Ethnobotanical documentation and quantitative analysis of medicinal plants used in traditional rheumatic diseases treatment in the Setif Region, northeastern Algeria

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Research

Abstract

Background: This ethnobotanical study documents and analyzes traditional medicinal knowledge in the Setif region of northestern Algeria.

Methods: Data were collected from 310 informants, including herbalists, using semi-structured interviews. Quantitative ethnobotanical indices, frequency citation (FC), the use value of species (UVs), the fidelity level (FL), informant consensus factor (ICF), informant agreement ratio (IAR), were applied to assess the cultural importance and reliability of recorded species.

Results: The analysis identified 67 medicinal plant species belonging to 37 botanical families, among which Lamiaceae were the most represented. Seeds are the most used parts (31%) while majority of the preparations were prepared as powder, poultice, and maceration (29%, 18%, and 15%, respectively). *Lepidium sativum* L. and *Zingiber officinale* Roscoe were the most frequently cited plants, with citation frequencies of 14% and 12%, respectively, and a fidelity level of 100%. The calculated IAR values revealed that 18 species out of 67 have maximum values equal to 1.The ICF for rheumatic diseases treated by the local population showed a maximum value of 0.916; this category of diseases was treated with all the species identified in the surveys (67 species).

Conclusions: The obtained results represent a source of information concerning the medicinal flora of the region and could eventually constitute a database for further investigations aiming at inventorying all the medicinal flora of all regions of Algeria and exploring their composition.

Keywords: Rheumatic diseases; Ethnobotanical study; Medicinal plants; Quantitative analysis; Algeria.

Background

The history of the use of traditional medicine dates back to the early history of man. It can be defined as: the sum of all data, medicines, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not; used in the preservation of health as well as in the prevention, diagnosis, improvement, or treatment of physical and mental illness (Singh and Rastogi, 2018). Developed countries too are now beginning to acknowledge the importance of traditional medicine and are experimenting with the integration of the two systems within the sphere of healthcare. Today, close to half of the population in many industrial nations practices some form of traditional and complementary medicine (Park *et al.* 2012). Natural products from plants have been the basis of medical treatment since prehistory because they treat many diseases and health problems; herbs, especially medicinal herbs, have constantly acted as an overall indicator of ecosystem health (Jamshidi-Kia *et al.* 2017, Karbab *et al*. 2020, Karbab *et al.* 2021). The study of the relationships between humans and plants is called ethnobotany. In the present day, the collection of ethnomedicinal data before it is too late, and the elaboration of a large inventory covering the known plant uses in rural environments, is very important. The conservation of that knowledge is a question that constitutes a scientific, on the one hand, and cultural, on the other, heritage to be conserved (Rebbas *et al.* 2012, Mohammadi *et al.* 2016). In addition, most of the active compounds used in scientific medicine and technology were originally taken from this traditional knowledge (Ouelbani *et al.* 2016).

The term "rheumatism" refers to a series of different diseases of the musculoskeletal system that cause chronic and often intermittent pain, swelling, and stiffness affecting the joints or connective tissue (Kosztyla-Hojna *et al.* 2015). More than 200 conditions are classified as rheumatic diseases, including rheumatoid arthritis, lupus and Sjögren's disease (Ortíz-Fernández *et al.* 2023). Age, hormonal changes (especially in pre- and postmenopausal women, physical activity, being overweight, and diet are the main causes of rheumatism (Desai *et al.* 2022). Other causes, however, include cold exposure, genetic disorders, infections (bacterial, viral), and metabolic conditions including the buildup of uric acid crystals in tissues and joints, as in the case of gout (Earwood *et al.* 2021, Katsumoto *et al.* 2024, Zhang *et al.* 2025). Rheumatoid arthritis affects 0.5-1% of the population worldwide, with a higher prevalence in women (Black *et al.* 2023). From 1990 to 2019, the global rheumatisms incidence increased by 6.47% (Zou *et al.* 2023). Rheumatism patients are twice as likely to develop heart disease, lung conditions, and chest infections, which account for 10-20% of all fatalities (Dooley *et al.* 2021). Rheumatoid nephropathy belongs to the group of the most severe extra-articular complications of RA and is associated with an extremely poor prognosis. In the tubulointerstitial pathology of kidney in rheumatoid nephropathy, the impaired renal function is marked with an increased level of creatinine in the blood and the decrease in the glomerular filtration rate (GFR) and the functional renal reserve. The morphological of nephropathy in the context of RA are predominantly mesangial proliferative glomerulonephritis in (48.4%). In addition to the above forms of kidney disease in the context of RA, the secondary amyloidosis is noted in 29.0%, nephritis in 16.1%, membranous glomerulonephritis in 3.2%, and focal glomerulonephritis (Tang *et al.* 2024).

Medications are used to treat pain and inflammation. First, nonsteroidal anti-inflammatory drugs (NSAIDs) and analgesics like paracetamol are prescribed. Injections of natural hormones called corticosteroids can lessen swelling if these are insufficient. When a patient has discomfort in just single joint or in a few major joints, intra-articular injections can also be very helpful. However, these drugs have undesirable side effects on human body, affecting the digestive, renal and respiratory systems (Vonkeman *et al.* 2010). This is why scientists and pharmaceutical companies are keen to confirm the efficacy of herbal plants and use them as consistent anti-inflammatories and painkillers (Uritu *et al.* 2018). Despite the increased number of ethnobotanical studies conducted in Algeria, there is still scarce information on medicinal plants used for treating rheumatic diseases in the region of Setif. Furthermore, quantitative ethnobotanical evidence related to these traditional practices has yet not been adequately documented. Thus, the objective of this study is to report and quantify medicinal plants used traditionally for the treatment of rheumatic diseases in northeastern Algeria.

Materials and Methods

Study area

The current research was conducted in the province of Setif, situated in the northeast of Algeria (300 km from the capital, Algiers). The province of Setif is situated within the high plains of eastern Algeria; it also occupies a central position, serving as a crossroads surrounded by six other provinces. Its geographical extension is approximately 6549.64 kilometer square as subscript, and the province is composed of 60 municipalities, distributed across 20 different Daïras (Fig. 1). The altitude of the province varies from 900 to 2000 m (Priya and Kumar, 2023). The province has a Mediterranean climate, ranging from humid to semi-arid (Zegers-Hochschild *et al.* 2017).

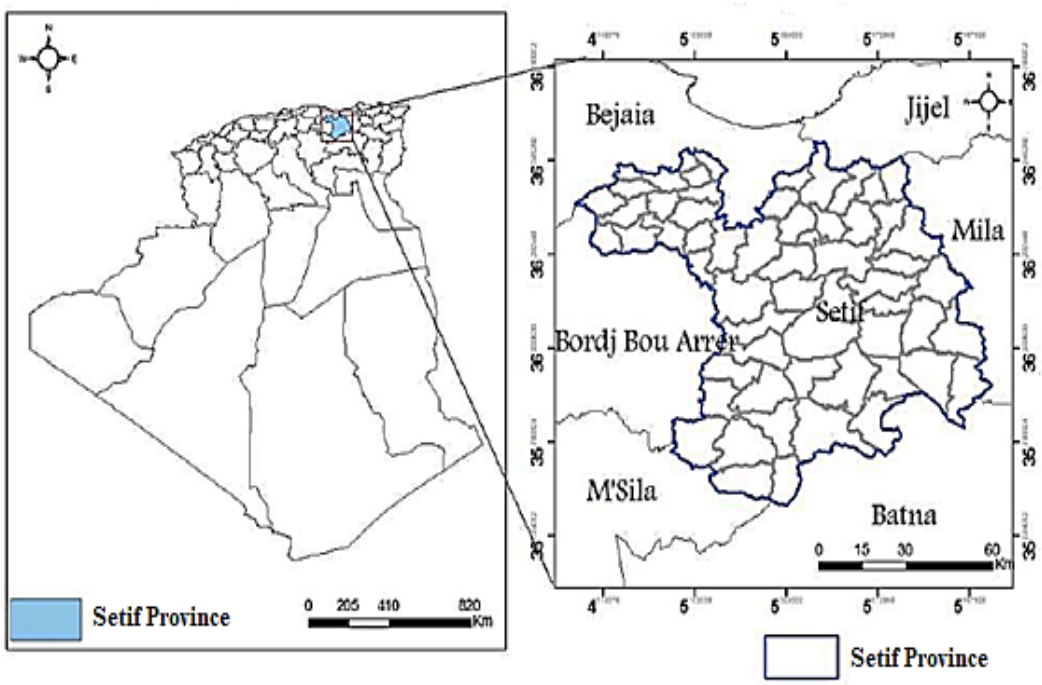

Figure 1. Map of Algeria illustrating the localities subjected to the survey

Data Analysis

The ethnobotanical survey was conducted in some regions of Setif (the Localities of Setif, Ain Oulmene, and Salah Bey). The present study is based on a series of ethnobotanical surveys using a pre-developed questionnaire. The questions were compiled from several similar surveys in order to collect as much information as possible regarding the interviewer as well as the plants in question (Hani *et al.* 2023). The interviews conducted with traditional healers were direct and focused on the same topic, in which they were required to share information regarding the basics of the survey and the plants they used in detail (e.g., which part was used, the method of preparation, etc.). Setif is composed of 60 municipalities. The selection of municipalities was carried out following a preliminary investigation during an exploration mission in the study area. The villages were selected along transects from the capital of the Wilaya and oriented in the cardinal direction south. For the sample method, we have carried out a non-probability sampling oriented selection. The municipalities were selected for this purpose, based on their accessibility. A questionnaire form was also designed and used to interview the tradipractitioners and centered around: types of rheumatic diseases treated, kind of used plant species of medicinal plant, different parts of plant used, and mode of preparation of plant. Information regarding ethnobotany of herbal medicines practiced in addressing rheumatic diseases was acquired using semi-structured, open-ended interviews with 81 tradipractitioners and 229 informants during field investigation. Interviews were translated into Arabic, the native language of the informants. The field investigation was undertaken during the period from November 2023 to April 2024. A total of 310 questionnaires were collected, including responses from individuals and herbalists, as shown in Table 1, which presents the demographic characteristics of the interviewed individuals.

Table 1.The demographic characteristics of informers and traditional healers.

Distribution of informers and traditional healers	Number		Percentage %	
	Informants	Traditional healers	Informants	Traditional healers
Sexe				
Male	56	81	24	100
Female	173	0	76	0
Age (years)				
A1 :<20	11	0	5	0
A2 :< [20-30]	32	5	14	6
A3 :< [30-40]	58	5	25	6
A4 :< [40-50]	39	19	17	23
A5 :< [50-60]	30	17	13	21

A6 :< [60-70]	26	17	11	21
A7 :>70	33	18	17	22
Educational level				
Illiterate	75	4	33	5
Elementary school	61	34	26	42
Secondary school	68	35	30	43
University	25	8	11	10

Analysis of ethnobotanical data

The frequency and percentages distribution for the various demographic variables were analyzed for the respondents. The results obtained for the various medicinal plants were analyzed for Frequency of Citation (FC), Use value of species (UVs), Fidelity Level (FL), Informant Consensus Factor (ICF), and Informant Agreement Ratio (IARs).

Frequency Citation (FC) was obtained using the following formula:

FC= (Number of times a particular species was mentioned / total number of times that all species were mentioned) × 100 (Agbodjento *et al.* 2021); it is used for a better relative expression of citations.

Use Value of species (UVs), (Phillips,1996) modified by Rossato *et al.*(1999) and later simplified by Thomas *et al.*(2009), is a quantitative method which shows the relative importance of known species in a community (Houéhanou *et al.* 2016). The formula is as follows:

$$UVs = \Sigma U/N$$

Where: U is the total number of citations of medicinal uses of the species mentioned and N is the number of informants.

Fidelity Level (FL) was calculated to quantify the importance of a species for a given disease. It is the ratio of the number of informants citing the species for a given disease (Np) to the total number of informants citing the plant for any disease (N) (Phillips, 1996):

$$FL = (Np/N) \times 100.$$

Informant consensus factor (ICF) measures the homogeneity of information among informants on the medicinal uses of plants. ICF values are low (close to 0) if plants are randomly selected or if there is little exchange of information between the populations. They approach 1 when informants agree on the use of the plants concerned (Trotter and Logan, 2019). It was calculated according to the formula:

$$ICF = (Nur - Nt) / (Nur - 1)$$

where, Nur is the number of citations used in each category; Nt is the number of species reported in each category.

Informant Agreement Ratio (IAR) was proposed by Trotter and Logan in 2019 as follows:

$$IARs = Nr\text{-}Na/Nr\text{-}1 < 1$$

Where Nr is the total number of replies or quotations recorded for species s and Na is the number of conditions or diseases treated with that species. IARs for a medicinal species range from 0 (when the number of conditions treated is equal to number of quotations recorded) to 1 (where all participants agree to the exclusive use of the species for a particular condition) (Thomas *et al.* 2009). Unlike the Usage Value (UV), which does not much reflect the consensus of informers, this technique takes this parameter into account (Bakwaye *et al.* 2013).

Plant Part Value (PPV) used to identify the most commonly utilized part of the plant during the interviews, calculated using the following this formula:

$$PPV=Ru \text{ plant part } /RU$$

Where RU is the number of uses reported for all plant parts. This index shows the frequently used plant parts through the determination of the number of times each plant part is mentioned in a single record under the heading of “RU plant part” compared to the total number of records: 4873. Table 2 and Fig. 2 show the most frequently used plant parts in terms of the

values obtained through the PPV index. From the data presented in Fig.2, it is evident that. The seeds are the most parts used followed by leaves and roots. All the plant parts have a usage, provided they need to accomplish a purpose.

Results

Demographic characteristics

Traditional practitioners

Table 1 showed that the ages of the herbalists varied between 20 and 80, the majority age group being 30 to 70 years and men represented 100% of this population, while women represented 0%.Regarding educational attainment, 43% of the population had a secondary education, 42% had a primary education. Ethnobotanical information is acquired from various sources, the majority of sources of information: the experience of others (43%), followed by the experience of others through reading (19%). In our ethnobotanical study a set of 229 informants were interviewed, women use herbal medicine for the treatment of rheumatic diseases more than men with a percentage of 76% while men represent 24%.

Medicinal plant species used in the treatment of rheumatism

Our study identified 67 species belonging to 37 families cited by traditional healers and residents of the different regions of Setif. Table 2 summarizes the results obtained. *Lepidium sativum* L. and *Zingiber officinale* Roscoe represent the most frequently reported species, accounting for 14.8% and 11.2% of total citations, respectively. This is followed by *Urtica dioica* L. with 6.9%, *Curcuma longa* L*. at* 6.09%, *Thapsia garganica* L. *at* 5.7%, *Panicum miliaceum* L. at 4.1%, and finally *Citrullus colocynthis* L. *Schrad and Peganum harmala* L. with an identical rate of 3.9%.

Plants parts used and preparation methods

According to the Table 2 and Fig. 2, the plant parts of plants used to treat rheumatic diseases varied from one species to another. The seeds are the most parts used (31%) followed by leaves (27%), roots (25%), fruits (8%), bark (4%), then whole (3%) and flowers (1%).The results shown in the Fig. 3 indicate that powdered plants are the most common method of preparation (29%), followed by poultices (18%), then infusions (15%), and finally preparations by boiling, mixing, and raw application (8%, 7%, and 7%, respectively). Other preparation methods (infusions, creams, and oils) represent 5%, and finally, preparation using a water bath (1%). Herbalists, interviewees, and even physicians recommended the simultaneous use of certain plants, either in mixtures or with other substances.

Table 2 showed that the plants were mainly used orally (51%), followed by external route (49%). The duration of treatment only when the pain recedes, with PAM remedies, ranks first 29% of the total, followed by a duration of 1 month (23%), followed by a duration of 22% for the duration until recovery, and finally 15%, 6%, and 5% respectively for durations of 20 days, 3 months, and a few hours. The most used type of liquid in the preparation of medicinal plants is oil (40%), followed by water (24%), and 12% and 11% are prepared by milk and honey, followed by 7% of liquid combination, and finally 6% for the use of yogurt (Fig3).

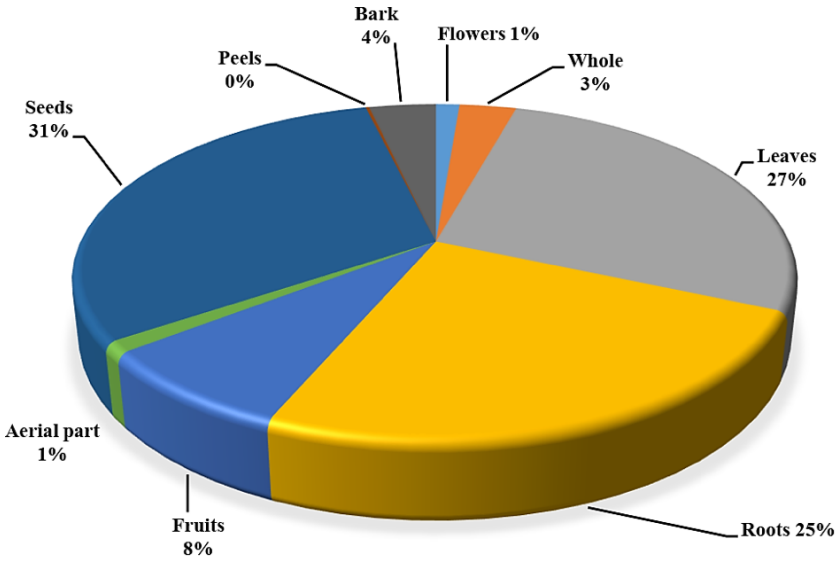

Figure 2. Distribution of plant parts used in the treatment of rheumatic diseases in Setif region.

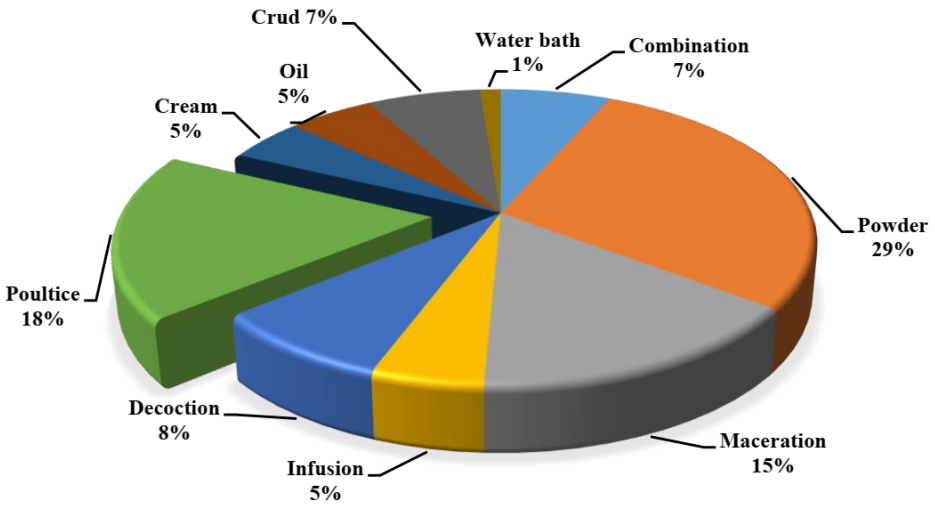

Figure 3.Preparation method of plant used in the treatment of rheumatic diseases in Setif region.

Quantitative analysis of ethnobotanical data

The medicinal Use Values (Med. UVs) calculated for the plant species used by the respondents showed that: *Lepidium sativum* L.*, Zingiber officinale Roscoe* were those with the highest importance 0.149 and 0.113 respectively. Followed by *Urtica dioica* L. (UVs= 0.07), *Curcuma longa* L. (UVs= 0.061), *Thapsia garganica* L. (UVs= 0.057), *Panicum miliaceum* L. (UVs= 0.041), then *Citrullus colocynthis* L. *Schrad., Peganum harmala* L.*, Thymus serpyllum* L. with a value (UVs= 0.03). Out of the 67 species identified, 11 species had average values between (0.02 and 0.01). The remaining 47 species having a minimum value between (0 and 0.01). Having obtained less interesting to lower values

In our study, majority of plants had high FL and the highest FL of 100% was recorded for 4 plant species *(Zingiber officinale* Roscoe*, Lepidium sativum* L., *Phoenix dactylifera* L.*, Plantago ovata* Forssk.). Only species (*Piper cubeba* L.f*)* shows low fidelity value (FL<50). In addition, 62 other medicinal plant species have significant Fidelity Level (FL between 50% and 95.455%).The results obtained (table 2) show that the category with the highest degree of agreement of the informants (ICF) was gout (0.916) with 30 species, followed by Osteoporosis with 30 species (ICF=0.904), bone pain with 53 species (ICF=0.897), rheumatoid arthritis with 50 species (ICF=0.886).

According to the Table (2), the values of the med. IARs. obtained revealed that 18 species have maximum values equal to (1), namely: *Alpinia officinarum* Hance*, Elettaria cardamomum* (L.) *Maton., Marrubium vulgare* L., *Ajuga iva* (L.) *Schreb., Anacyclus pyrethrum* (L.) *Link., Saussurea costus* L., *Artemisia herba-alba* Asso., *Asphodelus microcarpus* Mill., *Scilla autumnalis* L., *Thapsia garganica* L.*, Foeniculum vulgare* Mill*, Ulmus* L., *Peganum harmala* L., *Punica granatum* L., *Panax ginseng C.A. Mey., Cyperus esculentus* L., *Illicium verum Hook.f., Phoenix dactylifera* L. of the 67 species identified, 16 species had average values between 0.96 and 0.75 and we have 11 species with values varying between 0.75 and 0.25. The 22 remaining species having a minimum value equal to 0.

Table 2. List of medicinal plants used to treat rheumatic diseases in Setif region.

Family name	Botanical name	Local name(s)	Part used	Preparation mode	Administration mode	Duration of the treatment	Solvent Type	U	FC(%)	UVs	Na	Nr	IARs	Np	FL(%)
Zingiberaceae	*Zingiber officinale* Roscoe, 1807	الزنجبيل	Roots	Powder/Decoction/ Maceration/ Compresses	Oral/ external application	1Month	Honey/ Water/ Oil	63	11.290	0.113	63	4	0.952	63	100.000
	Curcuma longa L. 1753	الكركم	Roots	Powder/ Decoction/ Maceration/ Compresses	Oral/ external application	1Month	Water/ Milk/ Honey	34	6.093	0.061	34	4	0.909	30	88.235
	Alpinia officinarum Hance. 1873	الخنجلان	Roots	Decoction/ Powder	Oral/ external application	Until healing	Water/ Honey/ Oil	4	0.717	0.007	4	1	1.000	3	75.000
	Elettaria cardamomum (L.) Maton. 1811	بذور الهيل	Seeds	Decoction	Oral	Until healing	Water	1	0.179	0.002	2	1	1.000	1	50.000
Brassicaceae	*Lepidium sativum* L. 1753	حب الرشاد	Seeds	Crude/ Powder/ Infusion/ Compresses	Oral/ external application	20 days	Honey/ Milk/ Oil /Yogurt	83	14.875	0.149	83	4	0.963	83	100.000
	Sinapis arvensis L. 1753	زريعة الخردل	Seeds	Maceration/ oil	External application	Until healing	Oil	3	0.538	0.005	3	3	0.000	2	66.667
	Brassica oleracea var. capitata L. 1753	الكرنب	Leaves	Double boiler / Compresses	External application	Some hours	Oil	2	0.358	0.004	2	2	0.000	1	50.000
Lamiaceae	*Marrubium vulgare* L. 1753	مريوت	Leaves	Decoction/ Maceration/ Compresses/oil	External application	Some hours	Oil	8	1.434	0.014	8	1	1.000	5	62.500
	Thymus serpyllum L. 1753	الزعتر	Leaves	Decoction/ Maceration/ Compresses/ Powder	Oral/ external application	3Months	Water/ Honey/ Oil	20	3.584	0.036	20	4	0.842	19	95.000

	Salvia rosmarinus Spenn. 1835	اكليل الجبل	Leaves	Decoction/ Maceration/ Powder/ oil	Oral/ external application	3Months	Water/ Oil	9	1.613	0.016	9	3	0.750	8	88.889
	Mentha spicata L. 1753	النعناع	Leaves	Decoction/ Compresses/Maceration/ Oil	Oral/ external application	Until healing	Water/ Oil	5	0.896	0.009	5	3	0.500	4	80.000
	Ajuga iva (L.) Schreb. 1774	شندقورا	Whole plant	Decoction/ Powder	Oral	3Months	Water/ Oil	2	0.358	0.004	2	1	1.000	1	50.000
	Salvia hispanica L. 1753	بذور الشيا	Seeds	Maceration	Oral	Only when you feel the pain	Water	3	0.538	0.005	3	2	0.500	2	66.667
	Thymus vulgaris L. 1753	الزعيترة	Leaves	Infusion	Oral	Until healing	Water	1	0.179	0.002	2	2	0.000	1	50.000
	Lavandula angustifolia Mill. 1768	الخزامى	Flowers	Powder/ Compresses	External application	Only when you feel the pain	Water	1	0.179	0.002	2	2	0.000	1	50.000
Poaceae	*Salvia officinalis* L. 1753	المرمية	Leaves	Powder	Oral	1Month	Honey	1	0.179	0.002	2	2	0.000	1	50.000
	Panicum miliaceum L. 1753	البشنة	Seeds	Powder	Oral	1Month	Water/ Honey/ Yogurt	23	4.122	0.041	23	2	0.955	19	82.609
	Avena sativa L. 1753	الشوفان	Seeds	Powder	Oral	Until healing	Honey/ Yogurt	4	0.717	0.007	4	3	0.333	3	75.000
	Triticum aestivum L. 1753	القمح	Seeds	Maceration	Oral	Until healing	Water	2	0.358	0.004	2	2	0.000	1	50.000
	Hordeum vulgare L. 1753	الشعير	Seeds	Maceration	Oral	Until healing	Water	3	0.538	0.005	3	3	0.000	2	66.667
Astéracées	*Anacyclus pyrethrum* (L.) Link. 1822	القنطس	Roots	Decoction/ Compresses	Oral/ external application	Only when you feel the pain	Water/ Honey/ Oil	12	2.151	0.022	12	1	1.000	11	91.667
	Saussurea costus L. 1964	القسط الهندي	Roots	Powder	Oral	Until healing	Honey/ Water	1	0.179	0.002	2	1	1.000	1	50.000
	Chrysanthemum L. 1753	الاقحوان	Flowers	Powder	Oral	1Month	Honey	1	0.179	0.002	2	2	0.000	1	50.000

	Artemisia herba-alba Asso. 1779	الشيح	Leaves	Maceration/ Compresses	External application	Until healing	Oil	1	0.179	0.002	2	1	1.000	1	50.000
	Chamaemelum nobile(L.) All. 1785	البابونج	Flowers	Powder/ Decoction	Oral	1Month	Honey/ Water	1	0.179	0.002	2	2	0.000	1	50.000
Liliaceae	*Allium sativum* L. 1753	الثوم	Fruits	Crude/ oil	Oral	Until healing	Water	4	0.717	0.007	4	4	0.000	3	75.000
	Asphodelus microcarpus Mill. 1768	البرواق	Fruits	Decoction/ oil	External application	15 days	Oil	1	0.179	0.002	2	1	1.000	1	50.000
	Allium cepa L. 1753	البصل	Fruits	Maceration	External application	Until healing	Oil	4	0.717	0.007	5	4	0.250	3	60.000
	Scilla autumnalis L. 1753	العنصل	Fruits	Decoction/ Compresses	External application	Only when you feel the pain	Oil	1	0.179	0.002	2	1	1.000	1	50.000
Apiaceae	*Thapsia garganica* L. 1753	الدرياس "بونافع"	Roots/ Leaves/Bark	Decoction/ Maceration/ Compresses	External application	Only when you feel the pain	Oil	32	5.735	0.057	32	1	1.000	29	90.625
	Foeniculum vulgare Mill. 1768	زريعة البسباس	Seeds	Decoction	Oral	Until healing	Water	2	0.358	0.004	2	1	1.000	1	50.000
Piperaceae	*Piper nigrum* L. 1753	الفلفل الاسود	Seeds	Decoction/ Powder	Oral/ external application	Until healing	Water/ Honey/ Oil	3	0.538	0.005	3	3	0.000	2	66.667
	Piper cubeba L.f. 1782	الكبابة	Fruits	Decoction/ Powder/ Compresses	Oral/ external application	Only when you feel the pain	Water/ Honey/ Oil	1	0.179	0.002	3	3	0.000	1	33.333
Cucurbitaceae	*Citrullus colocynthis* L. Schrad. 1838	الحنظل	Fruits	Crude	External application	Only when you feel the pain	Oil	22	3.943	0.039	22	3	0.905	21	95.455
	Ecballium elaterium(L.) A. Rich.. 1824	فقوس الحمير	Fruits	Powder/ créme	External application	Only when you feel the pain	Oil	6	1.075	0.011	6	2	0.800	5	83.333
Pedaliaceae	*Sesamum indicum* L. (1753)	جلجلان	Seeds	Powder	Oral	1Month	Honey/ Yogurt	4	0.717	0.007	4	4	0.000	3	75.000

	Harpagophytum DC. ex Meisn. 1840	مخلب الشيطان	Roots	Decoction/ Creme	Oral/ external application	Only when you feel the pain	Water	3	0.538	0.005	3	3	0.000	2	66.667
Lauraceae	*Cinnamomum verum* J.Presl. 1825	القرفة	Bark	Decoction/ Powder	Oral/ external application	Only when you feel the pain	Water/ Honey/ Oil	7	1.254	0.013	7	3	0.667	5	71.429
	Laurus nobilis L. 1753	الرند	Leaves	Maceration/ oil	External application	Until healing	Oil	3	0.538	0.005	3	3	0.000	2	66.667
	Cinnamomum camphora(L.) J. Presl. 1825	الكافور	Leaves	Maceration/ oil	External application	Until healing	Oil	2	0.358	0.004	2	2	0.000	1	50.000
Myrtaceae	*Eucalyptus globulus* Labill.. 1800	الكاليتوس	Leaves	Maceration/ oil	External application	Until healing	Oil	6	1.075	0.011	6	2	0.800	5	83.333
	Syzygium aromaticum L. Merr. & L.M.Perry. 1939	الطيب	Seeds	Decoction/ Compresses/ Powder/oil	Oral/ external application	Until healing	Water/ Honey/ Oil	12	2.151	0.022	12	2	0.909	11	91.667
Ranunculaceae	*Nigella sativa* L. 1753	السنوج	Seeds	crude/ Powder/ Maceration	Oral/ external application	1Month	Honey/ Oil/ yogurt	5	0.896	0.009	5	3	0.500	4	80.000
Aloeaceae	*Aloe vera* (L.) Burm.f. 1768	الصبار	plante entiére	Compresses	External application	Some hours	Oil	9	1.613	0.016	9	2	0.875	7	77.778
Fabaceae	*Trigonella foenum-graecum* L. 1753	الحلبة	Seeds	Maceration/ Infusion	Oral	Only when you feel the pain	Water	7	1.254	0.013	7	3	0.667	6	85.714
Urticaceae	*Urtica* L. 1753	الحريق "القراص"	Leaves	Decoction/ Maceration/ Compresses	Oral/ external application	Only when you feel the pain	Water/ Oil/ Oil	39	6.989	0.070	39	3	0.947	35	89.744
Ulmaceae	*Ulmus* L. 1753	"الدردار لسان العصفور"	Leaves/ Bark	Compresses	External application	Only when you feel the pain	Oil	4	0.717	0.007	4	1	1.000	3	75.000
Rutaceae	*Ruta graveolens* L. 1753	الفيجل	Leaves	Maceration/ Compresses	Oral	Until healing	Water	2	0.358	0.004	2	2	0.000	1	50.000

Anacardiaceae	*Pistacia lentiscus* L. 1753	الضرو	Leaves/ Bark	Maceration/ oil	Oral/ external application	Until healing	Water/ Oil	5	0.896	0.009	5	2	0.750	4	80.000
Nitrariaceae	*Peganum harmala* L. 1753	الحرمل	Leaves	Powder/ Compresses	external application	Until healing	Oil	22	3.943	0.039	22	1	1.000	20	90.909
Malvaceae	*Hibiscus sabdariffa* L. 1753	الكركدية	Leaves	Decoction/ Maceration/ Compresses	Oral/ external application	Until healing	Water/ Oil	4	0.717	0.007	4	3	0.333	3	75.000
Theaceae	*Camellia sinensis* (L.) Kuntze. 1887	الشاي الأخضر	Leaves	Infusion	Oral	Until healing	Water/ Honey	6	1.075	0.011	6	3	0.600	5	83.333
Capparaceae	*Capparis* L. 1753	الكبار	Roots/ Leaves/ Fruites	Compresses	External application	some hours	Oil	4	0.717	0.007	4	2	0.667	3	75.000
Cupressaceae	*Juniperus phoenicea* L. 1753	العرعار	Leaves	Decoction	Oral	Until healing	Water/ Honey	3	0.538	0.005	3	2	0.500	2	66.667
Linaceae	*Linum usitatissimum* L. 1753	زريعة الكتان	Seeds	Decoction/ Maceration	Oral/ external application	Until healing	Water	8	1.434	0.014	8	2	0.857	5	62.500
Dioscoreaceae	*Dioscorea communis* (L.) Caddick & Wilkin. 2002	الكرمة السوداء	Roots	Powder/ créme	External application	Only when you feel the pain	Oil	2	0.358	0.004	2	2	0.000	1	50.000
Myristicaceae	*Myristica fragrans* Houtt. 1774	جوزة الطيب	Fruites	Powder/ Compresses	Oral/ external application	Only when you feel the pain	Water/ Honey/ Oil	7	1.254	0.013	7	2	0.833	6	85.714
Salicaceae	*Salix alba* L. 1753	الصفصاف	Leaves/ Roots	Decoction	Oral	Only when you feel the pain	Water	15	2.688	0.027	15	3	0.857	14	93.333
Iridaceae	*Crocus sativus* L. 1753	الزعفران	Leaves	Maceration	Oral	Until healing	Water	1	0.179	0.002	2	2	0.000	1	50.000
Punicaceae	*Punica granatum* L. (1753)	قشور الرمان	Pelures	Decoction	Oral	Until healing	Water	1	0.179	0.002	2	1	1.000	1	50.000
Araliaceae	*Panax ginseng* C.A. Mey.. 1843	الجيسنغ	Roots	Powder	Oral	Until healing	Honey	3	0.538	0.005	3	1	1.000	2	66.667

Cyperaceae	*Cyperus esculentus* L. 1753	حب العزيز	Seeds	Powder	Oral	Until healing	Milk	2	0.358	0.004	2	1	1.000	1	50.000
Schisandraceae	*Illicium verum* Hook.f. 1888	نجمة الارض	Fruits	Decoction/ Powder	Oral/ external application	Until healing	Water/ Honey/ Oil	1	0.179	0.002	2	1	1.000	1	50.000
Primulaceae	*Primula* L. 1753	زهرة الربيع	Flowers	Powder/ Infusion	Oral	Until healing	Water	1	0.179	0.002	2	2	0.000	1	50.000
Plantaginaceae	*Plantago ovata* Forssk. 1775	بذور القاطونة	Seeds	Maceration	Oral	Until healing	Water	1	0.179	0.002	2	2	0.000	2	100.000
Apocynaceae	*Nerium oleander* L. 1753	الدفلة	Leaves	Powder/ Compresses	External application	some hours	Oil	3	0.538	0.005	3	3	0.000	2	66.667
Arecaceae	*Phoenix dactylifera* L. 1753	طلع النخليل	Seeds/ Fruite	Crude / Powder	Oral	3Months	Oil / Honey	2	0.358	0.004	2	1	1.000	2	100.000

Quantitative analysis of ethnobotanical data

The most cited diseases in rheumatic diseases

The results of this study revealed that 53 plants were used to bone pain, *Lepidium sativum*L. and *Zingiber officinale Roscoe* being the most cited species, and 30 plants have been used to treat gout, with *Lepidium sativum* L. and *Zingiber officinale Roscoe* being the most commonly cited, and 50 plants have been recorded rheumatoid arthritis. Respondents also mentioned 30 plants for the Osteoporosis (Table 3).

Table 3. Informant consensus factor values (ICF) by category for ethnobotanical treating rheumatic diseases.

Categories	Species used and number of citations	Nt	Nur	ICF
Bone pain	*Zingiber officinale Roscoe* (63), *Curcuma longa* L.(34), *Lepidium sativum* L.(83), *Marrubium vulgare* L.(8), *Panicum miliaceum* L.(23), *Nigella sativa* L. (5),*Thymus serpyllum* L.(20), *Citrullus colocynthis* L.*Schrad*(22), *Salvia rosmarinus Spenn*., (9), *Aloe vera* (L.) Burm.f., (9), *Cinnamomum verum J.Presl* (7), *Thapsia garganica* L. (32),*Urtica* L. (39), *Ruta graveolens* L.(2), *Allium sativum* L. (4), *Pistacia lentiscus* L.(5), *Syzygium aromaticum* L.*Merr. & L.M.Perry*, (12), *Eucalyptus globulus Labill*., (6), *Hibiscus sabdariffa* L. (4), *Peganum harmala* L. (22), *Mentha spicata* L. (5), *Camellia sinensis*(L.) *Kuntze*, (6), *Capparis* L. (4),*Cinnamomum camphora*(L.) *J. Presl*, (2),*Sinapis arvensis* L. (3), *Brassica oleracea var. capitata* L.(2), *Sesamum indicum* L.(4),*Salix alba* L. (15), *Myristicafragrans Houtt*. (7), *Ecballium elaterium*(L.) A. *Rich.*(6), *Dioscorea communis* (L.) *Caddick & Wilkin* (2),*Crocus sativus* L.(1), *Saussurea costus(Falc.) Lipsch*. (1), *Panax ginseng C.A. Mey*.(3), *Illicium verum Hook*.f. (1), *Alpinia officinarum Hance* (4), *Piper nigrum* L. (3), *Chamaemelum nobile* (L.) All.(1), *Hordeum vulgare* L. (3),*Allium cepa* L. (4), *Plantago ovata Forssk* (1), *Asphodelus microcarpus* (1),*Chrysanthemum* L.(1), *Primula* L.(1), *Thymus vulgaris* L.(1), *Harpagophytum DC. ex Meisn*. (3), *Nerium oleander* L. (3), *Phoenix dactylifera*L. (2), *Lavandula angustifolia* (1),*Salvia officinalis* L.(1), *Piper cubeba L.f.*(1), *Scilla autumnalis* L. (1).	53	506	0.897
Gout	*Zingiber officinale Roscoe*(63),*Curcuma longa* L.(34),*Lepidium sativum* L. (83),*Avena sativa* L.(4),*Thymus serpyllum* L.(20),*Citrullus colocynthis* L. *Schrad*. (22),*Allium sativum* L.(4),*Laurus nobilis* L.(3),*Urtica* L. (39),*Trigonella foenum-graecum* L.(7),*Cinnamomum verum J.Presl*(7),*Salvia rosmarinus Spenn*. (9),*Hibiscus sabdariffa* L. (4),*Mentha spicata* L. (5),*Camellia sinensis*(L.)*Kuntze*, (6),*Juniperus phoenicea* L.(3),*Sinapis arvensis* L. (3),*Brassica oleracea var. capitata* L. (2),*Piper nigrum* L. (3),*Triticum aestivum* L. (2),*Saussurea costus(Falc.) Lipsch*. (1),*Sesamum indicum* L. (4),*Ajuga iva* L.(2),*Ecballium elaterium*(L.) *A. Rich*. (6),*Plantago ovata Forssk*. (1),*Allium cepa* L. (4),*Hordeum vulgare* L. (3),*Chamaemelum nobile*(L.)All. (1),*Harpagophytum DC. ex Meisn*(3),*Lavandula angustifolia* (1)	30	349	0.916
Rheumatoid arthritis	*Zingiber officinale*(63),*Curcuma longa* L.(34),*Lepidium sativum* L. (83),*Avena sativa* L. (4),*Nigella sativa* L.(5), *Thymus serpyllum* L. (20),*Citrullus colocynthis* L.(22), *Salvia rosmarinus*(9), *Aloe vera* L.(9),*Cinnamomum verum*(7),*Trigonella foenum-graecum* L.(7),*Urtica* L.(39),*Ulmus* L.(4), *Laurus nobilis* L.(3),*Ruta graveolens* L.(2),*Allium sativum* L.(4),*Pistacia lentiscus* L.(5),*Hibiscus sabdariffa* L.(4),*Eucalyptus globulus(*6),*Syzygium aromaticum* L.(12),*Mentha spicata* L. (5),*Camellia sinensis* L.(6), *Cinnamomum camphora* L.(2),*Linum usitatissimum* L.(8),*Brassica oleracea var. capitata* L. (2), *Dioscorea communis* L.(2), *Myristica fragrans*(7), *Salix alba* L. (15),*Salvia hispanica* L.(3),*Sesamum indicum* L.(4),*Crocus sativus* L.(1), *Saussurea costus*(1),*Triticum aestivum* L.(2), *Piper nigrum* L.(3),*Thymus vulgaris* L. (1),*Primula* L.(1), *Chrysanthemum* L.(1), *Plantago ovate* (1), *Allium cepa* L.(4), *Hordeum vulgare* L.(3), *Artemisia herba-alba*(1),*Elettaria cardamomum* L.(1), *Chamaemelum nobile* L.(1),*Harpagophytum* DC. (3),*Nerium oleander* L.(3),*Salvia officinalis* L.(1),*Piper cubeba* L.(1), *Juniperus phoenicea* L.(3), *Asphodelus microcarpus* (1), *Sinapis arvensis* L.(3)	50	432	0.886
Osteoporosis	*Zingiber officinale* (63), *Curcuma longa* L. (34), *Lepidium sativum* L. (83), *Avena sativa* L. (4), *Nigella sativa* L. (5), *Thymus serpyllum* L.(20),*Allium sativum* L.(4),	30	306	0904

	Trigonella foenum-graecum L.(7), *Capparis* L. (4), *Linum usitatissimum* L. (8), *Salix alba* L. (15), *Salvia hispanica* L. (3), *Sesamum indicum* L.(4), *Crocus sativus* L.(1), *Punica granatum* L. (1), *Cyperus esculentus* L. (2), *Triticum aestivum* L. (2), *Illicium verum* (1), *Piper nigrum* L. (3), *Plantago ovate* (1), *Foeniculum vulgare (2), Allium cepa* L. (4), *Hordeum vulgare* L. (3), *Elettaria cardamomum* L.(1), *Chamaemelum nobile* L. (1), *Salvia officinalis* L. (1), *Lavandula angustifolia (*1), *Panicum miliaceum* L. (23)			

Discussion

Since the beginning of human history, plants have been used to treat a variety of illnesses (Selvi *et al.* 2020). Herbal medical techniques are still important and relevant despite modernization, particularly in developing nation's where they are crucial to attaining human health objectives. Because herbal medicine is frequently readily available, reasonably priced, and associated with few or no adverse effects when compared to synthetic drugs, people who have rheumatic diseases continue to turn to it for remedies (Sarri *et al.* 2014; Bouzabata and Mahomoodally, 2020).

This study set out to identify and gather information on plants used in the Setif region of Algeria to treat rheumatic diseases. A correlation between gender and the usage of traditional medicine was noted. Where medicine was noted, with women being more likely than men to employ herbal remedies to treat rheumatic conditions. This explains why writing prescriptions for herbal medicines worries women more. These findings are comparable to those of a study carried out in Morocco and southwest Algeria (Chaachouay *et al.* 2021). Anyinam (1995) asserts that knowledge of the properties and applications of medicinal plants is typically passed down from one generation to the next after extensive experience. Because it is not always guaranteed, the dissemination of this knowledge is currently under threat.

The most used method of administration for the treatment of rheumatic diseases is oral followed by external application. This predominance of oral administration constitutes the bulk of the preparation and use of plants in traditional medicine, it can be explained by its high effectiveness for treating these diseases (Selmani *et al.* 2017, Djerrou *et al.* 2022). Seventy percent of the species listed were utilized in with other plant components or non-plant substances. Combinations of several species can have a synergistic effect in addition to reducing the toxicity or side effects of certain of the mixture's plants (Bruschi *et al.* 2011). Including components like milk, honey, olive oil, or sugar is to make some plants that have an intolerably bitter flavor more palatable. In this ethnobotanical study, we found that the most used type of liquid in the preparation of medicinal plants for the treatment of rheumatic diseases among informants and herbalists is oil due to the bioavailability of certain active principles of medicinal plant, which are better absorbed when associated with certain adjuvants (Léonil and Cauvin, 2011).

Fidelity level (FL) is an important method for determining for which condition a particular species is most effective and can indicate the use of a particular species for a particular disease (Shil *et al.* 2014). In this study, FL values ranged from 33.33% to 100%. Generally, a 100% fidelity for a particular plant indicates that all usage reports mentioned the same method of using the plant for treatment. Therefore, high fidelity demonstrates the specificity of the plant for a particular disease and indicates good therapeutic potential against the specific disease (Asnak *et al.* 2016). High FL plants may contain large amount of bioactive compounds, therefore, are highly recommended for further phytochemical investigations (Hassan-Abdallah *et al.* 2013). Low fidelity, on the other hand, demonstrates indiscriminate use. Informant consensus factor (ICF) depends on the availability of plants in the study area to treat diseases, its value ranges from 0 to 1. The ICF values may vary from culture to culture reflecting the differences in medicinal plants found and used in these areas, and the ailments for which these plants are used (Caunca *et al.* 2021). The highest value of ICF indicates agreement in taxa selection among informants, while a low value indicates the reduced use of some to proper format. In the present study, ICF values ranged from 0.886 to 0.916 by use category. These high ICF values indicated reasonable reliability of informants on the use of plant species (Lin and Dibling, 2002). Additionally, this indicates that locals share their knowledge of the use of species for ethnobotanical therapy of rheumatic diseases in our study area. The calculated IARs values showed that 18 species have values equal to 1, indicating that survey participants agreed on the specific use of the species for a particular disease category (Thomas *et al.* 2009).

Despite the advances in modern medicine and the emergence of chemical drugs, traditional herbal medicine still holds the distinction of being an excellent treatment for certain diseases and is widespread among a wide segment of the population, where it continues to play an effective and important role. Arthritis and rheumatic diseases are often chronic and disabling, and medications do not always meet patients' expectations. Sometimes, patients resort to other practices, such as the use

of medicinal plants. Traditional herbal medicine, despite its popularity among the population, is not without side effects that can lead to poisoning or, in some cases, death. This requires proper use, strict supervision, and full awareness.

Conclusion

The current study presents a comprehensive ethnobotanical inventory and quantitative examination regarding medicinal plant traditions for the management and treatment of rheumatic ailments in the Setif district within the northeastern part of Algeria. The study findings underscore the richness and variability in traditional knowledge as practiced by local stakeholders, especially the elderly population and traditional healers, regarding the profound cultural importance attached to medicinal plant therapeutics in the management and treatment of rheumatic conditions. In addition, the quantitative ethnobotanical indicators that were used, including Use Value, Informant Consensus Factor, as well as fidelity levels, showed that there was agreement among the informants concerning specific plant species, thus demonstrating their reliability in addressing rheumatism. Beyond documenting indigenous cultural practices, this study also emphasizes the need to preserve ethnomedicinal practices that are often under threat due to socio-cultural dynamics and modernization trends. The markedly high consensus values obtained for some species indicate that these could prove to be ideal candidates for future validation their drug potential. Priority should be given to the eighteen types that have 100% accuracy in pharmacological testing for their effectiveness in treating inflammation and relieving pain. Concurrent toxicological assessment is essential, especially for types known for their toxicity. Future studies should include safety data and sociodemographic analyses. In conclusion, it can be said that the ethnobotanical heritage in the Setif region serves as a valuable resource for further development in the field of complementary therapy for rheumatic diseases. Therefore, there is a need to integrate such ethnobotanical knowledge with scientific research to be helpful for biodiversity, health systems, and the rational use of plant-based medicines. Hence, further documentation and inter/transdisciplinary research are vital for preserving ethnobotanical knowledge, considering its possible utility in modern medicine.

Declarations

List of abbreviations: PPV-Plant Part Value; IAR -Informant Agreement Ratio; U - total number of citations of medicinal uses of the species mentioned; Nr- total number of replies or quotations recorded for species; Na- number of conditions or diseases treated with species; Np- number of informants citing the species for a given disease; Nur- number of citations used in each category; Nt -number of species reported in each category; FL- Fidelity Level; FC- Frequency Citation; UVs- The use value of species; ICF- Informant consensus factor.

Ethics approval and consent to participate: Before beginning the ethnobotanical study, we obtained verbal consent from all participants.

Consent for publication: Not applicable

Availability of data and materials: The data featured in this manuscript can be obtained from the corresponding author.

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Author contributions: I.D., N.H.D. & H.H conducted the ethnobotanical survey, processed the data, and wrote the first version of the manuscript. N.H.D., H.H & M.M. prepared the questionnaire and collected the data. I.D. identified the plant species and directed the ethnobotanical survey. A.K. & N.C. monitoring data collection and analysis, helping with discussions, produced the location map, A.K., N.C. & S.K. contributed to the revision of the final version of the text.

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