Ethnobotanical survey of medicinal plants traditionally used for eczema treatment in Morocco

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Ethnobotany Research and Applications 32:33 (2025) - http://dx.doi.org/10.32859/era.32.33.1-21
Manuscript received: 22/07/2025 - Revised manuscript received: 26/11/2025 - Published: 27/11/2025

Research

Abstract

Background: This study aimed to document and analyze the traditional use of medicinal plants for treating eczema in Morocco, with the goal of preserving local knowledge and identifying potential candidate species for further pharmacological investigation. By focusing on the practices of local herbalists, we sought to establish a comprehensive database of plants commonly employed for dermatological care, particularly eczema.

Methods: Semi-structured questionnaires were administered to 200 herbal practitioners across various Moroccan regions (Marrakech, Casablanca, Rabat, Fez, Oujda) in their native language, Darija. The plant species mentioned were cross-referenced with relevant literature, and the collected data were systematically analyzed.

Results: The ethnobotanical survey documented 107 plant taxa belonging to 48 botanical families, with Asteraceae being the most frequently cited. Leaves were the most commonly used plant part, and powdering was the primary preparation method. Remedies were predominantly administered as poultices, typically applied at night. Notably, twenty-three of the documented species have been previously reported in the scientific literature for their efficacy in managing dermatological conditions, including eczema.

Conclusions: This study highlights the importance of ethnobotanical surveys in preserving traditional knowledge and identifying medicinal plants in Morocco for eczema treatment. However, further laboratory studies are needed to validate their therapeutic potential.

Keywords: Ethnobotanical survey, traditional uses, treatment, eczema, medicinal plants, Morocco.

Background

The skin, as the human body's largest organ, serves as a critical barrier against environmental stressors, including pathogens, physical injuries, and chemical agents (Fania *et al.* 2022). Beyond its protective function, it plays a role in sensor and perception, fluid regulation, vitamin D synthesis, and thermoregulation (Cavero *et al.* 2013; Tabassum & Hamdani, 2014). Due to its direct exposure to external stimuli, the skin is highly susceptible to various disorders, including eczema, burns, dermatitis, ringworm, and other inflammatory or infectious conditions (Eichenfield *et al.* 2014). Among these, atopic dermatitis (AD)—commonly referred to as eczema—is a chronic, pruritic, and inflammatory skin disease characterized by dryness, erythema, and lichenified plaques (Radhakrishnan *et al.* 2024). AD often begins in early childhood and affects an estimated 10-30% of children and 2-10% of adults worldwide, with increasing prevalence in both industrialized and developing countries (Kolb and Ferrer-Bruker, 2023). In Morocco, ISAAC studies have reported that 13-20% of children present with eczema symptoms, particularly in urban areas where environmental triggers and allergens are more prevalent (Bouayad *et al.* 2006). This relatively high prevalence is attributed to a combination of genetic predisposition and environmental factors, such as urbanization, exposure to pollutants, and lifestyle changes associated with the hygiene hypothesis (Bouayad et al. 2006; Kolb and Ferrer-Bruker, 2023). Historically, eczema symptoms have been managed within the framework of traditional Moroccan and Arabic medicine (Tibb/Unani) for centuries, often classified under broader categories of inflammatory skin conditions and chronic itching. However, the formal recognition and epidemiological study of eczema as a distinct entity only expanded with the rise of modern dermatology and large-scale studies such as ISAAC in the late 20th and early 21st centuries.

Pharmacological treatments, including corticosteroids, tacrolimus, and newer agents such as crisaborole and delgocitinib, have demonstarted efficacy in reducing inflammation and itch (Lee *et al.* 2016; Hoy, 2017; Moraes-Souza *et al.* 2025). Nevertheless, the long-term use of these drugs may lead to undesirable effects, high costs, or poor patient adherence (Priya *et al.* 2002). These limitations have encouraged the exploration of plant-based therapies as safer, more affordable alternatives, especially in communities where traditional medicine remains central to healthcare (Karaköse et al., 2019; Akbulut et al., 2019; Güler et al., 2021; Karaköse, 2022; Şen et al., 2022). Traditional medicine in Morocco is deeply rooted in cultural heritage and benefits from exceptional botanical richness. In fact, Morocco's strategic biogeographical location supports over 4,682 plant taxa, of which over 800 species (14% of Moroccan flora) are recognized for their medicinal and aromatic properties, including many used for skin ailments (Taleb, 2017; Jamaleddine *et al.* 2017; Labrighli *et al.* 2025). Herbal remedies are often prescribed by local herbalists (*attarine*), with species from families such as Asteraceae and Lamiaceae families widely employed in dermatological care (Abouri *et al.* 2012; Zari & Zari, 2015; Fakchich and Elachouri 2021). Although several Moroccan studies have documented the use of medicinal plants for wound healing and other skin conditions, there remains a significant gap regarding species specifically used for eczema treatment. Most existing research has been geographically limited or focused on general skin infections (Akbli *et al.* 2016; Laraqui *et al.* 2018; Salhi *et al.* 2019; Chaachouay *et al.* 2022; Ajjoun *et al.* 2022).

The present study aims to address this knowledge gap by conducting an ethnobotanical survey across eastern, western, and central Morocco to document traditional plant-based treatments for eczema. By engaging with herbalists and compiling regional knowledge, this work contributes to the preservation of indigenous practices and the identification of promising plant species for futur pharmacological validation. To our knowledge, this is the first ethnobotanical investigation in Morocco to focus specifically on plants traditionally used to treat eczema, offering valuable insights for future natural product development and public health integration.

Materials and Methods

Study area

Morocco, located in North Africa, is bordered by the Atlantic Ocean to the west, the Mediterranean Sea to the north, and Algeria to the east and southeast. It covers an area of approximately 716,550 km² and has a population estimated at 37.4 million (The World Factbook CIA 2025). The country exhibits diverse topography and climate, from coastal zones to arid inland plains and mountainous areas, providing favorable conditions for a wide variety of medicinal plants. This ethnobotanical study was conducted across five major Moroccan regions: Marrakech, Rabat and its surroundings, Oujda and its surroundings, Fez, and Casablanca (Fig. 1). These regions were chosen for their ecological diversity, cultural richness, and active herbalist practices.

Oujda and surroundings (eastern region): This region spans approximately 82,820 km², bordered by the Mediterranean Sea to the north and Algeria to the east and south. The study included Oujda, Jrada, Berkane, Ahfir, and Bnidrare, where the

traditional use of medicinal plants remains prevalent due to cultural heritage and proximity to rural communities (Fakchich and Elachouri 2014).

Rabat-Sale-Kenitra Region: Located in northwestern Morocco, this region includes Rabat, Sale, Skhirate-Temara, Tamesna, and surrounding rural communes. It is bordered by the Atlantic Ocean to the west and the Fez-Meknes region to the east. It covers 1,275 km² and had 5.13 million inhabitants in 2024 (Boutakrint 2024). The Mediterranean climate features mild, wet winters and warm, dry summers, while urbanized, traditional herbal practices persist in rural pockets because of their low cost.

Marrakech-Safi Region: The city of Marrakech, located at the foothills of the High Atlas Mountains in southern Morocco, covers about 2,625 km² and forms part of a region with approximately 4.89 million residents (Boutakrint 2024). The surrounding areas included in the study are known for their rich plant biodiversity and long-standing herbal traditions. Its semi-arid climate and varied elevation create favorable conditions for diverse medicinal species.

Fez-Meknès Region (Fez): Fez located in inland in northern Morocco, is bordered by Meknes, Sefrou, and Ifrane provinces. The Fez Medina (Fez el-Bali), a UNESCO World Heritage site, spans approximately 350 hectares (Ez-zoubi *et al.* 2022). Local populations continue to rely on herbalists (*attarine*) for treating common ailments, particularly skin conditions.

Casablanca-Settat Region: Located on the Atlantic coast in northwestern Morocco, Casablanca is Morocco's largest urban center and economic hub. The region covers a total area of about 20,394 km², this region is Morocco's most populous, with 7.69 million inhabitants—20.9 % of the country's population (Boutakrint 2024). While highly urbanized, traditional medicine remains an accessible alternative for many people, especially in surrounding rural districts.

Collectively, these regions represent over 71 % of Moroccan population and include both urban and peri-urban areas where plant-based traditional healthcare coexists with medical care. The selected sites provided a diverse representation of Morocco's environmental and cultural landscape.

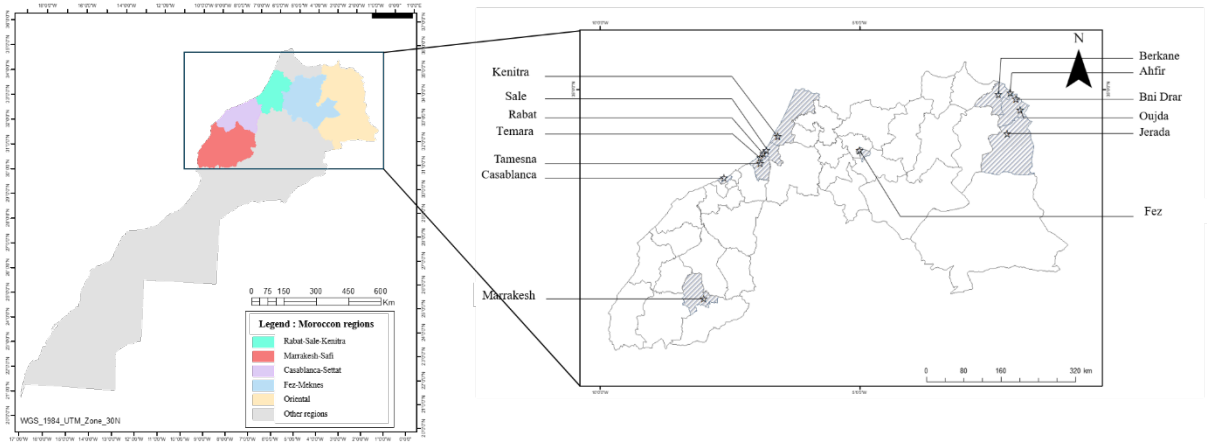

Figure 1. Distribution of survey points at the study area level (Source: DRF-M 2016; Created via ArcGIS software).

Data collection

An ethnobotanical survey was conducted from January 1st to July 30th, 2024, across the five target regions. The primary aim was to document traditional knowledge on medicinal plants used to treat eczema. This research was conducted in accordance with local norms for sharing of traditional knowledge. Prior informed consent was obtained from all participants, and the study was designed for non-commercial academic purposes, focusing on the preservation of cultural heritage. Data were collected through semi-structured face-to-face interviews in Darija, the Moroccan Arabic dialect commonly spoken by herbalists. Interviews were primarily carried out in traditional markets (souks) and herbalist shops, where plant-based remedies are widely sold. The survey also included practitioners from smaller towns and rural areas surrounding major cities, such as Berkane, Jrada, Bnidrar, and Skhirat, to ensure the representation of both urban and rural traditional knowledge. Before each interview, participants were informed about the study objectives and provided verbal consent. Participation was voluntary, anonymous, and uncompensated.

The questionnaire was based on established ethnobotanical protocols, and included both demographic and ethnobotanical information (Martin, 2004; De Albuquerque et al. 2007). It consisted of two main sections: the first section focuses on the demographic information of herbalists: (age, gender, level of education, duration of experience, and source of knowledge). The second section gathers data on ethnobotanical data (local name of the plant, parts used, preparation methods, mode of application, dosage and frequency of use, perceived effectiveness, and any known adverse effects). A total of 200 herbalists (13 Women and 187 men) of varying socio-economic backgrounds were surveyed using a non-probabilistic, site-representative sampling method. In each region, major markets and herbalist hubs we identified, and participants were approached sequentially until the target quota was achieved. Participants ranged from under 30 to over 50 years of age. Each interview lasted approximately one hour, allowing for detailed discussion and clarification of the reported practices.
The ethnobotanical knowledge was cross-verified, when possible, by comparing with existing local literature and confirming repeated citations across informants.

Plant identification and data validation

The identification of medicinal plant species reported by herbalists was conducted using a combination of fieldwork verification, vernacular name translation, and comparative botanical literature. Local names provided during interviews were first translated into their scientific equivalents using regionally recognized references, including: Traditional Moroccan Pharmacopoeia (Bellakhdar, 1997), “Flore pratique du Maroc” (Fennane et al. 1999), “Catalogues des plantes vasculaires du nord du Maroc” (Valdés et al. 2002; Volumes I & II). Scientific names were standardized according to the Angiosperm Phylogeny Group III (APG IV classification system. Plants were organized alphabetically by family, followed by vernacular names and reported ethnomedicinal uses. Taxonomic identification was cross-checked and was validated by prof. Hanane Boutaj from Laboratory of Life and Health Sciences, Faculty of Medicine and Pharmacy of Tangier, Abdelmalek Essaadi University, Morocco. Specimens provided by herbalists were photographed, sampled, dried, and preserved following the standard method described by Jain (1964).

All validated specimens were deposited in the Herbarium of Mohammed V University, ensuring traceability and availability for future reference. Additionally, a literature review was carried out using major scientific databases such as Web of Science, Scopus, ScienceDirect, and PubMed to confirm reported therapeutic use and assess prior ethnobotanical or pharmacological studies on eczema and related skin conditions.

Data Analysis

The ethnobotanical data were analyzed using a combination of descriptive statistics and quantitative ethnobotanical indices to evaluate the medicinal relevance and cultural significance of cited species.
Software and statistical tests

Data entry and preliminary cleaning were conducted using Microsoft Excel 2016. Ethnobotanical knowledge was assessed based on questionnaire responses, taking into account the number of plants cited, parts used, preparation methods, modes of application, dosage and frequency, perceived effectiveness, and known adverse effects. Whenever possible, the reported information was cross-verified with existing local literature and through repeated citations from multiple informants. The variable “ethnobotanical knowledge” was coded quantitatively, for example by counting the number of plants cited by each herbalist and the number of repeated citations. Quantitative analyses were performed using SPSS (Version 20) for Chi-square and other statistical tests, Jamovi for descriptive analyses, and Sphinx v5 for questionnaire processing. To assess the relationship between socio-demographic variables and ethnobotanical knowledge, the Pearson Chi-square test (1900) was applied. A p-value < 0.05 was considered statistically significant.

Ethnobotanical Indices

To determine the relative cultural and therapeutic importance of the plant species, the following ethnobotanical indices were calculated:

Family Use Value (FUV)

FUV reflects the cultural significance of plant families. The following formula was used to calculate this index:

$$FUV=UVs/Ns$$

Where UVs is the cumulative use value for a family and Ns is the number of species in that family (Sreekeesoon and Mahomoodally, 2014).

Use Value (UV)

UV measures the relative importance of each plant species based on the number of reported uses. This index was calculated using this formula:

$$UV = (\Sigma Ui)/N$$

Where Ui is the number of use reports by each informant for a given species, and N is the total number of informants (Vitalini et al. 2013).

Fidelity Level (FL)

FL measures the proportion of informants who use a plant species for the same ailment. FL index is estimated using the following formula:

$$FL (\%) = Ip/Iu \times 100$$

Where Ip is the number of herbalists, who cited a species for a specific ailment (eczema), and Iu is the total number of informants citing the plant for any use (Friedman et al. 1986).

Relative Frequency of Citation (RFC)

RFC quantifies how frequently a plant species is cited by informants and is calculated as:

$$RFC=FC/N$$

Where FC is the number of herbalists who mentioned a particular plant species, and N is the total number of informants (Tardío and Pardo-de-Santayana 2008).

Plant Part Value (PPV)

PPV assesses the preference for particular plant parts. The PPV was calculated using this formula:

$$PPV = (RU \text{ plant part})/RU$$

Where RU plant part is the number of uses for a specific plant part, and RU is the total number of use reports (Chaachouay et al. 2019).

Results and Discussion

Socio-demographic characteristics of the informants

A total of 200 herbalists were interviewed across five Moroccan regions: Rabat and surroundings (30%), Oujda and surroundings (21%), Fez (20.5%), Marrakesh (19.5%), and Casablanca (9%). The gender distribution was notably imbalanced, with 187 men (93.5%) and 13 women (6.5%) participating in the study (Table 1). This significant disparity ($p < 0.001$) reflects the male predominance in commercial herbalism in Moroccan marketplaces, consistent with national surveys (El Haouari *et al.* 2018). In contrast, within domestic or rural contexts, women are often primary custodians of ethnomedicinal knowledge and loyal consumers of medicinal plants (Jouad *et al.* 2001). Most participants were aged 30-40 years (30%), followed by those over 50 (28%), 40-50 (24%), and under 30 (17.5%). Although the p-value for age-related knowledge variation approached signi ficance ($p = 0.052$), older herbalists were generally considered to possess deeper knowledge due to intergenerational oral transmission, as emphasized in previous studies from the Rif and High Atlas regions (Belhaj *et al.* 2021; Chaachouay *et al.* 2022), and the know-how acquired through long years of experience. The relatively balanced age distribution suggests ongoing knowledge retention across generations, though younger practitioners may increasingly rely on written or online sources.

In terms of professional experience, nearly half of the herbalists had 10-30 years of practice (49.5%), followed by those with less than 10 years (32%), 30-50 years (16.5%), and only 2% had over 50 years of experience. The difference in ethnobotanical knowledge by experience was statistically significant ($p < 0.001$), in line with literature affirming that prolonged field engagement correlates with greater medicinal plant familiarity (El Haouari *et al.* 2018). The education level of respondents was also strongly associated with their knowledge sources ($p < 0.001$). Nearly half of the herbalists (49.5%) were illiterate, 17.5% had completed primary education, 20.5% secondary, and 12.5% held a university degree. These findings echo those of Chaachouay *et al.* (2022), Belhaj *et al.* (2021) and El Haouari *et al.* (2018), suggesting that lower formal education levels often correlate with stronger reliance on traditional, orally transmitted practices, while higher education may correspond

with declining usage or interest in traditional remedies. Regarding the origin of knowledge, 37.5% of informants attributed their expertise to cultural heritage, 35% to personal experience, and 20.5% to a combination of both. Only 6.5% reported learning from literary sources, and one participant mentioned other forms of acquisition. These patterns underscore the dominant role of oral and experiential transmission in Moroccan herbal medicine, consistent with observations from similar ethnobotanical research across the Maghreb (Tahraoui *et al.* 2007; Aribi 2013; Chaachouay *et al.* 2022).

Table 1. Socio-demographic characteristics of herbalists included in the study area.

Variable	Category	Number	Proportion of Respondents	P-value
Gender	Female	13	6.5%	<.001
	Male	187	93.5%	
Age	Under 30 years	35	17.5%	0.052
	30 - 40 years	60	30.0%	
	40 - 50 years	48	24.%	
	Over 50 years	56	28.0%	
Experience Duration	Under 10 years	64	32.0%	<.001
	10 - 30 years	99	49.5%	
	30 - 50 years	33	16.5%	
	Over 50 years	4	2.0%	
Surveyed City	Marrakech	39	19.5%	<.001
	Casablanca	18	9.0%	
	Rabat and surrounding	60	30.0%	
	Fez	41	20.5%	
	Oujda and surrounding	42	21.0%	
Education Level	None	99	49.5%	<.001
	Primary	35	17.5%	
	Secondary	41	20.5%	
	University	25	12.5%	
Source of Knowledge	Cultural heritage	75	37.5%	<.001
	Experience	70	35.0%	
	Cultural heritage+ Experience	41	20.5%	
	Literary research	13	6.5%	
	Others	1	0.5%	

Regional variation in plant species richness across selected Moroccan areas

The distribution of plant species across different regions shows some variation in species richness (Fig. 2). Marrakesh and Oujda (including their surrounding areas) each host the highest number of plant species, with 25 species recorded in both regions. This suggests these areas may offer favorable environmental conditions or diverse habitats supporting a wider variety of plant life. Following closely, the Rabat region and its surroundings have 23 plant species, indicating slightly lower but still substantial biodiversity. The Fez region shows a moderate diversity with 20 species, while Casablanca and its surrounding areas have the lowest number recorded, with 18 species. Overall, the data suggest that the regions of Marrakesh and Oujda represent hotspots of plant species richness within the studied areas, whereas Casablanca exhibits comparatively lower species diversity.

Most used families and their family use value (FUV)

A total of 107 medicinal plant species belonging to 48 botanical families were documented as treatments for eczema in the study area. The plants are arranged alphabetically, and for each one, the scientific name, botanical family, local name, used plant part, and traditional preparation method are provided, along with ethnobotanical indices including FUV, UV, FL, RFC, and PPV, as shown in Table 2 and Figures 3 and 4. The most dominant families based on species count were Asteraceae (15 species), Lamiaceae (11 species), Apiaceae (8 species), Rutaceae (5 species), Solanaceae, and Rosaceae (4 species), and emerging as the most represented families in the study area (Table 2). The prominence of Lamiaceae and Asteraceae is consistent with their pharmacological richness and their widespread traditional use across Morocco. The essential oils and extracts of these families are particularly valued for their content of secondary metabolites such as flavonoids and terpenoids, which contribute to their antimicrobial, anti-inflammatory, and antioxidant activities—key properties in the treatment of eczema and skin ailments (Abouri *et al.* 2012; Al-snafi, 2019; Rattray and Van Wyk, 2021; Arora *et al.* 2022).

Based on the FUV index, the six most representative families were Lythraceae (FUV = 0.089), Oleaceae (FUV = 0.067), Asphodelaceae (FUV = 0.042), Asteraceae (FUV = 0.036), Apocynaceae (FUV = 0.021) and Lamiaceae (FUV = 0.019) (Fig. 3). The high FUV score of Lythraceae, despite having fewer species than other families, may reflect the specialized use and strong consensus surrounding *Lawsonia inermis*, which was frequently cited for eczema treatment (Semwal *et al.* 2014; Anand *et al.* 2022). This is consistent with its traditional application for inflammatory and infectious skin diseases, as also observed by Chaachouay *et al.* (2022), Ajjoun *et al.* (2022), and Orch *et al.* (2021) for broader dermatological conditions. Oleaceae, represented primarily by *Olea europaea*, also showed a high FUV (0.067), confirming its significance in Moroccan herbal practices, especially for soothing and moisturizing dry or eczematous skin (Orch *et al.* 2021; Ajjoun *et al.* 2022; Arora *et al.* 2022). In contrast, although Lamiaceae and Asteraceae included a greater number of species, their FUV values (0.019 and 0.036, respectively) were lower, suggesting a broader but less concentrated usage pattern. This indicates that while these families are pharmacologically rich and commonly used in traditional medicine, their applications for eczema may be more diverse and less specific per informant.

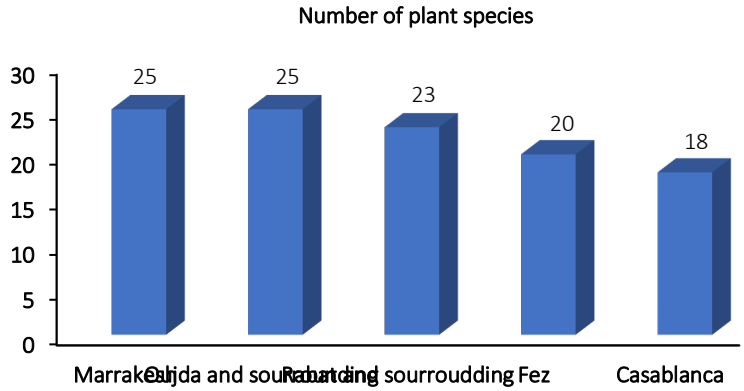

Figure 2. Distribution of plant species used for eczema treatment across studied regions.

Diversity of medicinal plants and their use value (UV)

In the present study, use value (UV) was used to assess the relative cultural and therapeutic significance of medicinal plant species cited by Moroccan herbalists for the treatment of eczema (Table 2). UV scores ranged from low values (e.g., <0.1) to notably high values above 3.0. This index reflects both the frequency of citation and perceived efficacy of a given species among the informants. The eight most cited species with the highest UV values were *Laurus nobilis* (UV = 3.153), *Peganum harmala* (UV = 2.367), *Marrubium vulgare* (UV = 2.071), *Aloe vera* (UV = 1.480), *Ziziphus spina-christii* (UV = 1.281), *Artemisia herba-alba Asso* (UV = 1.181), *Chamomilla recutita* (UV = 1.085), and *Juniperus phoenicea* (UV = 1.085). These species are widely recognized across Morocco for their dermatological applications, with *L. nobilis* emerging as the most culturally important in our sample. Its high UV suggests both widespread use and strong consensus regarding its efficacy in managing symptoms associated with eczema, such as inflammation, itching, and microbial infections (Petkova *et al.* 2019). Despite its prominence, *L. nobilis* has received limited attention in Moroccan ethnobotanical literature focused on skin diseases, highlighting the need for further phytopharmacological investigation. Our findings align partially with those of Chaachouay *et al.* (2022) in the Rif region, where *Inula viscosa, Lawsonia inermis*, *Silene csereii*, and *Chenopodium ambrosioides* were among the species with the highest UV values for general skin disorders. However, this study reported UV values not exceeding 0.293, indicating that species such as *L. nobilis* and *P. harmala* are more central in eczema-specific treatments than in broader dermatological contexts. Similarly, *M. vulgare* has been previously cited in Moroccan surveys for treating skin conditions (Abouri *et al.* 2012; Salhi *et al.* 2019). However, our UV is significantly higher, likely reflecting this species' specific relevance to eczema treatment in Moroccan phytotherapy. *P. harmala* also shows an exceptional UV, which is notable given its restricted therapeutic window due to its psychoactive and potentially toxic alkaloids. Nevertheless, it is traditionally used in Morocco for anti-inflammatory and antimicrobial purposes, particularly in dermal and mucosal ailments (El-Rifaie 1980; Arif *et al.* 2022). This cultural trust, reflected in its UV, necessitates validation under controlled conditions. *Z. spina-christii*, often used in Moroccan rural areas for dermatoses and skin dryness, also scored a high UV. Its emollient, antimicrobial, and anti-itching properties are supported by traditional uses, though it remains underreported in scientific literature focused on eczema (Abdulrahman *et al.* 2022). Interestingly, several of the most cited species—*A. vera*, *A. herba-alba*, and *C. recutita*—have been widely reported in North African and Mediterranean studies for dermatological use (Feily and Namazi 2009; Arora *et al.* 2022; Houti *et al.* 2023). Their UVs in our study are higher than those previously recorded by Oukadir *et al.* (2024), suggesting their intensified use in eczema-specific ethnomedicine. In contrast to low-UV species, which

are often mentioned sporadically or for multi-herbal preparations, high-UV taxa are more consistently applied, commonly available in herbalist shops, and widely accepted among practitioners. According to Vitalini *et al.* (2013), plant species with high UV are considered culturally significant and may serve as promising candidates for future phytochemical and pharmacological studies.

Fidelity level (FL) of medicinal plants used for eczema treatment

Fidelity Level (FL) quantifies the consensus among informants on whether a species is exclusively or predominantly used for treating one condition, expressed as a percentage. A high FL value suggests that a plant is consistently and reliably used by many people for the same purpose, reinforcing its ethnomedicinal importance. In the present study, FL values were calculated for all 107 plant species cited by herbalists across five Moroccan regions. The results, summarized in Table 2, show that *A. vera* achieved the highest score (FL=100%), indicating that all informants who mentioned this plant associated it exclusively with the treatment of eczema. *P. harmala* followed closely with an FL=95%, despite its broader medicinal applications in other cultural contexts. This high fidelity in eczema use demonstrates a focused knowledge within Moroccan ethnobotany, where *P. harmala* is valued for its antimicrobial and soothing properties (Abouri *et al.* 2012; Ajjoun *et al.* 2022). *L. nobilis*, which had the highest UV score (3.153), exhibited an FL of 84.7%, reflecting both high citation frequency and strong (RFC=0.55), though slightly more diversified, therapeutic application (Petkova *et al.* 2019). *Punica granatum* was reported with an FL of 72.3%, suggesting its use spans several dermatological conditions beyond eczema, such as fungal infections or wound healing (Dimitrijevic *et al.* 2024). The majority of plant species (102 out of 107) had FL=70%, indicating that while they are regularly cited for eczema, they are also known to be applied in treating other skin-related issues (e.g., burns, acne, itching, or infections) (Abouri *et al.* 2012; Chaachouay *et al.* 2022; Ajjoun *et al.* 2022; Snoussi *et al.* 2025). These findings align well with previous ethnobotanical studies focused on skin diseases in Morocco and North Africa, though few isolate eczema specifically. For instance, Chaachouay *et al.* (2022) found that *L. inermis* had FL = 100% for dermal wound disease in northern Morocco. This aligns with our findings, particularly for *A. vera* and *P. harmala*, which are also widely cited and used specifically for eczema. In Algeria, Bouafia *et al.* (2021) reported that *Juniperus phoenicea* and *Brocchia cinerea* had FL values ranging from 80% to 95% for use in managing eczema and dermatitis. *J. phoenicea in our study exhibited an FL of 70% and a UV of 1.085, confirming its importance in North African ethnotherapy*. *L. nobilis*, while often underrepresented in previous Moroccan studies on skin ailments, showed both high UV and high FL in our study.

Relative frequency of citation (RFC) of medicinal plants used for eczema treatment

The RFC values for the medicinal plants used in eczema treatment in Morocco ranged from 0.28% to 5.82% (Table 2). The six most frequently cited species with notably high RFC percentages are *M. vulgare* (5.82%), *A. vera* (4.16%), *Malus domestica* (3.60%), *A. herba-alba* (3.32%), *C. recutita,* and *J. phoenicea* (both at 3.05%). Among these, *M. vulgare* had the highest RFC, indicating that it is widely recognized and cited by herbalists as a preferred remedy for eczema. This high RFC is consistent with its high UV (2.071) and FL values, highlighting its cultural and therapeutic importance. Interestingly, *M. domestica*—though not pharmacologically emphasized in other studies—also received a notable number of citations, suggesting possible regional or culturally specific uses that may warrant further investigation. This suggests that plants with high RFC values not only reflect their local reputation and cultural salience but also point to common ethnomedical patterns in the broader Maghreb region (Chaachouay *et al.* 2019; Orch *et al.* 2021). High RFC species such as *M. vulgare* and *A. vera* represent promising candidates for phytochemical and pharmacological validation, especially given their concurrent high Use Values (UV) and Fidelity Levels (FL).

Plant parts used and their plant part value (PPV)

The Plant Part Value (PPV) index allows for the identification of which parts are culturally and therapeutically most important in a given ethnobotanical context. In our study, as shown in Figure 4, the most frequently used plant part was the leaf, with a PPV of 0.497, followed by the fruit (0.259), whole plant (0.200), and seeds (0.130). Less commonly used parts included flowers (0.073), stems (0.038), bark (0.030), aerial parts (0.024), and twigs (0.014). The dominance of leaves (49.7%) in traditional eczema remedies can be attributed to several factors, such as richness in bioactive compounds (flavonoids, phenolic acids, essential oils, and alkaloids), which exhibit anti-inflammatory, antioxidant, and antimicrobial properties crucial for managing eczema (Orch *et al.* 2021; Ajjoun *et al.* 2022). Additionally, harvesting leaves is generally more sustainable than uprooting whole plants or harvesting bark, making this practice both culturally and ecologically favorable. These findings are in agreement with Chaachouay et al. (2022) and Orch et al. (2021) who reported that leaves are the most commonly used part for treating dermatological conditions. This similarity suggests a broader regional reliance on leaf-based phytotherapy for skin ailments. Fruits (PPV = 0.259) and whole plants (PPV = 0.200) also played a notable role, particularly in species like *P. granatum, A. vera,* and *Z. spina-christii*. These parts are commonly associated with soothing, moisturizing, and wound-healing effects, which are highly desirable in eczema management (Abouri *et al.* 2012; Zari and Zari 2015).

Table 2. Medicinal plant species cited by herbalists in the study area

Scientific name	Vernacular Name	Part Used	Preparation Method	Administration Mode	VC	RFC %	FL%	UR	FUV	UV	Regions
Alliaceae						**1.39**	**-**	**-**	**0.007**	**-**	
· *Allium cepa* L.	Basala	Fruit	Juice	Poultice	1	1.11	70	222	-	0.395	Rabat and surrounding
· *Allium sativum* L.	Toum	Fruit	Grinding / Infusion	Poultice	2	0.28	70	56	-	0.100	Oujda and surrounding
Aizoaceae						0.28	-	-	0.003	-	
· *Carpobrotus edulis* (L.) N.E.Br.	Balsam	Leaf / Twigs	Grinding / Infusion	Poultice	3	0.28	70	56	-	0.100	Casablanca
Amaranthaceae						1.94	-	-	0.007	-	
· *Chenopodium ambrosioides* L.	Mkhinza	Leaf	Grinding	Poultice	4	1.11	60.2	222	-	0.395	Marrakesh
· *Suaeda egyptiaca* (Hasselq.) Zohary	Lkalaam	Fruit	Grinding	Poultice	5	0.55	70	110	-	0.196	Marrakesh
Apiaceae						3.89	-	-	0.011	-	
· *Kundmannia sicula* (L.) DC.	Ziyata	Leaf	Decoction / Ash	Poultice	6	1.11	70	222	-	0.395	Rabat and surrounding
· *Coriandrum sativum* L.	Kasbour	Whole plant	Grinding	Poultice	7	0.28	70	56	-	0.100	Fez
· *Petroselinum crispum* (Mill.) Fuss	Lmaadnous	Whole plant	Grinding	Poultice	8	0.28	70	56	-	0.100	Fez
· *Ammodaucus leucotrichus* Coss. & Durieu	Kamoune saufi	Leaf	Grinding	Massage/Friction	9	0.55	70	110	-	0.196	Rabat and surrounding
· *Pimpinella anisum* L.	Anise	Leaf	Decoction	Poultice	10	0.28	70	56	-	0.100	Rabat and surrounding
· *Daucus carota* L.	Khizou	Stem	Decoction	Poultice	11	0.83	70	166	-	0.295	Casablanca
· *Apium graveolens* L.	Krafss	Aerial part	Grinding	Massage/Friction	12	0.28	70	56	-	0.100	Marrakesh
· *Ammi majus* L.	Taylan	Seed	Grinding	Massage/Friction	13	0.28	70	56	-	0.100	Fez
Apocynaceae						4.16	-	-	0.021	-	
· *Nerium oleander* L.	Defla	Leaf	Infusion	Poultice	14	1.94	70	388	-	0.690	Marrakesh
· *Euphorbia echinus* Hook.f.	Daghmouss	Leaf	Infusion / Decoction	Poultice	15	2.22	70	444	-	0.790	Rabat and surrounding
Arecaceae						0.28	-	-	0.003	-	
· *Cocos nucifera* L.	Jawz lhindiye	Seed	Essential Oil	Poultice	16	0.28	70	56	-	0.100	Rabat and surrounding
Aristolochiaceae						0.55	-	-	0.006	-	
· *Aristolochia longa* L.	Barstem	Whole plant	Grinding	Poultice	17	0.28	70	56	-	0.100	Oujda and surrounding
Asphodelaceae						4.16	-	-	0.042	-	
· *Aloe vera* (L.) Burm.f.	Loevera	Leaf	Grinding / Essential Oil	Poultice	18	4.16	100	832	-	1.480	Oujda and surrounding

Asteraceae						12.2	-	-	0.036	-	
· *Artemisia herba-alba* Asso	Chih	Leaf	Decoction	Poultice	19	3.32	70	664	-	1.181	Marrakesh
· *Chamomilla recutita* (L.) Rauschert)	Babounj	Flowers / Whole plant	Decoction / Grinding / Essential Oil	Poultice	20	3.05	70	610	-	1.085	Oujda and surrounding
· *Hyoscyamus niger* L.	Sicrane	Whole plant / Seed	Grinding / Decoction	Poultice	21	1.11	70	222	-	0.395	Rabat and surrounding
· *Saussurea costus* (Falc.) Lipsch.	Kist lhindiye	Leaf / Twigs	Grinding	Poultice	22	0.55	70	110	-	0.196	Rabat and surrounding
· *Atractylis gummifera* L.	Addad	Aerial part	Grinding	Poultice	23	0.55	70	110	-	0.196	Rabat and surrounding
· *Helianthus annuus* L.	Tournosol	Seed	Decoction	Poultice	24	0.28	70	56	-	0.100	Oujda and surrounding
· *Dittrichia viscosa* (L.) Greuter	Tifljouj	Seed /Leaf/ Stem	Grinding /Essential Oil	Poultice /Oral	25	0.83	70	166	-	0.295	Oujda and surrounding
· *Anthemis nobilis* L.	Bahar nabil	Flowers	Essential Oil	Massage/Friction	26	0.28	70	56	-	0.100	Oujda and surrounding
· *Arctium lappa* L.	Bardona	Leaf	Grinding /Infusion	Poultice /Oral	27	0.55	70	110	-	0.196	Marrakesh
· *Helichrysum italicum* (Roth) G.Don	Dahabe chams	Leaf	Essential Oil	Massage/Friction	28	0.28	70	56	-	0.100	Marrakesh
· *Anacyclus pyrethrum* (L.) Lag.	Takandicha	Seed	Grinding /Decoction	Poultice	29	0.28	70	56	-	0.100	Fez
· *Carlina Acaulis* L.	Tafgha	Leaf	Infusion	Poultice	30	0.28	70	56	-	0.100	Oujda and surrounding
· *Bubonium graveolens* (L.) Cass.)	Tafssa	Leaf	Grinding /Infusion	Poultice	31	0.28	70	56	-	0.100	Casablanca
· *Matricaria pubescens* (Desf.) Schultz Bip.	Kartoufa	Leaf	Grinding /Infusion	Poultice	32	0.28	70	56	-	0.100	Casablanca
· *Reichardia tingitana* (L.) Roth	Nagd	Leaf	Grinding /Infusion	Poultice	33	0.28	70	56	-	0.100	Casablanca
Brassicaceae						0.84	-	-	0.003	-	
· *Brassica napus* L.	Saljam	Leaf	Grinding	Poultice	34	0.28	70	56	-	0.100	Marrakesh
· *Barbarea vulgaris* R.Br.	Khardal bari	Flowers	Essential Oil	Poultice	35	0.28	70	56	-	0.100	Oujda and surrounding
· *Bourago officinalis* L.	Himhim	Flowers	Maceration	Oral	36	0.28	70	56	-	0.100	Fez
Cactaceae						0.83	-	-	0.008	-	
· *Cactus sp.*	Sabar	Leaf	Grinding	Poultice	37	0.83	70	166	-	0.295	Oujda and surrounding
Cucurbitaceae						2.49	-	-	0.009	-	
· *Citrullus colocynthis* (L.) Schrad.	Lhadja,handal	Fruit	Juice /Grinding	Massage/Friction	38	1.66	70	332	-	0.591	Rabat and surrounding
· *Ecballium elaterium* (L.) A.Rich.	Figuist lhmir	Fruit	Juice	Massage/Friction	39	0.55	70	110	-	0.196	Casablanca
· *Cucurbita moschata* Duchesne ex Poir.	Lkaraa lkhadra	Fruit	Skin	Poultice	40	0.28	70	56	-	0.100	Fez
Cupressaceae						3.88	-	-	0.014	-	
· *Juniperus phoenicea* L.	Aar aar	Bark / Fruit	Essential Oil	Poultice	41	3.05	70	610	-	1.085	Casablanca

· *Juniperus thurifera* L.	Le Cade	Leaf	Grinding /Essential Oil	Poultice	42	0.55	70	110	-	0.196	Marrakesh
· *Thuja occidentalis* L.	Afssa	Leaf	Decoction	Oral	43	0.28	70	56	-	0.100	Oujda and surrounding
Cannabaceae						0.28	-	-	0.003	-	
· *Cannabis sativa* L.	Lhachih	Leaf	Essential Oil	Massage/Friction	44	0.28	70	56	-	0.100	Fez
Caryophyllaceae						0.28	-	-	0.003	-	
· *Saponaria officinalis* L.	Saponaire	Aerial part	Maceration	Poultice	45	0.28	70	56	-	0.100	Casablanca
Equisetaceae						0.28	-	-	0.003	-	
· *Equisetum arvense* L.	Dayl lhssan	Whole plant	Infusion	Poultice	46	0.28	70	56	-	0.100	Fez
Euphorbiaceae						0.83	-	-	0.008	-	
· *Ricinus communis* L.	Kharwaa	Fruit / Seed	Essential Oil	Massage/Friction/Oral	47	0.83	70	166	-	0.295	Oujda and surrounding
Fabaceae						3.05	-	-	0.008	-	
· *Trigonella foenum-graecum* L.	Halba	Seed	Grinding /Infusion	Poultice	48	1.94	70	388	-	0.690	Oujda and surrounding
· *Glycine soja* Siebold & Zucc.	Soja	Seed	Essential Oil /Grinding	Massage/Friction	49	0.55	70	110	-	0.196	Marrakesh
· *Arachis hypogaea* L.	Cawcaw	Seed	Essential Oil	Massage/Friction	50	0.28	70	56	-	0.100	Oujda and surrounding
· *Acacia ehrenbergiana Hayne*	Tamat	Leaf	Grinding	Poultice	51	0.28	70	56	-	0.100	Fez
Geraniaceae						0.55	-	-	0.006	-	
· *Pelargonium graveolens* L'Hér. ex Aiton	Aatracha	Leaf /Flowers	Essential Oil	Oral	52	0.55	70	110	-	0.196	Fez
Grossulariaceae						0.28	-	-	0.003	-	
· *Ribes uva-crispa* L.	Iinab Taalab	Fruit	Infusion	Poultice	53	0.28	70	56	-	0.100	Fez
Hypericaceae						0.28	-	-	0.003	-	
· *Hypericum perforatum* L.	Danab lkhayl	Leaf	Decoction	Poultice	54	0.28	70	56	-	0.100	Fez
Lamiaceae						16.89	-	-	0.019	-	
· *Marrubium vulgare* L.	Merriwa	Leaf	Decoction /Infusion	Poultice	55	5.82	70	1164	-	2.071	Rabat and surrounding /Casablanca
· *Rosmarinus officinalis* L.	Azir	Leaf/ Whole plant	Grinding	Poultice	56	1.39	70	278	-	0.495	Rabat and surrounding
· *Teucrium polium* L.	Jaadiya	Leaf	Decoction	Poultice	57	1.39	70	278	-	0.495	Casablanca
· *Ajuga iva* (L.) Schreb.	Chendgora	Leaf	Decoction	Poultice	58	0.83	70	166	-	0.295	Marrakesh
· *Lavandula coronopifolia* Poiret	Lokhzama	Leaf /Whole plant	Grinding /Decoction	Poultice /Oral	59	2.49	70	498	-	0.886	Fez
· *Salvia officinalis* L.	Salmia	Leaf	Grinding /Decoction	Poultice /Rinse	60	0.55	70	110	-	0.196	Casablanca
· *Origanum vulgare* L.	Zaatar	Whole plant	Grinding /Essential Oil	Poultice	61	2.49	70	498	-	0.886	Fez

· *Mentha spicata* L.	Naa naa	Leaf	Decoction	Poultice	62	0.55	70	110	-	0.196	Rabat and surrounding
· *Mentha pulegium* L.	Flayou	Leaf	Infusion	Poultice	63	0.55	70	110	-	0.196	Oujda and surrounding
· *Origanum syriacum* L.	Mardodouch	Leaf	Essential Oil	Oral /Poultice	64	0.55	70	110	-	0.196	Rabat and surrounding / Casablanca
· *Thymus vulgaris* L.	Thymus /Zaitra	Stem	Grinding	Poultice	65	0.28	70	166	-	0.295	Marrakesh
Linaceae						1.66	-	-	0.004	0.1	
· *Linum usitatissimum* L.	Lkatan	Seed	Decoction	Oral	66	0.83	70	166	-	0.196	Fez
· *Cinnamomum camphora* (L.) J.Presl	Camphre	Leaf	Essential Oil	Poultice	67	0.28	70	56	-	-	Marrakesh
· *Laurus nobilis* L.	Lghar/ Rand	Leaf / Seed	Decoction /Grinding/Essential Oil	Poultice	68	0.55	84.7	110	-	3.153	Marrakesh
Lythraceae						8.86	-	-	0.089	-	
· *Lawsonia inermis* L.	Henna	Leaf / Whole plant	Infusion / Grinding	Poultice	69	8.86	70	1772	-	0.1	Marrakesh
Malvaceae						0.84	-	-	0.003	0.1	
· *Hibiscus sabdariffa* L.	Karkadiya	Leaf	Decoction	Poultice	70	56	70	0.28	-	0.1	Rabat and surrounding
· *Adansonia digitata* L.	Baobab	Leaf	Grinding	Poultice	71	0.28	70	56	-	-	Rabat and surrounding
· *Malva sylvestris* L.	Khobiza	Leaf	Grinding	Poultice	72	0.28	70	56	-	0.1	Casablanca
Moraceae						0.28	-	-	0.003	-	
· *Quercus suber* L.	lLferchi	Leaf / Seed/ Twigs	Grinding	Poultice	73	0.28	70	56	-	0.395	Marrakesh / Oujda and surrounding
Myrtaceae						1.39	-	-	0.007	0.1	
· *Myrtus communis* L.	Rayhan	Flowers / Leaf	Decoction / Grinding	Poultice	74	1.11	70	222	-	-	Oujda and surrounding
· *Syzygium aromaticum* (L.) Merr. & L.M.Perry	Krnfl	Flowers	Decoction	Poultice	75	0.28	70	56	-	0.196	Rabat and surrounding
Nitrariaceae						0.55	-	-	0.006	-	
· *Peganum harmala* L.	Harmal	Fruit / Seed	Grinding	Poultice	76	0.55	95	110	-	2.367	Rabat and surrounding / Marrakesh
Oleaceae						6.65	-	-	0.067	-	
· *Olea europaea* L.	Zaytoune	Fruit	Essential Oil	Poultice	77	6.65	70	1330	-	0.196	Rabat and surrounding
Pedaliaceae						0.55	-	-	0.006	-	
· *Sesamum indicum* L.	Simsime	Seed	Essential Oil	Massage/Friction	78	0.55	70	110	-	0.295	Rabat and surrounding

Pinaceae						0.83	-	-	0.008	-	
· *Pinus halepensis* Mill.	Tayda / sanawbar	Flowers	Grinding	Poultice	79	0.83	70	166	-	0.1	Marrakesh
Poaceae						0.28	-	-	0.003	-	
· *Triticum aestivum* L.	Nokhala	Seed	Decoction	Poultice	80	0.28	70	56	-	0.1	Fez
Portulacaceae						0.28	-	-	0.003	-	
· *Portulaca oleracea* L.	Baklato lmae	Leaf	Grinding	Poultice	81	0.28	70	56	-	0.196	Casablanca
Punicaceae						0.55	-	-	0.006	-	
· *Punica granatum* L.	Romane	Fruit peel	Grinding	Poultice	82	0.55	72.3	110	-	0.495	Oujda and surrounding
Ranunculaceae						1.39	-	-	0.014	-	
· *Nigella sativa* L.	Hab souda, Sanouj	Seed	Essential Oil	Oral / Poultice	83	1.39	70	278	-	0.1	Oujda and surrounding
Rhamnaceae						0.28	-	-	0.003	-	
· *Ziziphus spina-christii* (L.) Desf.	Sdra	Leaf	Essential Oil	Massage/Friction	84	0.28	70	56	-	1.281	Oujda and surrounding
Rosaceae						4.98	-	-	0.013	0.196	
· *Malus domestica* Borkh.	Tofah	Fruit	Vinegar	Rinse	85	3.6	70	720	-	0.196	Casablanca
· *Prunus amygdalus* Batsch	Louz	Flowers / Fruit	Essential Oil	Massage/Friction	86	0.55	70	110	-	0.1	Casablanca
· *Prunus dulcis* (Mill.) D.A.Webb	Louz lmor	Fruit	Essential Oil	Poultice	87	0.55	70	110	-	-	Casablanca
· *Prunus armeniaca* L.	lmichmich	Fruit	Essential Oil	Poultice	88	0.28	70	56	-	0.1	Oujda and surrounding
Rubiaceae						0.28	-	-	0.003	-	
· *Galium aparine* L.	lsak	Twigs	Grinding	Poultice	89	0.28	70	56	-	0.295	Marrakesh
Rutaceae						2.78	-	-	0.006	0.1	
· *Citrus limonum* Risso	Lemon	Fruit	Juice / Essential Oil	Poultice	90	0.83	70	166	-	0.1	Marrakesh
· *Citrus reticulata* Blanco	Mandarin	Fruit	Juice	Poultice	91	0.28	70	56	-	0.1	Oujda and surrounding
· *Citrus sinensis* (L.) Osbeck	Orange	Fruit	Juice	Poultice	92	0.28	70	56	-	0.395	Marrakesh
· *Citrus aurantium* L.	Larange	Leaf	Grinding	Poultice	93	0.28	70	56	-	-	Marrakesh
· *Ruta chalepensis* L.	lfijl	Fruit	Essential Oil	Massage/Friction	94	1.11	70	222	-	0.495	Oujda and surrounding
Sapotaceae						1.39	-	-	0.014	-	
· *Argania spinosa* (L.) Skeels	Argan	Oral	Essential Oil	Poultice	95	1.39	70	278	-	0.69	Oujda and surrounding
Solanaceae						3.61	-	-	0.01	0.1	
· *Hyoscyamus albus* L.	Bounarjouf	Seed	Decoction / Infusion	Poultice	96	1.94	70	388	-	0.1	Marrakesh
· *Capsicum annuum* L.	Folfol lhar	Fruit	Infusion	Poultice	97	0.28	70	56	-	0.395	Fez

· *Solanum nigrum* L.	Bouknina	Leaf	Infusion	Poultice	98	0.28	70	56	-	-	Marrakesh
· *Mandragora officinarum* L.	Tofah liichk	Fruit	Juice	Massage/Friction	99	1.11	70	222	-	0.295	Casablanca
Theaceae						0.83	-	-	0.008	-	
· *Camellia sinensis* (L.) Kuntze	Chajarat chay	Leaf	Essential Oil	Massage	100	0.83	70	166	-	0.295	Fez
Thymelaceae						0.83	-	-	0.008	-	
· *Aquilaria malaccensis* Lam.	Aghrass	Stem	Grinding	Poultice	101	0.83	70	166	-	0.395	Oujda and surrounding
Urticaceae						1.11	-	-	0.011	-	
· *Urtica dioica* L.	Harriga	Leaf	Decoction / Essential Oil	Poultice	102	1.11	70	222	-	0.1	Rabat and surrounding
Violaceae						0.28	-	-	0.003	-	
· *Viola odorata* L.	Banafsaj	Flowers	Maceration	Oral	103	0.28	70	56	-	0.1	Fez
Vitaceae						0.28	-	-	0.003	-	
· *Vitis vinifera* L.	Inab	Seed	Essential Oil	Massage	104	0.28	70	56	-	0.1	Rabat and surrounding
Zingiberaceae						0.83		-	0.003	0.196	
· *Zingiber officinale* Roscoe	Sknjbir	Leaf	Decoction	Poultice	105	0.28	70	56	-	-	Rabat and surrounding
· *Curcuma longa* L.	Karkoum	Stem	Infusions	Poultice	106	0.55	70	110	-	0.495	Fez
Zygophyllaceae						1.39	-	-	0.014	-	
· *Zygophyllum sp.*	Aagaya	Aerial part	Decoction / Infusion / Maceration	Poultice	107	1.39	70	278	-	0.395	Marrakesh

VC: Voucher codes. FCR: Frequency of Citation Ratio. FL: Fidelity level. UR: use report. FUV: Family Use Value. UV: Use Value

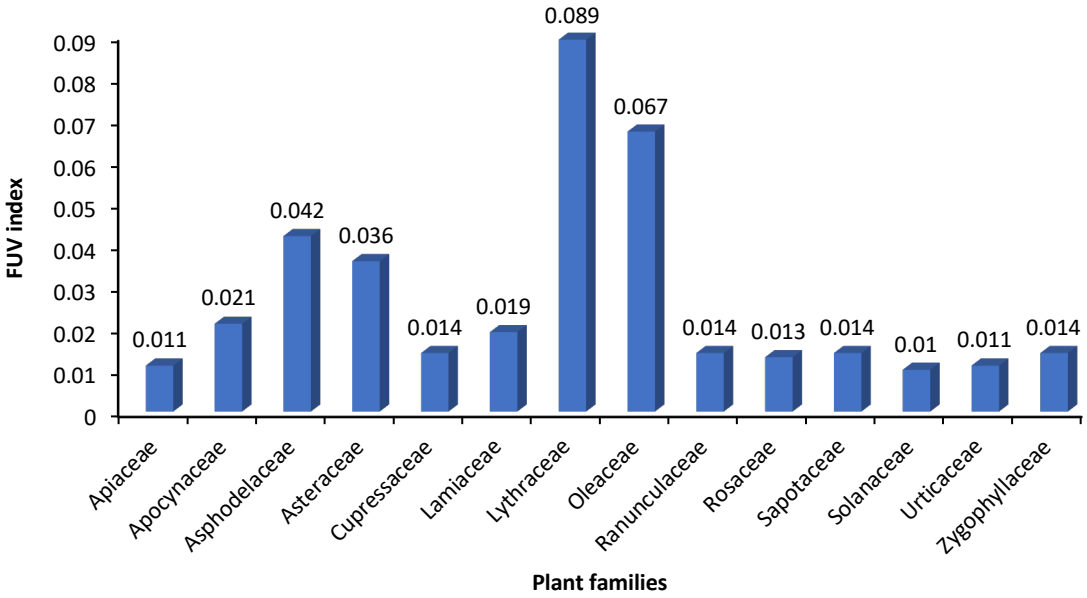

Figure 3. Family use value (FUV) of Moroccan medicinal plants used for eczema treatment.

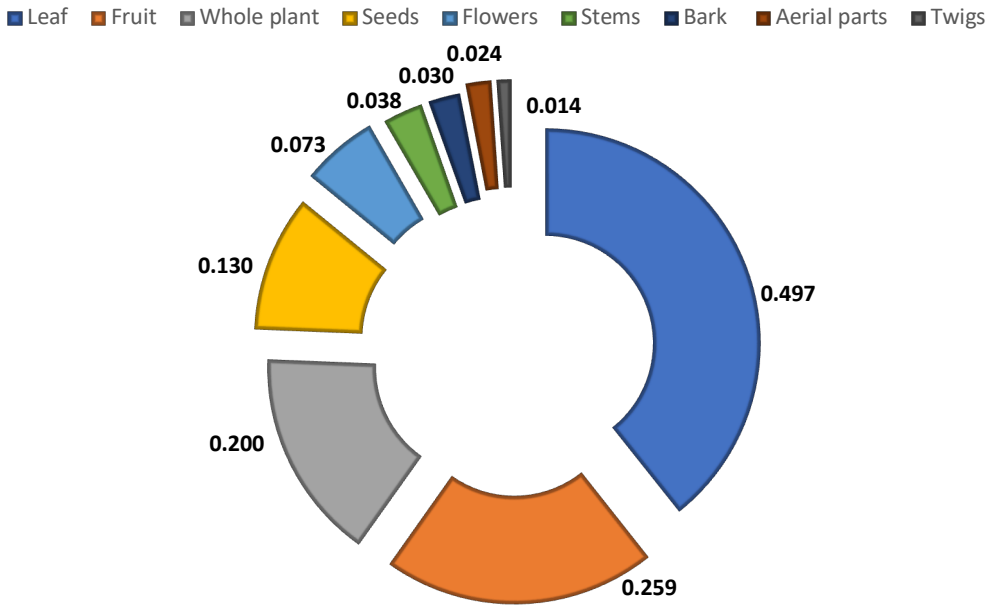

Figure 4. Plant part used for eczema treatment (PPV index) in the study area.

Preparation Methods of Medicinal Plants for Eczema Treatment

The preparation method of a medicinal plant significantly influences its therapeutic efficacy, bioactive compound availability, and ease of use. In this study, herbalists across five Moroccan regions employed various methods to prepare remedies for eczema, as shown in Figure 5. In the current study, herbalists employed several methods, with grinding (33.33%) was the most commonly reported, followed by essential oil extraction (22.46%), decoction (19.57%), infusion (14.49%), maceration (2.90%), and other methods (10.14%) (Fig. 5). These results are in agreement with those of Chaachouay *et al.* (2022), Ajjoun *et al.* (2022), and Snoussi *et al.* (2025) who also reported decoction and infusion as the most dominant methods for preparing remedies for dermatological disorders in northern and southern Morocco, respectively. However, our higher rate of essential oil use suggests an increased reliance on aromatic species and a possible influence of modernized and less professional herbal medicine practices. Regional differences in preparation methods often reflect local plant availability, traditional practices, and community knowledge, while techniques like grinding and oil extraction tend to better preserve a broader spectrum of bioactive compounds, while boiling can degrade sensitive molecules (Fongang Fotsing *et al.* 2022).

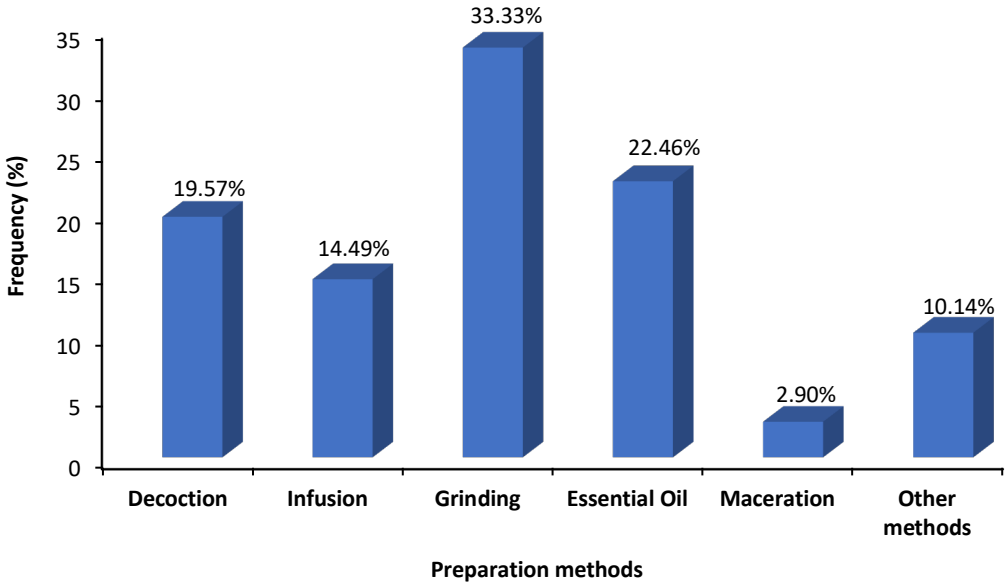

Figure 5. Frequency of preparation methods used for eczema treatment in the study area.

Modes and Timing of Application

Most remedies were administered topically, consistent with eczema's localization on the skin (Table 3). The majority of herbalists (55.02%) used fresh plant material, whereas 44.98% relied on dried forms. The preference for fresh plants is often attributed to the belief that fresh material retains more active compounds and offers more potent effects, especially for topical applications. This is consistent with findings from Chaachouay *et al.* (2022), where Moroccan informants emphasized the therapeutic superiority of fresh leaves and gels for treating skin conditions. Dosing in traditional medicine is typically non-standardized. In our study, tablespoons (50%) and teaspoons (17.68%) were the most commonly cited measures, followed by handfuls (18.18%), while 14.14% reported other units (e.g., "a pinch," "as needed"). This variability underscores the experiential and observational nature of dosage determination in ethnobotanical practices and highlights the need for standardization in future pharmacological validations.

The poultice was the most reported mode of application (70.19%), supporting direct delivery of therapeutic agents to inflamed or itching areas. Regarding the timing of application, the majority of respondents recommended applying treatments at night (49.41%), with fewer citing the morning (17.25%) or afternoon (6.67%). This nighttime preference may be attributed to traditional beliefs that the skin is more permeable and receptive to treatment during rest, when metabolic and healing processes are heightened. Additionally, applying remedies at night reduces exposure to environmental irritants like dust or sun and allows for longer skin contact. Most herbalists indicated that remedies were to be used "until full recovery" (57.14%), reflecting a symptom-driven approach rather than time-based dosing. This is typical in traditional systems where the course of treatment adapts to individual responses rather than fixed durations. Interestingly, 95.48% of herbalists reported no side effects, which suggests either effective traditional knowledge in preparation and dosing or possibly a cultural perception that natural remedies are inherently safe. However, caution is warranted as certain species like *Atractylis gummifera*, *Peganum harmala*, and *Nerium oleander* are known to be toxic and require further pharmacovigilance (Achour *et al.* 2012; Ed-dahmani *et al.* 2024). This highlights the importance of scientific validation to assess both efficacy and safety in standardized conditions.

Strengths and Limitations

This study provides a comprehensive ethnobotanical assessment of medicinal plants used for eczema across five Moroccan regions, based on a substantial sample of 200 herbalists. The application of quantitative indices—UV, FL, RFC, and PPV—enhances the analytical rigor by objectively evaluating the relative importance of species and the degree of cultural consensus, thereby facilitating meaningful comparisons with future and prior research. Nonetheless, several limitations must be acknowledged. The pronounced gender imbalance (93.5% male participants), while reflective of the male-dominated commercial herbalist sector, may have led to an underrepresentation of traditional knowledge held by female practitioners, who are often key custodians of ethnomedicinal practices in domestic or rural contexts. The reliance on self-reported data

and non-standardized dosing conventions also introduces the potential for recall bias. Additionally, the cross-sectional study design did not control for seasonal and regional variations in plant availability, which may have influenced citation frequencies and reported preparation methods.

Table 3. Distribution of herbalist's responses on plant post-treatment, dosage, administration mode, application timing, duration of use, and side effects.

Variable	Category	Proportion of Respondents (%)
Post-Treatment of the Plant	Dried plant	44.98
	Fresh plant	55.02
Dose	Handful	18.18
	Teaspoon	17.68
	Tablespoon	50.00
	Other	14.14
Mode of Administration	Poultice	70.19
	Rinsing	04.81
	Massage/Friction	16.83
	Other	08.17
Time of Application	Morning	17.25
	Afternoon	06.67
	Night	49.41
	Random	26.67
Duration of Use	One day	07.39
	One week	24.63
	One month	10.84
	Until recovery	57.14
Side Effects	Yes	04.52
	No	95.48
Types of Side Effects	Itching, Allergy	50.00
	skin irritation	50.00

Future Pharmacological Investigations

The medicinal plants with high UV and FL values identified in this study—including *L. nobilis, P. harmala,* and *A. vera*—represent promising candidates for further pharmacological investigation. A structured research pipeline is recommended, beginning with *in vitro* assays to evaluate relevant biological activities, including anti-inflammatory, antimicrobial, antioxidant, and wound-healing properties. Promising extracts should then undergo *in vivo* studies using animal models of dermatitis to confirm efficacy and establish preliminary safety profiles. Concurrently, phytochemical characterization using chromatographic and spectroscopic techniques is essential to identify the active compounds responsible for the observed effects. Rigorous toxicity assessments must be integrated to define safe dosage ranges, particularly for species with known toxic compounds like *P. harmala*. Ultimately, these preclinical trials should inform the design of controlled clinical trials to validate the therapeutic potential of these plants and support the development of evidence-based, culturally informed topical formulations for eczema management.

Conclusion

This ethnobotanical study provides one of the first in-depth investigations into medicinal plants traditionally used for eczema treatment in Morocco. Interviews with 200 herbalists across five regions (Marrakech, Rabat, Oujda, Fes, and Casablanca) documented 107 species from 48 botanical families, with Lamiaceae and Asteraceae being the most represented. The quantitative ethnobotanical indices highlighted L. nobilis, P. harmala, M. vulgare, and A. vera as the most culturally and therapeutically significant species, combining high UV, RFC, and FL values. This supports their status as culturally validated remedies and makes them promising candidates for further pharmacological exploration. Leaves were the commonly used plant part, followed by fruits and whole plants, reflecting both accessibility and phytochemical richness. Remedies were prepared mainly through grinding; essential oil extraction, or decoctions, and most were applied topically as poultices, often at night, and continued until full recovery. These practices align with traditional beliefs regarding skin receptivity during rest and emphasize the personalized, symptom-driven nature of folk medicine. The alignment of high RFC values with culturally trusted plants across the Maghreb underscores regional consistency in ethnomedicinal knowledge. While most herbalists

reported no adverse effects, perceived safety requires verification through rigorous toxicological and pharmacological studies. Overall, this study bridges traditional knowledge with scientific validation, emphasizing the need to preserve Morocco's ethnobotanical heritage while promoting systematic research on its therapeutic potential. Such efforts may inform future natural product development and foster culturally informed approaches to eczema management.

Declarations

List of abbreviations: AD: Atopic Dermatitis, ISAAC: International Study of Asthma and Allergies in Childhood, APG: Angiosperm Phylogeny Group, FUV: Family Use Value, UV: Use Value, FL: Fidelity Level, RFC: Relative Citation Frequency, PPV: Plant Part Value, FC: Citation Frequency, N: Total Number of Informants, UVs: Cumulative Use Value for a family, Ns: Number of Species in that family, Ui: Number of use reports by each informant for a given species, Ip: Number of herbalists, Who Cited a Species, Iu: Total number of informants citing the plant for any use, RU plant part: number of uses for a specific plant part, RU: Total number of use reports.

Ethics approval and consent to participate: The data were collected in accordance with ethical standards, ensuring confidentiality, anonymity, and informed consent. All participants were fully informed about the purpose of the study prior to data collection.

Consent for publication: Not applicable

Availability of data and materials: The data from this study have not been deposited in public repositories.

Competing interests: The authors declare no conflicts of interest.

Funding: Not applicable

Author contributions: Khairo El Baria Metni: Study design, conduction of ethnobotanical surveys, active participation in structuring the methodology, manuscript writing, data analysis, and interpretation. **Hanane Boutaj:** Data analysis, interpretation, methodology development, manuscript writing, Review and editing, and interpretation. **Qamar Mesbahi**: Data analysis, contribution to methodology. **Noureddine Oufkir**: Investigation, writing of the original draft, methodology, and formal analysis. **Mouna Ameggouz**: Investigation, writing of the original draft, methodology, and formal analysis. **Siham El Bassami:** Review and editing, methodology, formal analysis, and drafting. **Mariem Qostal:** Review and editing, methodology, formal analysis, and drafting. **Abha Cherkani Hassani:** Investigation, writing of the original draft, methodology, and formal analysis. **Hanane Benzeid:** Study design and supervision, contribution to methodology, manuscript refinement, and review editing. All authors read, reviewed, and approved the final version of the manuscript.

Acknowledgements

The authors sincerely thank all the respondents who participated in this survey. The authors are equally grateful to the research assistants and colleagues who offered support throughout the study. This collaborative effort was vital to the success of the project.

Literature cited

Abdulrahman MD, Zakariya AM, Hama HA, Hamad SW, Al-Rawi SS, Bradosty SW, Ibrahim AH. 2022. Ethnopharmacology, Biological Evaluation, and Chemical Composition of *Ziziphus spina-christi* L. Desf: A Review. Advances in Pharmacological and Pharmaceutical Sciences 2022(1):4495688.

Abouri M, El Mousadik A, Msanda F, Boubaker H, Saadi B, Cherifi K. 2012 An ethnobotanical survey of medicinal plants used in the Tata Province, Morocco. International Journal of Medicinal Plants Research 1:99-123.

Achour S, Rhalem N, Khattabi A, Lofti H, Mokhtari A, Soulaymani A, Turcant A, Bencheikh RS. 2012. *Peganum harmala* L. poisoning in Morocco: about 200 cases. Therapie 671:53-58.

Ajjoun M, Kharchoufa L, Merrouni IA, Elachouri M. 2022. Moroccan medicinal plants traditionally used for the treatment of skin diseases: from ethnobotany to clinical trials. Journal of Ethnopharmacology 297:115532.

Akbli M, EL Rhaffari L, Messaouri H, Rhallabi N, Ait M'hand R, Mellouki F. 2016. Ethnobotanical study of plants used in the treatment of cutaneous infections in urban areas of the region of grand Casablanca - Morocco. IOSR Journal of Environmental Science, Toxicology and Food Technology 10:38-48. doi: 109790/2402-1009013848

Akbulut S, Karakose M, Özkan Z.C. 2019. Traditional Uses of Some Wild Plants in Kale and Acıpayam Provinces in Denizli. Kastamonu Üniversitesi Orman Fakültesi Dergisi 19(1):72-81. doi: 10.17475/kastorman.543529

Al-snafi AE. 2019. A review on *Lawsonia inermis*: a potential medicinal plant. International Journal of Current Pharmaceutical Research 11:1-13 doi: 1022159/ijcpr2019v11i535695

Anand U, Tudu CK, Nandy S, Sunita K, Tripathi V, Loake GJ, Dey A, Proćków J. 2022. Ethnodermatological use of medicinal plants in India: From ayurvedic formulations to clinical perspectives-A review. Journal of Ethnopharmacology 284:114744.

The World Factbook CIA, 2025. Morocco. Url: https://wwwciagov/the-world-factbook/countries/morocco/ (Accessed on 28/06/2025).

Aribi I. 2013. Etude ethnobotanique de plantes médicinales de la région du Jijel: Etude anatomique, phytochimique, et recherche d'activités biologiques de deux espèces. mémoire de Magistère, Université des Sciences et de la Technologie Houari Boumediène, Alger pp :120.

Arif M, Wang X, Kazi MSK, Ullah Khan S, Saeed S, Khan AM, Khan RA, Afzal M, Nawaz AF, Zia MA, Elansary OH. 2022. Antimicrobial activities of different solvent extracts from stem and seeds of *Peganum harmala* L. Plos One 17(4):pe0265206.

Arora P, Shiveena B, Garg M, Kumari S, Goyal A. 2022. Curative potency of medicinal plants in management of eczema: a conservative approach. Phytomedicine Plus 22:100256.

Belhaj S, Chaachouay N, Zidane L. 2021. Ethnobotanical and toxicology study of medicinal plants used for the treatment of diabetes in the High Atlas Central of Morocco. Journal of Pharmacy & Pharmacognosy Research 95:619-662.

Bellakhdar J. 1997. La Pharmacopée marocaine traditionnelle Médecine arabe ancienne et savoirs populaires Ibis Press, Paris, France. Pp:764.

Bouafia M, Amamou F, Gherib M, Benaissa M, Azzi R, Nemmiche S. 2021. Ethnobotanical and ethnomedicinal analysis of wild medicinal plants traditionally used in Naâma, southwest Algeria. Vegetos 34:654-662.

Bouayad Z, Aichane A, Afif A, Benouhoud N, Trombati N, Chan-Yeung M, Aït-Khaled N. 2006. Prevalence and trend of self-reported asthma and other allergic disease symptoms in Morocco: ISAAC phase I and III. The International Journal of Tuberculosis and Lung Disease 10(4):371-377.

Boutakrint M. 2024. Census: Five Regions Constitute 70% of Morocco's Population 2024. Available from: https://barlamantodaycom/2024/11/08/rgph-2024-five-regions-constitute-70-of-moroccos-population/?utm_source=chatgptcom (Accessed on 28/06/2025).

Cavero RY, Akerreta S, Calvo MI. 2013. Medicinal plants used for dermatological affections in Navarra and their pharmacological validation. Journal of Ethnopharmacology 149(2):533-542. doi: 101016/jjep201307012

Chaachouay N, Benkhnigue O, Zidane L. 2022. Ethnobotanical and Ethnomedicinal study of medicinal and aromatic plants used against dermatological diseases by the people of Rif, Morocco. Journal of Herbal Medicine 32:100542.

Chaachouay N, Benkhnigue O, Fadli, M, El Ibaoui, H, Zidane L. 2019. Ethnobotanical and ethnopharmacological studies of medicinal and aromatic plants used in the treatment of metabolic diseases in the Moroccan Rif. Heliyon 5(10):e02191. doi: 101016/jheliyon2019e02191

De Albuquerque UP, De Medeiros PM, De Almeida ALS, Monteiro JM, Neto EMDFL, de Melo JG, Dos Santos JP. 2007. Medicinal plants of the caatinga semi-arid vegetation of NE Brazil: a quantitative approach. Journal of Ethnopharmacology 114(3):325-354.

Dimitrijevic J, Tomovic M, Bradic J, Petrovic A, Jakovljevic V, Andjic M, Živković J, Milošević SĐ, Simanic I, Dragicevic N. 2024. *Punica granatum* L. Pomegranate extracts and their effects on healthy and diseased skin. Pharmaceutics 16(4):458.

Ed-dahmani I, Mabchour I, Lfitat A, Bousraf FZ, Taleb M, Abdllaoui A. 2024. Ethnobotanical study of potentially toxic plants of Fez-Meknes region, eastern middle atlas, Morocco. Tropical Journal of Natural Product Research 82:6115-6133.

Eichenfield LF, Tom WL, Chamlin SL, Feldman SR, Hanifin JM, Simpson EL, Berger TG, Bergman JN, Cohen DE, Cooper KD, Cordoro KM. 2014. Guidelines of care for the management of atopic dermatitis: section 1 Diagnosis and assessment of atopic dermatitis. Journal of the American Academy of Dermatology 70(2):338-351.

El Haouari M, El Makaoui S, Jnah M, Haddaouy A. 2018. A survey of medicinal plants used by herbalists in Taza Northern Morocco to manage various ailments. Journal of Materials and Environmental Science 96:1875-1888.

El-Rifaie MES. 1980. *Peganum harmala*: its use in certain dermatoses. International Journal of Dermatology 19(4):221-222.

Ez-zoubi Y, Lairini S, El Amrani S, El-Akhal F, Farah A, Bouslamti R, El Ouali Lalami A. 2022. Ethnobotanical survey of herbs used in the preservation of food products in Fez, Morocco. Journal of Ethnic Foods 91:29.

Fakchich J, Elachouri M. 2014. Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. Journal of ethnopharmacology 154(1):76-87.

Fakchich J, Elachouri M. 2021. An overview on ethnobotanico-pharmacological studies carried out in Morocco, from 1991 to 2015: systematic review part 1. Journal of Ethnopharmacology 267:113200. doi: 101016/jjep2020113200

Fania L, Moretta G, Antonelli F, Scala E, Abeni D, Albanesi C, Madonna, S. 2022. Multiple roles for cytokines in atopic dermatitis: from pathogenic mediators to endotype-specific biomarkers to therapeutic targets. International Journal of Molecular Sciences 235:2684.

Feily A, Namazi MR. 2009. Aloe vera in dermatology: a brief review. Giornale Italiano Di Dermatologia E Venereologia: Organo Ufficiale, Societa Italiana Di Dermatologia E Sifilografia 144(1):85-91.

Fennane M, Tattou MI, Mathez J. 1999. Flore pratique du Maroc : Manuel de détermination des plantes vasculaires Pteridophyta, Gymnospermae, Angiospermae Lauraceae- Neuradaceae Institut Scientifique, Rabat, Maroc. Pp :36.

Fongang Fotsing YS, Bankeu Kezetas JJ, Batiha GES, Iftikhar A, Lenta Ndjakou B. 2022. Extraction of bioactive compounds from medicinal plants and herbs. IntechOpen. doi: 105772/intechopen98602

Friedman J, Yaniv Z, Dafni A, Palewitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. Journal of Ethnopharmacology 16(2-3):275-287.

Güler O, Polat R, Karaköse M, Çakılcıoğlu U, Akbulut S. 2021. An ethnoveterinary study on plants used for the treatment of livestock diseases in the province of Giresun (Turkey). South African Journal of Botany 142: 53-62. doi: 10.1016/j.sajb.2021.06.003

Houti H, Ghanmi M, Satrani B, Mansouri FE, Cacciola F, Sadiki M, Boukir A. 2023. Moroccan endemic *Artemisia herba-alba* essential oil: GC-MS analysis and antibacterial and antifungal investigation. Separations 10(1):59.

Hoy SM. 2017. Crisaborole ointment 2%: a review in mild to moderate atopic dermatitis. American Journal of Clinical Dermatology 18:837-843.

Jain SK. 1964. The role of botanist in folklore research. Folklore 5(4):145-150.

Jamaleddine M, El Oualidi J, Taleb MS, Thévenin T, El Alaoui-Faris FE. 2017. Inventaire et état de conservation des plantes aromatiques et médicinales PAM au Maroc. Phytothérapie 15(3):114.

Jouad H, Haloui M, Rhiouani H, El Hilaly J, Eddouks M. 2001. Ethnobotanical survey of medicinal plants used for the treatment of diabetes, cardiac and renal diseases in the North centre region of Morocco Fez-Boulemane. Journal of Ethnopharmacology 77(2-3):175-182.

Karaköse M. 2022. An ethnobotanical study of medicinal plants in Güce district, north-eastern Turkey. Plant Diversity 44(6): 577-597. doi: 10.1016/j.pld.2022.03.005

Karaköse M, Akbulut S, Özkan ZC. 2019. Ethnobotanical study of medicinal plants in Torul district, Turkey. Bangladesh Journal of Plant Taxonomy, 26(1), 29-37. doi: 10.3329/bjpt.v26i1.41914

Kolb L, Ferrer-Bruker SJ. 2023. Atopic Dermatitis-Statpearls-NCBI Bookshelf. StatPearls [Internet] Treasure Island FL URL: https://wwwncbinlmnihgov/books/NBK448071/ (Accessed on 25/06/2025).

Labrighli K, Barone G, Moujahdi C, El Oualidi J, Domina G. 2025. Crop wild relatives and wild harvested plants of Morocco: checklist and priorities for conservation. Genetic Resources and Crop Evolution 7:1-35.

Laraqui O, Manar N, Laraqui S, Ghailan T, Deschamps F, Hammouda R, Laraqui CEH. 2018. Prevalence of skin diseases amongst Moroccan fishermen. International Maritime Health 69:22-27. doi: 105603/IMH20180004

Lee JH, Son SW, Cho SH. 2016. A comprehensive review of the treatment of atopic eczema. Allergy, Asthma & Immunology Research 83:181-190.

Martin GJ. 2004. Ethnobotany: A Methods Manual Earthscan London, p 01.

Moraes-Souza R, Sarto R, Lima de Mesquita Y. 2025. Efficacy and Safety of Topical Delgocitinib for Chronic Hand Eczema: A Systematic Review and Meta-Analysis of Randomized Controlled Trials Poster presented at the 2025. American Academy of Dermatology Annual Meeting Orlando, Florida March 7 to 11, 2025.

Orch H, Chaachouay N, Douiri EM, Faiz N, Zidane L, Douira A. 2021. Use of medicinal plants in dermato-cosmetology: An ethnobotanical study among the population of Izarène Jordan. Journal of Pharmaceutical Sciences 14(3):323-340.

Oukadir Z, Rhazi NS, Lyoussi B. 2024. Ethnobotanical study of aromatic and medicinal plants used in traditional phytotherapy in Midelt region of Morocco. JAPS: Journal of Animal & Plant Sciences 34(5):1317-1330.

Pearson KX. 1900. On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science 50(302):157-175.

Petkova Z, Stefanova G, Girova T, Antova G, Stoyanova M, Damianova S, Gochev V, Stoyanova A, Zheljazkov VD. 2019. Phytochemical investigations of laurel fruits *Laurus nobilis.* Natural Product Communications 148:p1934578X19868876.

Priya KS, Gnanamani A, Radhakrishnan N, Babu M. 2002. Healing potential of *Datura alba* on burn wounds in albino rats. Journal of Ethnopharmacology 83:193-199. doi: 101016/S0378-87410200195-2

Radhakrishnan J, Kennedy BE, Noftall EB, Giacomantonio CA, Rupasinghe HV. 2024. Recent advances in phytochemical-based topical applications for the management of eczema: a review. International Journal of Molecular Sciences 25(10):5375.

Rattray RD, Van Wyk BE. 2021. The botanical, chemical and ethnobotanical diversity of southern African Lamiaceae. Molecules 26(12):3712. doi: 103390/molecules26123712

Salhi N, Bouyahya A, Fettach S, Zellou A, Cherrah Y. 2019. Ethnopharmacological study of medicinal plants used in the treatment of skin burns in Occidental Morocco (area of Rabat). South African Journal of Botany 121:128-142. doi: 101016/j sajb201810038

Semwal RB, Semwal DK, Combrinck S, Cartwright-Jones C, Viljoen A. 2014. *Lawsonia inermis* L. henna: ethnobotanical, phytochemical and pharmacological aspects. Journal of Ethnopharmacology 155:80-103. doi: 101016/j jep201405042

Şen G, Akbulut S, Karaköse M. 2022. Ethnopharmacological study of medicinal plants in Kastamonu province (Türkiye). Open Chemistry 20(1): 873-911. doi: 10.1515/chem-2022-0204

Snoussi I, El Jouari O, Gourinda A, Najdi A, Gallouj S. 2025. The role of phytotherapy in the management of dermatological conditions: The case of the northern region in Morocco. Our Dermatol Online 161:25-32. doi: 107241/ourd202513

Sreekeesoon DP, Mahomoodally MF. 2014. Ethnopharmacological analysis of medicinal plants and animals used in the treatment and management of pain in Mauritius. Journal of Ethnopharmacology 157:181-200.

Tabassum N, Hamdani M. 2014. Plants used to treat skin diseases. Pharmacognosy Reviews 8:52-60. doi: 104103/0973-7847125531

Tahraoui A, El-Hilaly J, Israili ZH, Lyoussi B. 2007. Ethnopharmacological survey of plants used in the traditional treatment of hypertension and diabetes in southeastern Morocco Errachidia province. Journal of Ethnopharmacology 110(1):105-117.

Taleb M S. 2017. Aromatic and medicinal plants in Morocco: Diversity and socio-economic role. International Journal of Agricultural and Biosystems Engineering 11(12):812-816.

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.

Valdés B. Rejdali M, Achhal El Kadmiri A, Jury JL, Montserrat JM. 2002. Catalogue des plantes vasculaires du Nord du Maroc, incluant des clés d'identification. Vol 1. Editorial CSIC-CSIC Press. Pp: 33.

Vitalini S, Iriti M, Puricelli C, Ciuchi D, Segale A, Fico G. 2013. Traditional knowledge on medicinal and food plants used in Val San Giacomo Sondrio, Italy— an alpine ethnobotanical study. Journal of Ethnopharmacology 145(2):517-529.

Zari ST, Zari TA. 2015. A review of four common medicinal plants used to treat eczema. Journal of Medicinal Plants Research 9(24):702-711.