Ethnopharmacognosy of *Echinops spinosus* L. in North Africa: a mini review

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**ABSTRACT**

**Background:** The genus *Echinops* (Asteraceae family, Echinopeae class) consists of ca. 120 species and is native to Africa, the Middle East, Europe, and Asia. In Algeria, this genus is represented by the very common species *Echinops spinosus* L. also known as “tesskra,” which is used as a diuretic, hypoglycemic, for stomachic effects, liver disorders, and post-partum care.

**Objective:** The aim of this presentation is to provide an overview of the ethnopharmacognosy studies conducted on *E. spinosus* in North Africa. Data on ethnomedicinal uses, chemical constituents, and pharmacological activity were systematically compiled.

**Methods:** Several popular search databases, including PubMed, ScienceDirect, Scopus, Web of Science, and Stanford libraries were scrutinised to extract relevant information. The research focused only on English-written papers published between 1980 and 2017.

**Results:** *Echinops spinosus* L. is traditionally used in North Africa, and it was found that the most ethnomedicinal use reports were from Morocco and Algeria. Promising results have been reported regarding its phytochemistry and pharmacological activity. Forty-three compounds were isolated from different parts of this species. No studies have been conducted to highlight the toxicity and clinical safety of this species.

**Conclusion:** This review highlights the therapeutic potential of *E. spinosus* used in traditional medicine. Furthermore, clinical trials on standardized preparations are necessary to explore the full safety and efficacy of *E. spinosus* in North Africa.

**Introduction**

The genus *Echinops*, belongs to the family Asteraceae (formerly Compositae) and comprises ca. 120 species distributed throughout the Mediterranean region, in central Asia, and in tropical Africa [1]. In Algeria, this genus is represented by the very common species *Echinops spinosus* L. According the African Plant Database, as well as the Plant List database, this name is synonymous with *E. spinosissimus* Turra [2–4]. It thrives in arid desert conditions with an annual rainfall varying between 20 and 100 mm, and has a wide ecological range for soil, including coastal, calcareous dunes, sandy, and gravelly to rocky surfaces [5]. Botanical classifications have subdivided *Echinops spinosus* L. into two subspecies [6,7]:

*E. spinosus* ssp. *eu. spinosus* Maire (var. *chaetocephalus* Pomel) and *E. spinosus* ssp. *bovei* (Boiss.) Maire (var. *pallens* Maire.), which is also known as *E. bovei* Boiss [8]. Recent data provided by synonymic survey of the Cardueae (Compositae) genera database, validated the scientific name of *E. spinosissimus* subsp. *bovei* (Boiss.) Greuter ≡ *E. bovei* Boiss [9].

Three other species have been reported in Algeria, but appear to be not very common: a) *E. ritro* L., known under the name of “oursin bleu” or “echinops” in French, has a southern European distribution, and occurs in southern Europe, western Asia, and even Siberia; b) *E. sphaerocephalus* L. is a mountainous species; and c) *E. strigosus* L.

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Echinops spinosus L. in North Africa

is distributed in the Iberian and North Africa area, especially in southern Spain and Algeria, and is widespread in the most western part of the Tell, from Tenes to the Moroccan border [6]. The literature reveals that 24 species of the genus Echinops have been subjected to varying degrees of scientific investigation [10]. Conversely, very little is known about E. spinosus [11,12]. Therefore, the objective of this review is to provide a detailed comparison of the chemical composition and pharmacological properties displayed by E. spinosus in North Africa with the widely studied species. Several search databases, including PubMed, ScienceDirect, Scopus, and Web of Science, were probed to extract information between 1980 and 2017.

Vernacular names

In Algeria, E. spinosus L. is known in the Berber language under the names “Taskra,” “Teskera,” “Taskra” Ameskelit T, and Sarsor, and in Arabic by the names: “fouga el djemel,” “chouk el djemel,” “suk ej-jmal,” Kachir, Ikchir, Chouk el Hamir, Chicau, and Sorr [13–15]. In the Tamahq language, this species is called Téfariast [16].

The Arabic name of “qounfoudzia” (de hérisson), is the transcription in Greek of “Ekhinos.” The vernacular name of “ri ayi el-ibil” has the meaning “Camel Pasture” [14]. In Morocco, this species is known under the names of “tasekra, asekra, teskra, chouk el hamir; suk al-himar, and tîmat” [17].

Botanical description and habitat

E. spinosus is a perennial herb growing to 1 m and more, with erect brownish to reddish stems, few long leaves from 10 to 15 cm, hairy, arachnoids, and with very long spines. The inflorescence is often a single hemispherical globe up to 5 cm in diameter during the flowering period. It is surrounded with numerous long spines (Figure 1). The small hermaphroditic flowers that compose the dense head are tubular, turning from green to white and yellowish when in full bloom. The fruits are small achene topped by membranous scales to ease dispersion [18].

In Algeria, two very polymorphous subspecies have been described: 1) ssp. bovei (Boiss.) Maire: stems pubescent, not glandular. The achenes are composed into distinct pieces at the base. The leaves are whitish and woolly on both sides. E. bovei is a Southern Mediterranean-Saharan taxon, and is widespread in Algeria [19,20]; and 2) ssp. eu. spinosus Maire: annual plant, upright and firm stems, from 40 to 60 cm. The distribution of E. eu spinosus is limited to the pre-desert regions in septentrional and central Sahara and is considered as a Saharo-Sindian taxon [6,7].

Phytochemistry

The genus Echinops is one of the taxa with characterized alkaloids within the Asteraceae family [21]. An overview of the literature on E. spinosus showed that reports concerning the phytochemistry of the Algerian species are very limited, with only two studies undertaken [11,12]. Preliminary qualitative phytochemical screening of various secondary metabolites by specific chemical tests was carried out on extracts of the aerial parts and roots, which indicated that the aqueous extract contained alkaloids, tannins, flavonoids, quinones, reducing sugars, and starch [11].

Phytochemical investigations of E. spinosus from North Africa in Morocco, Algeria, Tunisia, and Egypt led to the isolation and identification of 42 metabolites belonging to the phytochemical classes of quinoline alkaloids (S₁–S₂) [1], sesquiterpenoids (S₃) [22], flavonoids (S₄–S₂₆) [12,23], and sterols (S₂₇–S₃₉) [24]. The names of the isolated compounds and their sources are provided in Table 1 and the chemical structures are depicted in Table 2.

In 2009, the isolation of two sesquiterpenoids with a novel carbon framework was reported and named echinopine A and echinopine B [22]. In 2016, Bouattour et al. [24] identified 13 sterols in E. spinosus from Tunisia. The two most abundant compounds were β-sitosterol (44.97%) followed by stigmasterol (34.95%) [24]. In the same year, the occurrence of flavonoids was reported in the aerial parts of E. spinosus from Algeria and Egypt.
Twenty-three flavonoids were isolated [12, 23]. One year later, Bouattour et al., isolated a new derivative of apigenin named apigenin-7-β-D-ß-D-glucoside-(4"-O-trans-p-coumaroyl) [27]. The occurrence of simple quinoline alkaloids in the aerial and/or underground parts was reported in *E. ritro*, *E. echinatus* Roxb [28,29], *E. albicaulis* [30], and *E. niveus* [31]. Furthermore, members of the genus *Echinops* are also reported to contain flavonoids, triterpenoids, and thiophene acetylenes [21,29,30,32–34]. As far as information provided in the literature, thiophenes are a class of heterocyclic compounds which are characteristic secondary
Table 2. Chemical structures of isolated compound extracted from *Echinops spinosus* L.
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metabolites derived from plants belonging to the family Asteraceae such as *Echinops*. Based on this, the distribution of thiophenes in different species of the genus *Echinops* has been examined in six species, including: *E. grijissii* Hance, *E. pappii* Chiov, *E. hispidus* Fresen, *E. transiliensis* Golosh, *E. latifolius* Taush, and *E. latifolius* Taush. Twenty thiophenes have been reported in nine Ethiopian species: *E. amplexicaulis*, *E. papii*, *E. ellenbeckii*, *E. hispidus*, *E. hoehnelii*, *E. kebericho*, *E. longisetus*, *E. macrochaetus*, and *E. giganteus* [34]. In parallel, it should be noted that *E. spinosus* has not been screened for thiophene composition; only one chemical report described the structure of a new thiophene in roots collected from Morocco, which is known as the acetylencylene 2,2-dimethyl-4-[5′-(prop-1-ynyl)-2,2′-bithiophen-5-yl]-1,3-dioxalane (S40) [26]. Furthermore, a new sesquiterpenoid 11-hydroxyisocoumarin-2-en-5-one (S41) was described for the first time in the dichloromethane extract of the roots of *E. spinosis-simus* subsp. *spinosa* Greuter from Morocco [22]. In 2017, Bouattour et al., isolated a C50-pentacyclic triterpadiene A-neooleana-3(5),12-diene (S42), which might be a marker of identification of *E. spinosus* from other species of *Echinops* [27].

**Ethnobotanical aspects**

Traditional preparations of *E. spinosus* are frequently used in folk medicine as an abortifacient, as a diuretic, and for blood circulation, diabetes, gastric pain, indigestion, and spasmolytic problems [35]. In traditional medicine practices, *E. spinosus* is known in the Chinese [36] and North African traditions [37]; the latter reporting the ethnomedicinal use of the stems, leaves, and roots as a diuretic drug.

In Algeria, the roots or flower heads of *E. spinosus* have been used in the treatment of prostatism and dysmenorrhea. This botanical remedy has also been used as a peripheral vasoconstrictor in the treatment of hemorrhoids, varicose veins, and varicocele, in various venous hemorrhages and in metrorrhagia. It is considered as a hypertensive drug [13,14]. Table 3 presents the diverse ethnomedicinal uses of various parts of *E. spinosus* in North Africa.
Pharmacological properties

Anti-inflammatory activity

Over a long period of time, many medicinal plants have been used for the treatment and management of various forms of inflammatory conditions by African traditional healers and herbalists. However, most of these plants are not documented as compared to the Chinese or Indian traditional medicines. About 5,000 plant species have used for centuries for the treatment of various diseases, including anti-inflammatory diseases. A few African medicinal plants with demonstrated anti-inflammatory and analgesic properties have been documented in the last two decades [18].

The genus *Echinops* is used traditionally in North Africa for its anti-inflammatory actions [46]. In 1999, Rimbau et al., assessed the anti-inflammatory activities of the aqueous, ethanol, and chloroform extracts from the rhizome of *E. spinosus* [47]. Two experimental methods were used: a) carrageenan-induced rats sub-plantar edema inflammatory...
Micrococcus luteus is a source of phenolic compounds that were isolated from the methanolic extract from leaves of *E. echinatus*. The extract was assayed in the hind paw oedema method, which showed an inhibitory effect of 61.3% ± 2.8% (i.p.), 3 mg/kg, compared with 32.4% for the reference group. In the experimental model in mice, the percentage inhibition for the chloroform extract was 56.1%, compared with 34% for the reference group. Table 4 summarizes the effects of the extracts used in the study, and the positive control used.

In parallel, a wide range of anti-inflammatory activity has been shown for *E. echinatus* used in the Indian System of Medicine for the treatment of fever and inflammatory diseases. In 1989, *E. echinatus* L. was extensively studied for its acute anti-inflammatory induced in rats by carrageenan, formaldehyde-induced acute and chronic arthritis, and adjuvant-induced acute and chronic arthritis. Taking into account the methods described to assess the anti-inflammatory activity of *E. spinosus* [48], it was found that the ethanol extract of the whole plant of *E. echinatus* at a dose of 100 mg/kg was less effective than *E. spinosus*. It is noticeable that the percentage of inhibition in the acute carrageenan paw edema was higher in intraperitoneal (i.p.) than oral (p.o.) dosing, with a percentage of inhibition 67.4%, compared with 38.9% for the reference group. A study showed that the ethanol extract of *E. spinosus* had the greatest ability to reduce DPPH radicals, with an IC$_{50}$ value of 147 µg/ml. As expected, it was reported for the roots of *E. spinosus* that there is a positive correlation between the condensed tannin content and activity in the DPPH assay [35].

Comparatively, high scavenging DPPH activities were shown for the methanolic extract of seeds and leaves of *E. orientalis* [54]. It was shown that the aqueous extract of *E. ritro* is a source of phenolic compounds based on gallic acid, measured by Folin–Ciocalteau methods (92.24 Gallic Acid Equivalents (GAE) mg/100 g), and exhibited higher DPPH scavenging activity compared with a synthetic antioxidant Butylated hydroxytoluene (BHT) [55].

### Antimicrobial activity

The antibacterial and the antifungal activities of the unsaponifiable matter, and a fraction isolated from the hexane extract of *E. spinosus*, were evaluated for their antimicrobial potential against eight Gram-positive and Gram-negative bacteria by measuring the diameter of the inhibition zone around the well, and the determination of their minimal inhibitory concentration (MIC) and minimum bactericidal concentration. The activity tests were conducted using the diffusion disc and broth microdilution assays. Very weak antibacterial activity, with MIC values of 125.0 µg/ml against *Staphylococcus aureus*, *Bacillus cereus*, and *Micrococcus luteus* (MIC > 125.0 µg/ml) was shown by this extract. No significant antifungal activity was observed [22].
Conclusions

The present paper summarizes the limited information on E. spinosus and highlights the therapeutic potential, which is used mainly as an anti-inflammatory drug in Algeria, as well as in Morocco. To the best of our knowledge, no study has been conducted to describe the toxicological effects of this species. Therefore, further clinical studies, based on standardized extracts from a sustainable source, must be designed to ensure the safety and efficacy of the extracts of this species which is widely used in traditional medicine in North Africa as an abortifacient drug.

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