



***Arctium atlanticum* in Moroccan and Algerian traditional medicine: a critical scoping review of ethnobotanical knowledge, botanical traceability, and conservation priorities**

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Review

Abstract

Background: *Arctium atlanticum* is a Moroccan-Algerian burdock associated with traditional medicinal practices but remains poorly documented as a people-plant relationship. This review synthesized ethnobotanical knowledge, vernacular nomenclature, botanical traceability, distribution, conservation, and limited experimental evidence directly attributable to the species.

Methods: Following Joanna Briggs Institute, PRISMA-ScR, and PRISMA-S guidance, Scopus, Web of Science, PubMed/MEDLINE, and Google Scholar were searched using the accepted name, historical synonyms, and vernacular names. The species-name search was updated on 13 July 2026, and vernacular-name searches were conducted on 29 July 2026. Direct evidence was analysed separately from contextual literature, and key decisions and extracted data were subsequently independently verified by a second author.

Results: Forty-two records were identified, eight duplicates removed, and 34 unique records screened. Nineteen sources were retained: 14 direct and five contextual. Four ethnobotanical surveys documented roots, leaves, underground parts, and capitula used as infusions, decoctions, raw material, or fried topical preparations. Reported purposes included hair and skin complaints, digestive and metabolic uses, and locally recorded “cancer” or “tumor” categories. Botanical traceability was uneven, while species-specific knowledge holders, transmission pathways, harvesting practices, doses, outcomes, and adverse effects were generally not reported. One publication provided in vitro evidence of antioxidant and cholinesterase-inhibitory activity. No validated species-specific phytochemical profile, toxicological study, or clinical evidence was found.

Conclusions: *A. atlanticum* is culturally relevant but ethnobotanically and experimentally underdocumented. Priorities are ethically grounded knowledge documentation, voucher-based authentication, population and harvesting assessment, conservation of associated knowledge, and characterization of documented preparations before pharmacological, computational, or preclinical investigation.

Keywords: *Arctium atlanticum*; *Lappa atlantica*; Burdock; Ethnobotany; Traditional knowledge; botanical traceability; Morocco; Algeria; PRISMA-ScR

Background

Ethnobotanical knowledge is not limited to lists of medicinal indications. It also encompasses the local names through which plants are recognized, the people who maintain and transmit knowledge, the organs selected, the ways preparations are produced and administered, and the ecological settings from which plant material is obtained. When these dimensions are incompletely documented, a reported medicinal use may become detached from both its cultural context and its botanical identity. This problem is particularly important for closely related plants that share vernacular names or are frequently discussed at the genus level.

Among burdocks, the scientific literature is dominated by *Arctium lappa* L. and, to a lesser extent, *A. tomentosum* Mill. and *A. minus* (Hill) Bernh. The North African species *A. atlanticum* (Pomel) H.Lindb. has received much less attention, despite being recorded in regional floras and medicinal-plant surveys from Morocco and Algeria (Kolomiets *et al.* 2021, Skowrońska *et al.* 2021).

The genus *Arctium* belongs to Asteraceae, tribe Cardueae. Its species are recognizable by their hooked involucre bracts, which attach mature capitula to animals and clothing and thereby promote epizoochorous dispersal.

Within this taxonomic setting, *A. atlanticum* is currently accepted as a species native to Morocco and Algeria (Royal Botanic Gardens, Kew 2026). It was first described as *Lappa atlantica* Pomel and was later treated as *A. minus* subsp. *atlanticum* (Pomel) Maire before being restored to species rank in the modern monograph of *Arctium* (Arènes 1950, Duistermaat 1996). Its principal diagnostic combination includes relatively broad involucre bracts and glabrous reddish-purple corollas that equal or exceed the involucre, together with smaller and more distinctly pedunculate capitula than those of several related burdocks (Duistermaat 1996).

The taxon has a geographically restricted Moroccan-Algerian distribution, but it is not limited to a single locality. Historical collections and recent inventories place it in western and northern Algeria and across several Moroccan mountain systems, including the Middle and High Atlas. Some regional floras describe the species as rare, yet no population-based assessment has established its area of occupancy, demographic trend, harvesting pressure, or formal conservation status.

Traditional knowledge provides an additional reason for closer attention. Surveys in Algeria and Morocco describe roots, leaves, capitula, or underground parts attributed to *A. atlanticum* in preparations for hair and skin complaints, digestive uses, traditional metabolic indications, and conditions recorded by investigators as “cancer” or “tumors” (Belhouala & Benarba 2021, Bouasla & Bouasla 2017, Errahmani & Zahir 2024, Ouelbani *et al.* 2016). These reports are culturally and scientifically valuable, but their meaning is easily overstated. An ethnobotanical indication demonstrates that a use was reported; it does not demonstrate that the preparation is effective, correctly dosed, or safe.

The available surveys also differ in the depth with which they document the human and cultural contexts of these practices. Vernacular names, plant parts, preparation methods, and broad indications are reported more frequently than the identity of the knowledge holders, modes of transmission, local explanations of illness, harvesting practices, plant sourcing, or perceived availability. Botanical traceability is similarly uneven, ranging from voucher-supported records to entries with incomplete or anatomically inconsistent documentation. These limitations affect not only scientific reproducibility but also the reliable preservation of the knowledge associated with the species.

Experimental evidence is considerably more limited. A genus-level review described the chemical composition of *A. atlanticum* as unstudied, and one subsequent publication reported in vitro antioxidant and cholinesterase-inhibitory responses of root extracts (Guettaf *et al.* 2022, Kolomiets *et al.* 2021). The full text confirmed botanical identification and herbarium deposition and described reference controls, replication, and statistical analysis, but did not provide a voucher number or species-specific chemical characterization. Findings from *A. lappa*, *A. tomentosum*, or other burdocks cannot be transferred to *A. atlanticum*, as comparative work has demonstrated variation according to species, organ, population, and collection site (Skowrońska *et al.* 2021).

A species-focused synthesis is therefore needed to reconstruct the fragmented botanical and ethnobotanical evidence, identify gaps in the documentation and conservation of traditional knowledge, and define the limited role that experimental evidence can presently support. The principal gap is not only the scarcity of species-specific studies, but also the uneven reliability with which reported medicinal practices can be linked to authenticated *A. atlanticum* material and interpreted within their original cultural context. Our targeted literature search did not identify a previous species-focused synthesis integrating the ethnobotanical knowledge, vernacular nomenclature, botanical traceability, geographical evidence, conservation concerns, and direct experimental evidence of *A. atlanticum*. Accordingly, the review distinguishes what is currently documented-accepted taxonomic status, occurrence in Morocco and Algeria, a small set of ethnobotanical records, and one in vitro experimental study- from what remains unresolved, including species-specific phytochemical composition, safety, population status, harvesting pressure, and species-specific cultural transmission. The present critical scoping review primarily maps ethnobotanical knowledge, vernacular nomenclature, botanical traceability, distribution, ecology, and conservation, while evaluating phytochemical, pharmacological, toxicological, and clinical evidence as secondary components. Its central methodological principle is that findings from authenticated *A. atlanticum* are treated as direct evidence, whereas information from other burdocks is used only as comparative context.

The review addressed four objectives:

- Clarify the accepted name, synonymy, diagnostic characters, vernacular nomenclature, geographical distribution, habitat, and conservation context of *A. atlanticum* in Morocco and Algeria.
 - Synthesize the documented traditional uses, plant parts, preparation methods, administration routes, knowledge holders, transmission pathways, and regional patterns associated with the species, while evaluating botanical traceability and cultural contextualization.
 - Assess the available phytochemical, pharmacological, toxicological, and clinical evidence directly attributable to *A. atlanticum* without transferring findings from related *Arctium* species.
- Identify the principal ethnobotanical, botanical, ecological, conservation, and experimentally justified research priorities for future investigation of the species.

Materials and Methods

Review design and question

This work was designed as a critical scoping review because the anticipated evidence base was small, heterogeneous, and distributed across disciplines with different reporting traditions. The review followed the PRISMA extension for scoping reviews (PRISMA-ScR) and updated Joanna Briggs Institute guidance (Peters *et al.* 2020, Tricco *et al.* 2018). Reporting of the literature searches was aligned with PRISMA-S (Rethlefsen *et al.* 2021). The review question, eligibility criteria, evidence categories, and data-charting fields were defined before completion of study selection; however, no formal protocol was prospectively registered or published.

The review question was: What evidence is available on the ethnobotanical knowledge, vernacular nomenclature, traditional preparations, botanical traceability, geographical distribution, and conservation of *Arctium atlanticum* in Morocco and Algeria, and how should the limited phytochemical, pharmacological, and safety evidence be interpreted in relation to these traditional uses? The Population-Concept-Context framework comprised: (i) *Arctium atlanticum* and records published under attributable botanical synonyms or reliably associated vernacular names; (ii) ethnobotanical knowledge, vernacular nomenclature, knowledge holders, plant parts, preparation and administration practices, botanical traceability, knowledge transmission, harvesting, conservation, and the limited phytochemical, pharmacological, toxicological, and clinical evidence; and (iii) Morocco, Algeria, and relevant North African cultural, botanical, and experimental contexts.

Information sources and search strategy

Scopus, Web of Science Core Collection, PubMed/MEDLINE, and Google Scholar were searched, with the main species-name search last updated on 13 July 2026 and the supplementary vernacular-name search conducted on 29 July 2026. Google Scholar was included because historical botanical literature, regional floras, proceedings, and grey literature were poorly represented in conventional biomedical databases. To broaden coverage beyond English-language indexed literature, targeted searching also considered French-language regional floras, theses, proceedings, historical botanical sources, and vernacular-name variants in English, French, and Arabic. Dedicated regional thesis repositories and comprehensive arabic-language bibliographic databases were not searched systematically, and this limitation is acknowledged below. Reference lists of key sources were examined, forward citations were checked, and targeted searches were conducted for taxonomic names, regional floristic records, and publications identified through citation chaining. Complete platform-specific search strategies, dates, and result counts are provided in Supplementary Table S1.

The core bibliographic search used the accepted name and attributable historical combinations: “*Arctium atlanticum*,” “*Lappa atlantica*,” “*Arctium minus* subsp. *atlanticum*,” and “*Arctium minus* ssp. *atlanticum*,” together with punctuation and abbreviation variants. All records returned by the productive exact-name searches were screened. For the productive Google Scholar exact-phrase searches, all results returned on the recorded search date were screened; therefore, no numerical cutoff or page-based stopping rule was applied. Domain terms such as taxonomy, distribution, ethnobotany, traditional medicine, medicinal use, phytochemistry, pharmacology, antioxidant activity, cholinesterase inhibition, and toxicity were used for targeted supplementary searching and domain-based screening but did not replace the exact taxon-name searches.

To improve the retrieval of ethnobotanical evidence that might not have been indexed under the accepted scientific name, an additional vernacular-name search was conducted on 29 July 2026 in Google Scholar, Scopus, Web of Science Core Collection, and PubMed/MEDLINE. The searches used the names **arkatyoun**, **arqtioun**, **bardan**, and **mezzr-izm**, together with spelling and transliteration variants and combinations involving Morocco, Algeria, ethnobotany, traditional medicine, and medicinal use. Google Scholar searches also included relevant terms in English, French, and Arabic.

The supplementary vernacular-name searches returned six records in Google Scholar, no records in Scopus, no records in Web of Science, and six false-positive records in PubMed. Four Google Scholar occurrences corresponded to two publications already present in the corpus, whereas the remaining two Google Scholar records and all six PubMed records were unrelated to *A. atlanticum* or North African ethnobotanical knowledge. No additional eligible source directly attributable to *A. atlanticum* was identified.

Records retrieved exclusively through vernacular-name searches were eligible for direct/species-attributable classification only when their connection to *A. atlanticum* could be supported by an accepted or historical scientific name, a voucher specimen, a diagnostic botanical description, an identifiable image, or another traceable botanical element. Records lacking sufficient botanical attribution were classified as contextual evidence or excluded from the species-level synthesis.

Searches concerning *A. lappa*, *A. minus*, and *A. tomentosum* were conducted separately to identify comparative chemical, pharmacological, or methodological literature. These records were not treated as evidence that a constituent, biological activity, traditional use, or safety property occurs in *A. atlanticum*. The search concepts and their roles in the review are summarized in Table 1.

Table 1. Search concepts and their role in the review.

Search component	Terms or approach	Purpose
Target taxon	“ <i>Arctium atlanticum</i> ”; “ <i>Lappa atlantica</i> ”; “ <i>Arctium minus</i> subsp. <i>atlanticum</i> ”; “ <i>Arctium minus</i> ssp. <i>atlanticum</i> ”	Retrieve direct and historical species records
Vernacular nomenclature	“ arkatyoun ”; “ arqtioun ”; “ bardan ”; “ mezzr-izm ”; spelling and transliteration variants; Arabic equivalents; combinations with Morocco, Algeria, ethnobotany, traditional medicine, and medicinal use	Retrieve ethnobotanical records potentially indexed without the accepted scientific name and assess the taxonomic reliability of local nomenclature
Evidence domains	taxonomy; nomenclature; distribution; flora; ecology; ethnobotany; medicinal use; phytochemistry; pharmacology; antioxidant; cholinesterase; toxicity	Support targeted supplementary searching and domain-based screening; not a replacement for exact-name queries
Comparative taxa	“ <i>Arctium lappa</i> ”; “ <i>Arctium minus</i> ”; “ <i>Arctium tomentosum</i> ”	Identify comparative methods and candidate analytical targets only; no direct attribution to the target species
Supplementary methods	Backward and forward citation searching; title and author searches; targeted regional-flora searches; vernacular-name searching in English, French, and Arabic	Identify poorly indexed historical, regional, ethnobotanical, and culturally relevant sources

Eligibility criteria and evidence categories

The primary corpus included sources that directly investigated *A. atlanticum* or an attributable synonym and provided extractable taxonomic, nomenclatural, palynological, typification, distributional, ecological, ethnobotanical, phytochemical,

pharmacological, toxicological, or clinical information. Eligible formats included peer-reviewed articles, monographs, floristic inventories, checklists, historical botanical reports, theses, and conference proceedings. No date restriction was imposed because nineteenth- and twentieth-century literature was indispensable for nomenclature and chorology.

Records were excluded when they were false-positive name matches, mentioned the species without extractable information, addressed another *Arctium* species without a clear comparative role, duplicated a more informative publication, or substantially overlapped with a later peer-reviewed source without adding unique target-species evidence. Grey literature was not excluded by format alone. The 2009 thesis on the *Arctium-Cousinia* complex, for example, was consulted but not counted as an independent included source because its relevant systematic content overlapped with the later journal article and it supplied no direct molecular data for *A. atlanticum*.

Evidence was organised into two explicitly separated streams. Direct/species-attributable evidence comprised records linked to *A. atlanticum*, *L. atlantica*, or *A. minus* subsp. *atlanticum*. Contextual/comparative evidence comprised purposively selected methodological criticism, medicinal-flora overviews, genus-level chemical reviews, and experiments on other burdocks. Contextual sources were used to evaluate transferability, suggest analytical approaches, and identify risks of species mixing; they could not establish that a constituent, activity, or safety property occurs in *A. atlanticum*.

Selection, extraction, and critical appraisal

Records were deduplicated using title, authors, publication year, and source. Titles and abstracts were screened first, followed by full-text assessment. Records retrieved through the supplementary vernacular-name searches were screened using the same eligibility criteria. Vernacular-name occurrences without sufficient botanical attribution to *Arctium atlanticum* were classified as contextual evidence or excluded as false-positive or non-attributable records.

During revision, the full text of the pharmacological article by Guettaf *et al.* (2022) was obtained and reassessed using the same experimental appraisal criteria. The study was therefore treated as full-text direct experimental evidence. No additional study was added to the corpus, and the final number of included sources remained unchanged. A structured extraction matrix captured variables appropriate to each evidence domain. Taxonomic and floristic sources were examined for accepted name, synonymy, diagnostic characters, examined specimens, localities, altitude, habitat, phenology, abundance terminology, and conservation-related information.

Ethnobotanical sources were examined for study region, study population, number and characteristics of informants, type of knowledge holder, vernacular name, voucher documentation, botanical identification procedure, plant part, source of plant material, harvesting practice, preparation method, administration route, dosage or frequency, locally reported indication, quantitative ethnobotanical indices, perceived efficacy, adverse-effect reporting, knowledge source or mode of transmission, ethical procedures, and conservation-related observations. Quantitative ethnobotanical indices were extracted as reported by the original studies and were not recalculated. Their definitions and denominators were checked against the source publications, and values from different studies were not treated as directly comparable unless the underlying calculation methods were sufficiently similar. Variables not provided by the original studies were recorded as “not reported” and were treated as evidence gaps rather than inferred.

Particular attention was given to the distinction between locally reported illness categories and biomedical diagnoses. Terms such as “purification,” “antibiotic,” “cancer,” and “tumor” were retained as reported by the original authors and were not interpreted as evidence of pharmacological activity or clinically confirmed disease. Vernacular names were similarly evaluated as culturally relevant identifiers but not as sufficient evidence of botanical identity in the absence of traceable authentication. Reported vernacular forms were preserved as published, and linguistic attribution was recorded only when explicitly supported by the original source. For the ethnobotanical synthesis, botanical confidence was categorized as voucher-supported, plausible but unvouchered, or botanically uncertain according to the presence of species-specific voucher documentation and any taxonomic or morphological inconsistencies in the source record.

Experimental studies were assessed for botanical authentication, extraction procedure, chemical standardization, reference controls, concentration-response analysis, independent replication, statistical reporting, assay interference, cytotoxicity, selectivity, biological-model relevance, and safety endpoints.

No single numerical appraisal tool was appropriate for sources ranging from nineteenth-century botanical reports to ethnobotanical surveys and enzyme assays. Critical appraisal was therefore domain-specific. Accordingly, a tailored domain-specific appraisal framework was used, with criteria adapted to the type of evidence and applied for interpretive weighting rather than to generate a numerical quality or risk-of-bias score. Taxonomic evidence was judged according to specimen

examination, diagnostic description, typification, and consistency with current nomenclature. Floristic evidence was judged according to field basis, locality precision, voucher documentation, abundance data, and distinction between regional rarity and formal conservation status.

Ethnobotanical evidence was judged according to sampling design, description of informants and knowledge holders, botanical authentication, documentation of vernacular nomenclature, preparation and administration details, quantitative use indices, cultural contextualization, knowledge transmission, ethical reporting, and distinction between local therapeutic terminology and biomedical interpretation. Experimental evidence was judged according to reproducibility, chemical definition, controls, selectivity, biological relevance, and safety assessment.

Synthesis, independent verification, and reporting

The evidence was synthesized narratively because the retained sources differed substantially in design, population, purpose, and outcome. No meta-analysis was appropriate. Direct/species-attributable evidence and contextual/comparative evidence were synthesized separately to avoid transferring traditional uses, chemical constituents, biological activities, or safety properties from related taxa to *Arctium atlanticum*.

Ethnobotanical evidence was synthesized thematically according to geographical and sociocultural setting, vernacular nomenclature, botanical traceability, knowledge holders, plant parts used, preparation methods, routes of administration, locally reported therapeutic categories, quantitative use indices, knowledge transmission, ethical reporting, harvesting practices, and conservation-related information. Regional similarities and differences were retained rather than combined into generalized medicinal claims. Variables that were absent from the original studies were reported as “not reported” and interpreted as documentation gaps.

Particular care was taken to preserve the terminology used in the original ethnobotanical surveys. Locally reported categories such as “purification,” “antibiotic,” “cancer,” and “tumor” were not converted into biomedical diagnoses or evidence of therapeutic efficacy. Similarly, vernacular-name similarity was not considered sufficient to establish botanical identity without traceable taxonomic support.

Contradictions and uncertainties were retained rather than harmonized artificially. Regional rarity was kept separate from formal IUCN conservation status, traditional indications were kept separate from demonstrated efficacy, and phytochemical or pharmacological findings from related *Arctium* species were kept separate from the composition and biological properties of the target species. The limited direct pharmacological evidence was interpreted as secondary experimental context and not as the central evidence base of the review.

Initial study selection, data extraction, and domain-specific appraisal were conducted by the first author, I.E.K., using the predefined eligibility criteria and data-charting framework. A second author independently verified the eligibility decisions, evidence classifications, full-text exclusions, and key extracted data against the available source material using Supplementary Table S6. On 31 July 2026, the second author also independently checked the records retrieved through the supplementary vernacular-name searches and confirmed their classification as previously included publications, duplicate occurrences, or unrelated false-positive records. No discrepancies were identified during either verification stage. Had any disagreement occurred, it would have been resolved by consensus between the two authors.

Complete search strategies, including the supplementary vernacular-name searches, record-disposition data, source characteristics, domain-specific appraisal criteria, data-charting fields, the independent-verification record, the PRISMA-ScR reporting crosswalk, the detailed research-priority framework, abstract-reported experimental outcomes, and comparative candidate analytical classes are provided in Supplementary Tables S1-S11.

Results

Search results and evidence landscape

The main species-name searches identified 27 records: 25 in Google Scholar and two in Scopus; PubMed and Web of Science returned no records for the exact taxon names. Citation chaining and targeted botanical searching added three records. The supplementary vernacular-name searches conducted on 29 July 2026 returned 12 additional records: six in Google Scholar and six in PubMed, whereas Scopus and Web of Science returned no records.

In total, 42 records were identified before deduplication. Eight duplicate records were removed, including four Google Scholar occurrences corresponding to two publications already present in the corpus, leaving 34 unique records for title and

abstract screening. Eleven records were excluded at this stage: three false-positive or unrelated records identified during the original search and eight unrelated records retrieved through the supplementary vernacular-name searches.

Twenty-three reports were sought for retrieval. Full text was obtained for 23 reports. Four full-text reports were excluded. The final synthesis therefore comprised 19 sources: ALL evaluated in full text (Fig. 1; Supplementary Tables S2, S3, and S5).

Fourteen sources formed the primary direct/species-attributable corpus: four taxonomic or systematic sources, five floristic or geographical sources, four ethnobotanical surveys, and one pharmacological article. Five additional full-text sources supplied methodological, medicinal-flora, genus-level chemical, or comparative experimental context. These five sources were analysed separately and were not counted as evidence that a traditional use, chemical constituent, biological activity, or safety property occurs in the target species.

The supplementary vernacular-name searches identified no additional eligible source. Their contribution was therefore methodological rather than numerical: they confirmed that the available ethnobotanical evidence remains concentrated in the previously identified surveys and highlighted the limited taxonomic specificity of vernacular nomenclature when unsupported by voucher-based authentication. The apparent breadth of the bibliography should not be mistaken for a large experimental or ethnobotanical evidence base; most direct sources remain botanical. The evidence domains represented among the 19 included sources are summarized in Table 2.

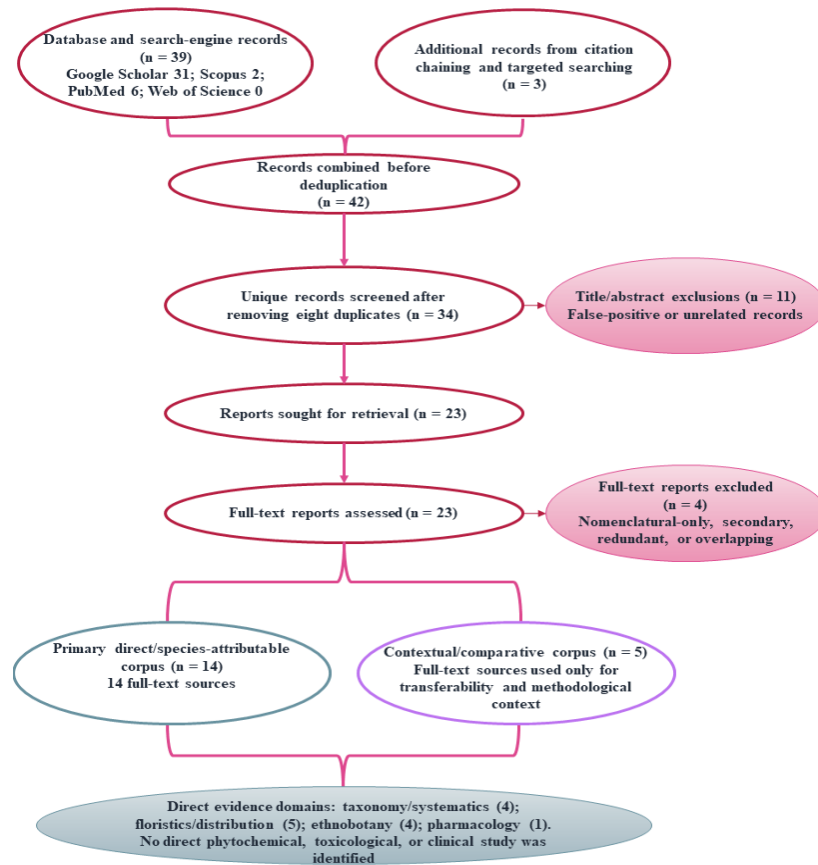


Figure 1. PRISMA-ScR flow diagram for the identification and classification of direct and contextual evidence.

Table 2. Evidence domains represented among the 19 included sources.

Evidence domain	Number	Main contribution
Taxonomy, nomenclature, and systematics	4	Species delimitation, synonymy, morphology, pollen, typification, and classification
Distribution, ecology, and floristics	5	Historical and recent occurrence records from Morocco and Algeria

Ethnobotany	4	Traditional uses, organs, preparations, vernacular names, and botanical traceability
Direct pharmacology	1	In vitro antioxidant and cholinesterase-inhibitory assays
Methodological, secondary, or comparative context	5	Medicinal-flora recognition, taxonomic reliability, genus chemistry, and interspecific comparison
Total	19	Fourteen direct/species-attributable and five contextual/comparative sources

Taxonomy, nomenclature, and species delimitation

The accepted name used throughout this review is *Arctium atlanticum* (Pomel) H.Lindb. The basionym is *Lappa atlantica* Pomel, and a major historical combination is *A. minus* subsp. *atlanticum* (Pomel) Maire. Current global taxonomic treatment accepts the species and places its native range in Morocco and Algeria (Royal Botanic Gardens, Kew 2026).

Arènes (1950) treated the taxon within a broad *A. minus* concept and assembled extensive morphological and geographical material from North Africa. Duistermaat's later monograph separated *A. atlanticum*, *A. minus*, and *A. nemorosum* as distinct species. The diagnostic value lies in a combination rather than a single character: relatively broad middle involucre bracts, glabrous corollas that equal or exceed the involucre, comparatively small capitula, and a racemose to subcorymbose synflorescence. Basal leaves were described as broadly ovate with hollow petioles and a pale, arachnoid lower surface (Duistermaat 1996).

Duistermaat (1996) also examined pollen, so the species is not supported by gross morphology alone. What remains missing is direct molecular placement. The molecular study that redefined the Arctioid lineage retained *A. atlanticum* in the accepted taxonomic framework, but the species itself was not represented by an accession in the published DNA dataset (López-Vinyallonga *et al.* 2011). Its current delimitation is therefore supported by morphology, palynology, herbarium evidence, and geography, while species-specific molecular confirmation remains pending.

Typification deserves careful wording. Duistermaat (1996) designated Faure material from Tlemcen as the neotype of *L. atlantica*. A North African type checklist also listed specimen MPU005639 under *Lappa sylvestris* Pomel, but publicly available metadata present its type status as uncertain (El Oualidi *et al.* 2012). That specimen should not be called a holotype, lectotype, or syntype without a dedicated nomenclatural reassessment, nor should it displace the published neotype of *L. atlantica*. The accepted name, principal synonyms, typification, diagnostic characters, and current evidential status of the species are summarized in Table 3.

Table 3. Taxonomic and nomenclatural synopsis of *Arctium atlanticum*.

Element	Current interpretation	Evidence and caution
Accepted name	<i>Arctium atlanticum</i> (Pomel) H.Lindb.	Accepted in the modern monograph and current global taxonomy (Duistermaat 1996, Royal Botanic Gardens, Kew 2026)
Basionym	<i>Lappa atlantica</i> Pomel	Historical records under this name are directly relevant
Infraspecific treatment	<i>Arctium minus</i> subsp. <i>atlanticum</i> (Pomel) Maire	Included when the record is clearly attributable to the North African taxon
Historically associated name	<i>Lappa sylvestris</i> Pomel	Relationship and type status require specialist reassessment
Neotype	Faure s.n., Tlemcen, Algeria (P)	Designated by Duistermaat (1996)
Main diagnostic combination	Broad involucre bracts; glabrous corolla equalling or exceeding the involucre; relatively small, pedunculate capitula	Identification is most reliable in flowering or fruiting material
Palynology	Examined in the monographic revision	Provides additional classical support
Direct molecular evidence	Not identified	Placement is currently inferred from broader systematic work, not a direct species sequence

Geographical distribution, ecology, and conservation

Historical and contemporary records converge on a north-western Maghrebian range. The species is best described as a Moroccan-Algerian endemic, not as a strictly Moroccan or strictly Algerian taxon. A nineteenth-century report documented *L. atlantica* around Oued Ouret and Terni near Tlemcen (Battandier & Trabut 1891), while later monographs compiled localities from Tlemcen, Constantine, Kabylia, Djurdjura, the Babor-Tababor area, and other Algerian regions (Arènes 1950, Duistermaat 1996). Moroccan records extend across the Middle and High Atlas and adjacent northern regions.

Recent field-based evidence shows that the species has not disappeared from either country. A five-year inventory in Marmoucha listed it as a spontaneous component of the eastern Middle Atlas flora and recorded the local name “*mezzrizm*” (Nassif & Tanji 2013). In Algeria, it appears in the updated flora of Belezma National Park and in both historical and current Djurdjura datasets (Benchouala *et al.* 2023, Meddour & Sahar 2025). An agricultural survey along the Moulouya wadi detected it in one of 22 alfalfa-olive fields or their margins, corresponding to an overall frequency of 5% and illustrating that at least some populations can occur in human-modified habitats (Tanji *et al.* 2026).

The ecological picture remains broader than any single habitat label. Historical records associate the species with moist oak or mixed forest, clearings, shaded places, alluvial or water-associated sites, roadsides, field margins, and calcareous nitrogen-rich soils, generally at montane elevations of approximately 800-1900 m (Duistermaat 1996). Recent reports add park grasslands and agricultural margins. These observations suggest ecological flexibility within predominantly cool or relatively humid mountain landscapes; they do not justify calling the species exclusively forest-dwelling, aquatic, rupicolous, or agricultural.

Conservation inference is limited. Belezma and Djurdjura sources describe the species as rare within regional floristic classification systems (Benchouala *et al.* 2023, Meddour & Sahar 2025). Such labels indicate low frequency or limited regional occurrence, but they are not equivalent to an IUCN Red List category. No species-specific assessment was identified in the IUCN Red List; therefore, the species is treated here as Not Evaluated (NE) at the IUCN level. No study estimated the number of populations or mature individuals, extent of occurrence, area of occupancy, fragmentation, recruitment, or trend. The defensible conclusion is that the species is geographically restricted and insufficiently assessed.

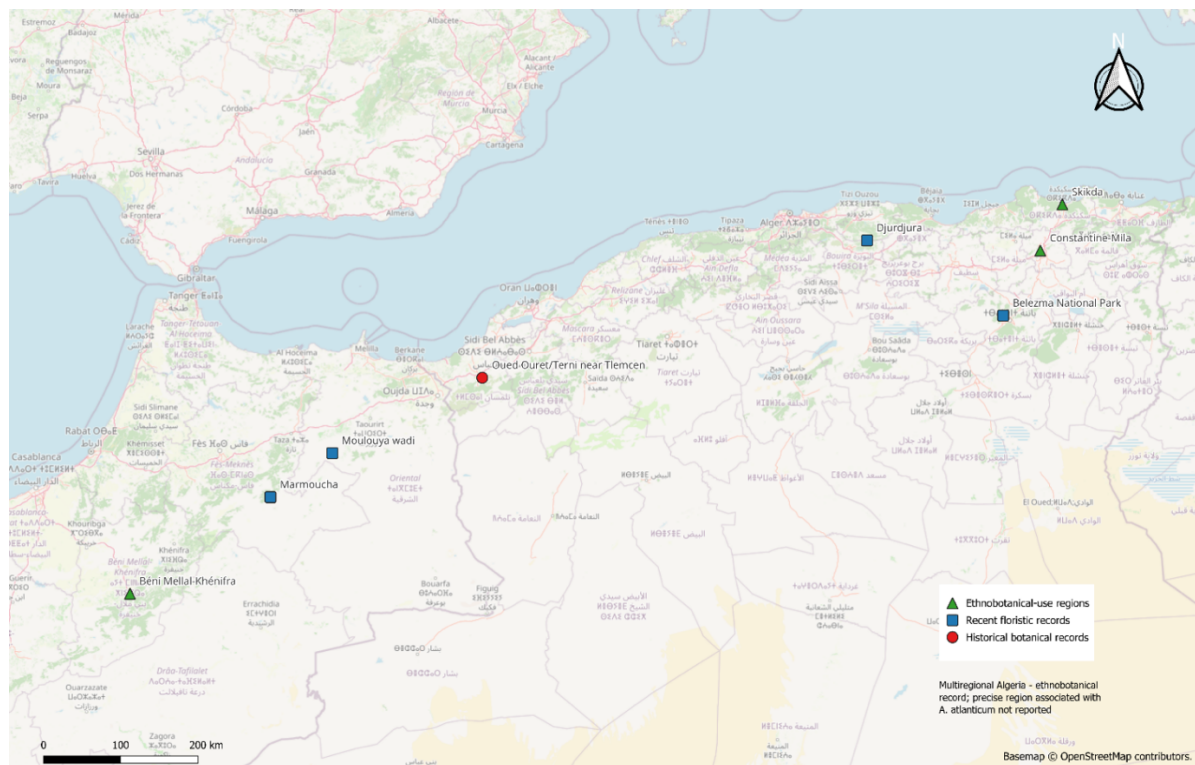


Figure 2. Geographical distribution of the principal historical, recent floristic, and ethnobotanical records of *Arctium atlanticum* identified in the review.

Symbols distinguish historical botanical records, recent floristic occurrences, and regions represented in ethnobotanical surveys. Locations are mapped at the level of geographical precision reported by the original sources; approximate regional placement does not represent exact collection coordinates. Map prepared using QGIS 3.44.14.

The selected geographical records and their evidential limits are summarized in Table 4.

Table 4. Selected geographical records and their evidential limits.

Country/region	Evidence	Main limitation	Period and source
Tlemcen, Algeria	Occurrence at Oued Ouret/Terni under <i>Lappa atlantica</i>	No coordinates, abundance, or species-specific microhabitat	1890-1891; Battandier & Trabut (1891)
Multiple Algerian regions	Herbarium-based distribution including Tlemcen, Constantine, Kabylia, Djurdjura, and Babor areas	Heterogeneous collection effort and mainly historical records	Historical; Arènes (1950), Duistermaat (1996)
Marmoucha, Morocco	Spontaneous occurrence in the eastern Middle Atlas	No target-specific abundance, coordinates, or voucher code reported in the list	2008-2012; Nassif & Tanji (2013)
Belezma National Park, Algeria	Recent inventory; classified as rare, hemicryptophytic, and zoochorous/epizoochorous	Regional rarity, not formal threat status; no population estimate	Benchouala <i>et al.</i> (2023)
Djurdjura, Algeria	Present in historical and current data; coded Algerian-Moroccan and rare	No target-specific population trend or coordinates	1854-2024 synthesis; Meddour & Sahar (2025)
Moulouya wadi, Morocco	One occurrence among 22 surveyed fields/margins	Highly localized observation; habitat position within field system unclear	2021-2022; Tanji <i>et al.</i> (2026)

Vernacular recognition and botanical traceability

Four primary surveys attributed medicinal uses to *Arctium atlanticum*: three were conducted in Algeria and one in Morocco. The recurrent form **arkatyoun** or **arqtioun** (ارقطيون; also reported as **الارقطيون**) was recorded in Constantine and Mila, Skikda, and the multiregional Algerian survey, whereas the Moroccan survey reported **bardan** (بردان) / **arqtioun** (ارقطيون). A floristic inventory from Marmoucha additionally associated the name **mezzr-izm** with the species; this Amazigh-associated local name was reported in Latin transcription in the original source, without an Arabic-script form. Although it did not report a medicinal use. These records indicate recognition of the plant, or of material attributed to it, across several geographical and linguistic settings. They do not establish that the vernacular names are taxonomically interchangeable or consistently refer to the same biological material.

Botanical traceability differed substantially among the four surveys. Voucher LBTE.11 supported the Skikda record, and voucher LRSBG/AB/20/119 supported the multiregional Algerian record. In contrast, the Constantine-Mila study did not display a species-specific voucher code and placed the taxon incorrectly under Brassicaceae rather than Asteraceae. The Moroccan record provided no target-specific voucher and coded the organ as a “bulb,” an anatomically inconsistent designation for *Arctium*. For interpretive purposes, botanical confidence was classified as voucher-supported, plausible but unvouchered, or botanically uncertain. The Skikda and multiregional Algerian records were classified as voucher-supported because they provided species-specific voucher numbers. The Constantine-Mila record and the Moroccan record were classified as botanically uncertain because of, respectively, the incorrect family assignment and the anatomically inconsistent “bulb” designation combined with the absence of a species-specific voucher. None of the four medicinal-use records met the intermediate category of plausible but unvouchered evidence.

Plant parts, preparations, and routes

The available records preserve several forms of practical knowledge rather than one standardized remedy. In Constantine and Mila, roots and leaves were prepared by infusion or decoction, with internal and external applications. In Skikda, an underground part was decocted and reportedly consumed at a frequency of one to two glasses per day. In the multiregional Algerian survey, leaves and capitula were fried and applied topically. In Béni Mellal-Khénifra, material coded as a “bulb” was reportedly used raw, although the administration route and exact nature of the underground organ were insufficiently characterized.

The documented practices varied according to plant organ, preparation method, and administration route. Most reports did not provide plant mass, solvent volume, preparation time, storage, co-ingredients, frequency, treatment duration, or criteria used to discontinue treatment.

In the table 5 arabic-script forms are reproduced from the source publications where provided. Mezzr-izm is retained in the Latin transcription used by Nassif and Tanji (2013), because no arabic-script form was supplied in the source.

Table 5. Primary ethnobotanical records of *Arctium atlanticum* and their documentation limits.

Study and setting	Overall Survey sample / species-specific reporters	Vernacular name and authentication	Material practice	Reported purpose and index	Principal interpretive limits
Ouelbani <i>et al.</i> (2016); Constantine and Mila, Algeria	79 informants overall: 45 herbalists and 34 local residents aged 60 years or older; number and profile of participants reporting <i>A. atlanticum</i> : not reported	Arkatyoun (ارقطيون); no species-specific voucher code displayed; incorrect family assignment Botanical confidence: botanically uncertain	Roots and leaves; infusion or decoction; internal and external uses	Hair loss; purification; traditional hypoglycemic, sudorific, digestive, dermatological, and “antibiotic” uses; use value (UV) 1.368	Exact informant group, organ-preparation-indication correspondence, dose, duration, plant source, outcome, and species-specific adverse effects not reported
Bouasla and Bouasla (2017); Skikda, Algeria	89 respondents. Number and demographic characteristics of participants reporting <i>A. atlanticum</i> : not reported	Arkatyoun (ارقطيون); voucher LBTE.11 Botanical confidence : voucher-supported	Underground part; oral decoction; 1-2 glasses/day	Indication reported as “cancer”; UV 0.33	Cancer type and diagnosis, plant-to-water ratio, glass volume, duration, concomitant treatment, outcome, and adverse effects not reported
Belhouala and Benarba (2021); multiregional Algeria	Survey involved traditional knowledge holders; Number and profile of participants specifically reporting <i>A. atlanticum</i> : not reported	Arkatyoun/arqtioun (الأرقطيون); voucher LRSBG/AB/20/119 Botanical confidence: voucher-supported	Leaves and capitula; fried; topical	Boils, pimples, and locally described “tumors”; each category represented by a single use report	Low consensus; frying procedure, quantity, duration, outcome, adverse effects, and species-specific transmission pathway not reported
Errahmani and Zahir (2024); Béni Mellal-Khénifra, Morocco	239 respondents, including consumers and herbalists; Species-specific reporters: 1; this participant was not further characterized	Bardan (بردان) /arqtioun (ارقطيون); no target-specific voucher; organ coded as “bulb” Botanical confidence: botanically uncertain	Raw plant material; route insufficiently characterized	Traditional management of hypercholesterolemia; frequency of citation (FC) 1, relative frequency of citation (RFC) 0.005	Single citation; possible coding or identification problem; no precise locality, dose, frequency, duration, measured lipid outcome, or species-specific adverse effect

Overall survey sample refers to the total number of participants in the original ethnobotanical study; species-specific reporters refers only to participants explicitly linked to the *A. atlanticum* record. ‘Not reported’ indicates that the original publication did not provide a species-specific number.

UV, FC, and RFC values are reproduced as reported in the original studies and were not recalculated. UV denotes use value; FC, frequency of citation; and RFC, relative frequency of citation. Because study designs, denominators, and calculation procedures may differ, these indices were interpreted within each original study and were not used for direct cross-study ranking.

The Ouelbani survey included 45 herbalists and 34 older members of the local population, but the article did not identify which group reported the *A. atlanticum* uses. The Skikda survey interviewed 89 people and deposited identified plant material as herbarium specimens; its table directly links voucher LBTE.11 to the underground-part decoction. The Moroccan study included 239 respondents across the five provinces of Béni Mellal-Khénifra, but its *A. atlanticum* entry was based on only one citation.

Patterns of use and limits of convergence

Topical and dermatological practices form the clearest recurring theme. Given that the evidence derives from only four ethnobotanical surveys, these recurring themes should be interpreted as descriptive patterns within the published record rather than as evidence of cultural consensus or widespread regional practice. The corpus includes external use for hair loss, general dermatological complaints, boils, pimples, and a cutaneous condition described by the original authors as “tumors.”

Metabolic uses were reported in two distinct settings. Ouelbani *et al.* recorded a traditional hypoglycemic purpose, whereas Errahmani and Zahir recorded one citation concerning hypercholesterolemia. These indications involve different outcomes and were not accompanied by measurements of blood glucose, cholesterol, or other clinical parameters.

The two records involving “cancer” and “tumors” are also fundamentally different. The Skikda report concerned an orally consumed decoction of an underground part, whereas the multiregional survey concerned fried leaves and capitula applied topically for pimples and locally described “tumors”. They preserve two reported therapeutic categories whose biomedical meanings were not established.

Terms such as “purification,” “antibiotic,” “cancer,” and “tumor” are therefore retained as presented in the original surveys. They are not converted into evidence of detoxifying, antibacterial, anticancer, or other pharmacological activity. This distinction is central because ethnobotanical reporting documents what people or survey authors called a practice; it does not independently confirm the biomedical diagnosis or biological mechanism.

Knowledge holders, transmission, and cultural continuity

The four surveys provide useful human context at the level of their overall study populations, but rarely connect this information directly to the *A. atlanticum* entry. The Constantine-Mila study involved both older local residents and younger herbalists, while the Skikda study collected respondent age, sex, education, income, and plant-source information. The multiregional Algerian study focused on traditional knowledge holders, and the Moroccan study included both consumers and herbalists. However, the publications did not establish, specifically for *A. atlanticum*:

- Who maintained each practice ;
- Whether the knowledge was familial, inherited, professional, or acquired from another source ;
- Whether it differed according to age, gender, language, or locality ;
- Whether the practice remained common or was declining ;
- How local users distinguished the plant from related burdocks or other plants bearing similar names.

These absences should not be interpreted as evidence that transmission or cultural context did not exist. Rather, they show that the surveys were designed primarily to inventory medicinal plants across broad regions and did not reconstruct the species-specific social history of *A. atlanticum*.

Harvesting practices were similarly underreported. Roots and underground organs may require destructive collection, yet the available entries did not document whether the plants were gathered from the wild, cultivated, purchased, substituted, or harvested according to local restrictions. Season, quantity collected, perceived availability, regeneration, and harvesting pressure were not linked to the species. This information gap is particularly important because floristic sources describe *A. atlanticum* as geographically restricted and regionally rare in some Algerian inventories.

Overall, the ethnobotanical literature preserves fragmented but meaningful evidence of regional names, selected organs, preparation practices, and therapeutic categories. Its greatest limitation is not simply the absence of experimental validation; it is the incomplete documentation of the people, transmission pathways, local classifications, harvesting systems, and ethical relationships through which this knowledge is maintained.

Limited experimental evidence

Only one experimental publication directly attributable to the target taxon was identified. Guettaf *et al.* (2022) investigated root material labelled *Arctium minus* subsp. *atlanticum* collected in Sétif, eastern Algeria. Taxonomic identification was performed by the Laboratory of Development of Natural Biological Resources at the University of Sétif, and voucher specimens were reported as deposited in the herbarium of the Faculty of Biology at the same university, although no voucher number was provided. Aqueous, hydromethanolic, and ethyl acetate extracts were evaluated using DPPH, galvinoxyl, β -carotene bleaching, CUPRAC, and AChE/BChE inhibition assays. Reference standards included BHA, BHT, α -tocopherol, and galantamine, and the experiments were reported in triplicate with statistical analysis based on one-way ANOVA followed by Tukey's post hoc test.

These findings provide direct in vitro experimental evidence but remain secondary to the ethnobotanical evidence synthesized in this review. The antioxidant tests were cell-free chemical assays, whereas cholinesterase inhibition was assessed using isolated enzymes. No cellular, animal, or human model was used.

The study did not report species-specific chromatographic profiling or compound identification, cytotoxicity, or selectivity assessment. In addition, cholinesterase IC₅₀ reporting was internally inconsistent: the abstract reported values of 265 ± 21 and 240 ± 6.3 $\mu\text{g/mL}$, whereas Table 3 reported IC₅₀ values of <200 $\mu\text{g/mL}$ despite inhibition remaining below 50% at 200 $\mu\text{g/mL}$. These discrepancies warrant cautious interpretation.

Phytochemical evidence gap

No species-specific phytochemical profile of authenticated *Arctium atlanticum* material was identified. The genus-level review by Kolomiets *et al.* (2021) explicitly indicated that the chemical composition of the species had not been studied, while the only direct experimental publication provided no chromatographic profile, marker quantification, total phenolic or flavonoid measurements, or isolated constituents. Consequently, no metabolite can currently be considered a confirmed constituent of *A. atlanticum*.

Related *Arctium* species contain phenolic acids and caffeoylquinic acid derivatives, flavonoids, lignans, polysaccharides, polyacetylenes, terpenoids, sterols, and other metabolite classes (Kolomiets *et al.* 2021, Ydyrys 2023). However, comparative analysis of authenticated *A. lappa* and *A. tomentosum* material showed that chemical profiles varied according to species, plant organ, population, and collection site (Skowrońska *et al.* 2021). These compounds therefore represent possible analytical targets for future investigation, not the presumed composition of *A. atlanticum*.

This evidence gap also limits the interpretation of traditional practices. The documented infusions, decoctions, raw material, and fried topical preparations cannot presently be linked to specific compounds or standardized extracts. Future chemical studies should therefore use voucher-authenticated material and examine organs and preparation methods that correspond, as closely as possible, to the practices documented in the ethnobotanical literature. Selected analytical targets derived exclusively from comparative literature are summarized in Supplementary Table S11.

Safety implications of documented traditional practices

No species-specific toxicological or clinical study of *Arctium atlanticum* was identified. The available literature contains no validated assessment of cytotoxicity, genotoxicity, acute or repeated-dose toxicity, dermal irritation, sensitization, or other organ- and extract-specific safety endpoints. The only direct experimental publication did not report a cytotoxicity experiment or selectivity index. The absence of such data constitutes an evidence gap and should not be interpreted as evidence of safety.

Safety considerations must be related to the practices actually documented in the ethnobotanical surveys. These included oral infusions and decoctions prepared from roots, leaves, or underground material; raw plant material associated with one Moroccan report; and fried leaves and capitula applied topically. However, plant quantity, preparation ratio, final concentration, duration of use, treatment frequency, participant characteristics, concomitant therapies, and systematic

monitoring of adverse effects were generally not reported. Even the reported intake of one to two glasses per day cannot be converted into a reproducible dose without information on glass volume and preparation concentration.

Botanical identity, organ, preparation, and source of material are also relevant to safety. A root decoction is not chemically equivalent to a raw underground organ, a leaf infusion, or a fried topical preparation. The incomplete voucher documentation in two surveys and the anatomically inconsistent “bulb” entry create additional uncertainty regarding the plant material actually used. Vernacular names should therefore not be relied upon as the sole basis for safety attribution.

The origin and harvesting environment of the material were rarely documented. *Arctium atlanticum* has been recorded in roadsides, disturbed sites, field margins, and agricultural systems, where collected plants could potentially be exposed to heavy metals, pesticide residues, dust, or microbial contamination. No contaminant analysis specific to the species was identified. In addition, harvesting roots or other underground organs may be destructive to individual plants and could have conservation implications if practiced intensively; however, no study identified in this review quantified harvesting pressure or population-level effects.

No clinical trial, pharmacokinetic investigation, documented therapeutic case series, or pharmacovigilance dataset was found. There is consequently no evidence-based human dose, validated indication, contraindication, interaction profile, or established safety margin for *A. atlanticum*. Future safety research should begin with authenticated plant material and should reproduce the organ, preparation, and administration route documented in the traditional practice being evaluated.

Discussion

A fragmented but meaningful people-plant relationship

The strongest conclusion of this review is not that *Arctium atlanticum* has a demonstrated therapeutic effect, but that it occupies a documented, although fragmented, place in Moroccan and Algerian medicinal-plant knowledge. Across Algerian and Moroccan settings, the species or material attributed to it was associated with several vernacular names, plant organs, preparation methods, administration routes, and therapeutic categories. This diversity should not be forced into a single pharmacological narrative. It reflects the local, practical, and context-dependent character of ethnobotanical knowledge.

Topical and dermatological practices constitute the clearest recurring theme. The reviewed surveys reported external use for hair loss, dermatological complaints, boils, pimples, and a condition described as “tumors.” These reports involved roots, leaves, and capitula prepared by infusion, decoction, or frying. Their recurrence justifies closer ethnobotanical investigation of skin-related practices, but it does not establish a uniform dermatological tradition or demonstrate clinical efficacy. Hair loss, boils, pimples, general skin complaints, and locally described tumors are distinct conditions, and the preparations associated with them were not equivalent.

The metabolic reports also require separation. A traditional hypoglycemic purpose was documented in one Algerian survey, whereas the Moroccan survey recorded one citation for traditional management of hypercholesterolemia. These indications concern different physiological outcomes and were not supported by measurements of glucose, cholesterol, or treatment response. Combining them into a generalized “metabolic activity” would therefore exceed the evidence.

The same caution applies to the terms “cancer” and “tumor.” The Skikda record concerned an orally consumed decoction of an underground part for an indication described as “cancer,” whereas the multiregional Algerian record involved fried leaves and capitula applied topically for pimples and locally described “tumors.” Their organs, preparations, routes, and likely cultural meanings differed. They cannot be combined as convergent anticancer evidence. The review preserves these expressions as reported categories without translating them into confirmed biomedical diagnoses or therapeutic claims.

Traditional knowledge should be documented in its social context

The available surveys provide more information about medicinal-plant inventories than about the social history of knowledge associated specifically with *A. atlanticum*. At the survey level, they involved herbalists, consumers, older residents, and traditional knowledge holders. One study reported that much of the broader medicinal knowledge was inherited, while another included older local residents alongside younger herbalists. However, the publications rarely identified which type of participant reported the uses of *A. atlanticum*, how that person had learned the practice, or whether the knowledge was familial, professional, intergenerational, or acquired through markets or other social networks.

This absence is an important result. It does not demonstrate that transmission was absent; it shows that species-specific transmission was insufficiently documented. Future ethnobotanical studies should therefore record, when participants consent:

- The category and locality of the knowledge holder ;
- The language and vernacular terminology used ;
- The source and mode of knowledge transmission ;
- Whether the practice is current, declining, or being modified ;
- How the plant is recognized and distinguished from similar species ;
- Whether material is collected, cultivated, purchased, or substituted.

Local therapeutic terminology should be preserved before biomedical interpretation. Expressions such as “purification,” “antibiotic,” “cancer,” and “tumor” may represent translations, investigator-defined categories, or culturally specific descriptions of illness and care. Future work should record the original expression, its local explanation, and the later analytical category separately, rather than assuming direct equivalence with a biomedical diagnosis or pharmacological mechanism. This would reduce the risk of transforming culturally situated knowledge into unsupported biomedical claims.

Documentation should also respect the limits of disclosure. Not all knowledge is necessarily intended for unrestricted publication. Consent should be meaningful and ongoing, and participants or communities should be involved in decisions concerning acknowledgement, confidentiality, access to sensitive information, and benefit-sharing when their knowledge contributes to subsequent scientific or commercial investigation.

Botanical traceability protects both science and traditional knowledge

The taxonomic literature supports the recognition of *A. atlanticum* as a Moroccan-Algerian species, but botanical authentication within the ethnobotanical literature was uneven. Two surveys provided species-specific vouchers, whereas another displayed no species-specific voucher code and incorrectly placed the taxon under Brassicaceae. The Moroccan entry coded the used organ as a “bulb,” an anatomically inconsistent designation for *Arctium*.

These inconsistencies may arise from transcription, translation, coding, identification, or publication errors. Regardless of their origin, they weaken the connection between the reported practice and the scientific species name. A valid taxonomic species does not guarantee that every applied record attributed to it used correctly identified material. Similar taxonomic and chorological weaknesses have been identified as important sources of error in Algerian ethnobotanical research, where incorrect plant identification may subsequently affect phytochemical and pharmacological interpretation (Miara 2019).

Voucher-based authentication should therefore not be treated as a purely technical laboratory requirement. It protects knowledge holders from having their practices attached to the wrong plant and prevents scientific or commercial conclusions from being developed from misidentified material. Future studies should link:

- The local plant name;
- Photographs of the material recognized by participants ;
- Complete flowering or fruiting specimens ;
- Habitat, locality, coordinates, and phenology;
- Collector and identifier information ;
- A voucher code and herbarium deposition ;
- The corresponding interview or use record.

Local recognition and botanical expertise should be combined rather than treated as competing systems. DNA barcoding and direct phylogenetic inclusion would strengthen species confirmation, especially within the *A. minus* complex, but molecular data cannot replace careful morphology, vouchers, or documentation of local identification practices.

The traceability problems identified here are not unique to *A. atlanticum*. In a review of medicinal-plant research in Morocco, Ouarghidi *et al.* (2013) found that voucher collection was reported in 58% of the examined publications, whereas voucher numbers were reported in only 35%, and they emphasized that a single vernacular name may correspond to more than one botanical species. More recently, a methodological review of Moroccan ethnobotany identified persistent reporting gaps involving study duration, informant demographics, and statistical methods (Benamar *et al.* 2026). Together with the

taxonomic and chorological concerns previously highlighted for Algerian ethnobotanical research (Miara 2019), these findings place the traceability limitations observed for *A. atlanticum* within broader methodological challenges documented in Moroccan and Algerian ethnobotany, without implying that their frequency or severity is uniform across regions.

Conservation of the plant and conservation of knowledge

Arctium atlanticum has a geographically restricted Moroccan-Algerian distribution and has been described as rare in more than one regional Algerian flora. These reports do not constitute a formal threat assessment, but they justify precaution. No population-level study has established abundance, recruitment, demographic trends, area of occupancy, or harvesting pressure.

The reported use of roots and underground organs is potentially destructive at the individual-plant level because their collection may remove the whole plant ; however, the available evidence does not demonstrate that such harvesting currently constitutes a population-level pressure on *A. atlanticum*.

Yet none of the ethnobotanical entries established whether the material was:

- Collected from wild populations ;
- Cultivated ;
- Purchased from herbal markets;
- Obtained from disturbed or agricultural habitats ;
- Substituted with another burdock or another locally named plant.

Ecological and ethnobotanical investigation should therefore proceed together. Population surveys should revisit historical and recent localities and document abundance, recruitment, habitat condition, and threats. Ethnobotanical interviews should examine harvesting season, selected plant size, quantity collected, collection frequency, regeneration, perceived scarcity, local restrictions, cultivation, and substitution.

Plant conservation and knowledge conservation should not be assumed to follow the same trajectory. A biological population may persist while an associated practice declines, or traditional knowledge may remain active while access to the plant becomes restricted. A biocultural approach should monitor both dimensions and avoid treating communities only as sources of research information or as causes of harvesting pressure.

Phytochemistry and pharmacology have a supporting role

The experimental evidence is too limited to constitute the main foundation of the review. Only one directly attributable pharmacological publication was identified, its full-text in vitro antioxidant and cholinesterase assays provide preliminary experimental evidence, but the study lacked species-specific chemical characterization and cytotoxicity or selectivity assessment. But they do not outweigh the ethnobotanical and botanical evidence or establish therapeutic efficacy.

Similarly, no validated species-specific phytochemical profile was found. Compounds reported from *A. lappa*, *A. tomentosum*, or other burdocks may guide future analytical work, but they cannot be attributed to *A. atlanticum* without direct detection in authenticated material. Comparative literature is useful for generating analytical hypotheses, not for constructing a presumed chemical composition.

Future laboratory investigation should therefore support the ethnobotanical foundation rather than replace it. Chemical studies should prioritize voucher-authenticated organs and preparations that correspond to documented practices, including aqueous infusions or decoctions and topical preparations where scientifically reproducible. Different organs, populations, and harvesting environments should be compared because related burdocks show species-, organ-, and locality-dependent chemical variation.

Only authenticated and chemically characterized preparations should proceed to replicated bioassays with complete concentration-response data, appropriate controls, interference assessment, independent replication, and cytotoxicity testing. The biological models selected should relate to clearly documented practices without converting local illness categories into assumed mechanisms. Bioassay-guided fractionation, compound isolation, computational modelling, mechanistic studies, and preclinical investigation belong later in the sequence and only when the preceding ethnobotanical, botanical, ecological, chemical, and safety evidence justifies progression.

Prioritized research roadmap

The evidence gaps identified in this review support a staged research roadmap in which ethnobotanical documentation, botanical reliability, ethical engagement, and conservation precede experimental valorization. Progression should depend on completion of explicit minimum requirements at each stage rather than on the presumed medicinal potential of the species.

The first priority is to document the people-plant relationship more completely. Future ethnobotanical work should identify the geographical and linguistic setting of each use, the categories of knowledge holders involved, vernacular nomenclature, plant-recognition practices, knowledge-transmission pathways, plant sourcing, harvesting methods, preparation procedures, administration routes, and locally defined therapeutic categories. Original local terminology should be recorded separately from later biomedical interpretation. Consent, confidentiality, acknowledgement, community participation, and benefit-sharing should be incorporated from the beginning of the research process.

Botanical and ecological verification should proceed in parallel. Each use record should be linked to voucher-authenticated plant material, diagnostic photographs, collector and identifier information, locality, coordinates, habitat, and phenological stage. Molecular confirmation may strengthen the attribution of material within the *Arctium* minus complex but should complement, rather than replace, morphology and herbarium documentation. Population surveys should assess abundance, recruitment, habitat condition, harvesting pressure, and the consequences of destructive collection of roots or underground organs.

Only after these foundations are established should chemical and biological validation begin. Chemical studies should compare authenticated organs, populations, and preparations that reflect documented practices. Infusions, decoctions, raw material, and topical preparations should not be treated as chemically interchangeable. Analytical approaches may include liquid chromatography-high-resolution mass spectrometry (LC-HRMS), gas chromatography-mass spectrometry (GC-MS), and nuclear magnetic resonance (NMR), but the purpose should be to characterize the material actually used rather than to presume the presence of metabolites reported from related burdocks.

Replicated bioassays should be conducted only with chemically characterized preparations and should include complete concentration-response experiments, appropriate positive and negative controls, independent replication, interference assessment, and preliminary cytotoxicity or selectivity testing. Experimental models should be selected in relation to well-documented uses, while recognizing that local therapeutic categories may not correspond directly to a single biomedical mechanism.

Bioassay-guided fractionation, compound isolation, mechanistic studies, computational modelling, extract-specific toxicology, and staged preclinical investigation should be considered only when preceding botanical, ethnobotanical, ecological, chemical, and biological requirements have been satisfied. Computational approaches may support the investigation of experimentally confirmed compounds and plausible targets, but they should not be used to transfer chemical or pharmacological claims from other *Arctium* species.

Strengths and limitations of the review

The principal strength of this review is its species-level and ethnobotanical discipline. Historical botanical synonyms and vernacular names were searched, direct/species-attributable evidence was separated from contextual literature, and local therapeutic terminology was preserved without being converted into biomedical efficacy claims. The integration of taxonomy, floristics, ethnobotany, conservation, phytochemistry, pharmacology, and safety made it possible to examine not only what has been reported about *Arctium atlanticum*, but also how reliably the reported knowledge can be connected to the accepted botanical species.

The supplementary vernacular-name searches strengthened the assessment of ethnobotanical coverage. They confirmed that no additional eligible source was retrieved beyond the previously identified corpus and showed that local names alone provide insufficient taxonomic certainty. The thematic re-extraction of the four ethnobotanical surveys also made visible several dimensions that were incompletely reported, including species-specific knowledge holders, transmission pathways, plant sourcing, harvesting practices, local disease explanations, preparation details, and adverse-effect monitoring.

The proposed sequence therefore moves from ethically documented knowledge and authenticated plant material to conservation assessment, practice-relevant chemical characterization, reproducible biological testing, safety evaluation, and only then justified translational investigation. The principal evidence-building priorities are summarized in Figure 3, whereas detailed actions and minimum progression criteria, including subsequent fractionation, mechanistic, computational, and preclinical steps, are provided in Supplementary Table S9.

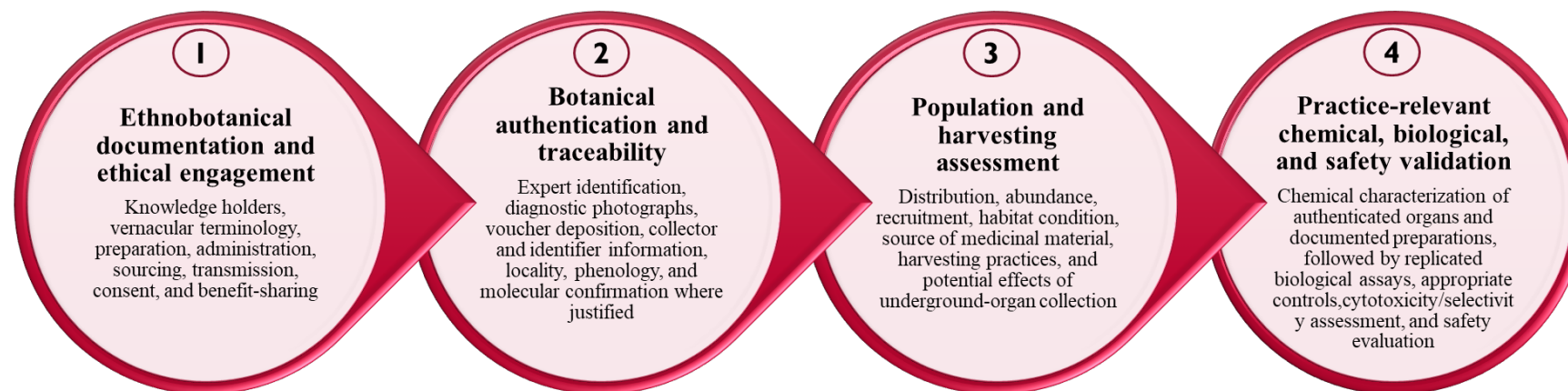


Figure 3. Simplified evidence-building roadmap for future research on *Arctium atlanticum*.

Further fractionation, compound isolation, mechanistic, computational, and preclinical studies should proceed only when supported by the preceding evidence.

Several limitations remain. The ethnobotanical evidence is based on only four surveys, and most were designed as broad regional inventories rather than species-focused investigations. Consequently, the demographic and cultural characteristics of the overall study populations could rarely be linked directly to the individuals who reported uses of *A. atlanticum*. Information concerning the language of individual use reports, knowledge transmission, harvesting season, perceived scarcity, market circulation, substitution, and the contemporary continuity of the practices was generally unavailable. These gaps restrict interpretation of the species-specific people-plant relationship.

Botanical traceability was also uneven. Two ethnobotanical records were supported by species-specific vouchers, whereas another displayed no species-specific voucher code and contained an incorrect family assignment. The Moroccan record lacked a target-specific voucher and coded the plant organ as a “bulb,” which is anatomically inconsistent with *Arctium*. These limitations introduce uncertainty regarding whether all reported practices concerned correctly identified *A. atlanticum* material.

Google Scholar was necessary for locating historical, regional, and grey literature, but its coverage and result counts are dynamic. Initial screening, data extraction, and appraisal were conducted by the first author and subsequently independently verified by a second author using the predefined eligibility criteria and data-charting framework. The supplementary vernacular-name search results were independently checked on 31 July 2026. Although this verification reduced the risk of selection and classification errors, the review did not use fully parallel duplicate screening from the beginning.

The full text of the only directly attributable experimental publication was obtained during revision, allowing a more complete methodological appraisal. Nevertheless, the study lacked species-specific chemical characterization and cytotoxicity or selectivity assessment, and an internal inconsistency was identified in the reporting of cholinesterase IC₅₀ values. Historical botanical records often lacked coordinates, standardized habitat descriptions, and abundance estimates. The review may also have missed unpublished herbarium records, local-language documents, community-held knowledge not represented in academic literature, inaccessible theses, or non-digitized regional sources. The small evidence base and the predominance of published and digitally accessible sources may also have introduced publication and availability bias, particularly for locally held or unpublished ethnobotanical knowledge.

Finally, “not reported” indicates that a variable was absent from the retrieved publication, not that the practice, knowledge pathway, or cultural feature did not exist. Likewise, “not identified” indicates absence from the literature retrieved by this review and should not be interpreted as proof that unpublished chemical, pharmacological, toxicological, ecological, or ethnobotanical data do not exist.

Conclusion

Arctium atlanticum is a taxonomically recognized Moroccan-Algerian burdock associated with a small but meaningful body of traditional medicinal knowledge. The four identified ethnobotanical surveys document several medicinal uses, but botanical traceability and cultural contextualization remain uneven, and only two medicinal-use records were voucher-supported. These records establish the presence of the species, or material attributed to it, in documented medicinal practices, but they do not demonstrate therapeutic efficacy or safety. Population status, harvesting intensity, knowledge transmission, and several preparation-related variables also remain insufficiently documented.

Future research should therefore prioritize ethically grounded, species-specific ethnobotanical documentation linked to voucher-based authentication, followed by population and harvesting assessment and chemical characterization of the organs and preparations corresponding to documented practices. Only one directly attributable pharmacological publication was identified, providing preliminary in vitro antioxidant and cholinesterase-inhibitory evidence that requires independent replication. Pharmacological, safety, mechanistic, computational, and preclinical investigations should proceed only from authenticated material and sufficiently characterized preparations, without transferring traditional uses, constituents, activities, or safety assumptions from related burdock species.

Declarations

List of abbreviations: DNA - deoxyribonucleic acid; FC - frequency of citation; GC-MS - gas chromatography-mass spectrometry; IUCN - International Union for Conservation of Nature; LC-HRMS - liquid chromatography-high-resolution mass spectrometry; NMR - nuclear magnetic resonance; PRISMA-ScR - Preferred Reporting Items for Systematic Reviews and

Meta-Analyses extension for Scoping Reviews; PRISMA-S - Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for reporting literature searches; RFC - relative frequency of citation; UV - use value.

Ethics approval and consent to participate: Not applicable. This study was a critical scoping review based exclusively on previously published and publicly accessible sources. No new research involving human participants, animals, biological samples, or direct collection of traditional knowledge was conducted. Ethical approval and informed-consent procedures, including prior informed consent where reported, were assessed from the original ethnobotanical publications. When such information was not provided in the source publication, it was recorded as 'not reported' and was not interpreted as evidence that consent had not been obtained.

Consent for publication: Not applicable.

Availability of data and materials: All data supporting the findings of this review are included in the main manuscript and its accompanying Supplementary Materials. Supplementary Tables S1-S11 provide the complete search strategies, full-text exclusions, characteristics of the retained sources, domain-specific critical appraisal, record flow and disposition, independent-verification record, data-charting framework, PRISMA-ScR reporting crosswalk, detailed research priorities, abstract-reported experimental outcomes, and comparative candidate analytical classes.

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

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Authors' contributions: I.E.K. conceptualized the review, developed the methodology, conducted the literature searches, performed the initial study selection, data extraction, domain-specific critical appraisal, and evidence synthesis, prepared the tables and figures, drafted the original manuscript, and had primary responsibility for the final content. Y.M. independently verified the eligibility decisions, evidence classifications, full-text exclusions, and key extracted data against the original sources, ensured data integrity, and contributed to the critical revision of the manuscript. I.B., M.E.-R., and O.E.-Z. contributed to the scientific interpretation of the findings, provided clinical and contextual expertise, and critically revised the manuscript. M.C. and K.B. contributed to the review and editing of the manuscript and provided clinical and contextual expertise. F.L. conceptualized the review, supervised the work, contributed to the review and editing of the manuscript, and assumes overall accountability for the published work. All authors have read and approved the final version of the manuscript.

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Supplementary Materials

The main species-name search was updated on 13 July 2026, and supplementary vernacular-name searches were conducted on 29 July 2026 and independently verified on 31 July 2026. Complete search strategies and recorded yields are provided in Supplementary Table S1, while record disposition is summarized in Supplementary Table S5. Botanical databases were consulted for nomenclature, specimen metadata, and occurrence context and were not pooled with bibliographic record counts unless retained as substantive evidence sources.

List of abbreviations: AChE – acetylcholinesterase; BChE – butyrylcholinesterase; CTX – contextual, methodological, or comparative evidence; DNA – deoxyribonucleic acid; ETH – ethnobotanical evidence; FC – frequency of citation; FLO – floristic, geographical, ecological, or conservation evidence; FT-EX – full-text report excluded after eligibility assessment; GBIF – Global Biodiversity Information Facility; IPNI – International Plant Names Index; IUCN – International Union for Conservation of Nature; MEDLINE – Medical Literature Analysis and Retrieval System Online; PHA – pharmacological evidence; PRISMA-ScR – Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews; RFC – relative frequency of citation; TAX – taxonomic, nomenclatural, or systematic evidence; TITLE-ABS-KEY – title, abstract, and keywords search field; TS – topic search field; UV – use value.

Table S1. Complete search strategies and final result counts.

a) Main species-name searches.

Source	Field/interface	Exact strategy or method	Records	Final date	Notes
Scopus	TITLE-ABS-KEY	TITLE-ABS-KEY ("Arctium atlanticum" OR "Lappa atlantica" OR "Arctium minus subsp. atlanticum" OR "Arctium minus ssp. atlanticum")	2	13 July 2026	No date, language, or document-type limits.
Web of Science Core Collection	Topic (TS)	TS=("Arctium atlanticum" OR "Lappa atlantica" OR "Arctium minus subsp. atlanticum" OR "Arctium minus ssp. atlanticum")	0	13 July 2026	No filters.
PubMed/MEDLINE	PubMed search box	("Arctium atlanticum" OR "Lappa atlantica" OR "Arctium minus subsp. atlanticum" OR "Arctium minus ssp. atlanticum")	0	13 July 2026	No filters.
Google Scholar	Exact phrase	"Arctium atlanticum"	20	13 July 2026	All returned results screened; no numerical or page-based cutoff was applied. Dynamic count.
Google Scholar	Exact phrase	"Lappa atlantica"	4	13 July 2026	All returned results screened; no numerical or page-based cutoff was applied. Dynamic count.
Google Scholar	Exact phrase	"Arctium minus subsp. atlanticum"	1	13 July 2026	All returned results screened. Punctuation/abbreviation variants were also checked and yielded no additional unique records.
Citation and targeted searching	Backward/forward citations; title/author and regional-flora searches	Reference lists of key sources; forward citations; targeted searches for taxonomic names, regional floristic records, and specifically identified papers.	3 additional	To 13 July 2026	Added Ouelbani <i>et al.</i> (2016), Belhouala & Benarba (2021), and Skowrońska <i>et al.</i> (2021).

Source	Field/interface	Exact strategy or method	Records	Final date	Notes
Google Scholar	Supplementary exact-phrase variant	" <i>Arctium minus</i> ssp. <i>atlanticum</i> "	0 unique	13 July 2026	Checked for unique records; none were added beyond the principal synonym searches.
Botanical resources	Accepted name, synonyms, specimens, and occurrence	Plants of the World Online, IPNI, GBIF, JSTOR Global Plants, Biodiversity Heritage Library, and relevant North African checklists	Not pooled	To 13 July 2026	Used for nomenclature, specimen metadata, and occurrence context; not added to the bibliographic count unless retained as a substantive source.
Historically associated name	Targeted contextual check	" <i>Lappa sylvestris</i> " Pomel	Context only	13 July 2026	Examined after citation chaining. It was not part of the core search, and no direct equivalence with <i>Lappa atlantica</i> was assumed.

b) Supplementary vernacular-name searches.

Source	Exact strategy	Records	Date	Screening outcome
Google Scholar	" <i>Arctium atlanticum</i> " "arkatyoun"	0	29 July 2026	No record
Google Scholar	" <i>Arctium atlanticum</i> " "arqtion"	0	29 July 2026	No record
Google Scholar	" <i>Arctium atlanticum</i> " "bardan"	1	29 July 2026	Errahmani and Zahir (2024), already included
Google Scholar	" <i>Arctium atlanticum</i> " "mezzr-izm"	1	29 July 2026	Nassif and Tanji (2013), already included
Google Scholar	"arkatyoun" ethnobotany	0	29 July 2026	No record
Google Scholar	"arqtion" ethnobotany	0	29 July 2026	No record
Google Scholar	"bardan" ethnobotany Morocco	3	29 July 2026	One previously included publication and two unrelated records
Google Scholar	"mezzr-izm" Morocco	1	29 July 2026	Nassif and Tanji (2013), already included
Google Scholar	"الأرقطيون" الجزائر طب شعبي	0	29 July 2026	No record
Google Scholar	"الأرقطيون" المغرب طب تقليدي	0	29 July 2026	No record
Scopus	TITLE-ABS-KEY(arkatyoun OR arkatioun OR arqtion OR arctioun OR arktioun OR "mezzr-izm" OR "mezzr izm" OR "mzzer izm")	0	29 July 2026	No record
Scopus	TITLE-ABS-KEY(bardan OR bardane) AND TITLE-ABS-KEY(Morocco OR Maroc OR Algeria OR Algerie) AND TITLE-ABS-KEY(ethnobotan* OR ethnomedic* OR "traditional medicine")	0	29 July 2026	No record
Web of Science Core Collection	TS=(arkatyoun OR arkatioun OR arqtion OR arctioun OR arktioun OR "mezzr-izm" OR "mezzr izm" OR "mzzer izm")	0	29 July 2026	No record

Source	Exact strategy	Records	Date	Screening outcome
Web of Science Core Collection	TS=((bardan OR bardane) AND (Morocco OR Maroc OR Algeria OR Algeria) AND (ethnobotan* OR ethnomedic* OR "traditional medicine"))	0	29 July 2026	No record
PubMed/MEDLINE	arkatyoun[Title/Abstract] OR arkatioun[Title/Abstract] OR arqtioun[Title/Abstract] OR arctioun[Title/Abstract] OR arktioun[Title/Abstract]	6	29 July 2026	Six unrelated false-positive records
PubMed/MEDLINE	(mezzr[Title/Abstract] AND izm[Title/Abstract]) OR (mzzr[Title/Abstract] AND izm[Title/Abstract])	0	29 July 2026	No record
PubMed/MEDLINE	(bardan[Title/Abstract] OR bardane[Title/Abstract]) AND (Morocco[Title/Abstract] OR Maroc[Title/Abstract] OR Algeria[Title/Abstract] OR Algerie[Title/Abstract]) AND (ethnobotan*[Title/Abstract] OR ethnomedic*[Title/Abstract] OR "traditional medicine"[Title/Abstract])	0	29 July 2026	No record
PubMed/MEDLINE	"Arctium atlanticum"[Title/Abstract] AND (ethnobotan*[Title/Abstract] OR ethnomedic*[Title/Abstract] OR "traditional medicine"[Title/Abstract] OR vernacular[Title/Abstract] OR "traditional use"[Title/Abstract])	0	29 July 2026	No record

The supplementary vernacular-name searches returned six Google Scholar records and six PubMed/MEDLINE records. Four Google Scholar occurrences represented two publications already present in the corpus. The remaining two Google Scholar records and all six PubMed records were unrelated false-positive retrievals. No additional eligible direct or contextual source was identified. The preliminary PubMed searches that produced broader false-positive retrievals through automatic term processing were replaced by the final field-restricted strategies reported above and were not counted separately.

Four reports were excluded after full-text eligibility assessment (Table S2).

Table S2. Full-text reports excluded and reasons for exclusion.

Screening ID	Report as recorded in the screening log	Reason for exclusion
FT-EX-01	Rivas-Martínez <i>et al.</i> (2011), later nomenclatural combination for <i>Arctium atlanticum</i> in the second part of Mapa de series, geoseries y geopermaseries de vegetación de España	Nomenclatural mention only. The later combination was treated as an isonym of the earlier H. Lindberg combination and added no new botanical or experimental evidence.
FT-EX-02	Spanish vegetation-series map/report mentioning the taxon	Secondary mention without an original observation, specimen, locality documentation, or additional extractable species-specific evidence.
FT-EX-03	General Ukrainian-language review of <i>Arctium</i> identified during screening	General and substantially redundant genus-level information; no sufficiently distinct target-species contribution beyond retained sources.
FT-EX-04	López-Vinyallonga, S. (2009). Evolució, filogènia i sistemàtica del complex <i>Arctium</i> -Cousinia. Doctoral thesis, Universitat de Barcelona	Substantial overlap with the 2011 peer-reviewed systematic article and no new molecular data directly generated for <i>A. atlanticum</i> .

Table S3. Characteristics, evidence classification, and evidential role of the 19 included sources.

ID	Source	Domain and evidence classification	Access	Main contribution	Main limitation
TAX-01	Arènes (1950)	Taxonomy; direct	Full text	Historical North African treatment, morphology, synonymy, and localities	Broad historical <i>A. minus</i> concept
TAX-02	Duistermaat (1996)	Taxonomy and palynology; direct	Full text	Species delimitation, diagnostic characters, pollen, neotypification, and distribution	No species-specific molecular evidence
TAX-03	El Oualidi <i>et al.</i> (2012)	Nomenclature; direct	Full text	North African endemic and type-specimen context	Status of associated specimen MPU005639 remains uncertain
TAX-04	López-Vinyallonga <i>et al.</i> (2011)	Systematics; direct context	Full text	Modern phylogenetic framework for the Arctioid lineage	<i>A. atlanticum</i> was absent from the molecular dataset
FLO-01	Battandier and Trabut (1891)	Distribution; direct	Full text	Historical occurrence near Tlemcen under <i>Lappa atlantica</i>	No coordinates or abundance data
FLO-02	Nassif and Tanji (2013)	Floristics; direct	Full text	Recent spontaneous occurrence in Marmoucha and vernacular name mezzr-izm	No target-specific abundance or voucher code
FLO-03	Benchouala <i>et al.</i> (2023)	Ecology and distribution; direct	Full text	Recent Belezma record and regional rarity terminology	No population estimate; rarity is not an IUCN category
FLO-04	Meddour and Sahar (2025)	Distribution and conservation; direct	Full text	Historical and contemporary presence in Djurdjura	No species-specific population trend
FLO-05	Tanji <i>et al.</i> (2026)	Agricultural ecology; direct	Full text	One recent occurrence among 22 surveyed fields or margins	Single localized record and uncertain microhabitat
ETH-01	Ouelbani <i>et al.</i> (2016)	Ethnobotany; direct	Full text	Roots and leaves, infusion or decoction, multiple reported uses, UV 1.368	Incorrect family assignment and incomplete voucher traceability
ETH-02	Bouasla and Bouasla (2017)	Ethnobotany; direct	Full text	Voucher LBTE.11; underground-part decoction; use reported as “cancer”; UV 0.33	Diagnosis, reproducible dose, outcomes, and safety not reported
ETH-03	Belhouala and Benarba (2021)	Ethnobotany; direct	Full text	Voucher LRSBG/AB/20/119; fried leaves and capitula applied topically	Each therapeutic category was represented by a single use report
ETH-04	Errahmani and Zahir (2024)	Ethnobotany; direct	Full text	Moroccan citation for traditional hypercholesterolemia management	FC 1/RFC 0.005; no target voucher; organ coded as “bulb”
PHA-01	Guettaf <i>et al.</i> (2022)	Cell-free pharmacology; direct	Full text	Root extracts evaluated in antioxidant and cholinesterase assays	No voucher number reported; no species-specific chemical characterization, cytotoxicity, or selectivity assessment; inconsistency in cholinesterase IC ₅₀ reporting

ID	Source	Domain and evidence classification	Access	Main contribution	Main limitation
CTX-01	Fennane and Rejdali (2016)	Medicinal-flora and conservation context	Full text	Broader Moroccan medicinal-plant diversity and conservation context	Not species-specific
CTX-02	Miara (2019)	Methodological context	Full text	Explains the consequences of taxonomic and chorological errors in ethnobotany	No primary data on <i>A. atlanticum</i>
CTX-03	Kolomiets <i>et al.</i> (2021)	Comparative phytochemistry	Full text	Summarizes genus-level chemistry and identifies the species-specific evidence gap	Evidence largely concerns other <i>Arctium</i> species
CTX-04	Skowrońska <i>et al.</i> (2021)	Comparative chemistry and activity	Full text	Demonstrates species-, organ-, population-, and locality-dependent variation	Does not investigate <i>A. atlanticum</i>
CTX-05	Ydyrys (2023)	Related-species review	Full text	Comparative chemistry and medicinal context for <i>A. tomentosum</i>	Indirect evidence only

Direct evidence was attributable to *Arctium atlanticum* or an accepted historical synonym. Contextual sources were used only for methodological interpretation or comparison and did not establish the traditional uses, composition, activity, or safety of the target species. The reason for each classification is reflected in the “Main contribution” and “Main limitation” columns.

Critical appraisal was domain-specific because the retained sources differed substantially in design and purpose. Interpretive weight reflects the role assigned to each source in this review and is not a validated numerical quality score.

Table S4. Tailored domain-specific critical appraisal framework and interpretive weight.

ID	Main appraisal consideration	Interpretive weight
TAX-01	Detailed historical morphology and locality synthesis, but based on a broad historical <i>A. minus</i> concept	Moderate–high for historical taxonomy and distribution
TAX-02	Most complete classical treatment based on specimens, morphology, pollen, and typification; no species-specific molecular confirmation	High for classical species delimitation
TAX-03	Useful nomenclatural cross-check, but the status of the associated specimen remains uncertain	Moderate for nomenclatural interpretation
TAX-04	Strong phylogenetic framework, but <i>A. atlanticum</i> was not included in the molecular accession dataset	Moderate for classification; low for direct molecular placement
FLO-01	Primary historical locality report without coordinates or abundance information	Moderate for historical occurrence
FLO-02	Multi-year Moroccan field inventory with limited species-specific voucher and abundance detail	Moderate for regional occurrence
FLO-03	Recent protected-area inventory using regional rarity terminology but no population assessment	Moderate for occurrence; low for threat inference
FLO-04	Long historical–contemporary synthesis without species-specific demographic data	Moderate for persistence; low for population trend
FLO-05	Standardized recent survey, but based on a single localized occurrence	Low–moderate for local occurrence
ETH-01	Quantitative ethnobotanical survey, but affected by an incorrect family assignment and incomplete voucher traceability	Moderate–low for reported traditional use
ETH-02	Species-specific voucher and documented preparation, but diagnosis, reproducible dose, outcomes, and safety were not reported	Moderate for reported traditional use only
ETH-03	Good voucher traceability and preparation detail, but each therapeutic category was represented by a single use report	Low–moderate for reported traditional use only
ETH-04	Direct Moroccan citation with quantitative indices, but based on one citation, no target voucher, and an anatomically inconsistent organ designation	Low
PHA-01	Only directly attributable experimental publication; botanical identification, controls, replication, and statistical analysis were reported, but chemical characterization, cytotoxicity, and selectivity were lacking and cholinesterase IC ₅₀ reporting was internally inconsistent	Low-moderate for in vitro activity; no therapeutic inference
CTX-01	Useful Moroccan medicinal-flora and conservation context without species-specific evidence	Contextual only
CTX-02	Strong methodological relevance to taxonomic reliability in ethnobotany, but no direct evidence on the target species	Contextual only
CTX-03	Useful genus-level synthesis that confirms the species-specific chemical gap	Moderate comparative relevance
CTX-04	Strong authenticated comparative experiment involving other <i>Arctium</i> species	High comparative relevance; no direct attribution
CTX-05	Additional related-species context, but indirect and partly genus-level	Low–moderate comparative relevance

This tailored framework was non-numerical. Criteria were adapted to the evidence domain and were used to guide interpretation rather than to generate a validated quality or risk-of-bias score.

High, moderate, low, and very low refer only to the evidential role assigned within this review. Contextual sources were not used to attribute traditional uses, chemical constituents, biological activities, or safety properties to *Arctium atlanticum*.

Table S5 reconciles the bibliographic record counts, retrieval outcomes, eligibility assessment, and final evidence corpus.

Table S5. Record flow and disposition.

Stage	Number	Explanation
Main database and search-engine records	27	Google Scholar, 25; Scopus, 2; PubMed/MEDLINE, 0; Web of Science, 0
Additional records from citation chaining and targeted searching	3	Records identified through reference lists, forward citations, and targeted botanical searches
Supplementary vernacular-search occurrences	12	Google Scholar, 6; PubMed/MEDLINE, 6; Scopus, 0; Web of Science, 0
Total records before deduplication	42	Main searches, targeted searching, and vernacular-name searches combined
Duplicate records removed	8	Four duplicates from the original search and four Google Scholar occurrences corresponding to publications already present in the corpus
Unique records screened	34	Records subjected to title and abstract screening
Records excluded at title/abstract stage	11	Three unrelated records from the original search and eight unrelated records from the vernacular-name searches
Reports sought for retrieval	23	Potentially eligible reports remaining after title and abstract screening
Full-text reports assessed for eligibility	23	Reports evaluated using the predefined eligibility criteria
Full-text reports excluded	4	Nomenclatural-only, secondary, redundant, or overlapping reports
Full-text sources retained	19	Fourteen direct/species-attributable sources and five contextual/comparative sources
Final synthesis	19	Fourteen direct/species-attributable sources and five contextual/comparative sources

The second author independently verified the eligibility decisions, evidence classifications, key extracted variables, and full-text exclusions. Records retrieved through the supplementary vernacular-name searches were independently checked on 31 July 2026.

Table S6. Independent second-author verification record.

Verification set	Items checked	Main elements verified	Outcome
TAX-01–TAX-04	4 sources	Taxonomic attribution, synonymy, diagnostic evidence, typification, and molecular-evidence status	Agreement; verified by Y.M. on 17 July 2026
FLO-01–FLO-05	5 sources	Locality, habitat, occurrence status, rarity terminology, and conservation limits	Agreement; verified by Y.M. on 17 July 2026
ETH-01–ETH-04	4 sources	Vernacular names, vouchers, plant parts, preparations, routes, use categories, quantitative indices, and documentation gaps	Agreement; verified by Y.M. on 17 July 2026
PHA-01	1 source	botanical identification and herbarium deposition, extraction procedures, antioxidant and AChE/BChE assays, reference controls, replication, statistical analysis, chemical-characterization and safety gaps, and internal inconsistency in cholinesterase IC ₅₀ reporting	Agreement; full-text reassessment verified by Y.M. on 18 September 2026
CTX-01–CTX-05	5 sources	Contextual classification and absence of direct attribution to <i>A. atlanticum</i>	Agreement; verified by Y.M. on 17 July 2026
FT-EX-01–FT-EX-04	4 reports	Eligibility assessment and reasons for full-text exclusion	Agreement; verified by Y.M. on 17 July 2026
Supplementary vernacular-name searches	12 retrieved occurrences	Four Google Scholar occurrences linked to two previously included publications; two unrelated Google Scholar records; six unrelated PubMed records; zero results in Scopus and Web of Science	No additional eligible source; no discrepancy; verified by Y.M. on 31 July 2026

Initial verification comprised 23 source or exclusion decisions, with 23 agreements and no discrepancies. Verification of the 12 vernacular-search occurrences likewise identified no disagreement and no additional eligible source.

Following retrieval of the full text of Guettaf *et al.* (2022) during revision, PHA-01 was reassessed and independently re-verified by Y.M.; no discrepancy was identified.

Table S7. Data-charting framework.

Domain	Variables charted
Bibliographic information	Author, year, title, source type, language, geographical setting, access status, and evidence category
Taxonomy and nomenclature	Scientific name used, synonymy, rank, authority, diagnostic characters, voucher or type information, palynology, and direct molecular evidence
Distribution and conservation	Locality, coordinates, altitude, habitat, survey date, abundance or rarity terminology, population trend, harvesting pressure, and conservation status
Ethnobotanical context	Study region, participant population, number and characteristics of informants, knowledge-holder category, language, vernacular name, and botanical authentication
Traditional practice	Plant part, source of material, harvesting method, preparation, route, dose or frequency, duration, locally reported indication, quantitative index, perceived outcome, and adverse effects
Knowledge and ethics	Knowledge source and transmission, continuity or decline, local plant-recognition practices, consent, confidentiality, acknowledgement, community participation, and benefit-sharing
Experimental evidence	Authentication, organ, extraction, chemical characterization, assay, controls, concentration–response, replication, statistics, interference, cytotoxicity, selectivity, and biological relevance
Safety and clinical evidence	Toxicity, contaminants, pharmacokinetics, interactions, human dose, adverse events, efficacy outcomes, and clinical-study design
Critical interpretation	Direct or contextual classification, principal contribution, main limitation, interpretive weight, and unsupported inferences to avoid

Variables absent from the original publications were recorded as “not reported” and were treated as documentation gaps rather than inferred absences. Locally reported therapeutic terms were preserved without conversion into biomedical diagnoses or efficacy claims.

Table S8. PRISMA-ScR reporting crosswalk.

PRISMA-ScR domain	Location in manuscript or supplement
Title and abstract	Title page and structured Abstract
Rationale and objectives	Background and the six review objectives
Protocol and registration	Materials and Methods, “Review design and question”; no prospective protocol registration
Eligibility criteria	Materials and Methods, “Eligibility criteria and evidence categories”
Information sources and search	Materials and Methods, “Information sources and search strategy”; Table 1; Supplementary Table S1
Selection and data charting	Materials and Methods, “Selection, extraction, and critical appraisal” and “Synthesis, independent verification, and reporting”; Supplementary Tables S5–S7
Critical appraisal	Materials and Methods, “Selection, extraction, and critical appraisal”; Supplementary Table S4

Synthesis methods	Materials and Methods, “Synthesis, independent verification, and reporting”
Selection results	Results, “Search results and evidence landscape”; Fig. 1; Supplementary Table S5
Characteristics of evidence sources	Results and Supplementary Table S3
Results of individual sources	Results subsections; Tables 3–5; Supplementary Tables S3–S4
Ethnobotanical synthesis	Results, “Vernacular recognition and botanical traceability,” “Plant parts, preparations, and routes,” “Patterns of use and limits of convergence,” and “Knowledge holders, transmission, and cultural continuity”
Experimental and safety evidence	Results, “Limited experimental evidence” and “Phytochemical evidence gap”; Supplementary Tables S10–S11
Critical interpretation	Discussion
Research implications	Discussion, “Prioritized research roadmap”; Fig. 2; Supplementary Table S9
Strengths and limitations	Discussion, “Strengths and limitations of the review”
Conclusions	Conclusion
Funding, competing interests, ethics, and data availability	Declarations

Supplementary Table S9 expands the staged roadmap presented in Fig. 2 and identifies the minimum evidence required before progression to the next research phase.

Table S9. Ethnobotanically grounded research priorities and minimum progression.

Phase	Priority and action	Minimum output before progression
I. Ethnobotanical and botanical foundation	1. Species-focused ethnobotanical documentation	Geographical and linguistic setting, knowledge-holder category, vernacular terminology, plant-recognition practices, knowledge transmission, preparation, route, plant sourcing, and locally reported therapeutic categories documented with meaningful consent
	2. Voucher-based botanical authentication	Complete specimen, diagnostic photographs, collector and identifier information, locality, coordinates, habitat, phenology, voucher code, and herbarium deposition linked to each use record
	3. Molecular and taxonomic confirmation	Voucher-linked molecular data supporting identification within the <i>Arctium minus</i> complex, interpreted together with morphology and herbarium evidence
II. Biocultural and ecological validation	4. Population and harvesting assessment	Updated occurrence map, population and recruitment observations, habitat condition, harvesting methods, source of medicinal material, perceived availability, and potential effects of destructive underground-organ collection
	5. Practice-relevant chemical characterization	Reproducible chemical profiles of authenticated organs, populations, and preparations corresponding to documented infusions, decoctions, raw material, or topical practices
	6. Replicated biological evaluation	Complete concentration–response data, appropriate controls, independent replication, interference assessment, chemical standardization, and preliminary cytotoxicity or selectivity data
III. Safety and justified translation	7. Fractionation and mechanistic investigation	Activity linked to defined fractions or confirmed compounds, with plausible mechanisms supported experimentally
	8. Preparation- and route-specific safety evaluation	Cytotoxicity, genotoxicity, contaminant assessment, dermal or oral safety endpoints, and extract-specific dose information corresponding to the documented traditional preparation
	9. Justified computational and preclinical investigation	Computational targets based on experimentally confirmed compounds and biological evidence, followed by staged preclinical evaluation only when botanical, chemical, efficacy, and safety requirements have been met

Progression should not be based solely on a reported traditional indication or preliminary cell-free activity. Each stage requires authenticated material, transparent documentation, and evidence appropriate to the organ, preparation, and administration route under investigation.

Supplementary Table S10 summarizes the full-text experimental evidence from the only pharmacological publication directly attributable to the target taxon.

Table S10. Full-text experimental evidence directly attributable to *Arctium atlanticum*.

Assay	Endpoint	Aqueous extract (AqE)	Hydromethanolic extract (HME)	Ethyl acetate extract (EAE)	Positive standards
DPPH radical scavenging	IC ₅₀ (µg/mL)	55.49 ± 1.06	59.38 ± 2.51	69.45 ± 5.49	BHA: 6.14 ± 0.41; BHT: 12.99 ± 0.41; α-tocopherol: 13.02 ± 5.17
Galvinoxyl radical scavenging	IC ₅₀ (µg/mL)	30.25 ± 1.73	37.04 ± 3.20	28.87 ± 0.18	BHA: 5.38 ± 0.06; BHT: 3.32 ± 0.18
β-Carotene bleaching inhibition	IC ₅₀ (µg/mL)	<400*	<400*	121.58 ± 16.76	BHA: 1.05 ± 0.03; BHT: 0.91 ± 0.01
CUPRAC reducing capacity	A _{0.5} (µg/mL)	95.26 ± 0.69	39.51 ± 2.74	37.41 ± 1.59	BHA: 5.35 ± 0.71; BHT: 8.97 ± 3.94
AChE inhibition	% inhibition at 100 and 200 µg/mL; reported IC ₅₀	Not active; IC ₅₀ not determined	16.99 ± 0.88%; 27.23 ± 1.56%; reported IC ₅₀ <200 µg/mL**	27.47 ± 1.87%; 41.39 ± 1.24%; reported IC ₅₀ <200 µg/mL**	Galantamine: 91.80 ± 0.20%; 94.77 ± 0.34%; IC ₅₀ 6.27 ± 1.2 µg/mL
BChE inhibition	% inhibition at 100 and 200 µg/mL; reported IC ₅₀	Not active; IC ₅₀ not determined	0.56 ± 0.58%; 5.58 ± 0.59%; reported IC ₅₀ <200 µg/mL**	29.18 ± 0.86%; 40.20 ± 1.12%; reported IC ₅₀ <200 µg/mL**	Galantamine: 73.57 ± 0.77%; 78.95 ± 0.58%; IC ₅₀ 34.75 ± 1.99 µg/mL

Source: Guettaf *et al.* (2022). Roots of *Arctium minus* subsp. *atlanticum* were collected during flowering in Sétif, eastern Algeria. Botanical identification was performed by the Laboratory of Development of Natural Biological Resources at the University of Sétif, and voucher specimens were reported as deposited in the herbarium of the Faculty of Biology, although no voucher number was provided. The study evaluated aqueous, hydromethanolic, and ethyl acetate extracts using cell-free antioxidant assays and isolated-enzyme AChE/BChE inhibition assays. Experiments were reported in triplicate, and statistical analysis used one-way ANOVA followed by Tukey's post hoc test. No species-specific chromatographic profile, identified constituent, cytotoxicity assessment, or selectivity index was reported.

* The values "<400" for the aqueous and hydromethanolic extracts in the β-carotene assay are reproduced exactly as reported in Table 2 of the source and were not recalculated.

**An internal reporting inconsistency was identified for the cholinesterase assays. Table 3 reports IC₅₀ values of <200 µg/mL for the hydromethanolic and ethyl acetate extracts, although inhibition remained below 50% at 200 µg/mL. In contrast, the article abstract reports anti-AChE and anti-BChE values of 265 ± 21 and 240 ± 6.3 µg/mL, respectively. These discrepant values are therefore reported without attempting to resolve or recalculate them.

Supplementary Table S11 summarizes selected chemical classes reported in related burdocks that may guide future analytical investigation but have not been confirmed in *Arctium atlanticum*.

Table S11. Candidate analytical classes reported in related *Arctium* species and their status in *Arctium atlanticum*.

Chemical class	Examples reported in related <i>Arctium</i> species	Comparative evidence	Status in <i>A. atlanticum</i>
Phenolic and caffeoylquinic acid derivatives	Chlorogenic acid; mono- and dicaffeoylquinic acid derivatives	Reported in authenticated roots and aerial parts of <i>A. lappa</i> and <i>A. tomentosum</i> , with species-, organ-, and locality-dependent variation	Not directly identified
Flavonoids	Quercetin, kaempferol, luteolin, apigenin, and glycoside derivatives	Reported mainly in aerial parts of related burdocks	Not directly identified
Lignans	Arctiin, arctigenin, and lappaol-type derivatives	Reported particularly in fruits, seeds, or roots of better-studied <i>Arctium</i> species	Not directly identified
Polysaccharides and polyacetylenes	Inulin, other fructans, polysaccharides, and polyacetylene derivatives	Reported principally from roots and selected extracts of related species	Not directly identified
Terpenoids, sterols, and lipophilic constituents	Lupeol, amyrin derivatives, phytosterols, fatty acids, and tocopherols	Reported in lipophilic extracts of <i>A. tomentosum</i> , <i>A. lappa</i> , and other studied burdocks	Not directly identified

Sources : Kolomiets *et al.* (2021), Skowrońska *et al.* (2021), and Ydyrys (2023). These classes are presented solely as candidate analytical targets. Their occurrence in related burdocks does not demonstrate their presence in *A. atlanticum*. Direct attribution requires detection in voucher-authenticated material using validated analytical methods.