



Taxonomy, traditional uses, phytochemical compounds and pharmacological activities of *Juniperus phoenicea* L. (Cupressaceae) complex in Algeria: A review

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Review

Abstract

Background: In Algeria, *Juniperus phoenicea* L. presents taxonomic problems. This complex has been cited in various works by many Algerian researchers across various disciplines under several names. Notably *J. phoenicea* L., *J. phoenicea* L. subsp. *phoenicea*, *J. phoenicea* var. *turbinata*, and *J. turbinata* Guss. Some of these studies have focused on comparing morphological characteristics to test their variability, while other studies have concentrated on phytochemical and pharmacological activities without considering their variability.

Methods: Information related to the taxonomy, ethnomedicinal, ethnoveterinary, phytochemical and pharmacological properties of the complex *J. phoenicea* in Algeria was systematically collected using relevant keywords from online databases such as Google Scholar, Science Direct, Web of Science, Springerlink, PubMed, Scopus, Algerian flora and theses.

Results: *J. phoenicea* L. considered one of the plant species with numerous biological activities and containing many valuable bioactive compounds, which has generated considerable interest among researchers. Furthermore, it plays an important role in the Algerian population because of its use in traditional human and animal medicine.

Conclusions: Future studies should incorporate genetic and molecular approaches to clarify the taxonomic variability of this complex and ensure accurate species delimitation. Integrating these data with ethnobotanical and phytochemical research is essential to improve the reliability of its biological and traditional use assessments.

Keywords: Red juniper, systematic, ethnobotany, ethnoveterinary, phytochemistry, pharmacological properties, Algeria.

Background

There are 67 species and 37 varieties in the genus *Juniperus* (Cupressaceae), which are divided into three sections, i.e., *Caryocedrus*, *Sabina*, and *Juniperus* (Bekhechi *et al.* 2012; Chelouati *et al.* 2025). The *Juniperus* section includes nine species distributed across East Asia and the Mediterranean region, along with *J. communis* L. which has a circumboreal range of distribution (Mao *et al.* 2010; Boumediene *et al.* 2025).

In the Northern Hemisphere, this genus represents a significant component of arid and semi-arid tree and shrub ecosystems (Adams 2004; Adams 2008) and is therefore an ideal model for examining the origins of disjunctions among arid northern floras (Mao *et al.* 2010). Boumediene *et al.* (2025) confirmed that abiotic factors, primarily climate, biotic interactions, and capacity for seed dispersal influence the geographic distribution of *Juniperus*.

In Algeria, junipers are represented by five taxa in the flora of (Quézel and Santa 1962-1963): *J. oxycedrus*, *J. communis* (ssp. *rufescens* (Link) Deb, ssp. *macrocarpa* (S. et Sm.) Ball and ssp. *eu-communis* (Syme) Engl. var. *hemisphaerica* (Presl.) Parl), *J. phoenicea* L., *J. thurifera* L (var. *africana* Maire), and *J. Sabina* L.

From the Canary Islands and the Atlas Mountains, through North Africa and southern Europe, extending eastward to Jordan and Saudi Arabia, the *Juniperus phoenicea* complex is widely dispersed throughout the Mediterranean region (Sahib *et al.* 2021; Boumediene *et al.* 2025). According to its distribution patterns, it displays a considerable amount of phenotypic heterogeneity (Farjon 2010; Boumediene *et al.* 2025).

The species variety of the *J. phoenicea* complex, which includes *J. phoenicea*, *J. turbinata*, and *J. canariensis*, makes it stand out within the Sabina section (Spach 1841 in Boumediene *et al.* 2025).

The bibliographic information in Algeria concerning this complex indicates wide taxonomic and nomenclatural variation in the research of experts in phytochemistry, phytoecology, and agrifood, and occasionally taxonomists (Elmir 2025), without, however, including a detailed biosystematic analysis. This variety poses a considerable challenge for the accurate characterization of this complex.

In this review, a careful examination of various studies on this complex with its various nomenclatures and taxonomic variations was carried out to group all these studies to facilitate access to information for future and potential research targeting this complex.

Materials and Methods

To achieve our objective, an in-depth search was conducted in several virtual databases, mainly Google Scholar, Scopus, Science Direct, PubMed, Web of Science, Springerlink and Dspace (a virtual platform for doctoral thesis repositories in Algeria), to identify published articles and theses. To identify the botanical characteristics of this complex, we examined two floras, namely the Flora of North Africa (Maire 1952) and the new flora of Algeria and southern desert regions (Quézel and Santa 1962-1963).

An advanced search was conducted using Boolean operators in the title, abstract and keyword fields for the *J. phoenicea* L complex in Algeria (*J. phoenicea* and *J. turbinata*) followed by the AND operator and with the desired information, such as taxonomy, chemical composition, antioxidant, anti-inflammatory, antimicrobial, antidiabetic and anticancer activities.

To determine their therapeutic uses, we consulted numerous articles from the aforementioned databases on ethnobotany and ethnoveterinary studies in different regions of Algeria.

The most relevant articles were selected based on their titles and abstracts, and their references were examined in detail to identify other relevant publications.

Results

Botanical description and ecology

In this section, we refer to the description of the species in the flora of Algeria and the southern desert regions of Quézel and Santa (1962-1963).

The red juniper (*J. phoenicea* L) is a monoecious tree, 4-8 m tall, with whorled leaves of 3, tightly imbricated in 6 rows, oval-obtuse. The fruits are red, 6-15 mm in diameter, and glossy when ripe.

It inhabits coastal dunes, hills, and mountains. Common (**C**) on the coast, **H 1-2** (H 1 = Algiers and Oran High Plateaus sub-sector) (H 2 = Constantine High Plateaus sub-sector), **AS 1-2-3** (AS 1 = Oran Saharan Atlas sub-sector) (AS 2 = Algiers Saharan Atlas sub-sector) (AS 3 = Constantine Saharan Atlas sub-sector (including the Aurès Mountains). Very rare (**RR**) in other regions. Chorology: Mediterranean circumvallation.

Taxonomy and geographical repartition

J. phoenicea, or red juniper, is an endemic Mediterranean plant (Ferrer-Gallego *et al.* 2017; El-Barougy *et al.* 2023) whose range spans from the Atlantic coasts of Portugal and Morocco to the eastern Mediterranean and Middle East, including large islands (Farjon & Filer 2013; Pavon *et al.* 2020).

Morphological, biochemical, and genetic studies conducted by Mazur *et al.* (2018) reveals that the complex *J. phoenicea* comprising three species *J. phoenicea* L. inhabits the Iberian Peninsula, southern France, and northwestern Italy; *J. turbinata* Guss. is located in coastal Mediterranean areas and northwest Africa mountains (Adams 2014; Sánchez-Gómez *et al.* 2018; Salvà-Catarineu *et al.* 2021); and *J. canariensis* Guyot & Mathou is native to the Canary Islands.

According to Adams (2014), this complex, which consist of *J. phoenicea* subsp. *phoenicea* and *J. phoenicea* subsp. *turbinata*, has always been regarded as a sympatric group. When while *J. canariensis* is classified as a variety of *J. turbinata* (Adams 2014; Lebreton & Perez De Paz 2001).

Phytochemical and morphological studies reveal two distinct species: *J. phoenicea* L., characterized by the absence of prodelphinidin and smaller galbulus (7-10 seeds), and *J. turbinata* Guss., which contains variable prodelphinidin levels (45-85%) and has a larger galbulus (3-6 seeds) (Lebreton & Thivend 1981; Lebreton 1983; Lebreton & Rivera 1988; Lebreton & Pérez De Paz 2001).

Further analysis of leaf essential oils (Adams *et al.* 1996) and genetic RAPDs studies (Adams *et al.* 2002) of several *J. phoenicea* L., S. I. Mediterranean populations corroborate these findings, with Mazur *et al.* (2003) noting significant morphological differences between the two taxa.

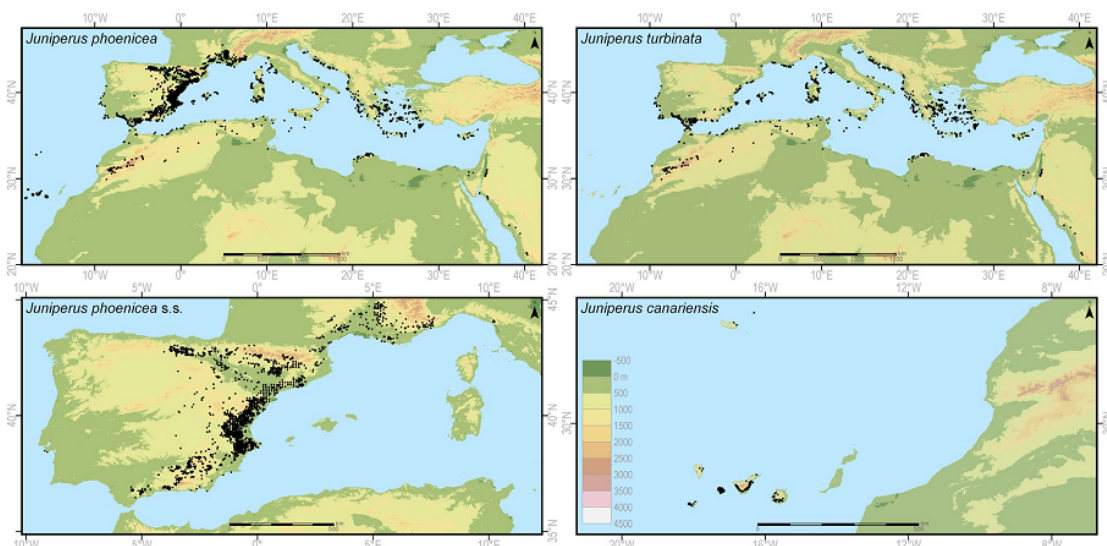


Figure 1. Geographic distribution of the *J. phoenicea* complex, *J. phoenicea* s.s., *J. turbinata*, and *J. canariensis* on the background of the mountain systems (Salvà Catarineu *et al.* 2021).

Pavon *et al.* (2020) emphasize the need for further exploration of *J. phoenicea* s.s. given that many taxonomic studies overlook Algeria. In this country, *J. phoenicea* L., identified by Quézel and Santa (1962-1963) in vague terms, requires more detailed examination as noted in Maire's (1952) Flora of North Africa. Elmir *et al.* (2024) confirm the taxonomic classification of *J. turbinata* in Algeria, highlighting distinct morphological differences between its maritime and Atlas Mountain populations, thus supporting the recognition of *J. turbinata* var. *occidentalis* and *J. turbinata* var. *montana*.

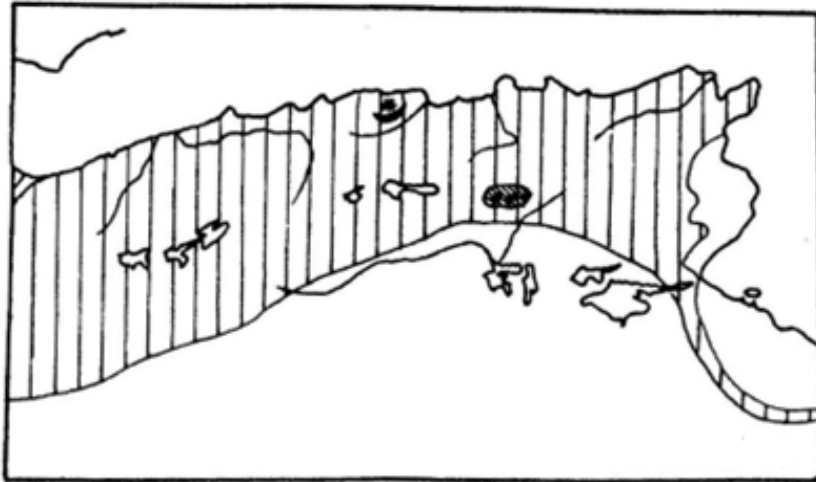


Figure 2. Area of *J. phoenicea* in Algeria (in vertical lines) (Quézel and Santa 1962-1963)

Taxonomy and geographical repartition

The synonyms listed in this section were compiled from the African Plant Database (<https://africanplantdatabase.ch/en/nomen/specie/131017/juniperus-phoenicea-subsp-turbinata-guss-arcang>).

J. phoenicea subsp. *turbinata* (Guss.) Arcang.

Protologue : Comp. Fl. Ital. (Arcangeli) 637 (1882)

Basionym: *Juniperus turbinata* Guss.

Synonym(s): Homotypic (2)

≡ *Juniperus phoenicea* var. *turbinata* (Guss.) Parl.

≡ *Juniperus turbinata* Guss. (1845)

Synonym(s): Heterotypic (7)

= *Juniperus phoenicea* subsp. *mediterranea* P.Lebreton & Thivend (1981)

= **Juniperus phoenicea* subsp. *eumediterranea* P.Lebreton & Thivend (1981)

= *Juniperus lycia* L. (1753)

= *Juniperus phoenicea* f. *mollis* Maire & Weiller (1952)

= *Juniperus turbinata* f. *megalocarpa* Maire (1952)

= *Juniperus phoenicea* f. *megalocarpa* Maire

= **Juniperus phoenicea* subsp. *phoenicea* auct.

Traditional uses

Human medicine

An examination of various ethnobotanical surveys conducted in several regions of Algeria reveals that this tree is highly regarded for its properties in traditional medicine. Widely cited as *J. phoenicea* L. and rarely as *J. phoenicea* L. subsp. *phoenicea*, it has been recommended for the treatment of various diseases and symptoms through the use of its different vegetative organs (Table 1).

This species is recommended in descending order for the treatment of various digestive diseases (colon, diarrhea, gastric ulcer, intoxication, stomach disorders, etc.) with 37.4%, followed by respiratory diseases (bronchitis, cough, asthma, influenza, etc.) with 11.2%, then skin diseases (burns, eczema, wounds, etc.) and urogenital diseases (kidney and genitourinary diseases, urinary or genital infections, aid of menstruation, etc.) with the same percentage of 8.4% each.

The plant's use against parasites (anthelmintic, antiparasitic, taeniafuge, and dewormer) ranks fifth with 6.5%, while glandular disorders, circulatory disorders, and osteoarticular diseases each rank sixth with 1.9%. Eye diseases and disorders, cancer, and neurological disorders rank last with only one mention each, or 0.9%. Finally, the remaining diseases, totaling 19.6%, were classified as other illnesses, disorders, and activities (abdominal pain, belly pains, nausea, vertigo, headache, sexual-reproductive problems, metabolic diseases, debility, anti-inflammatory, antibiotic, antiseptic, astringent, and carminative activities) (Fig. 3).

Table 1. Traditional uses of *J. phoenicea* L in human medicine in Algeria.

Taxa citation	Used part	Mode of preparation	Mode of administration	Use in human ethnomedicine	Reference
<i>J. phoenicea</i> L.	Not reported	Not reported	Not reported	Antidiarrheal, anti-hepatitis, anti-icteric, antibiotic, cardiotoxic, vulnerary, stomachical, taeniafuge, dewormer	Sari <i>et al.</i> 2013
<i>J. phoenicea</i> L.	Aerial parts	Infusion, decoction, tablet	Not reported	Anti-inflammatory, eye infections, digestive disorders, antihypertensive, eczema	Boudjelal <i>et al.</i> 2013
<i>J. phoenicea</i> L.	Palm (ends and wood) and fruits	Infusion	Oral	Abdominal pain. It is carminative, diuretic and anti-diarrheal	Benderradji <i>et al.</i> 2014
<i>J. Phoenicia</i> L.	Not reported	Not reported	Not reported	Gastro-intestinal system diseases	Benarba <i>et al.</i> 2015
<i>J. phoenicea</i> L.	Leaves, fruit	Not reported	Not reported	Gastro-intestinal complaints, Thyroid	Chermet & Gharzouli 2015
<i>J. phoenicea</i> L.	Leaves	Decoction	Oral	Stomach pain, gases	Benarba 2016
<i>J. phoenicea</i> L.	Leaves, stem + leaves	Infusion, decoction	Oral, external uses	Respiratory, urinary or genital infections, gastric ulcer, vertigo	Bouasla & Bouasla 2017
<i>J. phoenicia</i> L.	Leaves	Decoction	Not reported	Ulcers, other stomach disorders and diarrhea, effect on nausea, inflammation, lung diseases, poisoning and kidney diseases.	Miara <i>et al.</i> 2018
<i>J. phoenicia</i> L.	Aerial parts	Infusion, decoction	Not reported	Antiparasitic, antiseptic, detergent (treatment of wounds)	Miara <i>et al.</i> 2019-a
<i>J. phoenicia</i> L.	Berries	Infusion	Not reported	Worms	Baziz <i>et al.</i> 2020
<i>J. phoenicia</i> L.	Aerial parts, leaves, stems, seeds	Infusion, decoction	Oral	Anti-parasitic, antiseptic and detergent (treatment of wounds), ulcer, debility, stomach, nausea, Anti-diarrheic, inflammation, pulmonary diseases, dyspepsia, intoxication, treat diseases of the kidneys	Bendif <i>et al.</i> 2020
<i>J. phoenicia</i> L.	Leaves, leafy stems, fruit	Not reported	Not reported	Aid of menstruation, bronchitis, cough, gastritis, hyperglycemia, stomach aches	Kefifa <i>et al.</i> 2020
<i>J. phoenicia</i> L.	Not reported	Not reported	Not reported	Gastrointestinal system diseases, cancer, respiratory tract diseases, sexual-reproductive problems	Belhouala & Benarba 2021
<i>J. phoenicea</i> L. subsp. <i>phoenicea</i> .	Not reported	Infusion, decoction, powder	Not reported	Ulcer, diarrhea, gas, eczema, wound, burns, inflammation, food poisonings	Bouafia <i>et al.</i> 2021
<i>J. phoenicia</i> L.	Aerial parts	Decoction, infusion, paste,	Oral, topical	Asthma, colon, cough, influenza, rheumatism, ulcer	Djahafi <i>et al.</i> 2021
<i>J. phoenicia</i> L.	Leaves, fruit	Powder, decoction	Not reported	Antidiarrheic, anthelmintic, stomachache, headache, belly pains	Mechaala <i>et al.</i> 2021

<i>J. phoenicia</i> L.	Branches (ends, wood, fruits).	Infusion	Not reported	Antiparasitic, antiseptic, astringent, abdominal pain, carminative, antidiarrheal, diuretic	Ouadeh <i>et al.</i> 2021
<i>J. phoenicia</i> L.	Aerial parts	Decoction	Not reported	Respiratory tract diseases	Hassaïne & Benmalek 2023
<i>J. phoenicia</i> L.	Aerial parts, seeds	Decoction, maceration, infusion	Not reported	Skin diseases, kidney diseases	Hedidi <i>et al.</i> 2024
<i>J. phoenicia</i> L.	Aerial Parts, leaves, fruits	Infusion, decoction, maceration	Not reported	Diarrhea	Torche <i>et al.</i> 2024
<i>J. phoenicia</i> L.	Leaves	Decoction	Oral	Eczema, digestive disorders, diarrhea	Guerine <i>et al.</i> 2024
<i>J. phoenicia</i> L.	Leaves, fruits, aerial parts	Powder, Maceration, Decoction, Infusion, Fumigation	Not reported	Neurological diseases, metabolic diseases, digestive system diseases, genitourinary diseases, dermatological diseases, respiratory diseases, osteoarticular diseases,	Aouir <i>et al.</i> 2025
<i>J. phoenicia</i> L.	Aerial parts	Maceration, infusion, decoction	Not reported	Gastric ulcer, acute diarrhea	Khodja <i>et al.</i> 2025
<i>J. phoenicia</i> L.	Fruit	Tinctures, powder, decoction	Oral ingestion (drink), topic	Urological (urinary problems), digestive, respiratory (asthma)	Maghni <i>et al.</i> 2025

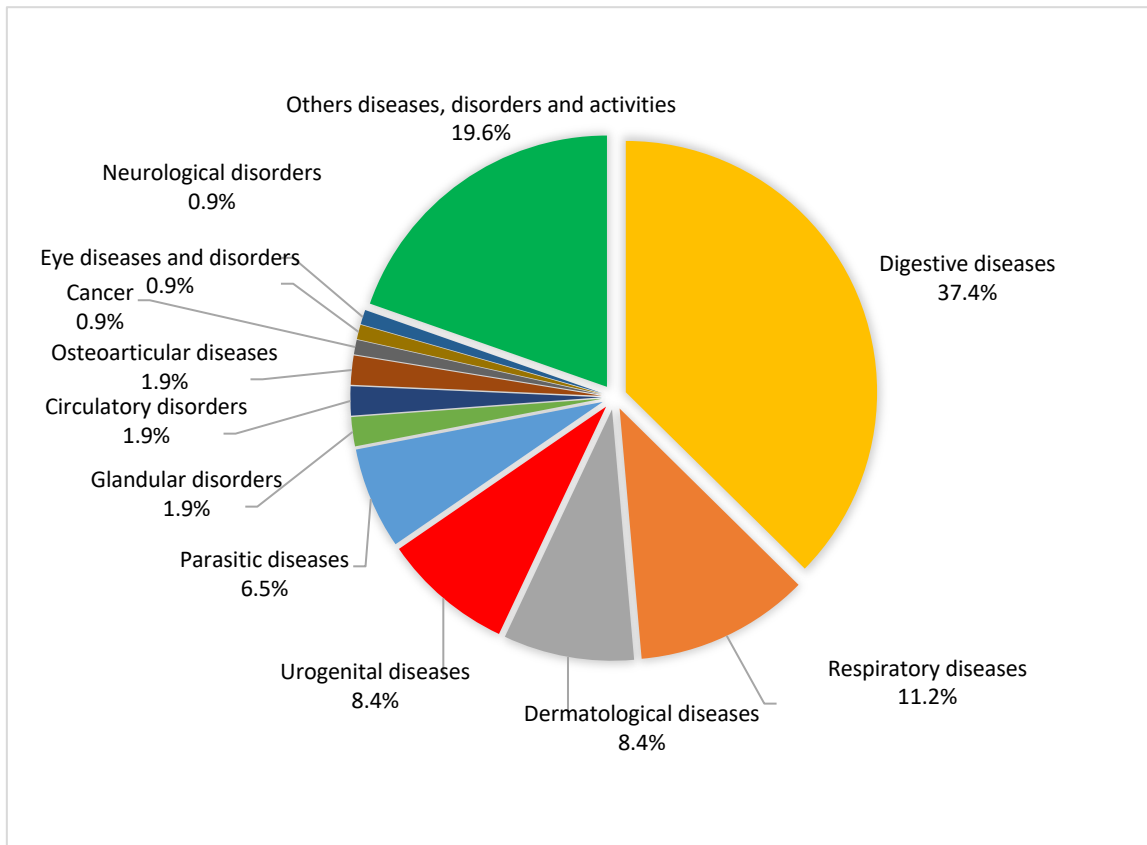


Figure 3. Frequency of diseases treated by red juniper in Algerian traditional human medicine.

The leaves constitute the most used part, with 27.8%, while the aerial part in general represents 25%. Next come the fruits in third position with 22.2%, then the seeds and the stem bark with the same percentage of 5.6%, while the mixture of bark and leaves, wood, berries, and branches in general comes in fifth position with 2.8% each (Fig. 4).

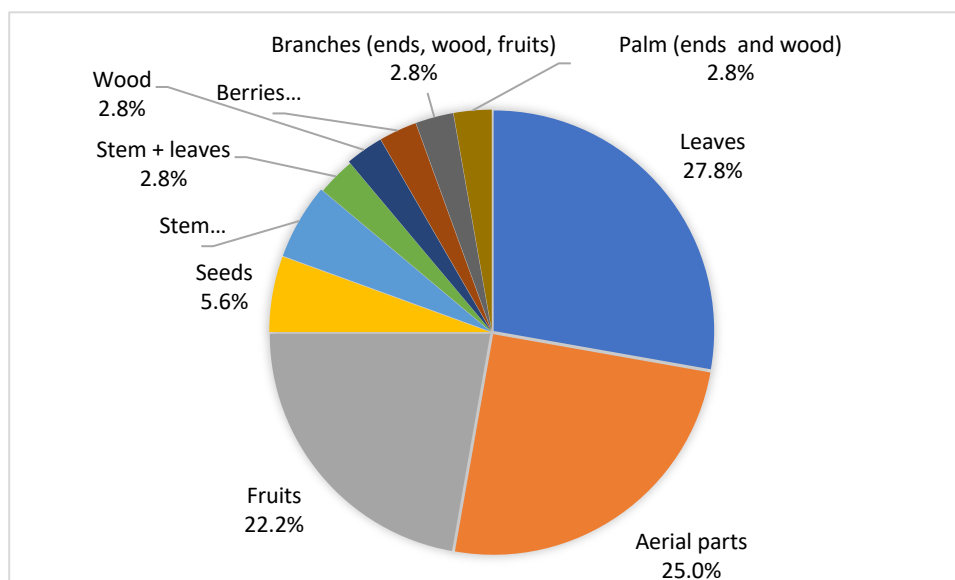


Figure 4. Frequency of parts used of red juniper in Algerian traditional human medicine.

Decoction and infusion are the most frequent methods of preparing *J. phoenicea* L., accounting for 39% and 31.7%, respectively, while maceration and powder each represent 9.8%. The remaining preparation methods (tablets, tinctures, fumigation, and pastilles) are the least common, each representing only 2.4% (Fig. 5).

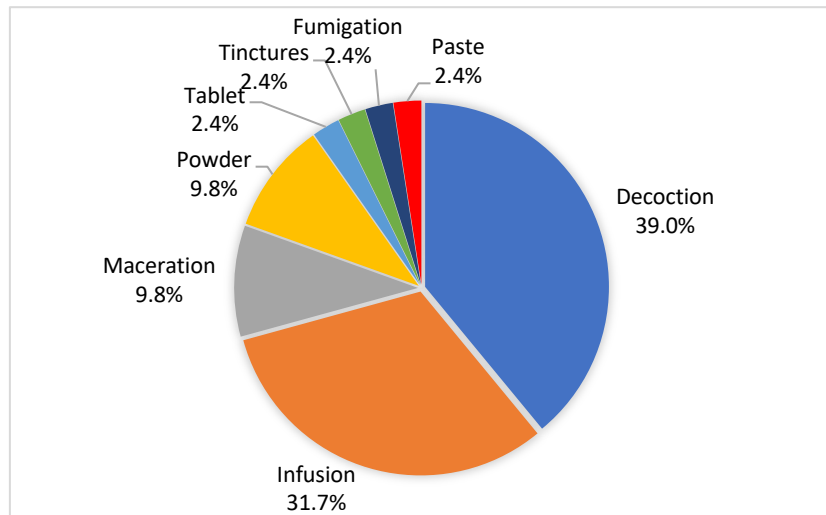


Figure 5. Frequency of preparation methods of red juniper in Algerian traditional human medicine.

Oral administration is dominant with 70% for the treatment of internal diseases, while topical administration accounts for 30% for external applications (Fig. 6).

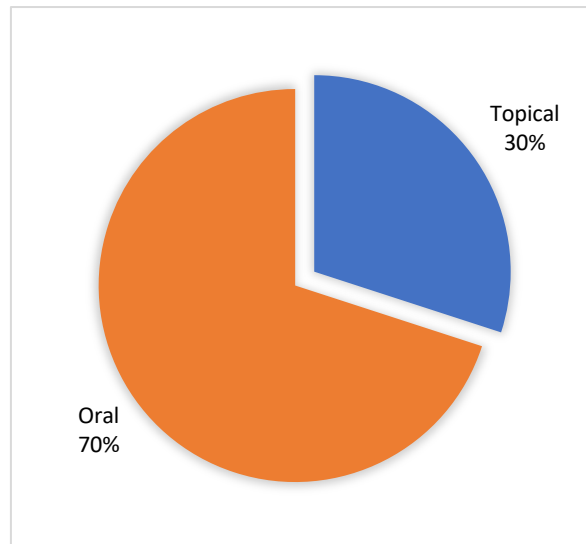


Figure 6. Frequency of administration methods of red juniper in Algerian traditional human medicine.

Veterinary medicine

The traditional utilization of plants for animal treatment in general remains poorly documented in Algeria. The therapeutic uses of *J. phoenicea* L. in veterinary medicine are presented in Table 2.

Table 2. Traditional uses of *J. phoenicea* L. in veterinary medicine in Algeria

Taxa citations	Used part	Mode of preparation	Mode of administration	Treated animal	Use in animal ethnoveterinary	Reference
<i>J. phoenicea</i> L.	Leaves	Decoction	Not reported	Goats, sheep, and cattle	For kidney problems, as well as for digestive disorders, scabies, and pulmonary tuberculosis.	Miara <i>et al.</i> 2019-b
<i>J. phoenicea</i> L.	Whole plant	Not reported	Oral	Not reported	Wounds and sores, pneumocystosis	(Halimi <i>et al.</i> 1997) in Djadouni & Meliani 2022

<i>J. phoenicea</i> L	Not reported	Not reported	Not reported	Not reported	Mastitis, digestive disorders, scabies	Boucherit <i>et al.</i> 2025
<i>J. phoenicea</i> subsp <i>phoenicea</i>	Leaves	Decoction	Oral	Sheep, Cattle, Goats	Digestive disorders	Hadjadj <i>et al.</i> 2025

The ethnoveterinary studies examined show that *J. phoenicea* L. is recommended for treating goats, sheep and cattle in descending order of dermatological diseases with 33.3%; digestive and respiratory diseases with 22.2% each; and finally renal and glandular diseases with 11.1% each (Fig. 7).

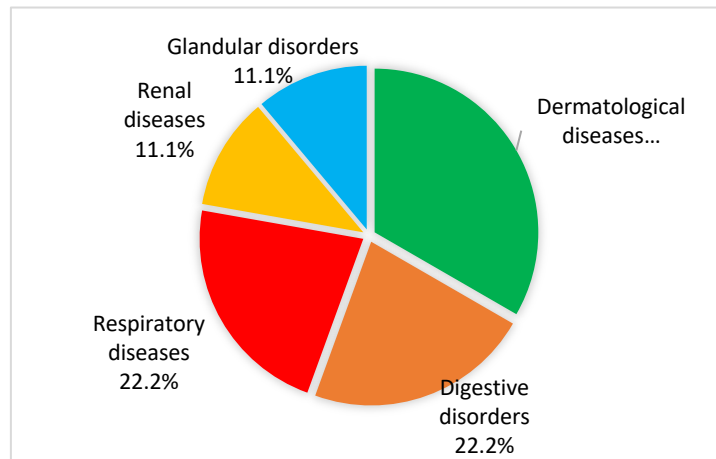


Figure 7. Frequency of animal diseases treated with red juniper in Algeria.

The leaves are more recommended to be used with 66.7%, while the use of all the organs of the plant constitutes 33.3% (Fig. 8) in decoction mode.

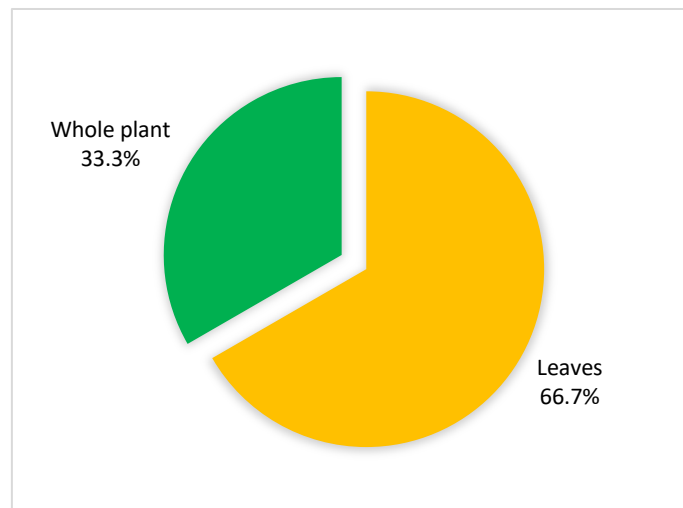


Figure 8. Frequency of parts of red juniper used for animal treatment in Algeria.

Chemistry and chemical composition

In this study, we conducted a comprehensive analysis of the chemical composition of *J. phoenicea* L. by synthesizing findings from various researchers. The focus was on the essential oil, methanolic, and ethanolic extracts from its aerial parts (leaves, branches, berries, and fruits) and stem composition. Notably, α -pinene was identified as the predominant compound in the essential oils across different regions of Algeria. The methanolic and ethanolic extracts were rich in flavonoids, saponins, tannins, and alkaloids, with significant compounds including 3-p-Coumaroylquinic acid, quercetin, and myricetin-O-pentoside found in the hydroethanolic and infusion extracts of *J. phoenicea*.

Table 3. Chemical composition of *J. phoenicea* L from different regions in Algeria

Taxa citations	Plant extract	Part	Compounds	Reference
<i>J. phoenicea</i> L.	Essential oil	Leaves	α -Pinene/camphene/ γ -Terpinene/Limonene/linalool/terpinolene/Tricyclene/ α -	Dob <i>et al.</i> 2008
<i>J. phoenicea</i> var.		Berries	Humulene/ β -Pinene/bornyl acetate/caryophyllene	Mazari <i>et al.</i> 2010
<i>turbinata</i>		Aerial parts	oxide/citronellol/elemol/germacrene B/germacrene D/Sabinene/ <i>trans</i> -	Bekhechi <i>et al.</i> 2012
		Fruits	pinocarveol/ α -Muuroolene/ α -Terpineol/ β -Elemene/ β -Phellandrene/Myrcene/p-	Menaceur <i>et al.</i> 2013
		Branches	cymene/terpinen-4-ol/ α -Fenchene/ β -Selinene/ γ -Muuroolene/ δ -3-carene/ δ -	Ramdani <i>et al.</i> 2013
Stems	Cadinene/borneol/Camphor/linalyl acetate/manoyl	Bakchiche <i>et al.</i> 2014		
			oxide/verbenene/verbenone/ α -Cadinol/ α -Phellandrene/ β -Bourbonene/ β -	Bouyahyaoui <i>et al.</i> 2016
			Caryophyllene/ γ -Cadinene/carvacrol/germacrene D-4-ol/Myrtenal/Myrtenol/p-	Harhour <i>et al.</i> 2018
			cymen-8-ol/p-Cymenene/p-mentha-1,5-dien-8-ol/ <i>trans</i> -carveol/ α -amorphene/ α -	Abdelli <i>et al.</i> 2018
			Copaene/ α -selinene/ α -Terpinyl acetate/ γ -elemene/ <i>cis</i> -Calamenene/ <i>cis</i> -	Boukhaloua <i>et al.</i> 2022
			verbenol/cubebol/cubenol/humulene/epoxide II/piperitone/thuja-2,4(10)-	Houari <i>et al.</i> 2022
			diene/Thujopsene/ <i>trans</i> -Verbenol/ α -Thujene/ β -Eudesmol/ β -Myrcene/(E)-	Ait-Mimoune <i>et al.</i> 2023
			nerolidol/(E)- β -Caryophyllene/abietadiene/Alismol/cadalene/cadina-1,4-	Osmani <i>et al.</i> 2025
			diene/Carvacrol/methyl/ether/carvone/carvotanacetone/ <i>cis</i> -	
			Chrysanthenyl/acetate/Cuminaldehyde/Flavonoids/Geranyl acetate/Isopulegyl	
			acetate/pinocamphone/Saponins/Terpinyl acetate/ <i>trans</i> -Calamenene/Zonarene/ α -	
			Calacorene/ α -Campholenal/ α -Campholene aldehyde/ α -Cubebene/ α -Humulene	
			oxide/ α -Terpinene/ β -phellandrene- β -Elemol/ γ -Eudesmol/ δ -2-Carene/ τ -Cadinol/ δ -	
			3-Carene/(E)- β -Caryophyllene/(E)- β -Farnesene/(+)- β -guaiene/(4E)-Decenal/(E)- β -	
			Ocimene/(E, E)-farnesol/(E, E)- α -farnesene/(E, Z)-2,4-decadienal/(Z	
)- β -ocimene/ Δ -3-Carene/ Δ -cadinene/ Δ -Elemene/1-epi-Cubenol/1,3,8-p-	
			Menthatriene/14-hydroxy - α - muuroolene/14-Hydroxy-9-epi-(E)-caryophyllene/1-	
			epi-cubenol/2,3-Dehydro-1,8-cineole/2,3-Dihydrofarnesol/2,4-Decadien-1-al/2,4-	
			Decadien-1-ol/2,5-dimethoxy- p-cymene/2,5-Dimethoxy-4-isopropyltoluene/2E,4	
			E-Decadienol/3-p-Coumaroylquinic acid/4-epi-Maaliol/4- Z-Decen-1-ol/4-Epi-	
			Cubebol/4-Terpineol/6-Camphenone/7-epi- α -selinene/7 α H, 10 δ H-Cadina-1(6),4-	
			diene/Abietal/African-1-ene/African-3(15)-ene/Alkaloids/amy	
			isobutyrate/Apigenin-6-C-	
			glucoside/Aromadendrene/Bicyclosesquiphellandrene/Bornylacetate/Brasila-1,10-	
			diene/Cadin-4-en-7-ol/Cadina-3,5-diene/Cadina-4,11-diene/Calamenene/Calarene	
			(+)/Camphene hydrate/Carvacrolmethylether/Carveyle acetate <i>cis</i> /Carvyl	
			acetate/Caryophylla-3,8(15)-dien-5 β -ol/Caryophyllene	
			oxyde/Caryophylleneoxide/Catechin/Catechin tannins/ <i>cis</i> - Piperitol/ <i>cis</i> - β -	
			Terpineol/ <i>cis</i> -3-Hexenol/ <i>cis</i> -Carveol/ <i>cis</i> -Linalool oxide/ <i>cis</i> -linalool oxide	

(furanoid)/cis-muurolo-4(14),5-diene/cis-Myrtanol/cis-p -Menth-2-en-1-ol/cis-Piperitol/cis-p-menth-2-en-1-ol/cis-rose oxide/cis-Thujone/cis-thujopsene/cis-totarol/cis-Verbenyl peroxide/cis- β -guaiene/Citronellyle
Propanoate/Cryptone/Cumin alcohol/Cymen-8-ol/Cymenene/Dec-9-en-1-ol/Deca-(2E,4E)-dien-1-ol/Dihydrocarvyl acetate/EE- α -Farnesene/Eicosan/Emodols/epi-Cubenol/Epi-bicyclo-sesquiphellandrene/epi-Cedrol/epi-cubebol/Epicubenol/Epizonarene/epi- α - cadinol (T-cadinol)/Estragole/ethyl hexanoate/Ethyl laurate/Eudesma-4(15),7-dien-1-ol/Eudesma-4(15),7-dien-1- β -ol/Fenchene/Fencholenic aldehyde/Fenchyl acetate/Fonenol/g -Elemene/Gallic tannins/geranial/Germacra-1(10),5-dien-4 b-ol/Germacrene- A/Germacrene-B/Germacrene-D/Heneicosan/Hexanal/Hexenyl cyclopentanone/Humulene oxide I/Humulene oxide II/Humulene-1,2-epoxyde/Isogeranial/Isomenthone/Isorhamnetin-O-pentoside/Isosylvestrene/Isothujanol/juniper camphor/khusinol/Ledene/Linalol Linalool oxide (trans)/Linalool oxide acetate/Linalool tetrahydro/longifolene/Manool oxide/Manoyl oxide/m-cymen-8-ol/m-Cymene/methyl carvacrol/methyl citronellate/Methyl N-methylanthranilate/Methyl6biflavone/Muurolo-5-ene-4- α -ol cis/Muurolo 4,14,5-dienecis/Myricetin-3-O-rhamnoside/Myricetin-O-dihexoside/Myricetin-O-hexoside/Myricetin-O-pentoside/Myricetin-O-pentoside-O-hexoside/Myrthenyl acetate/neoisopulegyl acetate/Nerolidol/Neryl acetate/Nonandecane/Nopol/o-Cymenene/p- Cymen-8-ol/p-Cymene/Para cymene/Perillene/Phellandral/Pinocamphone cis/pinocarvone/Piperiton/p-Mentha-1,3-dien-7-al/Pseudopinene/Pulegone/Quercetin-3-O-glucoside/Quercetin-O-hexoside/Quercetin-O-pentoside/Safranal/Salviadienol/Salvial-4(14)-en-1-one/Sibirene/Spathulenol/Steroids/Tannins/t-Cadinol + t-Muurolo/Terpenes/Terpinene-4-ol/Terpinenyl acetate/Thymol methyl ether/t-Muurolo/Toluene/Torilenol/trans-2-Hexenal/trans-4-Caranone/trans-7-epi-Sesquisabinene hydrate/trans-Cadina-1-4-diene/transCarvylacetate/trans-Linalool oxide/trans-Linalool oxide acetate/trans-linalool oxide acetate (pyranoid)/trans-p -Menth-2-en-1-ol/trans-Pinocamphone/trans-Piperitol/trans-rose oxide/trans-sabinol/trans-Verbeno/trans-Verbenyl peroxide/Valencene/Verbenol/ α -Campholenal/ α -Pinene oxide isomer1/ α -Pinene oxide isomer2/ α -Terpinene/ α -Terpineol/ α -Terpinolene/ α -Cadinol/ α -Copaene/ α -Cubebene/ α -Fenchene/ α -fenchol/ α -Humulene/ α -Phellandrene/ α -Terpineol/ α -Terpinyl acetate/ α -

			Cadinene/ α -Cadinol/ α -calacorene/ α -Campholenol/ α -Cedrene/ α -Cedrol/ α -copaene/ α -eudesmol/ α -fenchene/ α -Fenchyl acetate/ α -gurjunene/ α -humulene/ α -muurolene/ α -Phellandren-8-ol/ α -Pinene oxide/ α -Terpinene/ α -Terpineol/ α -Terpinolene/ α -Terpinylacetate/ α -thujene/ α -ylangene/ β -Caryophyllene/ β -Copaene/ β -Elemene/ β -Myrcene/ β -Phellandrene/ β -bourbonene/ β -Copaene/ β -eudesmol/ β -Fenchyl acetate/ β -Funebrene/ γ -gurjunene/ γ -Terpinene/ γ -Amorphene/ γ -Elemene/ γ -eudesmol/ γ -muurolene/ δ -3-Carene/ δ -Elemene/ δ -terpineol/ τ -Cadinol/ τ , Muurolol/ τ -Muurol	
<i>J. phoenicea</i> L.	Methanolic extract Ethanol extract	Aerial parts	Saponins/Flavonoids/Gallic tannins/Catechin tannins/Alkaloids/Tannins/Terpenes/Steroids/Emodols	Fadel <i>et al.</i> 2016 Draoui <i>et al.</i> 2020
<i>J. phoenicea</i> L.	Hydroethanolic Infusion extracts	Aerial parts	3-p-Coumaroylquinic acid/Catechin/Myricetin-O-pentoside-O-hexoside/Myricetin-O-dihexoside/Myricetin-O-hexoside/Apigenin-6-C-glucoside/Myricetin-3-O-rhamnoside/Myricetin-O-pentoside/Quercetin-3-O-glucoside/Quercetin-O-hexoside/Quercetin-O-pentoside/Methyl6biflavone/Isorhamnetin-O-pentoside	Ghouti <i>et al.</i> 2018

Pharmacological properties

Microbial activity

The antimicrobial activity of essential oils from *J. phoenicea* L has been extensively evaluated against various microbial strains. Studies indicate moderate antibacterial and antifungal effects across different bacteria and fungi. Mazari *et al.* (2010) found that oils from *J. phoenicea* displayed moderate activity against three Gram-positive and two Gram-negative bacteria. Ramdani *et al.* (2013) reported growth inhibition of nine bacteria using the disc diffusion method, with inhibition zones ranging from 7 to 45 mm. Bouyahyaoui *et al.* (2016) tested against one Gram-negative and four Gram-positive strains and found mixed results; the essential oil of dried leaves showed significant inhibition, notably against *Candida albicans*, although it was ineffective against *Pseudomonas aeruginosa*, the most resistant strain.

Akermi *et al.* (2017) reported inhibitory activity of *J. phoenicea* essential oil against seven bacterial strains and two fungi, noting that molds were more sensitive than bacteria. The minimum inhibitory concentration (MIC) was determined at 8 µl/ml for molds and 22.2 µl/ml for bacteria. Abdelli *et al.* (2018) conducted further tests against four Gram-negative and one Gram-positive bacteria and two fungi, yielding effective results only against *Bacillus cereus* and *Candida albicans*.

Boukhaloua *et al.* (2022) tested essential oils from *J. oxycedrus* and *J. phoenicea* against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Candida albicans*, showing good activity across most strains except for the resistant *Pseudomonas*. Ait-Mimoune *et al.* (2023) found Gram-negative bacteria more resistant to the essential oil compared to Gram-positive strains, although the oil was effective against *Proteus vulgaris*.

Ghouti *et al.* (2018) evaluated hydroethanolic and infusion extracts against several bacterial strains and found moderate to weak activity, particularly more effective against Gram-positive bacteria. The MIC values varied, with *J. phoenicea* extracts performing notably well against methicillin-resistant and susceptible *Staphylococcus aureus* at MIC values of 5 and 10 mg/mL, while its activity against Gram-negative bacteria was limited to *E. coli* and *Klebsiella pneumoniae*. Lastly, Draoui *et al.* (2020) highlighted the antibacterial effectiveness against both Gram-positive and Gram-negative strains, with significant inhibition observed for *E. coli* and *S. aureus*. Overall, *J. phoenicea* essential oils demonstrate variable but notable antimicrobial properties, especially against specific pathogens.

Anti-inflammatory activity

The study by Abdelli *et al.* (2018) demonstrates that oils from fresh leaves, dried leaves, and berries of *J. phoenicea* reduced carrageenan-induced paw oedema in mice by 16.8%, 15.2%, and 6.4%, respectively, after 6 hours with a dose of 400 mg/kg. Ghouti *et al.* (2018) evaluated the anti-inflammatory effect on RAW 264.7 cells by measuring nitric oxide (NO) production, finding all samples inhibited NO with EC50 values of 51 ± 4 to 122 ± 6 µg/mL, with the highest activity from hydroethanolic and infusion extracts (EC50 = 51 ± 4 and 70 ± 5 µg/mL). Osmani *et al.* (2025) explored the anti-inflammatory potential of *J. phoenicea* L. berries essential oil, revealing a concentration-dependent inhibition of lipoxygenase activity, ranging from 7.38% to 95.41%, particularly notable at doses of 100 and 200 µg/mL, achieving 74.36% to 95.41% inhibition.

Antioxidant property

The antioxidant potential of the samples of *J. phoenicea* L evaluated by Menaceur *et al.* (2013) using two separate methods, inhibition of free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) and reducing power. All essential oils showed a relatively weak antioxidant capacity. No improvement of the antioxidant activity by the SFMAE technique has been detected. *J. phoenicea* L ethanol extract was found to be remarkably effective toward DPPH inhibition, compared to chemical antioxidant BHT (IC = 9.8±0.1 and 28±0.7 mg/l, respectively); for reducing the power test it has also exhibited high activity in comparison with all studied essential oils and the chemical standard (BHT).

The antioxidant activity of various Algerian medicinal plants was assessed in several studies. Fadel *et al.* (2016) reported that *Cedrus atlantica* and *Marrubium vulgare* exhibited superior antioxidant properties, with IC50 values of 8.9 and 20.3 µg/ml, respectively, compared to lower activity in *J. phoenicea* and *J. oxycedrus*. Ghouti *et al.* (2018) used multiple in vitro methods, finding that *J. phoenicea*'s hydroethanolic and infusion extracts demonstrated effective antioxidant properties, particularly in TBARS assays, being two to three times more effective than Trolox. *J. phoenicea* showed low EC50 values of 12 µg/mL (hydroethanolic) and 22.4 µg/mL (infusion), indicating a strong ability to scavenge free radicals. Harhour *et al.* (2018) compared the essential oils of *J. phoenicea*'s berries and branches, finding the berries to have greater antioxidant activity at 100 µg/mL than branches, though both were less effective than BHT and ascorbic acid. Finally, Ait-Mimoune *et al.* (2023) noted that *J. phoenicea* exhibited a moderate antioxidant effect in their studies.

Cytotoxic effects

Four human tumor cell lines, MCF67 (breast carcinoma), NCI6H460 (non-small cell lung cancer), HeLa (cervical carcinoma), HepG2 (hepatocellular carcinoma), and the non-tumor porcine liver cell line (PLP2) using Sulphorhodamine to evaluate the cytotoxicity of two plants; *J. phoenicea* and *Cotula cinerea* in the work of Ghouti *et al.* (2018). Overall, regarding the antiproliferative effects of two species hydroethanolic and infusion extracts, the results show that with GI50 values ranging from 9 ± 1 to 101 ± 351 $\mu\text{g}/\text{mL}$, all of the tested samples demonstrated significant cytotoxic properties for the four human tumor cell lines tested. Additionally, the samples demonstrated cytotoxic effects on no-tumor cells; as a result, the GI50 values were significantly greater than both required to reveal antiproliferative activity in tumor cells and those displayed by the standard Ellipticine. Compared to *C. cinerea*, *J. phoenicea* hydroethanolic and infusion extracts showed a greater potential for cytotoxicity.

Conclusions

This review examines the nomenclature, ethnobotanical, ethnoveterinary, chemical composition, and pharmacological properties of the *J. phoenicea* L. complex, which is significant in Algeria's traditional medicine. The plant is used to treat various human ailments and livestock conditions, especially affecting the digestive, respiratory, and skin systems. Analysis of different extracts revealed that α -Pinene is the most abundant in essential oils, with flavonoids, saponins, tannins, and alkaloids prominent in methanolic and ethanolic extracts. Hydroethanolic and infusion extracts contain compounds like 3-p-Coumaroylquinic acid and quercetin. Their pharmacological properties include antimicrobial, anti-inflammatory, antioxidant, and cytotoxic effects, indicating important medicinal potential. This review is a valuable resource for future research, highlighting taxonomic variabilities and encouraging further studies on its therapeutic and pharmacological applications.

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