive use of *Punica granatum* L., *Curcuma longa* L., *Matricaria camomilla* L., *Crocus sativus* L. and *Carthamus tinctorius* L.

Conclusion: This study showed that the indigenous populations of the Pre-Rif, Middle Atlas and High Atlas regions use the plants as natural food additives, especially dyes. This wealth of plants is accompanied by knowledge and practices in phytotherapy acquired by the inhabitants over the centuries. We recommend that the documented plants be evaluated for their safety and efficiency in order to conclusively demonstrate their beneficial effects on health.

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Background

Food additives represent a tiny part of our diet, are now at the centre of a wide debate that feeds ignorance, prejudice and concern. According to Decree 1795-14 of the Ministry of Agriculture and the Ministry of Health of Morocco, there are more than 250 authorized additives classified into 18 categories

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(Order of the Minister of Health Morocco 2014) compared to 507 in France where it is divided into 24 categories (Reynal *et al.* 2009). All additives (colourants, preservatives, antioxidants, stabilizers, gellings, thickeners, flavours, taste enhancers, sweeteners) are added to foods to facilitate their manufacture, preservation and also to improve their nutritional qualities (Chaudhary *et al.* 2010, Msagati *et al.* 2012, Abdulmumeen *et al.* 2012). With the proliferation of out-of-home meals, and the presence of synthetic food dyes in most industrial dishes, it has become impossible to abstain from them.

Synthetic dyes usually contain chemicals that in high doses, could cause bloating, nausea and vomiting (Selar 2017). In the interest of preventing such problems, a permissible daily dose, below which no effect is found in the organism, has been defined for some dyes, without raising the issue of the lack of information for consumers. Some synthetic dyes are also suspected carcinogens (Fiolet *et al.* 2018, Takkouche *et al.* 2005). In this scenario, the exploration natural plant resources to replace synthetic colouring is crucial. The pharmaceutical, cosmetics and food Industries look forward for the replacement of synthetic dyes with harmless biocolourants. Complex and multidisciplinary studies have shown the colouring properties of aromatic and medicinal plants (AMP) which are exploited as natural colourants (Kundal *et al.* 2016, Chengaiah *et al.* 2010). This diversity of the species (Table 1) has shown that the plant kingdom, especially aromatic and medicinal plants, is a repository of natural bioactive substances with potential to be used as food additives, especially as natural dyes with diverse therapeutic virtues.

In Morocco, dyeing plants (saffron, safflower, pomegranate and madder) are renowned for their tinctorial qualities (yellow and red sources) and their pharmacological and nutritional properties. Thus, many edible plants, used as food dyes (carrot, grape skin, onion peel, walnut scramble, etc) are, ancestral sources of pigments. However, we find that few scientific studies have been conducted on natural dyes derived from tinctorial plant extracts.

Currently, despite the progress of pharmacology, the therapeutic and food use of AMP is persistent in many countries, especially developing countries (Botineau 2012). Indeed, of the 500,000 species of plants on earth, at least 80,000 would have valuable medicinal properties (Anderson *et al.* 1982). Like other parts of the world, Morocco is a veritable reservoir of plant genetic resources, with about 4,500 species and subspecies of vascular plants (Dupont *et al.* 2015). Traditional medicine has always played an important role in Moroccan pharmacopeia. Also, traditional food know-how is now recognized as a heritage that must be conserved, valued and reinvented. Biodiversity, the quality and diversity of local know-how and products, as well as the beauty of cultural landscapes, are undoubtedly among Morocco's strengths. Their appreciations is likely to restore economic and social dynamics and improved environmental sustainability in many rural areas. In this regard, the present study focuses on ancestral culinary and therapeutic knowledge in the pre-Rif, Atlas and top Atlas regions to establish a catalogue and inventory of AMP used as food additives (coloring, aroma and preservatives). The aim is to improve empirical knowledge through in-depth scientific research, focused on verifying the pharmacological and nutritional value of plants in the study areas. This would later help in the identification of new bioactive molecules of food and pharmaceutical interest.

Methods

Study area

The study area consists of 10 sites: Meknes, El Hajeb, Taza, Azrou, Ain Leuh, Boulemane, Ifrane, Khenifra, M'rirt, Midelt (Fig. 1). These sites can be grouped into three areas of the pre-rif mountains, the Middle Atlas and the High Atlas. These regions are reputed for traditional medicine.

Sampling

Ethnobotanical surveys were conducted between July 2017 and July 2018 to obtain a varied and comprehensive inventory. The sample consisting of herbalists, healers, collectors, researchers (pharmacists, doctors and academics) and associated actors was subdivided into ten strata, representing rural and urban municipalities. Using simple randomized sampling, 20 informants were then trained for each of the ten strata, and then are grouped to obtain a comprehensive sample of 200 informants.

A fact sheet in the form of a questionnaire (appendix 1) was designed to collect as much information as possible about the person surveyed (age, level of education, profession and family situation), data relating to AMP (areas of use; food uses as colourant, spices, preservatives, and flavourings; parts used and the adverse effects of these plants), and know-how concerning the therapeutic and food uses of natural colourants

Data Analysis Using Ethnobotanical Indices

Relative Frequency of Citation (RFC)

Relative frequency of citations reveals the local importance of each medicinal plant species used by peoples in the region. This index can also provide an indication of medicinal species are best known or have been used for a long time by the majority of informants and can be a source of reliability (Ouelbani *et al.* 2016). Knowledge about the medicinal uses of plants is easily preserved for future

dividing the citation frequency (CF) (the number of informants mentioning a useful species) by the total number of informants in the survey (N). This RFC

index ranges from 0 (when a species is not mentioned by any user as useful) to 1 (when all respondents mentioned the species as useful). RFC was calculated by using the formula RFC = FC/N **(**Vitalini *et al.* 2013).

Processing the results

Data collected was treated and analysed by SPSS 22-32 software, then transformed into graphs or histograms with Microsoft Excel 2019. The statistical study was based on the Principal Component Analysis (PCA). This analysis is carried out using Pearson-type matrixes using the "PCA" function to establish, on the one hand, the correlation between the socio-demographic information collected regarding plants used as food additives in each study region, and on the other hand, between information about the use of plants in each study site. Intermediate correlation matrixes, correlation coefficients between variables and the two F1 and F2 axes, and the projection of variables in the F1 and F2 axis space were obtained through XLSTAT Software. The ethnobotanical RFC index has been calculated to select medicinal species with a high RFC, which will be evaluated in subsequent phytochemical and pharmacological work for the identification of important bioactive molecules.

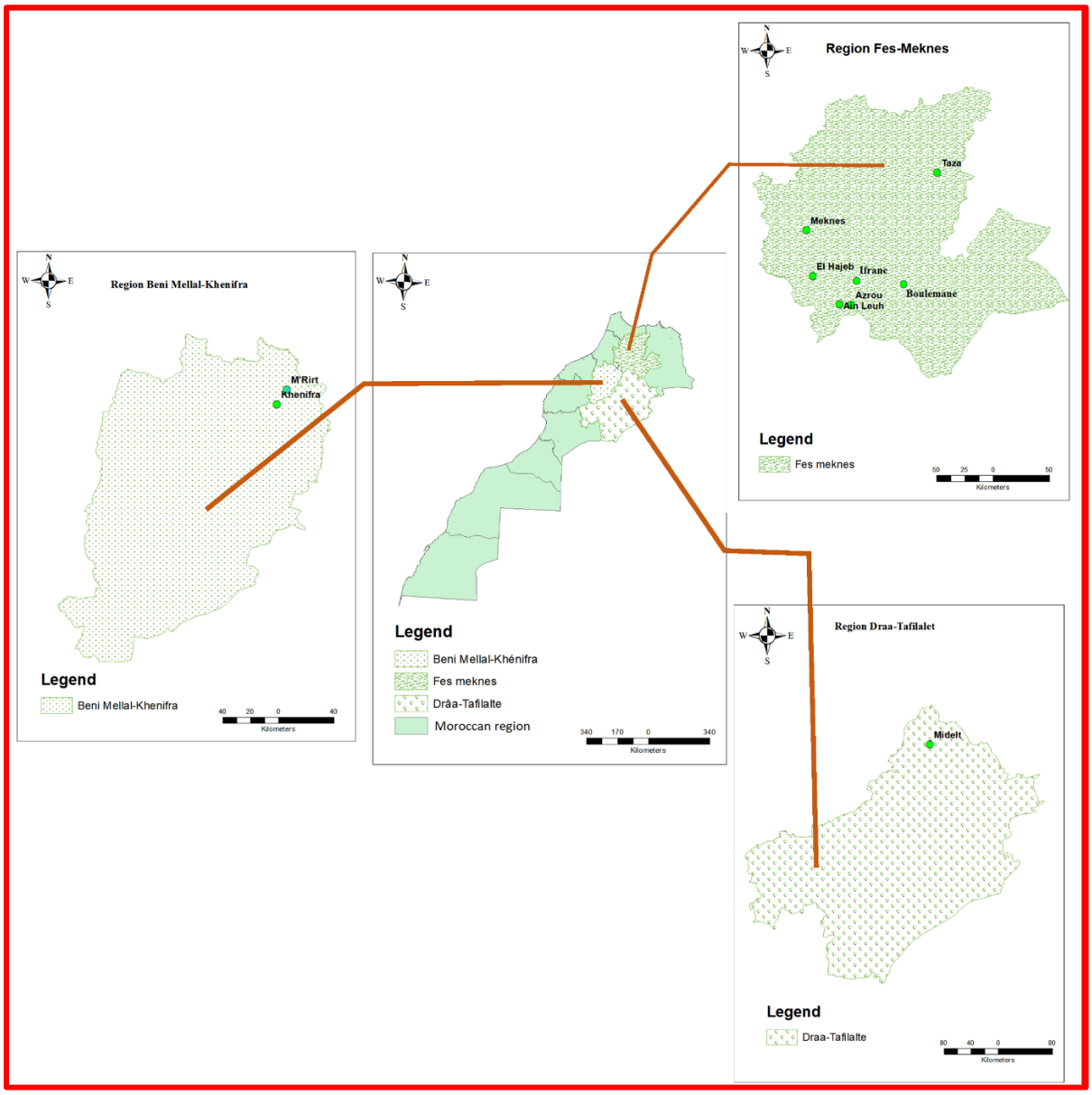

Fig. 1. Geographical location of the study area (Morocco)

Table **1.** Example dye plants and their medicinal properties

Botanical family	***Plant species***	**Used parts**	**Color**	**Chemical composition : pigment**	**Medical use**	**References**
Amaryllidaceae	*Allium cepa* L.	Onion bark	Yellow, green, orange	Flavonoids, tannins and anthocyanins	Antimicrobials, antidiabetic, anti-oxidants, digestive disorders, urinary retention, aphrodisiac, arteriosclerosis.	(Dorsch 1997, Hughes and Lawson 1991. Prakash *et al.* 2007)
Anacardiaceae	*Pistacia terebinthus* L.	Leaves and galls	Yellow	Anthocyanins, tannins : Myrisitine; Gallotanique acid	antiulcer, hepatoma, antimicrobial, astringent, expectorant, healing, antispasmodic	(Bozorgi *et al.* 2013)
Asteraceae	*Artemisia vulgaris* L.	Whole plant	Yellow	Flavonoids and tannins	Tonic, antipyretic, antispasmodic, vermifuge and stomach, hepatic, dysmenorrhea, antimicrobial.	(Abiri *et al.* 2018, Gilani *et al.* 2005, Khan and Gilani 2009)
Asteraceae	*Calendula officinalis* L.	flowers	Yellow to orange	Flavonoids and Carotenoids	Anti-inflammatory, anti-oedematous, antiviral, antitumor, immunomodulatory, HIV, dermatology.	(Kalvachev *et al.* 1997, Muley *et al.* 2009, Zitterl-Eglseer *et al.* 1997)
Asteraceae	*Carthamus tinctorius* L.	flowers	red	Quinochalcone NY2 75130 and 75135; NY27: 75125; NR26: 75140 carthamine	Anti-inflammatory stabilizes blood pressure, hepatic, removes bad cholesterol, anti-cancer, anticoagulant, antidiabetic.	(Asgarpanah and Kazemivash 2013)
Asteraceae	*Centaurea cyanus* L.	flowers	Blue	Anthocyanins / Cyanidin	Fever, menstrual disorders, constipation, hepatoprotective, eye irritation, anti-inflammatory, immunomodulatory, gastroprotective.	(Garbacki *et al.* 1999, Pirvu *et al.* 2012).
Asteraceae	*Cichorium intybus* L.	The whole plant, flowers	Brown, blue	anthocyanins	Diarrhea, strengthening of the prostate and other reproductive organs, lung cancer, hangover, and bile duct purification, spasmolytic, cholesterol, antiseptic, diabetes, hepatoprotective	(Al-Snafi 2016)
Asteraceae	*Erigeron canadensis* L.	flowers	Yellow	Flavonoids and Tannins	Antirheumatic, diuretic, anti-diarrheal, healing, anti-inflammatory, hemorrhoids, diabetes.	(Aslam *et al.* 2018, Lateef *et al.* 2018).
Brassicaceae	*Isatis tinctoria* L.	leaves	Blue	Indigo	Treat edema, tumors, wounds, healing, ulcers, scurvy, antipyretic, anti-inflammatory, antiseptic, anti-inflammatory	(Adachi *et al.* 2018, Jung *et al.* 2018).

Cesalpiniaceae	*Caesalpinia spinosa* (Molina) Kuntze	Cloves	Black	Hydrolyzable tannins	Antimicrobial, spasmodic, anti-cancer.	(Kondo *et al.* 2006, Skowyra *et al.* 2014. Urueña *et al.* 2013).
Euphorbiaceae	*Chrozophora tinctoria* L.	leaves	Green, Blue, Purple	Flavonoids anthraquinone	Antimicrobial, dysentery, antimutagenic, syphilis, typhoid, diabetes, parasite	(Abdalbasit 2004, Maurya *et al.* 2016).
Fabaceae	*Acacia dealbata* L.	Bark	Red to brown	Tannins / proanthocyanidins	Antimicrobial, antioxidant	(Silva *et al.* 2016).
Fabaceae	*Acacia decurrens* (J.C.Wendl.) Willd.	Bark	Brown	Tannins / proanthocyanidins	Headache, diarrhea, dysentery, antiseptic, diabetes	(Subhan *et al.* 2018)
Fagaceae	*Quercus cerris* L.	Bark	Beige brown-gray to black	Tannins	Astringent, vasoconstrictor, anti-inflammatory, antidiarrheal, antiseptic, stomach.	(Amorini *et al.* 1996; Majer, 1984, Matić, 2000)
Iridaceae	*Crocus sativus* L.	Stigmas	Yellow	Carotenoids, crocetin.	Neuroprotective, antitussive, hypolipidemic activity, anticonvulsant, antinociceptive, antidepressant, anxiolytic, cardiovascular protection, anticancer, antioxidant	(Hosseini *et al.* 2018)
Boraginaceae	*Origanum vulgare* L.	leaves	Red-purple	Anthraquinone	Antiseptic, antispasmodic, hypoglycemic, aperitif effect, analgesic, anti-inflammatory, antioxidant	(Lemhadri *et al.* 2004, Mockute *et al.* 2001)
Lythraceae	*Lawsonia inermis* L.	leaves	Yellow to brown, red, orange	Naphthoquinone, lawsone	Antimicrobial, antispasmodic, anti-parasitic, nephrolithiasis, antidiarrheal, anti-inflammatory, analgesic, antipyretic	(Alia *et al.* 1995. Singh *et al.* 2015)
Malvaceae	*Hibiscus sabdariffa* L.	Red chalices, fresh or dried	red	Flavonoids, anthocyanins	Hypotensive, hepatoprotective, anti-inflammatory, soothing, anti-asthenic, antispasmodic, anti-microbial	(Riaz and Chopra, 2018, Seung *et al.* 2018, Su *et al.* 2018).
Moraceae	*Ficus carica* L.	leaves	Yellow	Flavonols, anthocyanins, quercetin	Anticancer, anemia, antioxidant, coloring agent, antimalarial, antiprotozoal, chemoprevention, anti-inflammatory, hemoptysis, antiseptic.	(Badgujar *et al.* 2014. Gilani *et al.* 2008)
Myrtaceae	*Eucalyptus* sp.	leaves	Yellow to brown	Quercetin	Balsamic, thinner, anti-infective, antiseptic, antirheumatic, stimulant, tonic, antispasmodic	(Hmiri *et al.* 2011; Whitman and Ghazizadeh 1994)
Papaveraceae	*Papaver rhoeas* L.	flowers	Red, pink, purple	Anthocyanins and flavonoids	Antitussive, an antiseptic, a thickener, respiratory diseases, antispasmodic, jaundice, ulcer.	(Gürbüz *et al.* 2003. Soulimani *et al.* 2001)

Punicaceae	*Punica granatum* L.	Bark and fruits	Yellow	Ellagitannins	Antioxidants, hepatic, antidiarrheal, deworming, anti-cancer, anti-inflammatory, anti-diabetic	(Arun and Singh 2012, Lansky and Newman 2007)
Rosaceae	*Alchemilla vulgaris* L.	Whole plant	Light orange	Tannins	Antidiarrheal, diuretic, tonic, vulnerary, hemostatic, sedative, antirheumatic	(Dzabijeva *et al.* 2018, Lordani *et al.* 2018).
Rubiaceae	*Galium verum* L.	Roots and rhizomes and flowering tops	Red, pink	Anthraquinone	Antispasmodic, astringent, diuretic, vulnerary	(Bradic *et al.* 2018, Shafaghat *et al.* 2010)
Rubiaceae	*Rubia tinctorum* L.	Rhizomes	Red to orange	Anthraquinone : Alizarin and Purpurin	Laxative, diuretic, antilithiasis urinary, anti-inflammatory, antioxidative, antiproliferative,	(Goktas *et al.* 2009 ; Mishchenko *et al.* 2007)
Thymelaeaceae	*Daphne gnidium* L.	Airborne	Yellow	Flavones / Luteolin, Apigenin ...	Antiseptics, depurative, healing, insecticide.	(Cottigli *et al.* 2001 ; Cottiglia *et al.* 2002)
Urticaceae	*Urtica dioica* L.	Whole plant	Yellow	Flavonoids	Tonic, astringent, vasoconstrictor, hemostatic, anti-anemic, rickets, depurative, anti-infectious, anti-rheumatic, diuretic, uric acid suppressor, hepatic drainage, antidiarrheal, stomachic, lactogenic, revulsive	(Asgarpanah and Mohajerani 2012, Testai *et al.* 2002)
Zingiberaceae	*Curcuma longa* L.	Root or rhizome	Yellow-orange	Curcumin	Antioxidant, bloating anti-inflammatory, renal, intestinal, anticancer drugs, vasodilator, spasmodic, inotropic and chronotropic	(Ashraf, 2018, Jamil *et al.* 2018).
Zygophyllaceae	*Peganum harmala* L.	Seed	Red rose	Anthraquinone	Antibacterial, antifungal, antiviral, antioxidant, anti-diabetic, anti-tumor, anti-inflammatory, cytotoxic and insecticidal as well as hepatoprotective and antinociceptive effects	(Asgarpanah and Ramezanloo 2012)

Results and discussions

Use of plants by gender

Our study finds that men and women practice traditional medicine; mong the population who practice traditional medicine, 61.62% are men and 38.38% are women (Fig. 2). This reflects men specialise more on traditional medicine compared to women. The difference in the percentages observed is explained on the one hand by the number of men interviewed compared to women, and on the other hand, men are more active in the field of AMP than women (herbalists, collectors, etc.). However, in recent years, the participation of women has been increasingly noticed through the creation of associations, cooperatives or even pharmacies specializing in medicinal plants (Benkhnigue *et al.* 2016, Hmamouchi 2001). Hence, the share of women practitioners is bound to increase over time.

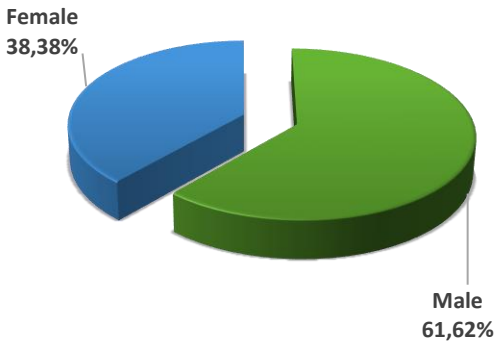

Fig. 2. Distribution of plant use by gender

Use of plants by age

Age plays a very important role in the activity of traditional medicine, the treatment of survey results has provided the graph below: Figure 3, which clearly shows the distribution of age percentages in study areas.

The use of aromatic and medicinal plants as natural food additives (dyes, preservatives, aroma and dietary supplements) in the study areas, is generally inherited from the previous generation. Though traditional use is widespread in all age groups, people over the age of 40 years have a high frequency of use of medicinal plants of 34.34%. These results are in line with other ethnobotanical work carried out at the national level, such as the work of Benlamdini in the forest of the Eastern High Atlas (High Moulouya) (Benlamdini *et al.* 2014) which showed that the elderly have more experience and knowledge related to aromatic and medicinal plants compared to other age groups. Our study also shows that young people have little interest in the therapeutic use of plants and do not believe in traditional medicine, preferring instead modern medicine. This result is similar to those obtained in previous ethnobotanical studies conducted in other regions of Morocco (Eddouks *et al.* 2017; Mehdioui and Kahouadji 2007). This reflects that the transmission of traditional knowledge from the elderly to the young is on the decline, and require specific interventions. However, there is relatively lesser frequency of use in the age group of 50-59 years. This is because, people over fifty years of age represent a population that is less and less active, and the majority of which is at risk of developing diseases with high co-morbidity such as kidney failure, heart problems, diabetes, cancer, etc. These diseases frighten people and limit the use of plants, especially for a population with a modest level of education.

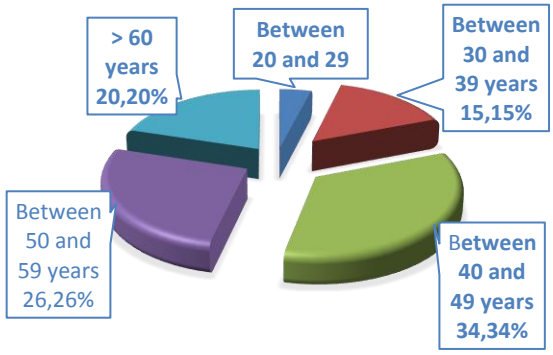

Fig. 3. Use of food additives by age group

Use of aromatic and medicinal plants (AMP) according to the marital status

The use of AMP is more in married persons (87.88%) than in singles (10.10%), and divorcees (2.02%) (Fig. 4). The married perhaps due to their greater responsibility in the homes, know more on the therapeutic effects of plants, and are involved in preparing infusions or decoctions for the care of their family especially for their children. These results confirm those obtained by (Benkhnigue *et al.* 2010; El Amri *et al.* 2015) who showed that married couples are the depositories of the secrets of medicinal plants and the inheritance of family knowledge adapted to their family. We can deduce that the activities of this population related to the AMP field are sources of major revenue that provide for the purpose of their needs and to address the problems of precariousness in which it lives. On the social level, the aromatic and medicinal plants sector remains a very promising sector in terms of creating revenue-generating activities through the development of natural plant resources in the commercial and pharmacological aspects. This is proven by several ethnobotanical surveys such as the work of El Azzouzi (Elazzouzi *et al.* 2018) in the same study region.

Occupation

Our study focused mainly on people who routinely exploit plants in various fields such as herbalists, healers, pickers, etc. to be able to extract more accurate information about AMP exploited as food plants and condiments (food additives). Users with information on food additives based on medicinal plants (Fig. 5) are herbalists with a percentage of 44.44%, collectors 13.13%, farmers 9.09%, Operators 6.06%, researchers 2.02%, healers 2.02%, and others (housewives, pharmacists, etc) with a frequency of 23.23%. According to a study carried out in 15 Moroccan cities among 2000 people, drug dealers were ranked first in the exploitation of aromatic and medicinal plants and constituted (98.4%), followed by herbalists (17.7%), pharmacists (8.1%) and finally healers (5.8%) (Errajraji *et al.* 2010).

Use of AMP according to education level

In our study area, 37.63% of the population are formally illiterate. This relatively high percentage is directly correlated with the level of education of the local population. While the levels of education (primary and secondary) represent 33.33% and 17.20% respectively. In contrast, university students and researchers use aromatic and medicinal plants very little, at the rate of 11.83% (Fig. 6). These results are similar to the work of Bammu (2015) in the Meknes-Tafilalt region (Bammou *et al.* 2015). Also, other studies have shown that the know-how on the use of medicinal plants is generally held by people not educated through the formal sector (Lahsissene *et al.* 2009, Omer *et al.* 2012).

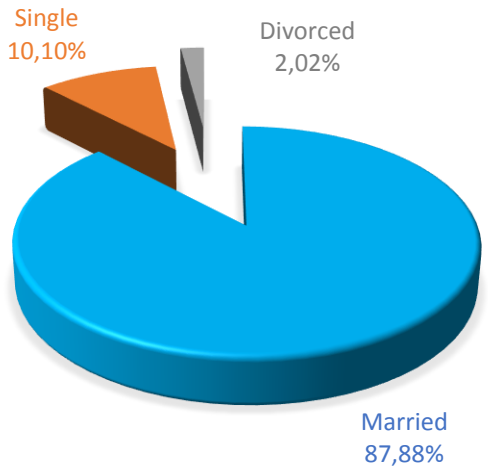

Fig. 4. Frequency of use of food additives according to marital status

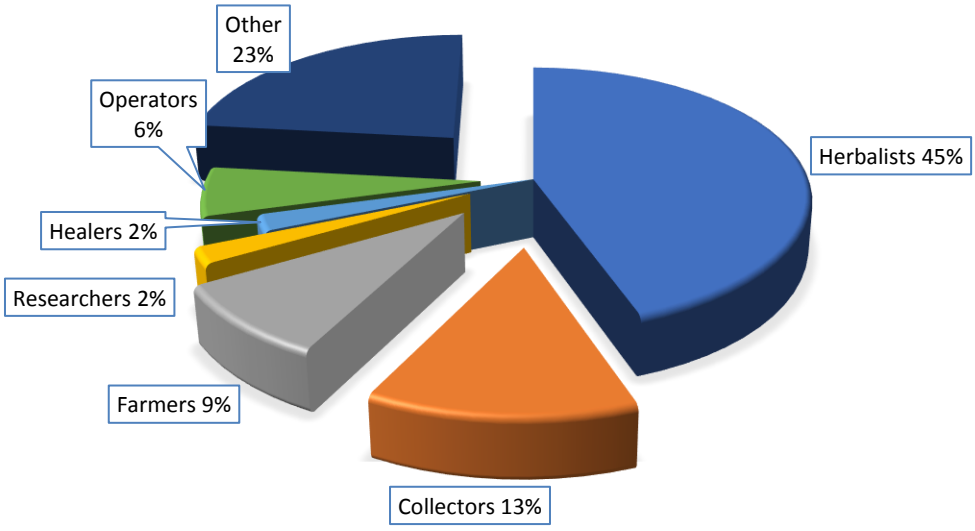

Fig. 5. Distribution of informants surveyed by occupation

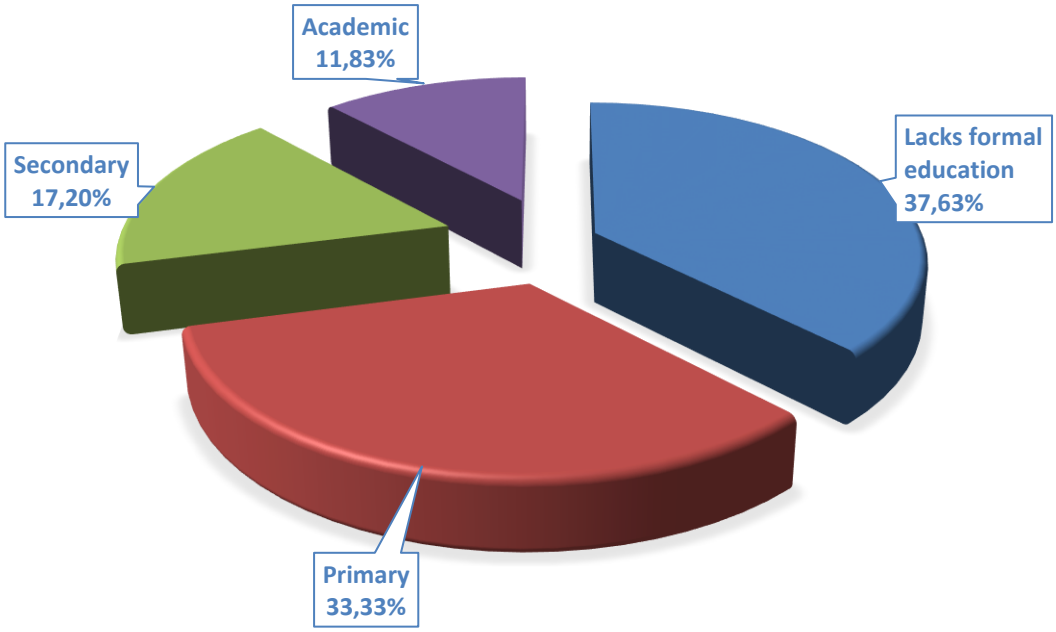

Fig. 6. Distribution of medicinal plant users by grade level

Multivariate analysis of socio-demographic data on PCA informants

Figure 7 shows the PCA based on all socio-demographic data of informants versus plants used as sources of natural food additives in each study region.

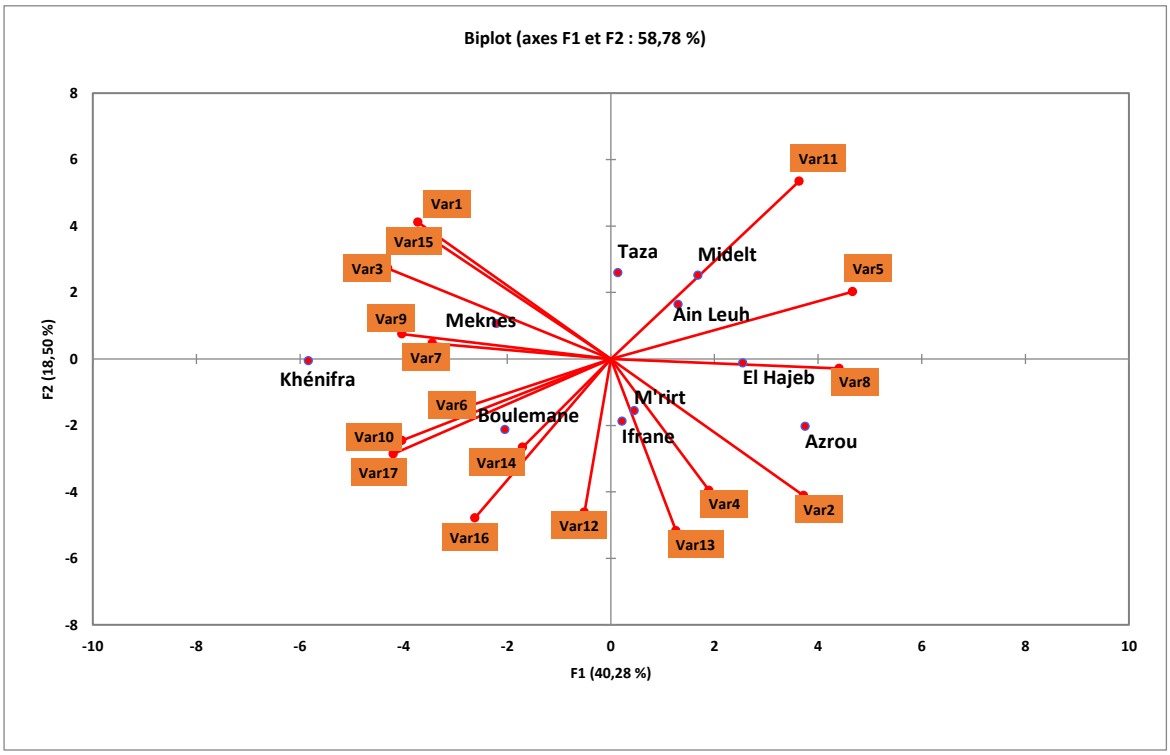

Fig. 7. Graphical Approach to Principal Component Analysis According to the Plan (F1xF2)
(Gender variables: var 1: Male, var 2: Female.Age groups variables: var 3: age range between 20 and 29 years old, var 4: between 30 and 39 years old, var 5: between 40 and 49 years old , var 6: between 50 and 60 years of age, var 7: age at over 60. Family situation variables: var 8: married, var 9: single, var 10: divorced. Profession variables: var 11: herbalists, var12: collectors , var13: farmers, var14: researchers, var15: healers, var16: farmers, var17: other professions.)

Examination of the correlation matrix between variables (Fig. 7) reveals the presence of sets of variables, made up of well-correlated variables. Variables 5 and 11 are positively correlated, i.e. herbalists over the age of 40 have more recourse to traditional medicine. The majority of the population surveyed in Taza, Midelt, El Hajeb and Azrou provinces are herbalists aged 40 to 49, married and have more knowledge about the field of plants. Indeed, in the Moroccan society herbalists are considered as more reliable sources of information and as paramedics.

Variables 12, 13, 4 and 2 are positively correlated in the same way. In this case, women from the M'rirt and Ifrane regions, whether pickers or farmers over the age of 30, have more recourse to the use of natural food additives in daily life; this is explained by the socio-economic situation of Middle Atlas regions, which is mediocre, knowing that the primary financial resource of this population remains is agricultural incomes.

Variables 6, 10, 14, 16 and 17 are positively correlated. Farmers and researchers aged 50 years old in the Boulemane region have been identified as useful sources of information on aromatic and medicinal plants used as food additives. This region is characterized by the presence of a significant wealth of plants, and the presence of several cooperatives and associations that exploit the richness and natural biodiversity of the region at the national and international level.

Finally, in the Meknes region, young people between the ages of 20 and 29, as well as older healers, represent the target population, which has guaranteed ancestral know-how in the field of plants.

Inventory of aromatic and medicinal plants listed as sources of food additives

From the 200 records filled out by the inhabitants in the regions studied, we inventoried 79 species of medicinal plants (appendix 2), belonging to a total of 35 botanical families (appendix 3). The survey identified 56 plant species used as sources of natural dyes, followed by 36 species used as aromatic plants and 31 as sources of natural preservatives. The determination of the scientific nomenclature of the species was carried out at the laboratory of plant botany and ecology of the scientific institute of Rabat.

Among the 35 families identified, the ones mostly used are: *Asteraceae* with a frequency of use of 16.55% followed by *Lamiaceae*, *Punicaceae* and *Zingiberaceae* with frequencies of use of 15.17%, 7.24% and 7.24% respectively. Other families account for fewer than 5.17%. These botanical families are the most represented in Morocco according to the latest floristic reports of the scientific institute of Rabat, and the most scientifically studied (Zakariya *et al.* 2018, Salhi *et al.* 2019). These families are primarily an important source of essential oils, phenols and flavonoids (Bouyahya *et al.* 2018, Ait-Sidi-Brahim *et al.* 2019). The predominant species used was *Punica granatum* L. with a relative citation frequency of 0.11%, followed by *Curcuma longa* L. and *Matricaria camomilla* L. with a frequency of 0.09%, as well as *Crocus sativus* L. (0.08%), *Capsicum annuum* L. and *Carthamus tinctorius* L. with a frequency of 0.05%. Various studies on the rind of the pomegranate fruit have shown that it contains two important benzoic acids, gallic acid and ellagic acid. It also contains hydroxycinnamic acids, derived from flavone molecules responsible for the yellow color, and anthocyanidins, responsible for the red color of pomegranates. Many studies have revealed the presence of ellagitannins, such as punicalin, punicalagine, corilagine, granatine A and granatine B (Fennane 2004). These antioxidant tannins, which represent up to 28% of the fruit's skin (Fennane 1998), have the ability to combat the oxidation of low-density lipoproteins known by bad LDL cholesterol (Fennane 1999).

The use of plant species

Use of aromatic and medicinal plants

The entire population investigated uses aromatic and medicinal plants for various purposes, either for their well-being or for healing and feeding.

Origin of the information

Figure 8 presents the origin of the information concerning the use of AMP. Indeed 58,59% of the population use aromatic and medicinal plants based on the experiences of the others, 22% of the population refers to the herbalists, while 8,08% of the people consult books and articles. At least 5,05% of people prefer to see audiovisual media, while 3,03% of the population surveyed refer to training, while, 2,02% of the population collect information from social networks. People use medicinal plants particularly based on the experiences of others, which shows that traditional practices are transmitted from people to people (Anyinam 1995).

Areas of use

Figure 9 presents the areas of use of aromatic and medicinal plants. From this figure, we find that AMP are heavily exploited in different areas. Indeed, the population surveyed uses plants in three specific areas: therapeutic, food and cosmetic in the following order, 39.60%; 35.84% and 24.56%. It should be noted that some species of aromatic and medicinal plants, such as thyme and chamomile, are highly appreciated and used by the population in all three fields.

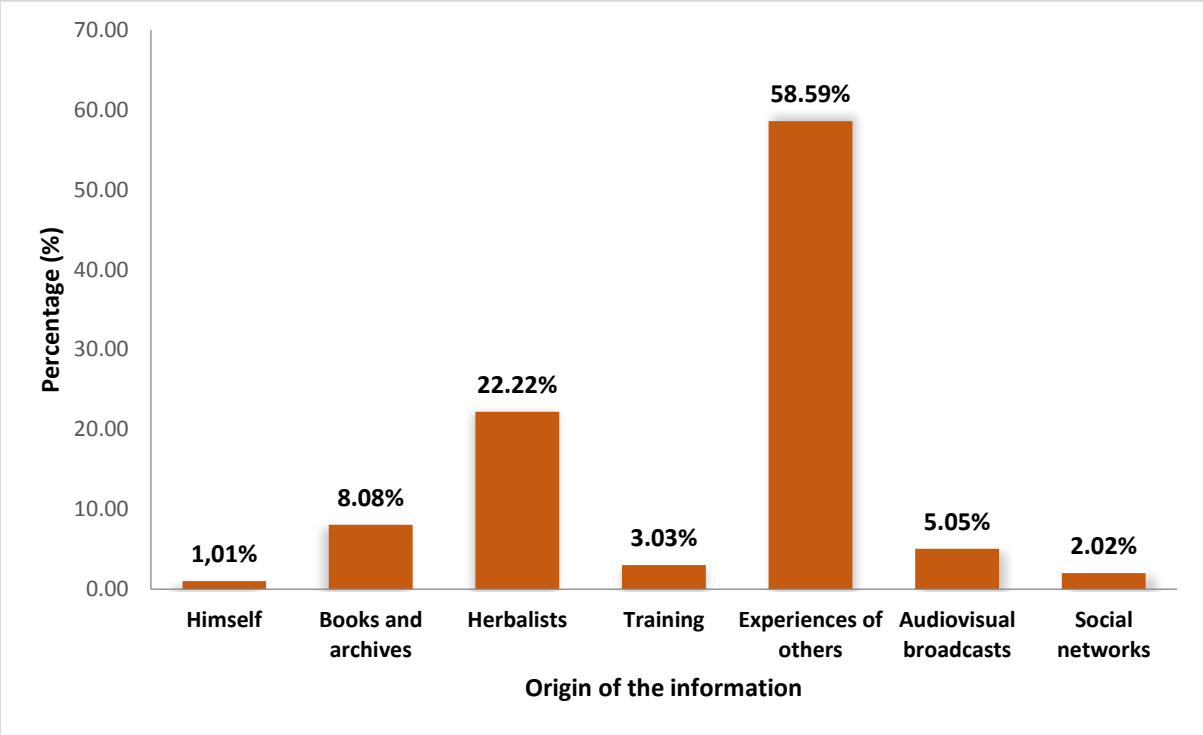

Fig. 8. Origin of the information related to the use of plants

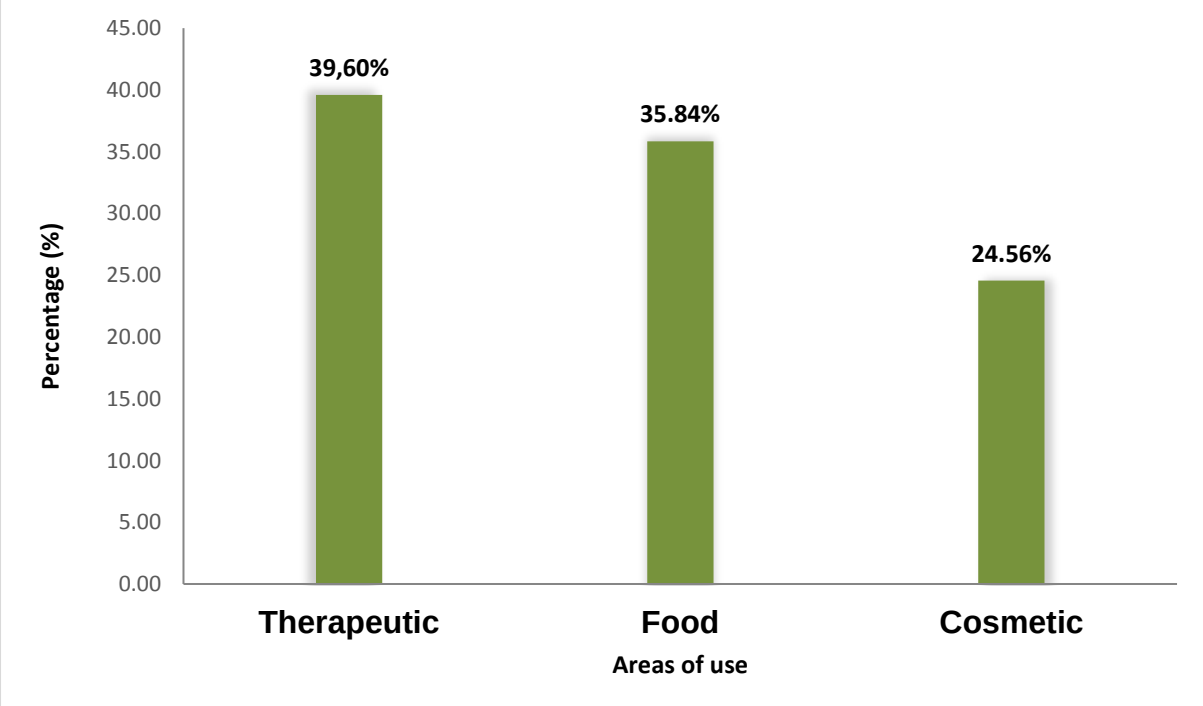

Fig. 9. Areas of use

Food use

According to figure 9, a significant percentage (35.84%) of the population surveyed uses aromatic and medicinal plants in the food field. Figure 10 specifies the food use of these plants as coloring, spice, preservative and aroma. In fact, 33.01% of people use plants as aromas to change the smell or taste of food, followed by 25.24% of respondents who use plants as dyes. So, on the one hand, 24.27% of the people surveyed use plants as a spice to give a savorto their food. On the other hand, 17.48% of the people surveyed use these plants as preservatives in order to prolong the duration of food. Thus, people use aromatic and medicinal plants with preservation properties.

Dyes are useful molecules in many applications; from food to textiles, cosmetics and coatings. Some molecules involved in the production, formulation or used as tinctorial materials are nevertheless pinned by national regulations (Morocco). In addition, according to this study, natural dyes are exploited primarily in three areas: food, cosmetics and textiles or weaving (Fig.11). In fact, 48.41% of the tinctorial plant's inventories are used to color foodstuffs, followed by 35.03% to color hair, and finally, they are used in the field of textile (weaving) to dye fabrics and yarns with 16.56%.

Use of plants as natural dyes

Traditional applications of coloring plants differ from one country to another, and from one ethnic group to another. Some plants are traditionally used as dyes for culinary reasons, for aesthetic or intrinsic efficiency purposes. This knowledge and knowledge about the properties of these plants are acquired by ancestral heritage. Similarly, the investigations carried out have made it possible to understand and realize that the vast majority of rural populations use the same plants for therapeutic uses. Figure 12 illustrates the different areas of use of natural dyes. At least 36.71% of the colouring plants inventoried are used simultaneously in the three areas: therapeutic, food and cosmetics. And 29.11% are used in the therapeutic and food fields, while 6.33% are used just in the food. These results are in perfect correlation with other works. Nonetheless, tinctorial plants have rarely been studied in Africa. Some authors have cited them in ethnobotanical surveys for other uses, especially in traditional medicine (Raponda-Walker *et al.* 1961, Bouquet 1969, Jansen *et al.* 2005, Adjanohoun 1988, Kimpouni 2001, Motte 1980).

Parts used

Flowers are the most used plant part with a percentage of 36,13% (Fig. 13), followed by roots (27,74%), fruits (18,06%), bark (6,45%), leaves (5,81%), seeds (3,87%) and finally the whole plant with a percentage of 1,94%. The high frequency of flower use can be explained by the ease and speed of its harvest as well as the richness of its flowers in secondary metabolites, especially flavonoids that are known as sources of colors and other medicinal and aromatic properties.

Adverse effects

The list of AMP species collected shows plants whose adverse effects have been proven by several scientific studies (Mantle *et al.* 2001, Roach *et al.* 1987, Shanker *et al.* 2005, Jouad *et al.* 2001). At least 15,03% of the coloring plants inventoried have adverse effects compared to 84.97% (Fig. 14). Among these plants are *Daphne gnidium* L. and *Ruta montana* L. which are responsible for diarrhea, digestive spasms, as well as other digestive disorders such as vomiting and hypersalivation. Indeed, it should be noted that the majority of the population surveyed are unaware of the adverse effects on certain plants used and the modalities of their use, including the methods of preparation and the quantity used. In light of this study, we would like to raise awareness among the local population about the risks and dangers of the anarchic use of plants for food and plant therapeutics, in particular, the use of plants as additives. (Dyes, preservatives or aromas).

Therapeutic properties of inventoried natural dyes

The population uses aromatic and medicinal dyes for their therapeutic properties (Fig. 15). Thus, 38.56% of respondents use these plants against other pathologies such as metabolic, dermatological, neurological diseases, followed by 37.91% of users who use these plants against infectious diseases caused by fungi and bacteria, while other users use these plants as antioxidants and anti-inflammatory drugs with a percentage of 17.65% and 5.88% respectively.

The most common colours

Among the commonly used and mostly wanted colours by the population surveyed (Fig. 16), yellow was preferred (66.01%).; compared to other colours; red colouring (16.99%), orange colouring (9.15%) and last, the Acajou, black and Brown coloration with percentages of 4.58%, up to 1.96% and 1.31%. most people use the yellow colour most often by mixing it with a primary dye to adjust the hue. In addition, the source of the yellow colour is the most universally widespread worldwide (Dikshit *et al.* 2018). Thus, the majority of plants identified in this survey are rich in phenolic compounds a source of yellow pigments, which are used as spice, colours, conservatives and aromas, especially from saffron, safflower and pomegranate tree.

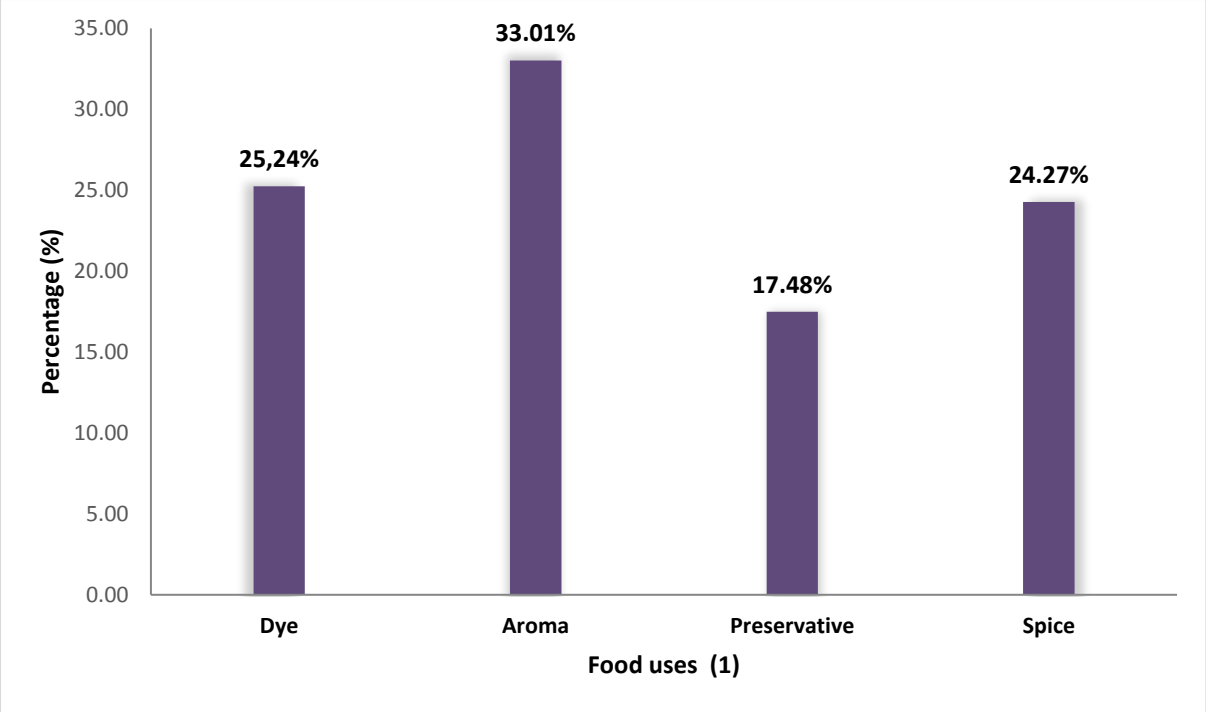

Fig. 10. Food uses of aromatic and medicinal plants

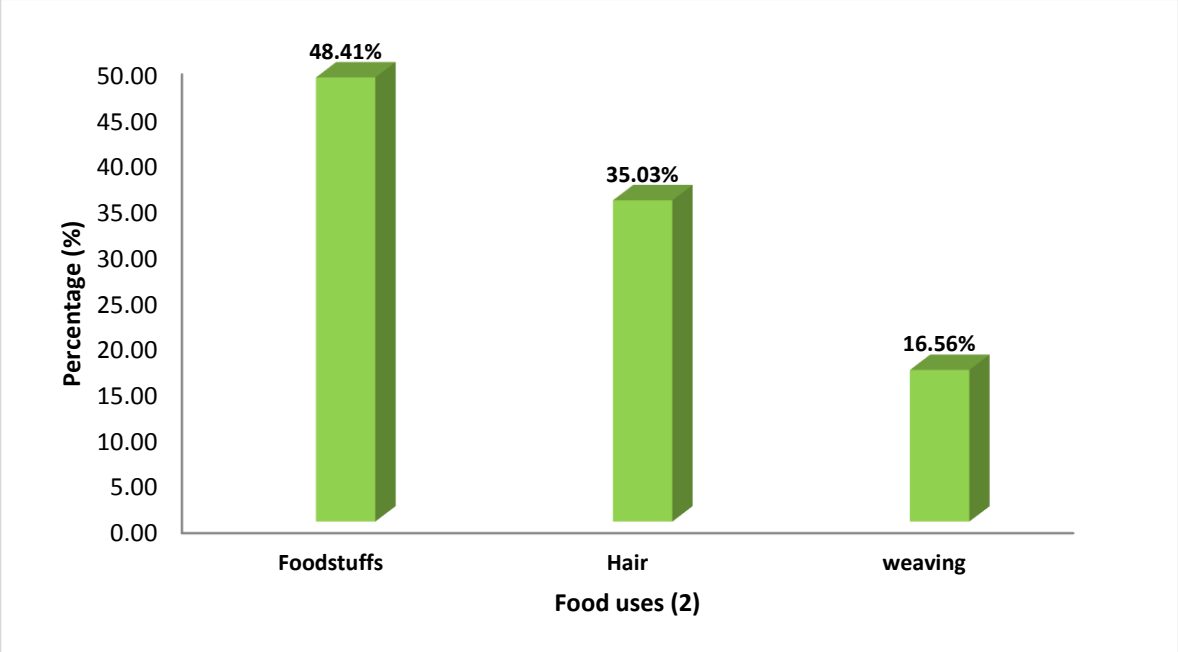

Fig. 11. Field of use of natural dyes

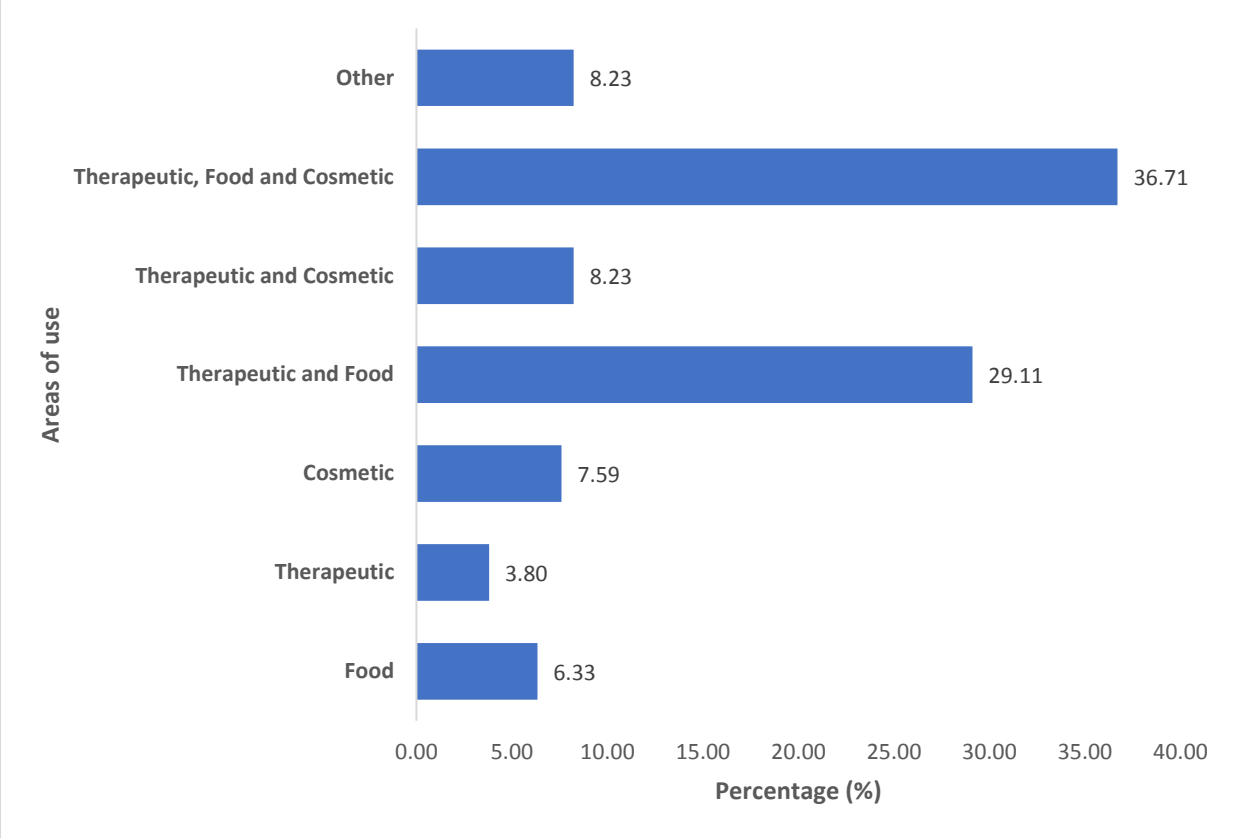

Fig. 12. Areas of use of natural dyes

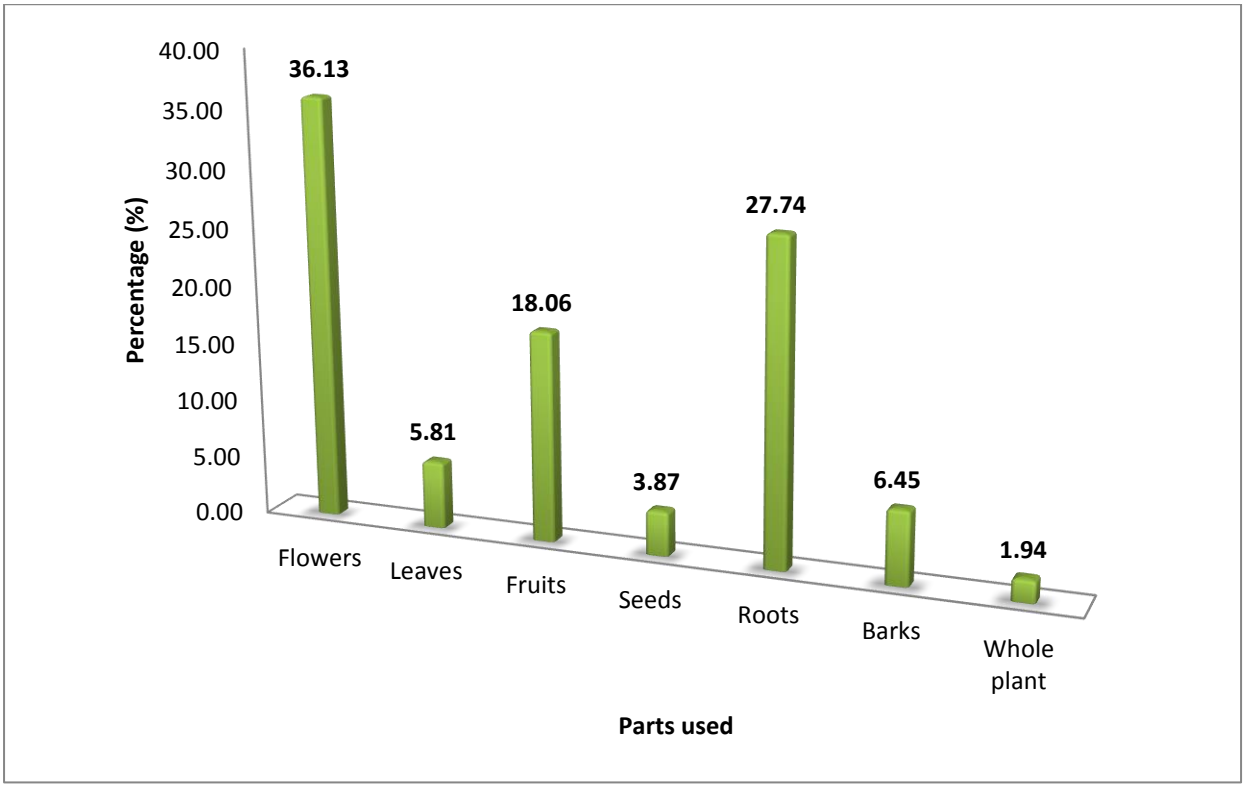

Fig. 13. Parts used

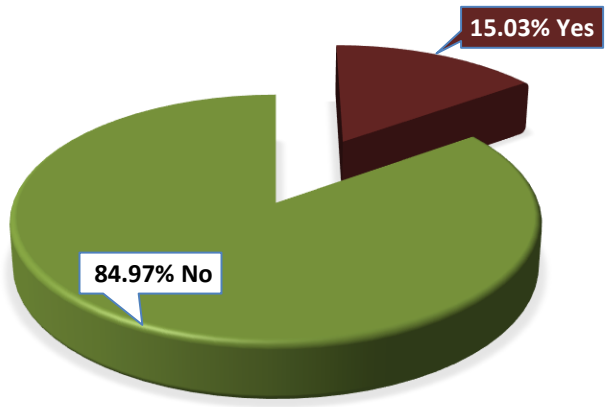

Fig. 14. Side effects

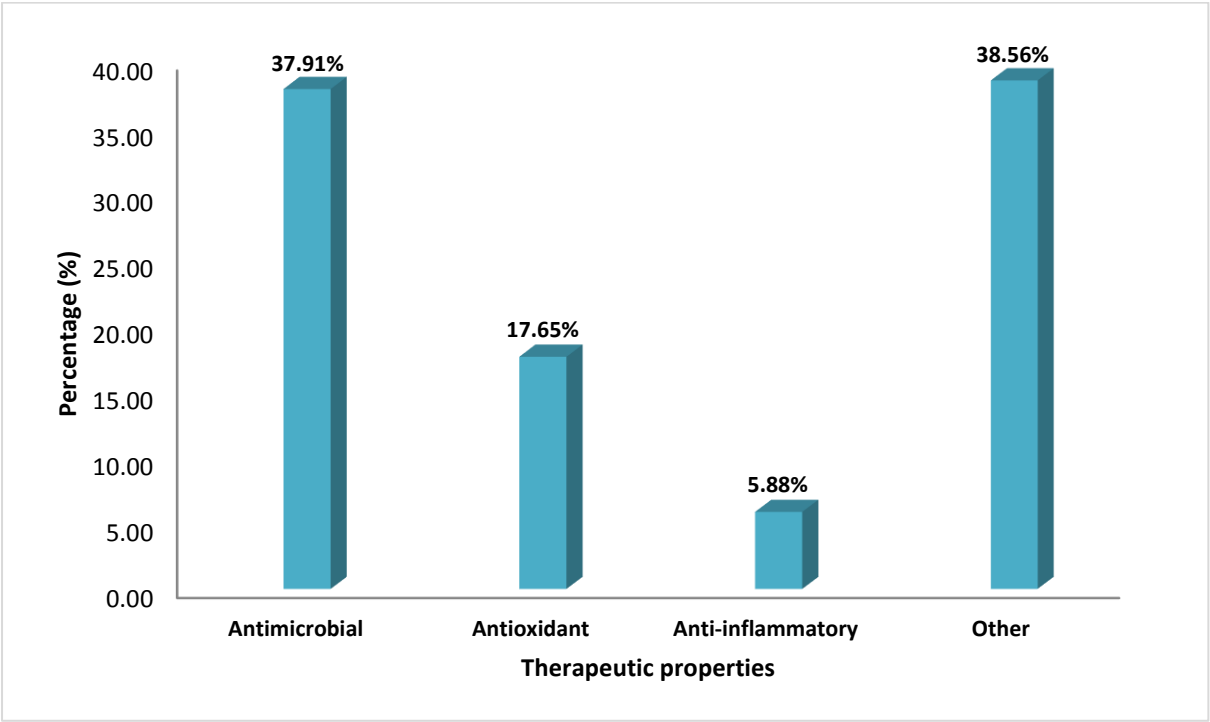

Fig. 15. Therapeutic properties

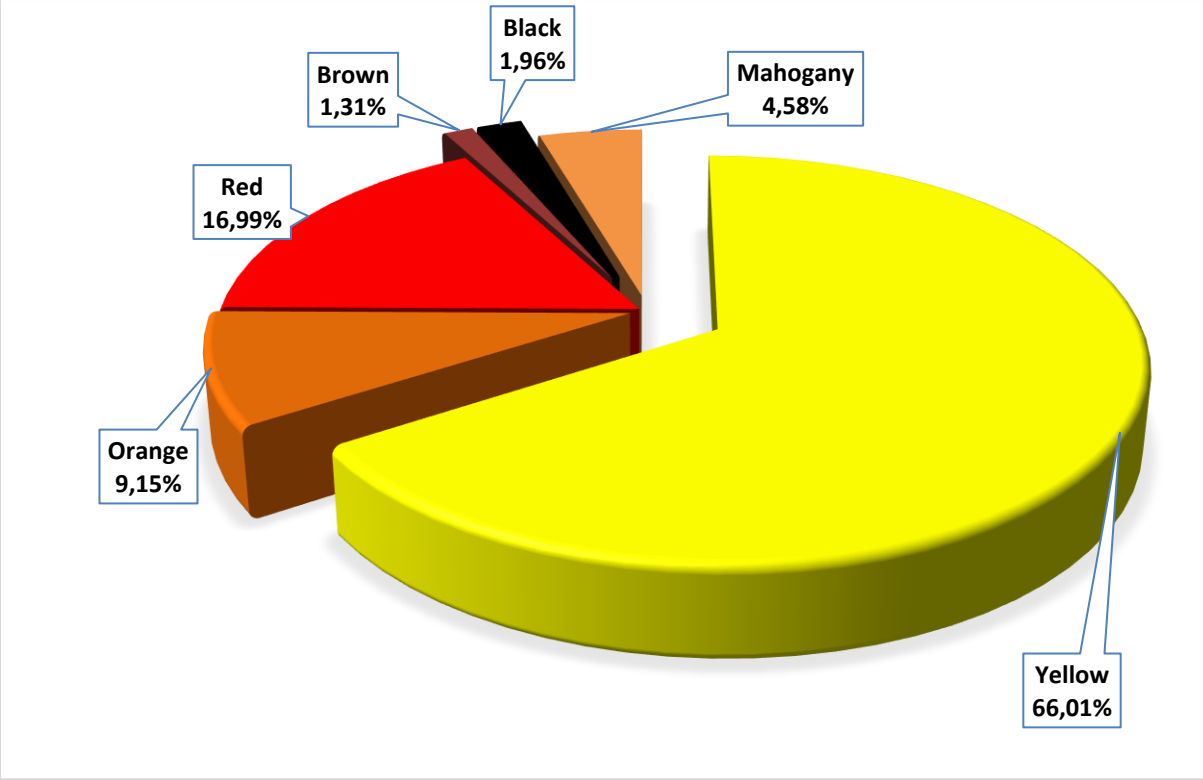

Fig. 16. Colours

Other properties of the tinctorial plants
The properties for which plant-based dyes are exploited by the population surveyed are illustrated in figure 17; we find that 42.86% of users employ them for their therapeutic, cosmetic and other unidentified properties, followed by 29.87% of those in the study area who use them to modify the taste, again as the aroma and curator with a percentage of 14,29% and 12,99% respectively.

Multivariate analysis of information on plants used by the population surveyed by PCA
Figure 18 shows the PCA based on all the data collected on plants use in each study region as sources of natural food additives.

The two axes (F1XF2) taken into account to describe the correlations between variables related to plant use as a source of natural additives alone holds 59.07% of the total information, with 21.07% for axis 1 and 37.99% respectively for Axis 2 (Fig. 18). This figure shows that all variables are presented in the circle and that the typological structure of the F1xF2 plan (Fig. 18) shows the individualization of four groups according to their degree of correlation:
- At the Taza, Azrou and Midelt provinces, the population surveyed uses plants as spices for food and weaving.
- At the El Hajeb, Ain Leuh and Ifrane provinces, the local population uses natural food additives in the field of cosmetology not only for facials, body, hair and make-up but also for their organic properties: antifungal and anti-dermatological.
- The surveyed population of the city of Meknes uses plants mainly as natural dyes and preservatives in different foodstuffs, as well as for hair care. The use of dye and organic preservatives is justified by the public's mistrust of synthetic additives. On the other hand, plants in this region are estimated as a plant of high therapeutic value.
- The population of the provinces of Boulemane and M'rirt uses natural resources in particular aromatic and medicinal plants for their therapeutic properties, as the socio-economic and climatic situation are difficult for these Populations.

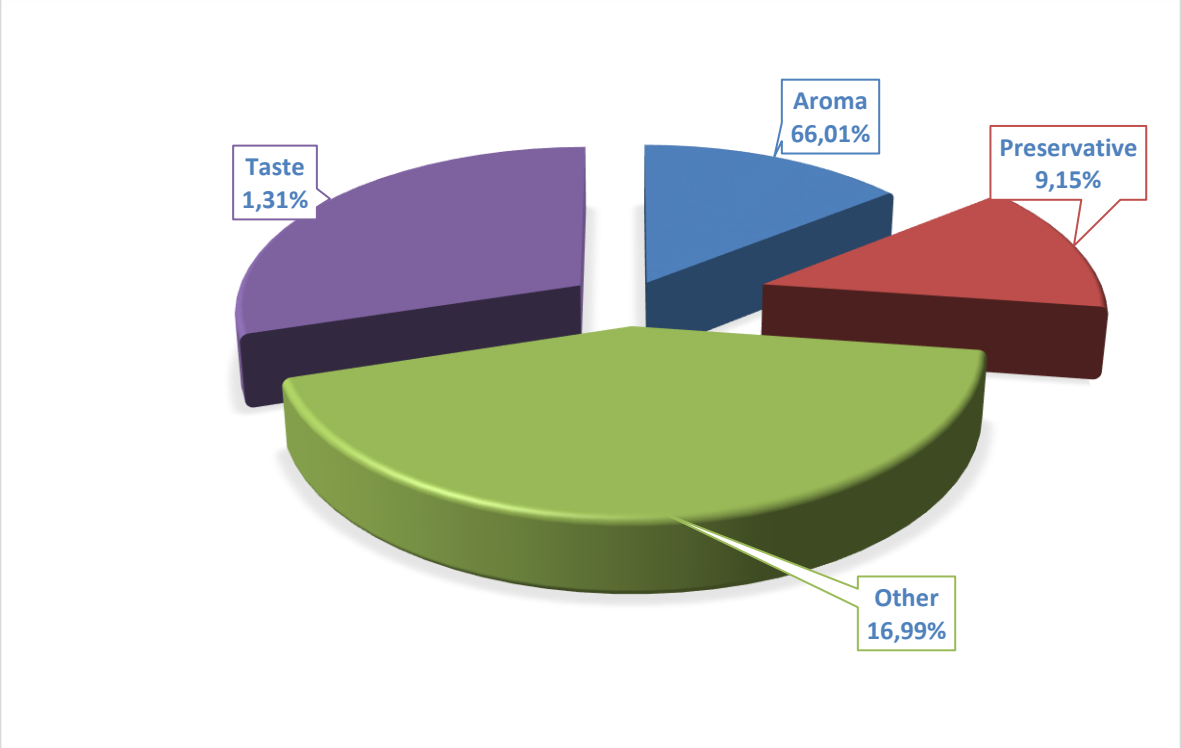

Fig. 17. Other uses of coloring plants

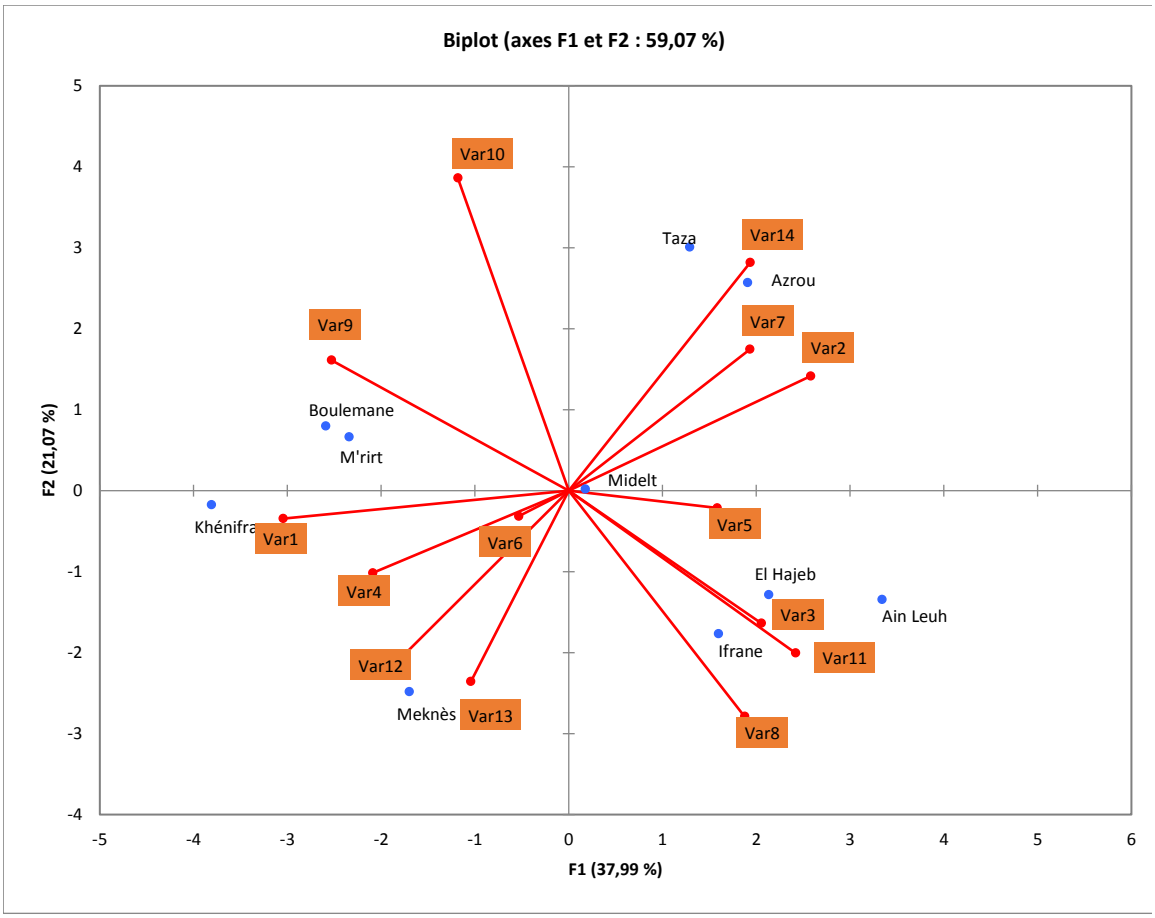

Fig. 18: Graphical Approach to Principal Component Analysis According to the Plan (F1xF2)
(Areas of plant use variable: var 1: therapeutic, var 2: food, var3: cosmetics. Food use variable: var 4: dyes, var5: dyes, var 6: preservatives, var 7: spices. Therapeutic properties of coloring plants variables: var 8: antimicrobials, var 9: antioxidants, var 10: anti-inflammatories, var11: other pharmacological properties.Use of natural dyes variables: var 12: food, var13: hair, var14: weaving).

Conclusion

This study identified 56 AMP already exploited in traditional Moroccan pharmacopeia as colouring plants. These can replace synthetic dyes and, thus, be used as natural additives on an industrial scale. At the same time, it is clear that this inventory can be considered as a source of information contributing to a better knowledge of Moroccan medicinal flora and local popular know-how. It can also provide a database for the recovery of tinctorial plants in different fields other than herbal medicine. Finally, the information acquired from the questionnaire sheets, led to production of a catalogue of 79 plant species, whose monographs are presented in alphabetical order of families, genres and species. Indeed, for each species, we specified the systematic position, the French vernacular name, the Arabic vernacular name, pharmacological properties, traditional local use and its toxicity (appendix 4). Knowing that natural pigments offer a strong advantage over synthetic pigments, it is necessary to study their safety and evaluate all their effects in order to conclusively demonstrate their beneficial effects on health.

Declarations

List of abbreviations: Not applicable.

Ethics approval and consent to participate: The purpose of the study was explained to the community members interviewed. Respondents were not asked to sign a particular consent form as the questionnaire was anonymous.

Availability of data and materials: The data was not deposited in public repositories.

Consent for publication: Not applicable.

Competing interests: The authors do not have any competing interests.

Funding: The ethnobotanical study of natural food additives of plant source was initiated within the framework of a project sponsored by the Somafaco Company. Later, this work was developed in the form of a topic for academic research (thesis). At this stage, the doctoral student Aziz Drioiche expanded and completed the fieldwork in other areas of Morocco within the framework of the project sponsored by the Fez Meknes region.

Author contributions: The co-authors participated in the research for this ethnobotanical study (fieldwork to complete the questionnaire). Pr. Zair Touriya is the coordinator of the two research projects (Somafaco and region) and supervised the research work of Aziz Drioiche. Moukaid Braim is the scientific representative of Somafaco who took part in discussions related to the project and the article.

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Appendix 1. **Questionnaire sheet on natural food additives** Fiche N° :……

Informant:

1. Sex: Male □ Female □
2. Age:<20 □ ; 20 - 29 □ ; 30 – 39 □ ; 40 - 49 □ ; 50 - 60 □ ; >60 □.
3. Family situation: Single □; Married □.
4. Academic level: None □; Primary □; Secondary □; University□.
5. Residential Headquarters: ……
6. Do you know any plants in the region that are in high demand or exported to a national or international market?

…….

……

……

7. Are you a plant user aromatic and medicinal? Yes □ No □
8. When you want to use plants (plant-based) you orient yourself by: Yourself □; books □; herbalists □; training □; others' experiences □; audiovisual programs □; others □.
10. Which plants do you use most often:

Legend:
fl: flowers / le: leaves / fr: fruits / st: stem / se: seed / ro: root /ba: bark / wp: whole plant.
* surround and check the good proposal

Latin name	Use	If food	If coloring	Part used				Side effects	Special properties	procurement
				Taste	Color	Aroma	Preservation			
…….	Food ☐ Therapeutic☐ Cosmetics ☐ Other ☐	Taste (.....)☐ Color (.....) ☐ Aroma ☐ Preservation☐ Other ☐	Food Hair Skin Fabric and thread Basket Pottery Wall Board Other	fl le fr st se ro ba wp	fl le fr st se ro ba wp	fl le fr st se ro ba wp	fl le fr st se ro ba wp			- Local: Yes □ No □ - If yes: Abundant Yes □ No □ - If not origin (.....) -Wild □ Cultivated □ - Very locally requested Yes □ No □ -Exported: Yes □ No □

Appendix 2. Summary table of aromatic and medicinal plants listed as sources of food additives in the survey with their number of indications

N°	Plant species	Family	Dye	Preservative	Aroma	Relative frequency of citation (RFC ; %)
1	*Punica granatum* L.	*Punicaceae*	X			0,11
2	*Curcuma longa* L.	*Zingiberaceae*	X	X		0,09
3	*Matricaria chamomilla* L.	*Asteraceae*	X		X	0,09
4	*Crocus sativus* L.	*Iridaceae*	X		X	0,08
5	*Capsicum annuum* L.	*Solanaceae*	X			0,05
6	*Carthamus tinctorius* L.	*Asteraceae*	X			0,05
7	*Rubia peregrina* L.	*Rubiaceae*	X			0,05
8	*Rosmarinus Officinalis* L.	*Lamiaceae*	X	X	X	0,04
9	*Ammodaucus leucotrichus* Coss.	*Apiaceae*	X			0,04
10	*Hibiscus sabdariffa* L.	*Malvaceae*	X		X	0,04
11	*Thymus zygis* subsp. *gracilis* (Boiss.) R. Morales	*Lamiaceae*	X	X	X	0,03
12	*Thymus vulgaris* L.	*Lamiaceae*	X	X	X	0,03
13	*Thymus satureioides* Coss.	*Lamiaceae*	X	X	X	0,03
14	*Papaver rhoeas* L.	*Papaveraceae*	X			0,03
15	*Beta vulgaris* L.	*Amaranthaceae*	X			0,02
16	*Trigonella foenum-graecum* L.	*Fabaceae*	X	X		0,02
17	*Quercus rotundifolia* Lam.	*Fagaceae*	X			0,02
18	*Juglans regia* L.	*Juglandaceae*	X			0,02
19	*Daphne gnidium* L.	*Thymelaeaceae*	X			0,02
20	*Alpinia officinarum* Hance	*Zingiberaceae*	X			0,02
21	*Pistacia lentiscus* L.	*Anacardiaceae*	X	X		0,02
22	*Myristica fragrans* Houtt.	*Myristicaceae*	X			0,02
23	*Avena sterilis* L.	*Poaceae*	X	X		0,02
24	*Ziziphus lotus* (L.) Lam.	*Rhamnaceae*	X			0,02
25	*Rubus ulmifolius* Schott	*Rosaceae*	X			0,02
26	*Populus nigra* L.	*Salicaceae*	X			0,02
27	*Artemisia herba-alba* Asso	*Asteraceae*	X	X	X	0,02
28	*Calendula officinalis* L.	*Asteraceae*	X			0,02
29	*Herniaria hirsuta* L.	*Asteraceae*	X			0,02
30	*Lavandula dentata* L.	*Asteraceae*	X		X	0,02
31	*Salvia lavandulifolia* Vahl	*Asteraceae*	X	X	X	0,02
32	*Isatis tinctoria* L.	*Brassicaceae*	X			0,02
33	*Cistus ladanifer* L.	*Cistaceae*	X			0,02
34	*Origanum compactum* Benth.	*Lamiaceae*	X	X	X	0,02
35	*Origanum elongatum* (Bonnet) Emb. & Maire	*Lamiaceae*	X	X	X	0,02
36	*Laurus nobilis* L.	Lauraceae		X	X	0,02
37	*Lawsonia inermis* L.	*Lythraceae*	X			0,02
38	*Eucalyptus globulus* Labill.	Myrtaceae		X		0,02

39	*Myrtus communis* L.	Myrtaceae		X		0,02
40	*Rosa canina* L.	Rosaceae		X	X	0,02
41	*Ruta montana* L.	*Rutaceae*		X	X	0,02
42	*Petroselinum sativum* Hoffm.	*Apiaceae*	X		X	0,01
43	*Coriandrum sativum* L.	*Apiaceae*	X		X	0,01
44	*Foeniculum vulgare* Mill.	*Apiaceae*	X	X	X	0,01
45	*Urtica dioica* L.	*Asteraceae*	X		X	0,01
46	*Helianthus Annuus* L.	*Asteraceae*		X		0,01
47	*Anacyclus pyrethrum* (L.) Lag.	*Asteraceae*	X			0,01
48	*Opuntia ficus-indica* (L.) Mill.	*Cactaceae*	X			0,01
49	*Cupressus sempervirens* L.	*Cupressaceae*		X		0,01
50	*Juniperus Communis* L.	*Cupressaceae*		X		0,01
51	*Juniperus oxycedrus* L.	*Cupressaceae*		X		0,01
52	*Ajuga iva* (L.) Schreb.	*Lamiaceae*	X			0,01
53	*Satureja montana* L.	*Lamiaceae*		X	X	0,01
54	*Mentha × piperita* L.	*Lamiaceae*		X	X	0,01
55	*Ocimum basilicum* L.	*Lamiaceae*		X	X	0,01
56	*Melissa officinalis* L.	*Lamiaceae*		X	X	0,01
57	*Mentha spicata* L.	*Lamiaceae*			X	0,01
58	*Allium cepa* L.	*Liliaceae*	X	X		0,01
59	*Syzygium aromaticum* (L.) Merr. & L.M.Perry	*Myrtaceae*	X	X		0,01
60	*Cymbopogon citratus* (DC.) Stapf	*Poaceae*		X	X	0,01
61	*Pimpinella anisum* L.	*Apiaceae*	X	X	X	0,01
62	*Cuminum cyminum* L.	*Apiaceae*			X	0,01
63	*Carduus tenuiflorus* Curtis	*Asteraceae*	X			0,01
64	*Capparis spinosa* L.	*Capparaceae*			X	0,01
65	*Glycyrrhiza glabra* L.	*Fabaceae*	X			0,01
66	*Ceratonia siliqua* L.	*Fabaceae*	X			0,01
67	*Illicium verum* Hook. f.	*Illiciaceae*	X			0,01
68	*Mentha pulegium* L.	*Lamiaceae*			X	0,01
69	*Mentha suaveolens* Ehrh.	*Lamiaceae*			X	0,01
70	*Cinnamomum cassia* Siebold	*Lauraceae*	X	X		0,01
71	*Allium sativum* L.	*Liliaceae*	X	X		0,01
72	*Malva sylvestris* L.	*Malvaceae*			X	0,01
73	*Morus alba* L.	*Moraceae*	X			0,01
74	*Jasminum grandiflorum* L.	*Oleaceae*			X	0,01
75	*Ranunculus bullatus* L.	*Ranunculaceae*	X			0,01
76	*Prunus dulcis* (Mill.) D.A.Webb	*Rosaceae*			X	0,01
77	*Citrus × aurantium* L.	*Rutaceae*	X		X	0,01
78	*Citrus × limon* (L.) Osbeck	*Rutaceae*	X		X	0,01
79	*Verbena officinalis* L.	*Verbenaceae*			X	0,01

Appendix 3. Distribution of botanical families surveyed by frequency and percentage of citations

Families	Frequency of citation	Percentage of citation (%)
Asteraceae	48	16,55
Lamiaceae	44	15,17
Punicaceae	21	7,24
Zingiberaceae	21	7,24
Apiaceae	15	5,17
Iridaceae	15	5,17
Fabaceae	10	3,45
Solanaceae	10	3,45
Rubiaceae	9	3,10
Malvaceae	8	2,76
Myrtaceae	8	2,76
Rosaceae	8	2,76
Cupressaceae	6	2,07
Poaceae	6	2,07
Papaveraceae	5	1,72
Rutaceae	5	1,72
Amaranthaceae	4	1,38
Anacardiaceae	4	1,38
Juglandaceae	4	1,38
Lauraceae	4	1,38
Myristicaceae	4	1,38
Rhamnaceae	4	1,38
Thymelaeaceae	4	1,38
Brassicaceae	3	1,03
Cistaceae	3	1,03
Liliaceae	3	1,03
Lythraceae	3	1,03
Salicaceae	3	1,03
Cactaceae	2	0,69
Capparaceae	1	0,34
Illiciaceae	1	0,34
Moraceae	1	0,34
Oleaceae	1	0,34
Ranunculaceae	1	0,34
Verbenaceae	1	0,34
Total (35 families)	**290 indications**	**100 %**

Appendix 4. Monograph of the most represented plant families in the study areas

Key : EN, English Name FN, French Name CN, Common Name PU, Part used LTA, Local traditional application T, Toxicity.

AMARANTHACEAE

- ***Beta vulgaris*** L.
  - **EN**: Beetroot
  - **FN**: Betterave commune
  - **CN**: Barba
  - **PU**: Bulbs
  - **LTA**: Dye; emollient laxative.

ANACARDIACEAE

- ***Pistacia lentiscus*** L.
  - **EN**: Lentisk
  - **FN**: Pistachier lentisque
  - **CN**: Drou
  - **PU**: Leaves, bark
  - **LTA**: Dye, preservative, sore belly; ailments of the intestine; antidiarrheal; antidiabetic, emmenagogues; diuretics; analgesics; antipyretic, astringent.

APIACEAE

- ***Ammodaucus leucotrichus*** Coss***.***
  - **EN**: Cumin hairy
  - **FN**: Cumin velu
  - **CN**: Kammûnsofi, Cumin laineux
  - **PU**: Fruits
  - **LTA**: Dye; vomiting, nausea, dysentery; diuretic and stimulating.

- ***Petroselinum sativum*** Hoffm**.**
  - **EN**: Parsley
  - **FN**: Persil
  - **CN**: Maâdnous
  - **PU**: aerial part, stem and seed
  - **LTA**: Dye, aromatic, antidiabetic, kidney stones, urolithiasis, hot, attenuating, appetizer, detergent, diuretic, expectorant, hepatic, emmenagogue, tonic, general stimulant, anti-anemia agent, stomachic, depurative, vermifuge, rheumatism.
  - **T**: Possible inflammation of the nerves and also a risk of miscarriage during pregnancy.

- ***Cuminum cyminum*** L.
  - **EN**: Cumin
  - **FN**: Cumin
  - **CN**: Kamoun
  - **PU**: Seeds

- **LTA**: Aromatic; digestive problems; urinary tract inflammation; carminative; antidiarrheal; antispasmodic, sudorific, galactogenic, stimulant, anthelmintic, diuretic and against mumps.

- ***Coriandrum sativum*** L.
- **FN**: Coriandre
- **CN**: Kasbour
- **CN**: Kasbour
- **PU**: Seed
- **LTA**: Dye, aromatic, diabetes, rheumatism, stomachic and carminative.

- ***Pimpinella anisum*** L.
- **EN**: Anise
- **FN**: Anis vert
- **CN**: Habathlawa
- **PU**: Seed
- **LTA**: Dye, preservative, aromatic, diabetes; digestive, antispasmodic, expectorant.
- **T**: neurological disorders (Garnier et aL., 1961).

- ***Foeniculum vulgare*** MilL.
- **EN**: wild fennel
- **FN**: Fenouilsauvage
- **CN**: Nafaâ El-beldi, Bessbass
- **PU**: seed, Côtes
- **LTA**: Preservative, Dye, aromatic, antidiabetic, anti-inflammatory, digestive diseases, stimulates lactation, antiparasitic.
- **T**: Anethole, the principle of the essential oil of fennel is used by Moroccan Jews to flavor alcohoL. Evil dosed once it caused a few accidents (stupor, hallucinations, convulsions) in people already ailing due to alcoholism (Bellakhdar 1997).

ASTERACEAE

- ***Anacyclus pyrethrum*** (L.) Lag.
- **EN**: African Pyrethrum
- **FN**: Pyrèthre d'Afrique
- **CN**: Aerq Chleuh/ Tiguentest
- **PU**: whole plant
- **LTA**: Dye; against cysts of the genital tract; diabetes;
- **T**: Skin irritation of the mucous membranes; nausea; fainting; respiratory disorders; gastrointestinal irritation, gastro-enteritis, colic, diarrhea; convulsions and headaches (Hmammouchi, 1999). Fumes, headache, tinnitus, and even loss of consciousness (Anonymous, 2009).

- ***Artemisia herba-alba*** Asso
- **EN**: White Wormwood
- **FN**: Armoise blanche
- **CN**: Chih, Izri
- **PU**: whole plant

- **LTA**: Dye, preservative, aromatic, gastrointestinal disorders, diabetes, ulcers, fever, intestinal parasites, rheumatism, constipation, heart disease, menstrual pain, cough, liver diseases, skin diseases, kidney disease, cancer, hair loss and anemia.
- **T**: In high doses, wormwood is neurotoxic abortion, hemorrhage (Pierre & Read, 1992).

- ***Calendula officinalis*** L.
- **EN**: Marigold
- **FN**: Souci officinal
- **CN**: Jemra
- **PU**: flowers
- **LTA**: Dye; Anti-inflammatory, hypotensive, spasmolytic, immunostimulant and cholesterol-lowering, anti-edematous, anti-venom, antibacterial, antiviral, antifungal and anticancer healing.

- ***Carduus tenuiflorus*** Curtis
- **EN**: thistle
- **FN**: chardon à capitulesgrêles
- **CN**: Chouka hmar
- **PU**: Flower heads
- **LTA**: Dye; hepatoprotective, anti-inflammatory, anti-spasmodic, hypotensive.
- **T**: severe toxicity has been rarely reported.

- ***Carthamus tinctorius*** L.
- **EN**: Safflower
- **FN**: Carthame
- **CN**: Quertum
- **PU**: Stigma, Seed
- **LTA**: Dye; diabetes; good for the lungs and stomach and relieves joint pain.
- **T**: Mildnephrotoxicity (Liu et aL., 2004)

- ***Lavandula dentata*** L.
- **EN**: Lavender
- **FN**: Lavande à feuillesdentées
- **CN**: El-khzama
- **PU**: The stems with leaves, inflorescence and the aerial part.
- **LTA**: Dye, aromatic, diabetes; Tonic, diuretic, vulnerary, antiseptic; To treat gastroduodenal disorders, kidney stones, dizziness and heavy periods, it uses the toothed lavender powder or infusion. The plant decoction is recommended in case of gastric acidity and liver diseases. Externally, chopped fresh plant applied on wounds, injuries, body lice and head, to disinfect. The oil friction is applied to the painful joint against rheumatism.

- ***Herniaria hirsuta*** L.
- **EN**: hairy rupturewort
- **FN**: Herniaire
- **CN**: Hrraslehjar
- **PU**: whole plant
- **LTA**: Dye; Against the pain of the urinary tract and the cold weather; kidney stones; wounds and ulcers

- ***Helianthus annuus*** L.
- **EN**: Sunflower
- **FN**: Tournesol
- **CN**: Nouarat chamess
- **PU**: Leaves, Roots Seeds
- **LTA**: Preservative; antifungal; antibacterial; antioxidant; antidiabetic;

- ***Matricaria chamomilla*** L.
- **EN**: Chamomile
- **FN**:Camomille vraie Camomille sauvage ;
- **CN**: Babounje
- **PU**: capitulates
- **LTA**: Dye, aromatic, diabetes; anti-inflammatory, antispasmodic, vulnerary, anti-allergic.

- ***Salvia lavandulifolia*** Vahl
- **EN**: Sage
- **FN**: Sauge
- **CN**: Salmia, Belranbou
- **PU**: Leaves
- **LTA**: Dye, preservative, aromatic, diabetes; Preservative; Emmenagogue, cholagogue, diuretic, anti-dyspeptic, antiseptic, anti-inflammatory, stimulating, choleretic, antispasmodic, antiperspirant, carminative, choleretic, stomachic, astringent, warming.
- **T**: The essential oil, in particular, can cause epileptiform convulsions (Bruneton 1996).

- ***Urtica dioica*** L.
- **EN**: Nettle
- **FN**: Grande ortie
- **CN**: L-hurrîga
- **PU**: whole plant except the root
- **LTA**: Dye, aromatic, anemia, rheumatism and hair loss, thyroid problems, adrenal gland, diuretic, obesity, circulatory problems, liver disease, cold, hyperglycemia, circulatory problems, prostate, cholesterol, skin rashes, hair care / anti-diabetic, anti-inflammatory, anti-inflammatory, coagulating.

BRASSICACEAE

- ***Isatis tinctoria*** L.
- **EN**: Woad
- **FN**: Pastel des teinturiers
- **CN**: Fajir
- **PU**: Leaf
- **LTA**: Dye; treatment edema, tumors and wounds.

CACTACEAE

- ***Opuntia ficus-indica* (**L.**)** MilL.

♦ **EN**: Prickly pear
♦ **FN**: Figuier d'Inde,Figuier de barbarie
♦ **CN**: Aknarî, Handiya, Karmôs-ennsârâ
♦ **PU**: Snowshoeing, flower and root
♦ **LTA**: Dye; antidiabetics; Kidney stones; Anti-inflammatory; against diarrhea and hemorrhoids
♦ **T**: Non-toxic, but ingestion of a large number of fruit causes persistent and sometimes dangerous constipation (Kahouadji 1995).

CAPPARACEAE

- ***Capparis spinosa*** L.

♦ **EN**: Caper bush
♦ **FN**: Câprier
♦ **CN**: Kabâr, taylult
♦ **PU**: The aerial part, the fruit and root
♦ **LTA**: Aromatic; diabetes; against weak heart, against disease spleen, swelling of the body and disturbances of the urinary system, antirheumatic, back against disease and maturation abscesses.

CISTACEAE

- ***Cistus ladanifer*** L.

♦ **EN:** Gum rockrose
♦ **FN:** Cisteladanifère
♦ **CN:** Touzalt
♦ **PU:** Leaf
♦ **LTA:** dye; diabetes; antidiarrheal, stomach pain; injuries; asthma.

CUPRESSACEAE

-Juniperus communis L.

♦ **EN**: Common juniper
♦ **FN**: Genévriercommun
♦ **CN**: Elarâr - Amzi
♦ **PU**: leaves
♦ **LTA**: Preservative; diabetes; In diuretic, digestive and stomachic.

Juniperus oxycedrus L.

♦ **EN**: Cade juniper
♦ **FN**: Genévrieroxycédre
♦ **CN**: El arâar – el gadi
♦ **PU**: Leaves

- **LTA**: Preservative; Haircare, and neurological, diabetes.

Cupressus sempervirens L.
- **EN**: Mediterranean cypress
- **FN**: Cyprèscommun
- **CN**: Srou
- **PU**: leaves and stems
- **LTA**: Preservative; diabetes; vasocon-strictor properties.

FABACEAE

- ***Ceratonia siliqua*** L.
- **EN**: Carob tree
- **FN**: Caroubier
- **CN**: L-kharrôb, Tikkida
- **PU**: fruit (pod) and bark
- **LTA**: Dye; antidiarrheal; diabetes; Stomachic, digestive diseases, respiratory diseases.

- ***Trigonella foenum-graecum*** L.
- **EN**: Fenugreek
- **FN**: Fenugrec
- **CN**: L-halba
- **PU**: Seed
- **LTA**: Preservative, Dye; tonic, hypoglycemic, hypocholesterolemic, detoxifying, anti-asthmatic, detoxifying, anthelmintic, antihypertensive, aphrodisiac, gastroduodenal disorders, coughs and constipation.

- ***Glycyrrhiza glabra*** L.
- **EN**: licorice;
- **FN**: Réglisse ;
- **CN**: ArqSûs
- **PU**: Root
- **LTA**: Dye; diuretic, refreshing, digestive, anti-inflammatory, depurative, tonic, expectorant, antispasmodic, antihistaminic, softening, chest.
- **T**: it is hypertension, edema accompanied by various disorders and resistant to treatment, followed by paralytic phenomena and heart rhythm disorders (Hmamouchi, 1999).

- ***Quercus rotundifolia*** Lam**.**
- **EN**: oak
- **FN**: chêne vert
- **CN**: Korrich
- **PU**: Bark, Fruit, leaf
- **LTA**: Dye; gastric pains; antidiabetic, tonic and antidiarrheaL.
- **T**: Fruits absorbed in large quantities cause delay digestion with nausea, abdominal pain and headache.

ILLICIACEAE

- ***Illicium verum*** Hook. f.
- ♦ **EN**: Star Anise
- ♦ **FN**: Badianier de Chine
- ♦ **CN**: Badiana
- ♦ **PU**: fruit
- ♦ **LTA**: Dye; diabetes, ENT disorders, digestive disorders, antiviral, antimicrobiaL.

IRIDACEAE

- ***Crocus sativus*** L.
- ♦ **EN**: saffron
- ♦ **FN**: Vraisafran
- ♦ **CN**: Za'franelhor
- ♦ **PU**: stigma flowers
- ♦ **LTA**: Dye; stones; Antidepressant, analgesic, kidney stones; cancer.

JUGLANDACEAE

- ***Juglans regia*** L.
- ♦ **EN**: Walnut
- ♦ **FN**: Noyer
- ♦ **CN**: L-guergua'a
- ♦ **PU**: The leaf and bark
- ♦ **LTA**: Dye; antimicrobial, antidiabetic.

LAMIACEAE

- ***Ajuga iva*** **(**L.**)** Schreb**.**
- ♦ **EN**: Bugle, Ivette
- ♦ **FN**: Bugle, Ivette
- ♦ **CN**: Chendgûra, Tûftolba
- ♦ **PU**: The stems with leaves and the aerial part
- ♦ **LTA**: Dye, detoxing, warming, antidiabetic, anthelmintic, hypoglycemic, astringent, antispasmodic, exciting, antidiarrheal, appetizer, anti-inflammatory, sedative, antipyretic, tonic, antiseptic, eupeptic, vulnerary, hypotensive, anti-cancer and ear ailments.
- ♦ **T**: Ajuga iva (from Morocco) is not toxic, but seems endowed with a sedative power (Bennaghmouch& aL., 2001).

- ***Ocimum basilicum*** L.
- ♦ **EN**: Basil
- ♦ **FN**: Basilic
- ♦ **CN**: Lahbaq
- ♦ **PU**: The stems with leaves

- **LTA**: Preservative, aromatic; diabetes; Urogenital; Antispasmodic, stomachic, galactagogue, pectoral, sedative, sternutatory; anti-inflammatory.
- **T**:The essential oil of the plant is dermo-caustic (Hmamouchi, 1999).

- ***Origanum elongatum*** (Bonnet) Emb. & Maire
- **EN**: oregano
- **FN**: origan
- **CN**: Zaâtar
- **PU**: The flowering tops and the stems with leaves
- **LTA**: Preservative, dye, aromatic,antipyretic, expectorant, sedative, antispasmodic, intestinal, digestive, antiseptic, hypotensive, bactericidal, diuretic, sedative, tonic.
- **T**: high dose, oregano is toxic and narcotic (Bainy 1993).

- ***Origanum compactum*** L.
- **EN**: oregano
- **FN**: origan
- **CN**: Azukenni, Za'tar
- **PU**: The flowering tops and the stems with leaves
- **LTA**: Preservative, dye, aromatic, stomachic, digestive, vulnerary, aphrodisiac, antispasmodic cough, expectorant, hypoglycemic, antiseptic, anti-inflammatory, tonic, appetite stimulant.
- **T**: high dose, oregano is toxic and narcotic (Bainy 1993).

- ***Melissa officinalis*** L.
- **EN**: Melissa
- **FN**: Melissa
- **CN**: Tourenjan
- **PU**: Leaves
- **LTA**: Preservative, aromatic; diabetes;digestive disease and cure for the intestines; herpes; antispasmodic.

- ***Mentha × piperita*** L.
- **EN**: Peppermint
- **FN**: menthe poivrée
- **CN**: naenaaeabdi
- **PU**: aerial part
- **LTA**: Preservative, aromatic; Stomachic, antispasmodic, relieve headaches, neuralgic, anti-inflammatory, eczema and biliary and pancreatic insufficiency.

- ***Mentha pulegium*** L.
- **EN**: Pennyroyal
- **FN**: Menthe pouliot
- **CN**: Fliyyo
- **PU**: aerial part
- **LTA**: Aromatic; diabetes; Antitussive, cholagogue, expectorant, carminative, digestive, antispasmodic, pulmonary antiseptic, refreshing, tonic, appetizer, stomachic, antitussive, choleretic.
- **T**: In high doses, pennyroyal is anAbortion plant and very neurotoxic (Franchomme&Penoë 2001). Ditto for the essential oil (Hmamouchi, 1999).

- ***Mentha spicata*** L.
- **EN**: Spearmint
- **FN**: Menthe enépi
- **CN**: Naanaa
- **PU**: Leaves
- **LTA**: Aromatic, hypotension, sedative, disinfectant, astringent, carminative, stomach, sedative, refreshing; stomachic

- ***Mentha suaveolens*** Ehrh*.*
- **EN**: Pineapple mint
- **FN**: Menthe à feuilles rondes
- **CN**: Marseta
- **PU**: whole plant
- **LTA**: Aromatic; diabetes; Laxative, tonic, digestive, diuretic, carminative, stomachic, eupeptic, antispasmodic, antiseptic, analgesic, anti-haemorrhoidal, antirheumatic.

- ***Rosmarinus officinalis*** L.
- **EN**: Rosemary
- **FN**: Romarin
- **CN**: Azir
- **PU**: leaves
- **LTA**: Dye, Preservative, aromatic; antidiabetic, kidney stones; drink, tonic, fortifying the heart, diuretic, choleretic, spasmolytic, antioxidant, hypoglycemic, vulnerary, stimulant, antispasmodic, antiseptic, antirheumatic, analgesic, emmenagogue, healing, hepato-protective, antifungal, antibacterial, anti-tumorigenic.
- **T**: the essential oil is neurotoxic saw the presence of camphor in its composition. The use of leaves, infusion, is not recommended for pregnant women (risk of abortion) (AGRA 1996). Chronic poisoning manifests as stomach bleeding, liver and albuminuria stéatomes (Hmamouchi, 1999).

- ***Satureja montana*** L.
- **EN**: savory
- **FN**: sarriette
- **CN**: Zâaetra, Touwichant, Zoukeni
- **PU**: whole plant
- **LTA**: Preservative, aromatic; intestinal disorders, vomiting, heart disease, stomach ulcer and acute diseases, eczema, gargle against dental aches and sore throats;
- **T**: The essential oil is dermocaustic (Hmamouchi, 1999)

- ***Thymus satureioides*** Coss*.*
- **EN**: Thyme-savory Morocco, Thyme saturéoïde
- **FN**: Thym-sariette du Maroc, Thym saturéoïde
- **CN**: Ziîtra
- **PU**: The sheet
- **LTA**: Preservative, dye, aromatic, antiseptic, diuretic, emmenagogue, tonic, antispasmodic, anthelmintic, carminative, anthelmintic, healing, antitussive, stimulant, expectorant, antipyretic, deodorant, repellent, eupeptic, sedative, vulnerary.

- ***Thymus vulgaris*** L.
- **EN**: Common thyme
- **FN**: Thymcultivé, Thymcommun

- **CN**: Azoukni
- **PU**: leaf
- **LTA**: Preservative, dye, aromatic, antiseptic, diuretic, emmenagogue, tonic, antispasmodic, anthelmintic, carminative, anthelmintic, healing, antitussive, stimulant, expectorant, antipyretic, deodorant, repellent, eupeptic, sedative, vulnerary.

- ***Thymus zygis* subsp. *gracilis*** (Boiss.) R. Morales
- **EN**: wild thyme
- **FN**: thymsauvage
- **CN**: Tazuknite, Ziitra
- **PU**: Leaf
- **LTA**: Preservative, dye, aromatic, antiseptic, diuretic, emmenagogue, tonic, antispasmodic, anthelmintic, carminative, anthelmintic, healing, antitussive, stimulant, expectorant, antipyretic, deodorant, repellent, eupeptic, sedative, vulnerary.

LAURACEAE

- ***Cinnamomum cassia*** Siebold
- **EN**: Cinnamon
- **FN**: Cannelle
- **CN**: L-Qarfa
- **PU**: Bark
- **LTA**: Dye, preservative, gallstones, diabetes, cancer, orofacial disorders.

- ***Laurus nobilis*** L.
- **EN**: Laurel
- **FN**: Laurier noble
- **CN**: Assâsîdnamûssa, Rand
- **PU**: leaf
- **LTA**: Aromatic, preservative, anti-diabetic; respiratory problems, nervous system diseases, dialysis, cough, hypertension, musculoskeletal and digestive problems, cardiovascular disease / hypoglycemic, tonics, carminative, genitourinary diseases

AMARYLLIDACEAE

- ***Allium Cepa*** L.
- **EN**: Onion
- **FN**: Oignon
- **CN**: L-bessla
- **PU**: Bulb, pellure
- **LTA**: Dye, preservative, diabetes, kidney stones, antimicrobiaL.

- ***Allium sativum*** L.
- **EN**: Garlic
- **FN**: Ail
- **CN**: Touma

- **PU**: bulb
- **LTA**: Dye, Preservative; kidney stones, antimicrobial, antiviraL.

LYTHRACEAE

- ***Lawsonia inermis*** L.
- **EN**: Henna
- **FN**: Henné
- **CN**: L-henna
- **PU**: leaf
- **LTA**: Dye; antidiarrheal; nephrolithiasis; antidiabetic, antifungaL.

MALVACEAE

- ***Hibiscus sabdariffa*** L.
- **EN**: Roselle
- **FN**: Oseille de Guinée
- **CN**: Karkadi
- **PU**: flowers Calyxes
- **LTA**: Dye; aromatic, antidiabetic, antineoplastic, antipyretic, anti-inflammatory, antimicrobial, antiparasitic.

- ***Malva sylvestris*** L.
- **EN**: Mallow
- **FN**: Grande mauve
- **CN**: Khobbeyza
- **PU**: Aerial parts
- **LTA**: Aromatic; Weight loss, gastrointestinal disorders, urinary system diseases, uterine pain, colds, stomach pain, skin and anti-inflammatory, emollient

MORACEAE

- ***Morus alba*** L.
- **EN**: Black mulberry
- **FN**: Mûrier noir
- **CN**: Etût
- **PU**: leaf
- **LTA**: Dye; antidiabetic, antiviral, antimicrobiaL.

MYRISTICACEAE

- ***Myristica fragrans*** Houtt**.**
- **EN**: Nutmeg / mace
- **FN**: Muscadier
- **CN**: Lgouza, Bsibisa

- **PU**: The nuts and mace
- **LTA**: Dye; lithiasis, aphrodisiac, anti-inflammatory, antimicrobiaL.

MYRTACEAE

- ***Eucalyptus globulus*** LabilL.
- **EN**: Eucalyptus
- **FN**: Eucalyptus
- **CN**: Kalybtus
- **PU**: Leaves
- **LTA**: Preservative; diabetes; Colds and flu, leishmaniasis, respiratory and antitussive

- ***Myrtus communis*** L.
- **EN**: Myrtle
- **FN**: Myrtecommun
- **CN**: Rihân
- **PU**: Leaves
- **LTA**: Preservative; diabetes;softening, fall, detangler, respiratory, cardiac and hepatic disease.

- ***Syzygium aromaticum*** (L.) Merr. & L.M.Perry
- **EN**: Clove
- **FN**: Giroflier
- **CN**: Qranfal
- **PU**: Flower buds
- **LTA**: Dye, Preservative; antimicrobial; anxiolytic; anti-inflammatory, antifungal, anesthetic, aromatic.
- **T**: Eugenol has strong dose may have genotoxic effects (Cortés-Rojas et al, 2014.).

OLEACEAE

- ***Jasminum grandiflorum*** L.
- **EN**: Jasmine
- **FN**: Jasmin blanc
- **CN**: Jawharedar
- **PU**: Leaves
- **LTA**: Aromatic; neurological condition;

PAPAVERACEAE

- ***Papaver rhoeas*** L.
- **EN**: Poppy
- **FN**: Coquelicot
- **CN**: Belaamane
- **PU**: Petals
- **LTA**: Dye; aromatic, sedative, anxiolytic, anti-ulcerogenic.

POACEAE

- ***Cymbopogon citratus*** (DC.) Stapf
- ♦ **EN**: Lemongrass
- ♦ **FN**: Citronnelle
- ♦ **CN**: Louizaroumia
- ♦ **PU**: whole plant
- ♦ **LTA**: Preservative, aromatic, cough, cold, fever, painful Rules.

- ***Avena sterilis*** L.
- ♦ **EN**: Oats
- ♦ **FN**: Avoinecultivée
- ♦ **CN**: El-Khortal
- ♦ **PU**: The seed
- ♦ **LTA**: Dye, preservative, Antidiabetic, antioxidant, antithrombosis, anti-inflammatory, anticancer.

PUNICACEAE

- ***Punica granatum*** L.
- ♦ **EN**: pomegranate tree
- ♦ **FN**: Grenadier
- ♦ **CN**: Rommân
- ♦ **PU**: The bark of the fruit
- ♦ **LTA**: Dye; antidiarrheal; stomachic; sntidiabétique, antioxidant.
- ♦ **T**: No toxicity to report, or indeterminate toxicity.

RANUNCULACEAE

- ***Ranunculus bullatus*** L.
- ♦ **EN**: Autumn buttercup
- ♦ **FN**: Renoncule
- ♦ **CN**: wdenlhalouf
- ♦ **PU**: Root
- ♦ **LTA**: Dye; kidney stones, menstrual pain, upset stomach, inducing delivery, antidiarrheal, nephrolithiasis.
- ♦ **T**: Causes stomatitis, burns and ulceration (Bellakhdar 1997).

RHAMNACEAE

- ***Ziziphus lotus*** **(**L.**)** Lam**.**
- ♦ **EN**: Jujube
- ♦ **FN**: Jujubier

- **CN**: Ssedra, Nbeg. Azogar
- **PU**: The leaves, fruit, roots and bark.
- **LTA**: Dye; kidney stones; stones; leucoma; antimicrobial; antidiabetic.

ROSACEAE

- ***Rubus ulmifolius*** Schott
- **EN**: Elmleaf blackberry
- **FN**: Ronce à feuillesd'Orme
- **CN**: Laâlîg
- **PU**: leaf
- **LTA**: Dye; antidiabeticantipyretic.

- ***Rosa canina*** L.
- **EN**: Rose
- **FN**: rosier
- **CN**: Ward, Tighfert
- **PU**: Leaves
- **LTA**: Preservative; aromatic; Stomachic, erectile dysfunction, headache, fall; astringent, laxative, anti-diarrhea, anti-inflammatory and stimulating

- ***Prunus dulcis*** (MilL.) D.A.Webb
- **EN**: almond, sweet almond, bitter almond
- **FN** : Amandier, amande douce, amande amère
- **CN**: Lûz
- **PU**: Fruit
- **LTA**: Aromatic, antidiabetics; Incapacity; antiscléreux; eczema; antifungaL.

RUBIACEAE

- ***Rubia peregrina*** L.
- **EN**: Madder
- **FN**: garancevoyageuse
- **CN**: Fuwa
- **PU**: root and rhizome
- **LTA**: Dye; jaundice; hepatoprotective effect; diuretic, appetizing, choleretic, emmenagogue and tonic
- **T**: Non-toxic at low doses (Kahouadji 1995).

RUTACEAE

- ***Citrus aurantium*** L.
- **EN**: Bitter Orange
- **FN**: Bigaradier
- **CN**: Ranj, Zenboue
- **PU**: Leaf, bark, fruit

- **LTA**: Colrant, aromatisan, anti-diabetic, antioxidant, anti-cancer,

- ***Citrus limon*** **(**L.**)** Osbeck
- **EN**: lemon
- **FN**: Bergamotier
- **CN**: L-hamedbeldî
- **PU**: Leaf, bark, fruit
- **LTA**: Dye, aromatic, antidiabetic, antihypertensive, anti-inflammatory, anti-fungal, respiratory ailments, heart ailments.

- ***Ruta montana*** L.
- **EN**: mountain rue
- **FN**: Rue sauvage
- **CN**: Fijel
- **PU**: whole plant
- **LTA**: Preservative, aromatic, digestive disorder, helminth infections, ulcers, rheumatism and difficult birth, stomach pain, infertility, analgesic, abortion, antispasmodic, anti-inflammatory (ophthalmic), emmenagogue, diuretic, sedative, sudorific, vermifuge, antimicrobial, diaphoretic;
- **T**: Leaves are irritant and blistering, properties due to the essential oil and in particular the methyl nonyl ketone is a rubefacient (El Haji, 1995).

SALICACEAE

- ***Populus nigra*** L.
- **EN**: black poplar
- **FN**: Peuplier noir
- **CN**: Baqs
- **PU**: Leaf buds
- **LTA**: Dye; antioxidant, anti-inflammatory, cardiovascular, hepatoprotective.

SOLANACEAE

- ***Capsicum annuum*** L.
- **EN**: Pepper, Paprika
- **FN**: Poivron, Paprika
- **CN**: Felfla
- **PU**: fruit
- **LTA**: Dye; diabetic, post-herpetic neuralgia, musculoskeletal pains, diabetic neuropathy, osteoarthritis and rheumatoid arthritis.

THYMELAEACEAE

- ***Daphne gnidium*** L.
- **EN**: Flax-leaved daphne
- **FN**: Garou
- **CN**: Lezzâz
- **PU**: leaves, bark

- **LTA**: Dye; antimicrobial; anti-inflammatory, anti-cancer.
- **T**: All parts of the plant are irritating but fruits are most often involved. 1-2 fruits in children lead to accused symptoms and ingestion of 12 fruit is considered a potentially fatal dose in adults (Jouglard 1977).

VERBENACEAE

- ***Verbena officinalis*** L.
- **EN**: Verbena
- **FN**: Verveine odorante
- **CN**: Elouiza
- **PU**: Leaves
- **LTA**: Aromatic, diabetes; neurological condition; Against insomnia, and abdominal pain; hypotensive; Refreshing.

ZINGIBERACEAE

- ***Curcuma longa*** L.
- **EN**: Turmeric
- **FN**: curcuma
- **CN**: lharqoum
- **PU**: rhizome
- **LTA**: Dye, preservative, anti-inflammatory, anticoagulant, anticancer, hepatoprotective, antimicrobial,

- ***Alpinia officinarum*** **Hance**
- **EN**: Lesser galangal
- **FN**: Galanga officinal
- **CN**: Khodenjal
- **PU**: rhizome
- **LTA**: Dye; against colds, flu, cold, painful periods and as warming, aromatic, digestive, antiemetic, antiseptic.