JBP
Journal of Biochemicals and Phytomedicine
eISSN: 2958-8561

Medicinal Flora and Local Knowledge on Shoulder Pain Relief in Ilam City, Western Iran: An Ethnobotanical Study

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ARTICLE INFO

Article Type:
Research

Article History:
Received: 08 Jun 2025
Revised: 09 Aug 2025
Accepted: 15 Aug 2025
Available online: 15 Oct 2025

Keywords:
Shoulder pain,
Ethnobotany,
Medicinal plants,
Traditional medicine,
Herbal therapeutics,
Phytotherapy

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ABSTRACT

Introduction: Shoulder pain is a common musculoskeletal problem resulting in functional impairment, reduced life quality and high health care costs. Traditional plant-based treatments continue to play a vital role in regions with restricted access to conventional healthcare although they lack proper documentation. The research investigates traditional medicinal plants and local treatment methods which people in Ilam city western Iran use to treat shoulder pain.
Methods: A cross-sectional ethnobotanical survey took place from April through November 2024 in Ilam city, western Iran. The research team conducted semi-structured interviews with 25 traditional healers who were recognized in their community. The research team obtained voucher specimens which underwent authentication procedures. The study used ethnobotanical indices to calculate use reports (UR) and relative frequency of citation (RFC) and percentage frequency of use (PFU) and informant consensus factor (ICF).
Results: Eleven identified medicinal species were identified by the informants from 9 botanical families which they used to treat shoulder pain. The most frequently used plant parts for treatment were aerial parts and the most common preparation method involved infusions. The total number of use reports (Nur) was 63 and the ICF value of 0.84 indicated strong agreement between informants. The highest citation values were found in *Datura innoxia* (UR=8, RFC=0.32, 95% Wilson CI=0.172–0.516), followed by *Medicago polymorpha*, *Crocus haussknechtii*, and *Ziziphora capitata* (UR=7, RFC=0.28).
Conclusion: The research used index-based ethnobotanical methods to identify culturally significant plant species in Ilam city which need further phytochemical and pharmacological assessment for shoulder pain treatment. The study documents and analyzes local practice, highlights species that require urgent toxicology, and underscores the need for conservation and ethically governed translational research.

Please cite this paper as:
Yaqoubi M, Mohammadi S, Kord M, Ekvan MH, Ahmadi A, Alidadpour S, et al. Medicinal flora and local knowledge on shoulder pain relief in Ilam city, western Iran: An ethnobotanical study. Journal of Biochemicals and Phytomedicine. 2025; 4(2): 12-25. doi: 10.34172/jbp.2025.13.

Introduction

The medical field identifies shoulder pain as a leading musculoskeletal disorder (Previtali et al., 2021). The estimated community prevalence of this condition is about 16–26% at any time, a lifetime prevalence up to 67% in the general population, and an approximate incidence rate of 37.8 per 1000 person-years (Lucas et al., 2022; Bento et al., 2019). The shoulder joint is the human body's most mobile joint and can experience multiple pathological conditions, including as rotator cuff disorders, adhesive capsulitis, glenohumeral arthritis and subacromial impingement syndrome (Veeger et al., 2007; Papatheodorou et al., 2006). The mentioned conditions lead to severe functional limitations, decreased life quality and high healthcare expenses worldwide (Virta et al., 2012; Kuijpers et al., 2006; Marks et al., 2018). The shoulder girdle consists of the clavicle and scapula which connect to the proximal humerus through multiple joints (sternoclavicular, acromioclavicular, glenohumeral, and scapulothoracic joints) (Prescher et al., 2000). The complex design of this structure makes it susceptible to both traumatic injuries and degenerative diseases (Azarderakhsh et al., 2025). Shoulder pain develops from various risk factors which include aging together with repetitive overhead work in occupations and sports participation and inherited genetic predispositions (Bodin et al., 2012; Van Der Windt et al., 2000). Industrialized nations spend millions of dollars each year on medical expenses for shoulder injuries because they must pay for direct healthcare costs and lost workdays that generate additional expenses (Virta et al., 2012; Kuijpers et al., 2006). Shoulder pain develops into a long-term condition which affects most people who experience it because they maintain persistent moderate symptoms that restrict their daily activities and disrupt their sleep and mental well-being. Shoulder pain develops from multiple sources which include inflammation and mechanical issues and neurogenic factors so patients need treatment approaches that address both symptoms and disease mechanisms (Lo et al., 2023; Dean et al., 2013).

While conventional treatments are available, the extended use of non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids for pain management leads to major adverse effects that affect the gastrointestinal system, cardiovascular health, and result in systemic toxic reactions (Zheng et al., 2014; Ranalletta et al., 2016).

Plant-based remedies have been used in traditional medicine for thousands of years and there are archaeological records of medicinal plant use dating to the beginning of human existence (Razmjoue et al., 2024). During the Middle Ages from the 5th to the late 15th centuries, Iranian physicians such as Rhazes, Avicenna, and Jorjani played an essential rule in developing and expanding the science of medicine with publishing manuscripts such as "Canon of Medicine" which was a main textbook in universities until early 18th century (Bahmani et al., 2014).

Ethnobotany, as the scientific investigation of relationships between people and plants has included the documentation and analysis of these traditional plant knowledge systems (Baharvand-Ahmadi et al., 2016). This becomes an interdisciplinary area of study, bringing together botanical science with anthropological techniques to understand how local communities identify, classify and manipulate plant resources for medicinal reasons (Asadi-Samani et al., 2016). Ethnobotanical study is an important tool in modern drug discovery and approximately 25% of all commercial pharmaceuticals made today originate from plants (Baharvand-Ahmadi et al., 2016). The systematic retrieval and conservation of traditional ecological knowledge is beneficial for scientific progress as well as the protection of cultural identity and sound natural resources management (Bahmani et al., 2018).

Ethnopharmacological relevance the use of medicinal plants for the treatment of joint pain and arthritic conditions is a common practice among several traditional medical systems in the world (Choudhary et al., 2015). Hundreds of modern anti-inflammatory drugs (including salicylates from willow bark and curcumin from turmeric) can be traced back to traditional arthralgia cures (Oketch-Rabah et al., 2019; Akaberi et al., 2021). The World Health Organization (WHO) has acknowledged traditional medicine systems to be important resources in the provision of therapeutics, especially for chronic pain because standard care is limited (Kasilo et al., 2014).

Ilam city, as the area of study, is situated in western Iran along the Iraqi border and there are different ecological zones among which are Zagros Mountain range to lowland plain leading to very rich botanic diversity (Bahmani et al., 2012). Diverse topography, Mediterranean climatic conditions and altitude difference (200-2800 meters above sea level) provide suitable condition for as many as more than 2000 species of plants,

about a quarter of Iran's total flora (Ghaneialvar et al., 2024). This biodiversity hot spot harbors a considerable number of endemic species and can be considered as an open laboratory for ethnobotanical studies where communities hold diversified knowledge of traditional uses of native medicinal plants (Bahmani et al., 2017).

This study aims to document and investigate the traditional medicinal plants of Ilam city for shoulder pain relief, identify their bioactive compounds (phytochemicals) as well as promote a scientific validation to local healing traditions.

Materials and Methods

Study area

The aim of this ethnobotanical study was to investigate on the use of traditional medicinal plants by indigenous methods in Ilam city which is the capital of Ilam Province, western Iran. Geographically, Ilam Province has an area of 20,133.11 km^2 and lies between 31°58′ and 34°15′ N latitude and 45°24′ and 48°01′ E longitude (Ghasemi et al., 2013). The region is bordered with Iraq for 425 km in the west, Kermanshah Province in the north, Lorestan Province in the east, and Khuzestan Province in the south (Figure 1). Located at coordinates 33°37′ N 46°24′ E (representing the city center) within this province, Ilam city sits at an elevation of approximately 1,371 meters (4,498 feet) above sea level. It is located in the heart of region which is full of high and tame mountains along with valleys and seasonal rivers of Zagross Mountain range.

According to the 2024 census from the "Iran Statistic Center", it is observed that the population of Ilam Province is 646,026, of whom 261,836 reside in Ilam city. Pahli (Feyli) Kurdish is the major language used in this area, and it is mainly inhabited by Kurdish groups who have long expertise in traditional medicine.

This study was planned and implemented in the form of a cross-sectional study from April 2024 through November 2024, and it was planned to record and evaluate the medicinal flora that is used by indigenous communities in the region. Ilam city was chosen for the study focus because it is highly floriferous, ethnobotanically strong, and currently using traditional medicine for musculoskeletal disorders treatment purposes.

Selection of Villages and Informants

The selection of village and informants for this ethnobotanical research was conducted in scientific and planned ways in an effort to document the indigenous knowledge towards the treatment of shoulder pain with medicinal herbs. Data was collected from direct questionings and ethnobotanical questionnaires filled in with 25 traditional healers and herbalists who are situated in Ilam city. The selection of the informants was made on the basis of their expertise in herbal medicine, years of exposure, and reputation in the local market.

In order to achieve a sufficient sample size, a revised list of all herbal druggists from Ilam city was provided by the "Deputy of Food and Drug" of Ilam province, so that the researchers could systematically visit these knowledgeable people. It was intended that the questionnaire would have sections for personal and demographic information, nomenclature in indigenous versus scientific classification of medicinal herbs, parts taken specifically for therapeutic purposes, methods of preparation, assumed uses for treatment, and typical claims for their curative qualities.

The Interviews took place in Persian, Kurdish, and Luri languages in order for the participants to have a clear understanding, and therefore, ethnobotanical information was documented with accuracy. Participants' answers were marked in a standardized sheet, and informed oral consent was taken ahead of their participation. This systematic approach helped ensure that the information thus acquired is genuine and culturally relevant in relation to the treatment of musculoskeletal disorders.

Plant Authentication

The herbarium samples were collected for the authentication of medicinally important plants that was identified in the ethnobotanical survey depending on questionnaire which plant cultivated. Plant species were authenticated at Biotechnology and Medicinal Plants Research Center, Ilam University of Medical Sciences, Iran. All received plant specimens were verified and compared with the scientific names using reliable online databases to confirm taxonomical identifications. For the verification of the botanical identification, Further plant specimens were scrutinized and confirmed by using morphological key for plants flora illustrated by Dr. Valiallah Mozaffarian. After identification, specimens were deposited in the herbarium and assigned accession numbers for reference in subsequent studies.

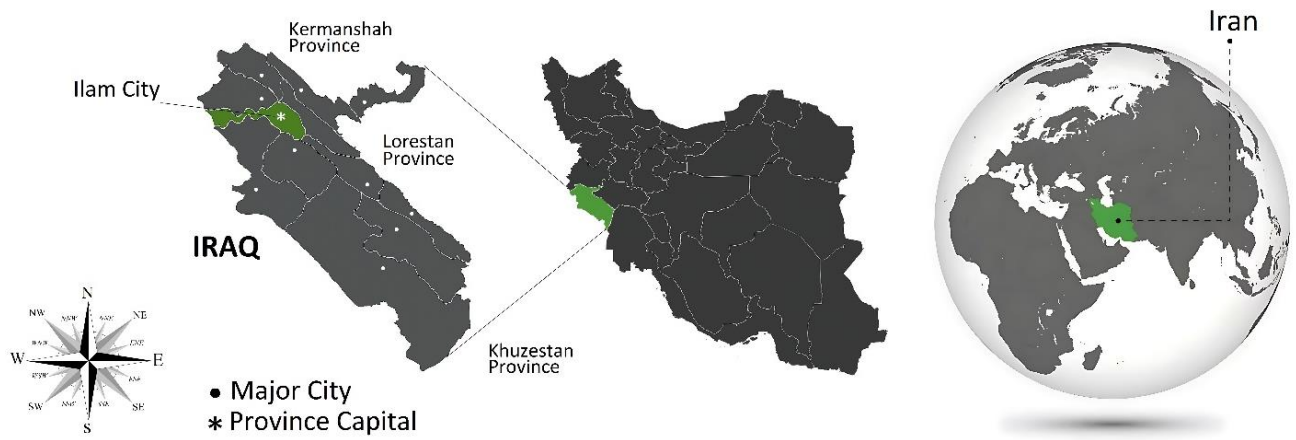

Figure 1. Map of Ilam Province, western Iran, indicating the location of Ilam City (provincial capital), with its position highlighted on the world map.

Data Processing and Statistical Analysis

The ethnobotanical data collected via structured questionnaires and semi-structured interviews was systematically tabulated in an Excel spreadsheet (Microsoft Corp., Redmond, WA; version 16.0) then analyzed quantitatively. We used descriptive statistics to summarize gender, age, education level and native language of informants, as well as overall patterns of plant utilization. The cultural importance and medicinal use value of the documented species were assessed using established ethnobotanical indices, i.e., Use Report (UR) and Relative Frequency of Citation (RFC).

All data were reviewed and rechecked for uniformity and accuracy prior analysis. Statistical analysis was performed using SPSS software (version 22, IBM Corp., Armonk, NY, USA). These techniques permitted a quantitative analysis of the dataset and enabled the determination of those species most frequently mentioned and used by the informants. These sorts of methods would give a strong basis for the comparison in priority between species and an indication on candidates for advancing into additional phytochemical and pharmacological analysis.

Usage Report Index (UR), Relative Frequency of Citation (RFC) and Informant Consensus Factor (ICF)

The Usage Report represents the total number of times a particular plant species was cited by informants for any medicinal use during the study. This index provides a direct measure of the breadth of application and recognition of each species within the community. For species i:

$UR_i = \sum_{j=1}^{N} u_{ij}$

which i is the species index, j is the informant index, N is the total number of informants (25), and u_{ij} is the binary indicator for species i and informant j.

If $u_{ij} = 1$: informant j cited species i for the target indication (shoulder pain relief).

If $u_{ij} = 0$: informant j did not cite species i for the target indication.

The Relative Frequency of Citation (RFC) was employed to normalize the citation frequency of each species relative to the total number of informants, thereby assessing its cultural prominence. RFC was calculated using the following formula for species i:

$RFC_i = \frac{FC_i}{N}$

which FC is the number of informants who mentioned i species, and N is the total number of interviewed informants. RFC values range from 0 to 1, with 0 indicating that no informants cited the species and 1 indicating unanimous citation across all informants.

The uncertainty around each RFC ($\hat{p}_i = RFC_i = FC_i / N$) was quantified using the Wilson score interval with $z_{0.975} = 1.96$. For an observed proportion $\hat{p}$ and sample size n the interval is computed as:

$\text{denom} = 1 + \frac{z^2}{n}$,

$\text{centre} = \hat{p} + \frac{z^2}{2n}$,

$\text{adj} = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n} + \frac{z^2}{4n^2}}$,

$\text{CIlower} = \frac{centre-adj}{denom}$, $\text{CIupper} = \frac{centre+adj}{denom}$

Percentage Frequency of Use (PFU) quantifies each species' contribution to the total number of use reports and is reported as a percentage. In this

study PFU was calculated as the share of species-level use reports among all use reports:

$$PFU_i = \frac{UR_i}{\sum_{k=1}^{s} UR_k} \times 100\%$$

which S is the total number of recorded species (total taxa) in the analysis ($S = 11$), and k is the summation index that runs over species.

Informant Consensus Factor measures the degree of agreement among informants about taxa used within a defined use-category. It was calculated for the overall shoulder-pain category and for predefined subcategories where relevant to capture modality-specific consensus:

$$\text{ICF} = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

where N_{ur} is the total number of use reports for the specified purpose, and N_t is the number of plant species used for that purpose. An ICF value close to 1 suggests high consensus among informants.

UR provides absolute citation load; RFC provides prevalence across informants and ICF indicates agreement within use-categories. Species prioritized for follow-up were those with high RFC, high UR and located within high-ICF categories. Where index results conflicted, taxa were examined qualitatively (preparation method, part used, reported efficacy) before prioritization (Leonti et al., 2022).

Limitations and Mitigation Strategies

Limitations of this study include recall bias, linguistic and dialect diversification, seasonal absence of some taxa, taxonomic uncertainty, partial uncooperativeness on behalf of several informants and purposive sampling with a modest sample size (N = 25). In order to address these limitations, we applied semi-structured interviews iteratively conducted in several visits, used a trained local interpreters and validated responses against Persian and Ilam-dialect glossaries, minimized seasonality through the fieldwork from flowering to non-flowering periods, obtained vouchers authenticated at the institutional herbarium, gathered information either face-to-face or by calling upon known informants from the list provided by Ilam Food and Drug Administration after obtaining written informed consent with assured anonymity were accepted, and compared questionnaires with interview data as well as with collected voucher specimens.

Results

Sociodemographic Profile of Informants

Twenty-five informants (Table 1) were interviewed. Participants comprised 52% male and 48% female traditional healers. The informants' educational backgrounds showed a distribution where 60% had a bachelor's degree and 20% held a diploma while 12% had a master's degree and 8% had an associate degree. Ages spanned 26–55 years. Seventeen informants (68%) were aged between 20 and 40 years old, while 8 informants (32%) were between 41-60 years old. Main spoken languages by the informants were Kurdish (60%), Persian (20%) and Luri (20%). This demographic profile underscores the socio-cultural diversity of knowledge holders contributing to the preservation and transmission of ethnobotanical practices in Ilam city.

Documented Medicinal Plant Species

A total of 11 medicinal plant species belonging to 9 botanical families were recorded as traditional remedies for shoulder pain in Ilam City (Table 2). The Solanaceae and Lamiaceae families appeared most often in the study results (Figure 2). The research data showed that aerial plant organs made up 42% of the total plant material used (Figure 3) while flowers, leaves and other plant parts followed in order of use. The majority of participants used infusion as their primary method for preparing remedies (44% according to Figure 4) although they also employed decoction and fresh plant consumption.

Quantitative Ethnobotanical Indices

The quantitative ethnobotanical indices (UR, ICF, PFU, RFC and 95% Wilson CI for RFC) were used to evaluate cultural importance of plants (Table 3). A total of 63 use reports (Nur) were recorded across the 11 taxa and the global informant consensus factor for the shoulder-pain category was ICF = 0.839, indicating high agreement among informants. The plant species Datura innoxia received the highest number of mentions for treating shoulder pain according to the study results (UR = 8; RFC = 0.32; 95% Wilson CI: 0.172–0.516; PFU = 12.70%). The participating practitioners mentioned Medicago polymorpha, Crocus haussknechtii and Ziziphora capitata as three plant species which they used frequently (each UR = 7; RFC = 0.28; 95% CI: 0.143–0.476) because of their widespread use in local medicine. Figure 5 shows the RFC values for each species with descending order and 95% Wilson confidence intervals. Datura innoxia appears highest; several taxa cluster with overlapping CIs, indicating that observed differences in citation proportions are not always statistically separable at this sample size.

Table 1. Sociodemographic profile of informants (n = 25).

Characteristics		Frequency	Percentage
Gender	Male	13	52%
	Female	12	48%
Education level	Diploma	5	20%
	Associate degree	2	8%
	Bachelor's degree	15	60%
	Master's degree	3	12%
Age Group	20-40 years	17	68%
	41-60 years	8	32%
	Minimum age (years)	26	
	Maximum age (years)	55	
Language	Kurdish	15	60%
	Luri	5	20%
	Persian	5	20%

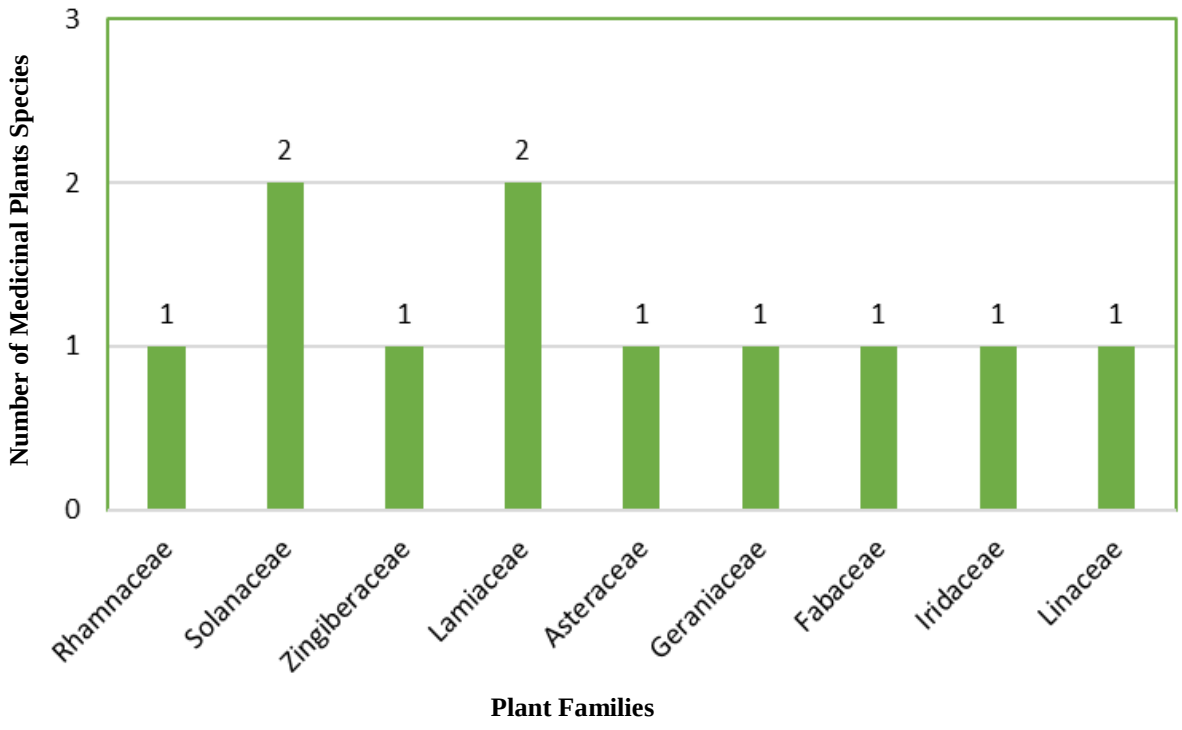

Figure 2. Ethnobotanical inventory of medicinal plants used for shoulder pain management in Ilam city, western Iran.

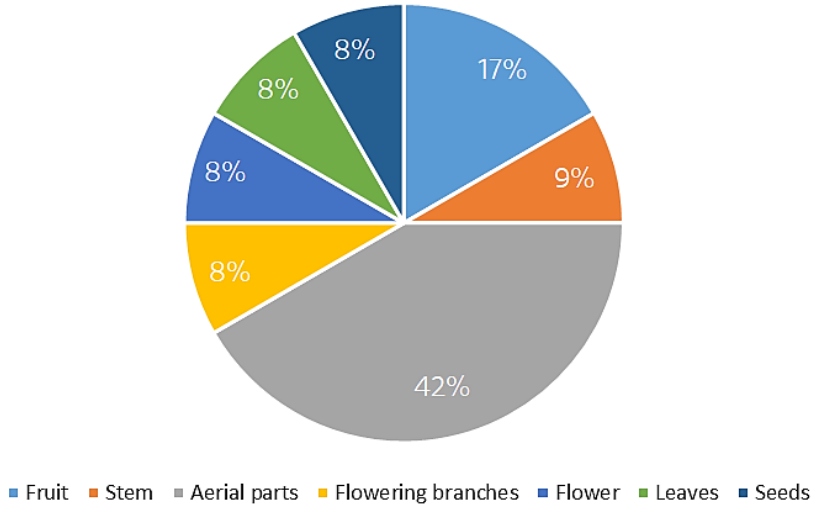

Figure 3. Quantitative ethnobotanical indices for recorded species used in shoulder pain management.

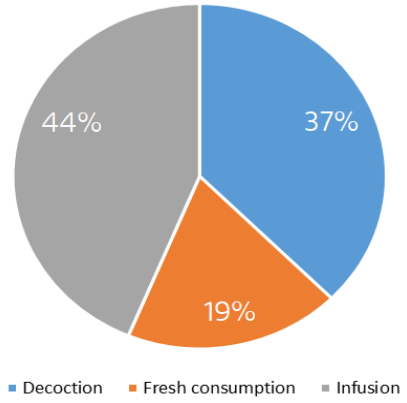

Figure 4. Distribution of recorded medicinal species by botanical family.

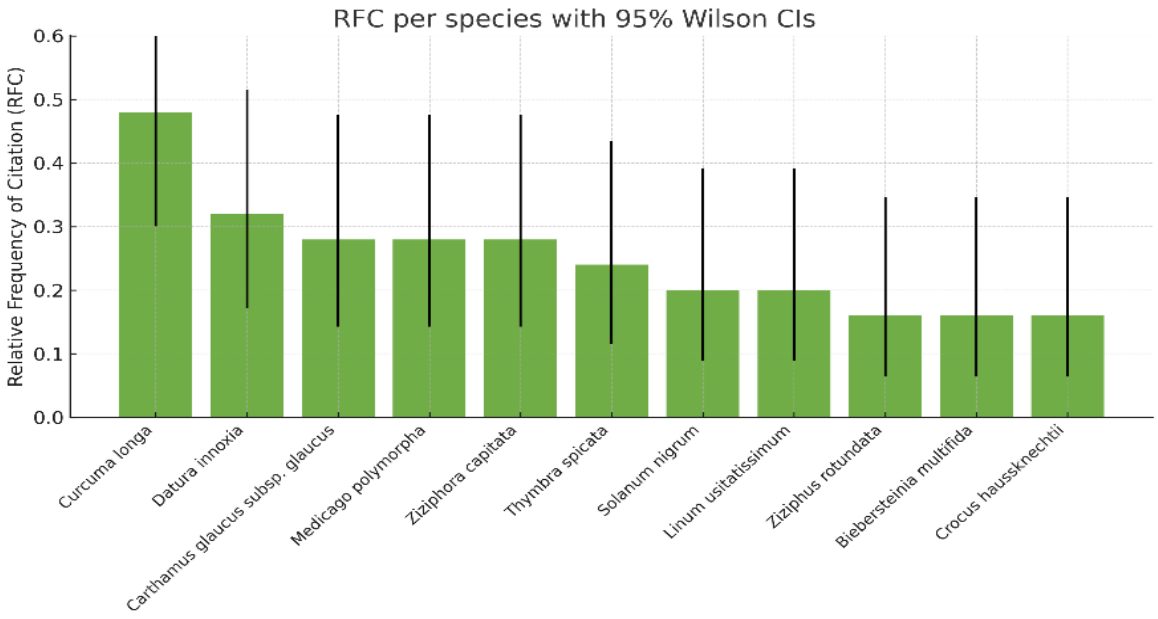

Figure 5. Relative Frequency of Citation per species with 95% Wilson confidence intervals. Species ordered by descending RFC; error bars represent 95% Wilson CIs.

Table 2: Ethnobotanical inventory of medicinal plants used for shoulder pain in Ilam City, Western Iran.

Persian Name	Scientific Name	Family	Common name	Traditional Preparation/Usage	Plant Part Used	Main compounds
Anab	*Ziziphus rotundata*	Rhamnaceae	Wild Jujube	Fresh consumption, decoction	Fruit	Flavonoids, polysaccharides, triterpenic acids and saponins
Tajryzi	*Solanum nigrum* L.	Solanaceae	Black Nightshade	Infusion	Fruit, flowering branches	Steroidal glycoalkaloids, steroidal saponins
Zard-Choubeh	*Curcuma longa*	Zingiberaceae	Turmeric	Plant powder, decoction	Stem	Curcuminoids, and volatile oils
Avishanak	*Thymbra spicata* L.	Lamiaceae	Spiked Thyme	Decoction, infusion	Aerial parts	Carvacrol, thymol, γ-terpinene, and p-cymene
Golrangeh-zard	*Carthamus glaucus* L. subsp. *glaucus*	Asteraceae	Glaucous Safflower	Infusion	Flower	Flavonoids, sesquiterpenes, and quinochalcones
Adamak	*Biebersteinia multifida*	Geraniaceae	Biebersteinia	Decoction, infusion	Aerial parts	Coumarins, flavonoids, and phenylpropanoids
Yonjeh-Khardar	*Medicago polymorpha* L.	Fabaceae	Burr Medic	Fresh consumption, decoction	Leaves	Triterpenoid saponins, flavonoids and hexadecanoic acid
Jo Ghasem	*Crocus haussknechtii*	Iridaceae	Haussknecht's Saffron	Infusion	Aerial parts	Crocins, crocetin, picrocrocin, and safranal
Katan	*Linum usitatissimum*	Linaceae	Flax	Fresh consumption, infusion	Seeds	Lignans, and alpha-linolenic acid
Datoureh	*Datura innoxia* Miller	Solanaceae	Downy Thorn-Apple	Infusion	Aerial parts	Tropane alkaloids
Kakouti Sarsan	*Ziziphora capitata*	Lamiaceae	Headed Ziziphora	Decoction	Aerial parts	Pulegone, thymol, carvacrol, flavonoids

Table 3: Quantitative ethnobotanical indices for recorded species used in shoulder pain management.

Plant Name	UR	RFC	RFC 95% Wilson CI	PFU (%)
Ziziphus rotundata	4	0.16	(0.064, 0.347)	15.3
Solanum nigrum L.	5	0.20	(0.089, 0.391)	19.2
Curcuma longa	5	0.20	(0.089, 0.391)	19.2
Thymbra spicata L.	6	0.24	(0.115, 0.434)	23.0
Carthamus glaucus L. subsp. *glaucus*	4	0.16	(0.064, 0.347)	15.3
Biebersteinia multifida	5	0.20	(0.089, 0.391)	19.2
Medicago polymorpha L.	7	0.28	(0.143, 0.476)	26.9
Crocus haussknechtii	7	0.28	(0.143, 0.476)	26.9
Linum usitatissimum	5	0.20	(0.089, 0.391)	57.6
Datura innoxia Miller	8	0.32	(0.172, 0.516)	26.9
Ziziphora capitata	7	0.28	(0.143, 0.476)	15.3

PFU: percentage of frequency of use; UR: usage report index; RFC: relative frequency of citation; 95% Wilson CI: 95% Wilson confidence interval.

Discusion

In recent decades, there has been a marked global resurgence in interest toward complementary and alternative medicine (CAM), particularly herbal therapies, for managing chronic conditions such as pain, driven by their perceived efficacy, accessibility, and fewer adverse effects compared to conventional pharmaceuticals (Tangkiatkumjai et al., 2020). This trend is especially pronounced in the context of musculoskeletal disorders like shoulder pain, where limitations of standard treatments, including NSAIDs and corticosteroids, prompt the exploration of plant-based alternatives with diverse pharmacological profiles. Ethnobotany plays a crucial role in this landscape, serving as an interdisciplinary bridge between traditional knowledge and modern science by documenting how communities interact with local flora for medicinal purposes, thereby preserving cultural heritage and facilitating drug discovery (Razmjoue et al., 2024). In regions like Ilam city, western Iran, nestled in the biodiverse Zagros Mountains, indigenous practices rooted in generations of empirical knowledge harness a rich array of plant species for shoulder pain relief, reflecting both ecological abundance and sociocultural traditions.

The findings of this study partly mirror regional and international ethnobotanical reports while also showing taxonomic differences in preferred remedies. Within Iran, similar ethnobotanical surveys have documented the reliance on local flora for pain relief. For instance, in Shahrekord, southwest Iran, 23 species of medicinal plants, including those from the Lamiaceae and Solanaceae families, are traditionally employed as analgesics, aligning with the prominent use of families like Lamiaceae (e.g., *Ziziphora capitata* and *Thymbra spicata*) and Solanaceae (e.g., *Datura innoxia* and *Solanum nigrum*) in our study for shoulder pain management (Basati et al., 2019). Another ethnobotanical study in Ilam province itself identified 16 plants, such as *Pistacia khinjuk* and *Amygdalus scoparia*, for back pain treatment, reflecting overlapping regional knowledge of herbal remedies for musculoskeletal issues, though our focus on shoulder pain highlights species like *Curcuma longa*, which is noted in Traditional Persian Medicine (TPM) for joint pain and arthralgia (Razmjoue et al., 2024). Babu et al. documented multiple Eastern Ghats species used for shoulder and joint dislocations including *Pavonia zeylanica, Pavonia odorata, Sida cordata, Bamboosa arundanaceae, Dendro calamusstrictus,* and *Tinospora sinensis,* with root powder as the dominant preparation method (Babu et al., 2020). Kantasrila and Panyadee reported *Blumea balsamifera, Phlogacanthus curviflorus,* and *Angelica dahurica* for shoulder symptoms, indicating use of aromatic and anti-inflammatory taxa in nearby floras (Kantasrila and Panyadee, 2023). Singh described topical application of *Abrus precatorius* (rosary pea) seed paste for shoulder stiffness and paralysis, highlighting seed-based poultices in local practice (Singh, 2015). Another ethnobotanical survey by Kantasrila et al. among the S'gaw Karenpeople of Thailand also

recorded *Pothos chinensis* and *Pothos scandens* from Araceae family for shoulder pain relief, illustrating the role of climbers and rhizomatous taxa in other cultural pharmacopeias (Kantasrila et al., 2024). Although the specific taxa vary by region and flora, the therapeutic aim of local analgesia, anti-inflammation and improved joint mobility is consistent across studies. Additionally, the preparation modalities differ based on several external reports emphasize root powders and seed pastes, whereas our survey largely recorded aerial parts and infusions. This suggests functional convergence and similar treatment goals with divergence in locally available species and preparation traditions, which results in practical implications.

Datura innoxia (Downy Thorn-Apple) is dominated by tropane alkaloids, chiefly hyoscyamine, scopolamine (hyoscine) and atropine that produce anticholinergic and antispasmodic effects (Jakabová et al., 2012; Amer and Amer, 2025). These properties may relieve local muscle spasm and pain but carry significant systemic toxicity that mandate strict dose control and toxicological evaluation (Gerretsen and Pollock, 2011; Krenzelok, 2019). Traditional topical or poultice applications for musculoskeletal pain may exploit local antispasmodic effects, yet any therapeutic use requires formal toxicology before clinical consideration. *Ziziphora capitata* (Headed Ziziphora) yields essential-oil monoterpenes (pulegone, thymol, carvacrol) together with flavonoids (Aghajani et al., 2008). Pulegone, thymol, and carvacrol have documented antimicrobial, anti-inflammatory and analgesic activities in preclinical models, meanwhile flavonoids contribute antioxidant and cyclooxygenase-modulating effects (Kachur and Suntres, 2020; Nasri, 2018; Donno et al., 2018). These combined phytochemicals plausibly mediate topical analgesia and inflammation reduction when used as infusions, oils or compresses for shoulder complaints. *Crocus haussknechtii* (Haussknecht's Saffron) is characterized by apocarotenoids (crocins, crocetin), picrocrocin and safranal. Crocins and crocetin are potent antioxidants and have anti-inflammatory and neuroprotective effects in experimental studies (Nam et al., 2010; Kermanshahi et al., 2020). Picrocrocin and safranal contribute pharmacologically active profiles including modulating inflammatory mediators and nociception (Pourbagher-Shahri and Forouzanfar, 2023; Cerda-Bernad et al., 2022). Such constituents support the traditional use of *Crocus spp.* in pain and mood disorders and justify targeted anti-inflammatory and analgesic pharmacology for shoulder-related applications. *Medicago polymorpha* (Burr Medic) contains triterpenoid saponins, diverse flavonoids and fatty acids including hexadecanoic (palmitic) acid (Tava et al., 2011; Yadav et al., 2024). Triterpenoid saponins and flavonoids are associated with anti-inflammatory, antioxidant and membrane-modulating activities that can reduce local inflammation and edema; fatty acids may aid topical absorption (Bai et al., 2018; Ríos et al., 2000). These compound classes provide a biochemical rationale for the species' traditional use in musculoskeletal complaints, but activity, formulation and safety require controlled phytochemical and bioassay validation.

Phytochemical profiles of taxa are consistent with anti-inflammatory and analgesic mechanisms, but ethnobotanical citation alone does not establish efficacy or safety. Prioritization for laboratory bioassays, mechanism studies and toxicology is recommended. Specifically, standardized extract preparation and phytochemical quantification should precede biological screening (in-vitro anti-inflammatory assays such as COX/LOX inhibition, cytokine profiling, antioxidant assays; and in-vivo analgesic and dose–response models). Active fractions should be isolated, chemically characterized and assessed for cytotoxicity, genotoxicity and ADME parameters. Given known toxicity in some taxa (e.g., tropane alkaloids in Datura innoxia), rigorous toxicological profiling is essential before any formulation development. Parallel work must address sustainable harvesting, voucher deposition, and ethical benefit-sharing with local knowledge holders. These steps will convert descriptive ethnobotanical signals into reproducible, safety-aware candidates for translational pharmacology and, ultimately, evidence-based clinical evaluation.

Conclusion

This study provides a systematic, voucher-verified ethnobotanical documentation in Ilam city focused specifically on remedies for shoulder pain and delivers an index-driven shortlist of high-priority taxa. By combining quantitative indices (UR, RFC, PFU, and ICF) and phytochemical annotation, the work not only records traditional practice but differentiates this local pharmacopeia from comparable surveys elsewhere in its taxonomic profile and predominant preparation modes

(aerial parts and infusions). The results therefore furnish a reproducible evidence base for prioritized phytochemical, pharmacological and toxicological follow-up, alongside recommendations for sustainable harvesting, voucher deposition and benefit-sharing with local knowledge holders. This study advances the field by converting descriptive ethnobotanical signals into a ranked, safety-aware pipeline for translational research.

Declarations

Conflict of interest

The authors declare no conflict of interest.

Acknowledgement

The authors thank the Student Research Committee of Ilam University of Medical Sciences, for logistical support.

Consent for publications

Informed consent was obtained from all individual participants included in the study.

Funding support

This study did not obtain any specific financial support from any funding organization within the public, private, or non-profit sectors.

Authors' contributions

A.P. conceptualized and designed the study, conducted the fieldwork including informant interviews and plant collection, performed data analysis using ethnobotanical indices, authenticated plant species, drafted the initial manuscript, and revised it for final submission. M.Y. and S.M. assisted in data collection and questionnaire administration. M.Ko. and M.H.E. contributed to plant identification and herbarium preparation. A.A. and S.A. supported statistical analysis and figure generation. M.Ke. helped with literature review and phytochemical discussions. All authors read and approved the final manuscript.

Ethical considerations

This study was approved by the Ethics Committee of Ilam University of Medical Sciences (Ethics code: IR.MEDILAM.REC.1401.069). The aims, methods and potential risks were presented to all participants through an understandable language (Kurdish/Persian/Luri) in order to avoid any misunderstanding in collected data. All participants provided written informed consent, participation was voluntary and they had the right to refuse or leave the study at any time without prejudice. No identifying information was collected and interviews and datasets were coded with identifiers removed at source to ensure confidentiality. Fieldwork and voucher specimen collections were also approved by local health authorities and representatives of traditional medicine practitioners. The collected plant samples were taken with the consent of concerned persons and processed as per the institutional guidelines and their voucher specimens have been submitted to institutional herbarium against voucher numbers. The study protocol was in accordance with relevant national research regulations and the ethical guidelines of the Helsinki Declaration. All electronic and paper data are accessible only by secure password-protected access and are recorded exclusively for the intent of the research.

Reference

Aghajani Z, Assadian F, Masoudi S, Chalabian F, Esmaeili A, Tabatabaei-Anaraki M, et al. Chemical composition and in vitro antibacterial activities of the oil of Ziziphora clinopodioides and Z. capitata subsp. capitata from Iran. Chemistry of Natural Compounds. 2008;44(3):387-9. doi: 10.1007/s10600-008-9073-4.

Akaberi M, Sahebkar A, Emami SA. Turmeric and curcumin: from traditional to modern medicine. Studies on Biomarkers and New Targets in Aging Research in Iran: Focus on Turmeric and Curcumin: Springer; 2021. p. 15-39. doi: 10.1007/978-3-030-56153-6_2.

Amer AM, Amer MM. Pharmacology of Tropane Alkaloids. Tropane Alkaloids: Sources, Chemistry, Pharmacology and Biotechnology: Springer; 2025. p. 103-32. doi: 10.1007/978-981-96-5805-3_5.

Asadi-Samani M, Moradi MT, Bahmani M, Shahrani M. Antiviral medicinal plants of Iran: A review of ethnobotanical evidence. International Journal of PharmTech Research. 2016;9(5):427-34.

Azarderakhsh J, Siebenlist S, Schneider O, Beck F, Flechtenmacher J. Degenerative Shoulder Diseases: Shoulder Injuries, Epidemiology, ICD10, Coding. Zeitschrift für Orthopädie und Unfallchirurgie. 2025;163(04):317-29. doi: 10.1055/a-2437-0981.

Babu NJ, Murty PP, Rao GN. Indigenous treatments and application of Ethnomedicine for treating sports injuries and other ailments. IOSR Journal of Pharmacy and Biological Sciences. 2020;15(2):44-57. doi: 10.9790/3008-1502034457.

Baharvand-Ahmadi B, Bahmani M, Eftekhari Z, Jelodari M, Mirhoseini M. Overview of medicinal plants used for cardiovascular system disorders and diseases in ethnobotany of different areas in Iran. J HerbMed Pharmacol. 2016;5(1):39-44.

Baharvand-Ahmadi B, Bahmani M, Tajeddini P, Rafieian-Kopaei M, Naghdi N. An ethnobotanical study of medicinal plants administered for the treatment of hypertension. Journal of Renal Injury Prevention. 2016;5(3):123. doi: 10.15171/jrip.2016.26.

Bahmani M, Khaksarian M, Rafieian-Kopaei M. Overview of the therapeutic effects of *Origanum vulgare* and *Hypericum perforatum* based on Iran's ethnopharmacological documents. Journal of Clinical and Diagnostic Research. 2018;12(7):FE01--FE4. doi: 10.7860/JCDR/2018/34177.11728.

Bahmani M, Nejad ASM, Shah NA, Shah SA, Rafieian-Kopaei M, Mahmoodnia L. Survey on ethnobotanical uses of anti-cancer herbs in Southern region of Ilam, West Iran. Journal of Biological Research-Bollettino Della Società Italiana Di Biologia Sperimentale. 2017;90(1). doi: 10.4081/jbr.2017.5939.

Bahmani M, Rafieian-Kopaei M, Avijgan M, Hosseini S, Golshahi H, Eftekhari Z, et al. Ethnobotanical studies of medicinal plants used by Kurdish owner's in south range of Ilam province, west of Iran. American-Eurasian Journal of Agricultural & Environmental Sciences. 2012;12(9):1128-33. doi: 10.5829/idosi.aejaes.2012.12.09.6599.

Bahmani M, Zargaran A, Rafieian-Kopaei M, Saki K. Ethnobotanical study of medicinal plants used in the management of diabetes mellitus in the Urmia, Northwest Iran. Asian Pacific journal of tropical medicine. 2014;7:S348-S54. doi: 10.1016/S1995-7645(14)60257-1.

Bai M, Yao G-D, Ren Q, Li Q, Liu Q-B, Zhang Y, et al. Triterpenoid saponins and flavonoids from licorice residues with anti-inflammatory activity. Industrial Crops and Products. 2018;125:50-8. doi: 10.1016/j.indcrop.2018.08.075.

Basati G, Abbaszadeh S, Zebardast A, Teimouri H. Analgesic medicinal plants in Shahrekord, southwest of Iran: An ethnobotanical study. Galen Medical Journal. 2019;8:e1593. doi: 10.31661/gmj.v8i0.1593.

Bento TPF, Genebra CVdS, Cornélio GP, Biancon RDB, Simeão SFAP, Vitta AD. Prevalence and factors associated with shoulder pain in the general population: a cross-sectional study. Fisioterapia e Pesquisa. 2019;26(4):401-6. doi:10.1590/1809-2950/18026626042019.

Bodin J, Ha C, Chastang JF, Descatha A, Leclerc A, Goldberg M, et al. Comparison of risk factors for shoulder pain and rotator cuff syndrome in the working population. American journal of industrial medicine. 2012;55(7):605-15. doi: 10.1002/ajim.22002.

Cerda-Bernad D, Valero-Cases E, Pastor J-J, Frutos MJ. Saffron bioactives crocin, crocetin and safranal: Effect on oxidative stress and mechanisms of action. Critical reviews in food science and nutrition. 2022;62(12):3232-49. doi: 10.1080/10408398.2020.1864279.

Choudhary M, Kumar V, Malhotra H, Singh S. Medicinal plants with potential anti-arthritic activity. Journal of intercultural ethnopharmacology. 2015;4(2):147. doi: 10.5455/jice.20150313021918.

Dean BJF, Gwilym SE, Carr AJ. Why does my shoulder hurt? A review of the neuroanatomical and biochemical basis of shoulder pain. British journal of sports medicine. 2013;47(17):1095-104. doi: 10.1136/bjsports-2012-091492.

Donno D, Mellano MG, De Biaggi M, Riondato I, Rakotoniaina EN, Beccaro GL. New findings in Prunus padus L. fruits as a source of natural compounds: Characterization of metabolite profiles and preliminary evaluation of antioxidant activity. Molecules. 2018;23(4):725. doi: 10.3390/molecules23040725.

Gerretsen P, Pollock BG. Drugs with anticholinergic properties: a current perspective on use and safety. Expert Opinion on Drug Safety. 2011;10(5):751-65. doi: 10.1517/14740338.2011.579899.

Ghaneialvar H, Heydarizadeh H, Razmjoue D, Tahmasebi M, Abbasi N, Bahmani M. Ethnobotanical study of medicinal plants effective on kidney stones: A case study of Ilam city, Ilam province, Iran. Journal of Islamic and Iranian Traditional Medicine. 2024;15(1):15-26. doi: 10.22034/15.1.15.

Ghasemi PA, Momeni M, Bahmani M. Ethnobotanical study of medicinal plants used by Kurd tribe in Dehloran and Abdanan districts, Ilam province, Iran. African Journal of Traditional, Complementary and Alternative Medicines. 2013;10(2):368-85. doi: 10.4314/ajtcam.v10i2.24.

Jakabová S, Vincze L, Farkas Á, Kilár F, Boros B, Felinger A. Determination of tropane alkaloids atropine and scopolamine by liquid chromatography–mass spectrometry in plant organs of Datura species. Journal of Chromatography A. 2012;1232:295-301. doi: 10.1016/j.chroma.2012.02.036.

Kachur K, Suntres Z. The antibacterial properties of phenolic isomers, carvacrol and thymol. Critical Reviews in Food Science and Nutrition. 2020;60(18):3042-53. doi: 10.1080/10408398.2019.1675585.

Kantasrila R, Pandith H, Balslev H, Wangpakapattanawong P, Panyadee P, Inta A. Ethnobotany and phytochemistry of plants used to treat musculoskeletal disorders among Skaw

Karen, Thailand. Pharmaceutical Biology. 2024;62(1):62-104. doi: 10.1080/13880209.2023.2292261.

Kantasrila R, Panyadee P. Traditional Thai Yuan medicinal plants for musculoskeletal disorders: a comprehensive review. PSRU Journal of Science and Technology. 2023;8(2):70-92.

Kasilo OM, Nikiema JB. World Health Organization perspective for traditional medicine. Novel Plant Bioresources: Applications in Food, Medicine and Cosmetics. 2014:23-42. doi: 10.1002/9781118460566.ch2.

Kermanshahi S, Ghanavati G, Abbasi-Mesrabadi M, Gholami M, Ulloa L, Motaghinejad M, et al. Novel neuroprotective potential of crocin in neurodegenerative disorders: an illustrated mechanistic review. Neurochemical Research. 2020;45(11):2573-85. doi: 10.1007/s11064-020-03134-8.

Krenzelok EP. Aspects of Datura poisoning and treatment. Clinical Toxicology. 2010;48(2):104-10. doi: 10.3109/15563651003630672.

Kuijpers T, van Tulder MW, van der Heijden GJ, Bouter LM, van der Windt DA. Costs of shoulder pain in primary care consulters: a prospective cohort study in The Netherlands. BMC musculoskeletal disorders. 2006;7(1):83. doi: 10.1186/1471-2474-7-83.

Leonti M. The relevance of quantitative ethnobotanical indices for ethnopharmacology and ethnobotany. Journal of Ethnopharmacology. 2022;288:115008. doi: 10.1016/j.jep.2022.115008.

Lo CN, Leung BPL, Sanders G, Li MWM, Ngai SP. The major pain source of rotator cuff-related shoulder pain: A narrative review on current evidence. Musculoskeletal Care. 2023;21(2):285-93. doi: 10.1002/msc.1719.

Lucas J, Van Doorn P, Hegedus E, Lewis J, Van Der Windt D. A systematic review of the global prevalence and incidence of shoulder pain. BMC musculoskeletal disorders. 2022;23(1):1073. doi: 10.1186/s12891-022-05973-8.

Marks D, Comans T, Bisset L, Thomas M, Scuffham PA. Shoulder pain cost-of-illness in patients referred for public orthopaedic care in Australia. Australian Health Review. 2018;43(5):540-8. doi: 10.1071/ah17242.

Nam KN, Park Y-M, Jung H-J, Lee JY, Min BD, Park S-U, et al. Anti-inflammatory effects of crocin and crocetin in rat brain microglial cells. European journal of pharmacology. 2010;648(1-3):110-6. doi: 10.1016/j.ejphar.2010.09.003.

Nasri S. Antinociceptive and anti-inflammatory effects of hydroalcoholic extract of aerial parts of *Thymus carmanicus* in male mice. Archives of Advances in Biosciences. 2018;9(1):36-44. doi: 10.22037/jps.v9i1.9763.

Oketch-Rabah HA, Marles RJ, Jordan SA, Dog TL. United States pharmacopeia safety review of Willow Bark. Planta Medica. 2019;85(16):1192-202. doi: 10.1055/a-1007-5206.

Papatheodorou A, Ellinas P, Takis F, Tsanis A, Maris I, Batakis N. US of the shoulder: rotator cuff and non–rotator cuff disorders. Radiographics. 2006;26(1):e23-e. doi: 10.1148/rg.e23.

Pourbagher-Shahri AM, Forouzanfar F. Saffron (*Crocus sativus*) and its constituents for pain management: A review of current evidence. Phytotherapy Research. 2023;37(11):5041-57. doi: 10.1002/ptr.7968.

Prescher A. Anatomical basics, variations, and degenerative changes of the shoulder joint and shoulder girdle. European Journal of Radiology. 2000;35(2):88-102. doi: 10.1016/S0720-048X(00)00225-4.

Previtali D, Bordoni V, Filardo G, Marchettini P, Guerra E, Candrian C. High rate of pain sensitization in musculoskeletal shoulder diseases: a systematic review and meta-analysis. The Clinical Journal of Pain. 2021;37(3):237-48. doi: 10.1097/ajp.0000000000000914.

Ranalletta M, Rossi LA, Bongiovanni SL, Tanoira I, Elizondo CM, Maignon GD. Corticosteroid injections accelerate pain relief and recovery of function compared with oral NSAIDs in patients with adhesive capsulitis: a randomized controlled trial. The American journal of sports medicine. 2016;44(2):474-81. doi: 10.1177/0363546515616238.

Razmjoue D, Ezati M, Abbasi N, Pirhadi M, Shojaei B, Bahmani M. Ethnobotanical study of medicinal plants used by local population of Ilam city on back pain, West of Iran. Traditional and Integrative Medicine. 2024. doi: 10.18502/tim.v9i3.16533.

Ríos J, Recio M, Maáñez S, Giner R. Natural triterpenoids as anti-inflammatory agents. Studies in natural products chemistry. 2000;22:93-143. doi: 10.1016/S1572-5995(00)80024-1.

Singh S. Ethnobotanical study of some climbers of Parsa district forest of Nepal. Journal of Medicinal Plants Studies. 2016;4:6-10.

Tangkiatkumjai M, Boardman H, Walker D-M. Potential factors that influence usage of complementary and alternative medicine worldwide: a systematic review. BMC Complementary Medicine and Therapies. 2020;20(1):363. doi: 10.1186/s12906-020-03157-2.

Tava A, Pecetti L, Romani M, Mella M, Avato P. Triterpenoid glycosides from the leaves of two cultivars of *Medicago polymorpha* L. Journal of agricultural and food chemistry. 2011;59(11):6142-9. doi: 10.1021/jf2005854.

Van Der Windt DA, Thomas E, Pope DP, De Winter AF, Macfarlane GJ, Bouter LM, et al. Occupational risk factors for shoulder pain: a systematic review. Occupational and environmental medicine. 2000;57(7):433-42. doi: 10.1136/oem.57.7.433.

Veeger H, Van Der Helm F. Shoulder function: the perfect compromise between mobility and stability. Journal of Biomechanics. 2007;40(10):2119-29. doi: 10.1016/j.jbiomech.2006.10.016.

Virta L, Joranger P, Brox JI, Eriksson R. Costs of shoulder pain and resource use in primary health care: a cost-of-illness study in Sweden. BMC musculoskeletal disorders. 2012;13(1):17. doi: 10.1186/1471-2474-13-17.

Yadav G, Yadav V, Patel A, Das S, Goyal M, Satpathy S, et al. Comprehensive review on traditional uses, phytochemistry, pharmacological properties and metal nanoparticles of a leafy vegetable, *Medicago polymorpha*. European Journal of Medicinal Chemistry Reports. 2024;11:100164. doi: 10.1016/j.ejmcr.2024.100164.

Zheng X-Q, Li K, Wei Y-D, Tie H-T, Yi X-Y, Huang W. Nonsteroidal anti-inflammatory drugs versus corticosteroid for treatment of shoulder pain: a systematic review and meta-analysis. Archives of Physical Medicine and Rehabilitation. 2014;95(10):1824-31. doi: 10.1016/j.apmr.2014.04.024.