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Review Article

Review on Ethnomedicinal and Pharmacological Uses of *Echinops kebericho* Mesfin in Ethiopia

Gadisa Demie

Forestry Department, College of Agriculture and Veterinary Science, Ambo University, Ambo, Ethiopia

Email address:
gadisademie@gmail.com

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Abstract: The genus *Echinops* is native to African countries, the Middle East, Europe, and Asia comprises 120 species. In Ethiopia, this genus is represented by well known endemic and critically endangered species *Echinops kebericho* Mesfin also known as "*Kebercho,"* in Amharic language which has a long history of ethnomedicinal uses. Due to the popularity of species as a source of ethnomedicine, this species is severely over-harvested throughout their distributional ranges. This review documents fragmented information on traditional uses and pharmacological evidence of *Echinops kebericho* in Ethiopia. This review article was carried out by searching studies in PubMed, Google scholar and Google search up to August 2019. The search terms were "*Echinops kebericho* Mesfin", "therapeutic" & "pharmacological". Ethnomedicinal uses of *Echinops kebericho* Mesfin has been recorded from different regions of Ethiopia for 32 human and 2 livestock ailments. *E. kebericho* is used to treat evil eye, headache, cough, stomachache, febrile illness and malaria ailments. The extracts of *E. kebericho*, particularly those from root, exhibited a wide range of pharmacological effects including antihelminthic, antibacterial, antifungal, antidiarrheal, anti spasmolytic and antimalarial activities. These pharmacological studies have established a scientific basis for therapeutic uses of *Echinops kebericho* Mesfin. Although Ethiopian *Echinops kebericho* is widely used by traditional practitioners but, it is threatened due to over exploitation of root part. Therefore, *E. kebericho* need urgent conservation attention, micro propagation, effective documentation and further research.

Keywords: *Echinops kebericho* Mesfin, Ethnomedicinal, Pharmacology

1. Introduction

The uses of medicinal plants have been widely practiced for thousands of years to treat various diseases in all over the world [1]. More than 35,000 plant species are being used as traditional medicine around the world [2]. In developing countries, about 80% of population still relies on traditional medicine for their primary health care [3]. The African countries also have a long history and up to 90% of the human population use medicinal plants as a source of drugs [4]. Likewise, traditional medicine has played a significant role in treating various ailments in Ethiopia [5-7]. The current reports revealed that around 80% of Ethiopian human population still depends on medicinal plants to fulfill their primary healthcare requirements [6], largely due to its cultural acceptability of healers, relatively low cost of traditional medicine [8], and lack of adequate healthcare services suffering the larger population of the country [9]. Nowadays, medicinal plants are not only used as local and traditional aliment but also registered as official remedy that is confirmed with pharmacopoeias [10]. Furthermore, a photochemical screening, often leads to the discovery of new compounds that can play a significant role in the global efforts against various ailments [11]. More than 50% of all modern drugs have natural origin; therefore, these products have a great role in the pharmaceutical sciences for drug development [12]. The current investigations have indicated that around 25% of the modern remedies have been obtained from medicinal plants [13].

Echinops kebericho Mesfin is also a plant with immense medicinal values with restricted distribution in Ethiopia. It is an erect enormous root stock-bearing perennial herb or shrub

that grows up to a height of 1.2 m with leafy stems [14]. It is a well known endemic and critically endangered medicinal plant belonging to family Asteraceae. *Echinops kebericho* has been used for curative and therapeutic properties intreating various infectious and non infectious diseases such as fever, headache, stomachache, malaria, and cough [15]. In the pharmacological action *E.kebericho*root extracts have also been reported forantihelmintic, antitumor, antimutagenic, antibacterial and fungicidal properties [16, 17]. In addition, extracts and essential oils of the roots were shown to have antimicrobial, antihelminthic, molluscicidal and *in vivo* antiplasmodialactivities [15, 18]. Current investigation has identified that *E. kebericho* have been reported to control veterinary and agricultural insect pests [19]. Because of their versatile biological and therapeutic activities, *E. kebericho* plants have been traditionally used for the treatment of various diseases in different parts of Ethiopia. However, there has not been any review conducted on therapeutic and pharmacological uses of *Echinops kebericho* to treat various diseases. Therefore, the present review compiles the fragmented information on the traditional and pharmacology uses of the *Echinops kebericho* species. This information will highlight the importance of the genus and will provide baseline information for future researchers intending to do further work on genus *Echinops*.

2. Material and Methods

A systematic analysis and review of research literatures related to genus *Echinops* used for traditional diseases treatment in Ethiopia was carried out between Januarys and August, 2019. A web-based systematic research literature search strategy was employed. Ethno-botanical/ethno-medicinal studies reporting on *Echinops kebericho* used for diseases treatment in Ethiopia were gathered by different search approaches, including; search for published journal articles using international scientific databases including PubMed, Google search, Google scholar, etc. Literature search was performed using the following key terms: Ethiopian *Echinops kebericho*/Traditional medicinal use *Echinops kebericho* plant, Ethnobotany/Ethnobotanical study of *Echinops kebericho* and Ethnopharmacology of *genus Echinops* in Ethiopia. All data were entered into Statistical Software Packages for Social Science (SPSS, software version 20). A descriptive statistical methods, percentage and frequency were used to analyze ethno-botanical data on reported *Echinops kebericho* plant. The results were presented using tables.

3. Results

The present review reported the majority of studies were in Oromia region located in the central part of Ethiopia. In most of the reported studies, the majority of informants were men (traditional healers, laypeople and experienced elders) at the ages between 35 and 85 years. In almost all studies, number of informants or interviewees was above 30. Mostly, field surveys, group discussions, and semi structured questionnaires were carried out from local inhabitants to collect the data. However, in some of the studies, direct interviews were also observed. A brief overview of the results is presented in the following sections.

3.1. Botanical Features and Distribution of Echinops Kebericho Mesfin

In Ethiopia, E. kebericho known by common name "*Kebercho"* in Amharic language [20, 21]. *Echinops kebericho* Mesfin belongs to the Asteraceae family, known only in Ethiopia, is an erect massive root stock-bearing perennial herb or shrub that grows up to a height of 1.2 m with leafy stems [22]. The leaf lamina is curved and is detached into pieces that consistently end in spikes. The corolla is white or brilliant blue [23]. Flower head 3–4 in diameter, spineless peduncle up to 5.5 cm long, arachnoid, pubscent, 1-2mm wide. *Echinops kebericho*, is endemic and critically endangered medicinal plant in Ethiopia.

Literatures reviews revealed that, 38 studies focused on genus Echinops, were found to be therapeutically evaluated. Among the genus Echinops known for medicinal value in Ethiopia, more than half (63%) of the genusbelonging to family Asteraceae (*Echinops kebericho* Mesfin*)* was confirmed for its therapeutic potentials. *Echinops kebericho* Mesfin*, Echinops maracandicus* Bunge, *Echinops hispidus Fresen, Echinops pappii* Chiov*, Echidnopsis dammanniana* Sprenger, *Echinops amplexicaulis* Oliv, *Echinops cacrochaetus* and *Echinops giganteus* A. Richare examples ofknown species of genus Echinops which grow in different parts of Ethiopia and are known to have medicinal properties [24-30]. The majority of *Echinops kebericho* Mesfin uses reported in Oromia (52%), Amhara (30%) and SNNPR (11%) regions [31-38]. The Oromia and Amhara regions share boundaries with many other regions in Ethiopia and are likely to share common flora and cultural practices, including in ethno-medicine. This long list of species also indicates that local people in these regions have an active interest in *E. kebericho* species. Moreover, the geographic distribution of *Echinops kebericho* Mesfin is likely to be predicated on local trend with regard to cultural and floral diversity including traditional medicinal practices. [39], and [40], reported that the plant belongs to the genus *Echinops* that comprises 125-130 species in the family Asteraceae/Compositae distributed in semi-humid zones of tropical and North Africa, Mediterranean basin, and temperate regions up to Central Asia. The twelve species of *E. kebericho* belongs to the Asteraceae family occur in Ethiopia are also confined to the highlands of the country between 7^{o} 30' N and 38^{o} 45' E and at altitudes between 1700 and 2900 m.a.s.l [41]. *E. kebericho* grows in dry and stony lateritic soils. It is different in habit and in dissection of the leaf blade. These plant populations in deep vertisols are low shrubs whereas those growing in dry, stony lateritic soils are perennial herbs [41].

Table 1. *Reported therapeutic Use of Echinops Kebericho Mesfin in Ethiopia.*

Diseases treated	Part used	Application	Region	Reference
Mosquitoes	Root	Dried parts burned to generate smoke	Oromia	[42]
Toothache	Root	Fresh root paste with water is given orally	Oromia	[26]
Abdominal aches Circling disease Coughing (L)	Root	The roots chopped and given with feed. Its root chopped, added to fire and smoked	Oromia	[43]
Coughing	Root	Infusion		
Head ache	Root	Smoke	Oromia	[44]
Fibre illness	Root	Smoke		
Fibre illness	Root	Smoke	Oromia	[21]
Evil eye		Not specified		
Toothache	Root	Pounded dry root is mixed with coffee	Oromia	[31]
Black leg	Root	Root is powdered and mixed with pulverized leaves to make decoction	Oromia	[38]
Respiratory, Liver		Not specified		
Evil eye	Root			
Evil sprit	Root	Not specified	Amhara	[35]
Malaise	Root			
Fever	Root			
Evil eye	Root	Drying, crushing and adding the seed on fire to smell		
Tape worm	Root	Drying and crushing then drink by Mixing with *Capsicum annuum* L. and salt	Amhara	[37]
Common cold	Root	Burning the root and inhale it		
Febrile illness	Root	Not specified		
Evil eye	Root	Dried root is applied to smoking orally.	Amhara	[32]
Mitat	Root	Dried root is smoking orally.		
Evil eye	Root	Smelling and inhaling	Amhara	[34]
Mitat	Root	Smelling and inhaling		
Epidemic diseases	Root	fumigated	Amhara	[33]
Evil eye	Above ground	Feces of donkey are added with it and add in to fire then expose to the smoke.	Tigray	[45]
Toothache	Root			
Sunstrik (meganya)	Root			
Acute sickness	Root			
Tonsillitis	leaf	Not specified	SNNPR	[36]
Common cold	Root			
Snake bite	Root			
Stomachache	Root			
Malaria	Root	Roots are crushed with seeds of *Guizotia abyssinica,* mixed with water and solution taken orally	Amhara	[46]
Abortifacient	Root			
Epilepsy	Root			
Epistaxis	Root			
Atrophy	Root	Not specified	SNNPR	[47]
Devil sickness	Root			
Dingategna	Root			
Tonsillitis	Root			
Evil eye	Root	The same as *Carisa edulis* and *Caparis tomentosa*.	Oromia	
Head ache	Root	Dry root is smoked to the patient.		[27]
Parasite	Root	Root is pounded together with leaf of *Vernonia amygdalina* and given to cattle as feed.		
Malaria	Root	Inhaling the root powder	Amhara	[48]
common cold	Root	Inhaling the root powder		
Evil eye	Root	Root powder is sprinkled on burning charcoal and smoke is inhaled	Oromia	[49]
Cough,	Root	Bulbs are infused, inhaled, and smoked.	SNNPR	[50]
Dislocated bone (livestock)	Root	Tie it on damaged part	Tigray	[51]
Fever	Root	Inhale the smoke		
Typhoid	Root			
Tonsilitis	Root			
Tooth ache	Root			
Common cold	Root			
Cancer	Root	Not specified	Oromia	[52]
Insect repellent	Root			
Hypertension	Root			
Colic	Root			
Evil eye	Root			
Evil spirits	Root			

3.2. Therapeutic Uses of Echinops Kebericho Mesfin

A survey of literatures showed several medicinal properties have been attributed to *Echinops kebericho* Mesfin in different regions of Ethiopia. The traditional uses of *Echinops* is referred to many folkloric and ethnobotanical studies done in Ethiopia, where the species is still used as primary sources of traditional medicine. A total of 32 human and 2 animal ailments are treated with *Echinops kebericho* (Table 1). [51] and [53] also showed the majority of medicinal plants were used to treat human diseases than livestock due to high prevalence of human diseases. But, [26] observed that local communities give priority for human health care than livestock due to inadequate modern healthcare centers in the study area till traditional healers are using local plants for the welfare of human health. The most commonly treated human ailments are evil eye followed by headache, cough, stomachache, febrile illness and malaria. Other studies conducted elsewhere in Ethiopia indicated the evil eye as common mental disorders [24, 54, 55]. The previous study in Dega Damot, Amhara, North western Ethiopia also showed that 34% of informants reported *Echinops kebericho* used to treat evil eye in the district [37]. Similarly, study around Dirre Sheikh Hussein, South-eastern Ethiopia [53] found that, *Echinops kebericho* Mesfin was frequently mentioned medicinal plant. The comparison of earlier ethnobotanical studies conducted in Ethiopia showed that, many similarities can be recognized when the ethnomedicinal uses of *Echinops kebericho* is considered in all regions (Table 1). This may imply that, local people of Ethiopia over wide area have the tendency to use the similar medicinal plant as a result of the wider distribution of medicinal plants in the country [33] and due to same selection criteria. On the top of this, similar uses of *Echinops kebericho* in different regions of country also showed the considerable dissimilarity with respect to preparation and application techniques. According to this review, traditional medicinal practitioners in Ethiopia apply different techniques of preparations including, crushing, powdering, and chopping (Table 1). They use simple techniques and equipments during their remedy preparation. For instance, powder of *Echinops* root is given to patients suffering evil eye by inhaling and roots are crushed with seeds of *Guizotia abyssinica*, mixed with water and solution taken orally [32, 34, 37, 42, 46]. Medicinal preparations from *Echinops kebericho* Mesfin have been suggested to shorten the course of illness from black leg, respiratory manifestations and liver disease [38]. Moreover, the smoke from burning the plant is inhaled to relieve headache [27, 31, 32, 34, 44, 50]. *Echinops kebericho* is traditionally used for the treatment of fibre illness, evil spirit, snake bite, tonsillitis, coughing and sudden illness [35, 36, 43, 56].

Traditional healers prepare herbal remedies either solely or in combinations and for oral use with water or other additives such as honey, sugar and mixing with other plant. The majority of the *Echinops kebericho* remedies (87.3%) are used as monotherapies. The review is in agreement with the finding of [53], which stated that single plant remedy preparations were high. However, multi therapies/ a mixture of *Echinops kebericho* root pounded together with leaf of *Vernonia amygdalina* given for cattle as a remedy for parasite [27]. Pounded dry root is mixed with coffee used for headache [31]. *E. kebericho* roots are crushed with seeds of *Guizotia abyssinica*, mixed with water and solution taken orally for treatment of malaria [46]. The use of multiple therapies in traditional medicine based on combining plants has recently been shown to increase the efficacy of the herbal medicine [57]. Study by [58], showed that the use of more than one plant species to prepare a remedy for ailments is attributed to the synergistic effects that they could have during ailment treatment.

In this review, root was the most commonly used plant part in the preparation of remedies as compared to other parts. [6, 48, 59] also found roots take the highest proportion in remedy preparation due to the efficacy of roots in treating the ailments. Study conducted in South Omo, Southern Ethiopia [60], indicated that roots remain in the soil and is easily available, even during the long dry seasons in arid and semi-arid areas. Moreover, the use of plants root could also be associated with early African beliefs in their powerful therapeutic effect to protect malaria and venereal diseases and to induce abortions [61, 62]. However, other studies conducted elsewhere in Ethiopia showed harvesting root of a plant poses more threat to survival of plant than collecting other parts such as fruits, seeds and leaves [63, 64]. Similarly, [65], found that *Echinops kebericho* was a critically endangered medicinal plant due commercial harvesting and sale of roots. Moreover, study conducted in West Gojjam Ethiopia [33] revealed that *Echinops kebericho* was approaching to extinct due to overharvesting root for medicine. But a study done in Guraghe zone, SNNPR of Ethiopia [66] indicated that 66% of *Echinops kebericho* threatened because of agricultural expansion.

3.3. Ethnopharmacological Properties

3.3.1. Antimicrobial Activity

The present review reported the extract of *E. Kebericho* root exhibited good antibacterial and antifungal activity. Report says that alcohol extracted from *E. Kebericho* root believed to be responsible for control against *S. aureus A. flavus* and *C. albicans* [67]. But, water based extracts showed weak antimicrobial activity**.** The higher polyphenols present in alcohol based extracts was found to posses stronger antimicrobial activity than water based extract.

3.3.2. Antimalarial Activity

Malaria is a world public health threat infecting about 300 million people each year [68]. Thus, medicinal plants are being commonly used to treat malaria due to the presence of anti plasmodial compounds [69]. Experiments by [70], demonstrated that *E. Kebericho* root extract in fraction of hexane and butanol have antimalaria activity with an optimal dose of 500 mg/kg body weight. Root extractof *E. Kebericho*

in crude ethanol showed parasitemia and extending the survival time of mice [15]. The extracts of *E. Kebericho* showed antiplasmodial activities against *Plasmodium Berghei* which supports traditional uses of species [71]. *E. Kebericho* Mesfin is also among traditionally used medicinal plants against wide ranges of diseases including malaria in Ethiopia [18, 72], showed that Sesquiterpenes compounds obtained from Echinops species exhibited antimalarial agents activities.

3.3.3. Antidiarrheal and Ant Spasmolytic Activities

Diarrhea is a widespread gastrointestinal disorder caused by infections. It is responsible for deaths of 5 million human populations every year [73, 74]. The present review reported the root extract of *Echinops kebericho* is used traditionally for the treatment of diarrhea in Ethiopia. [75], conducted an experiment with aqueous extracts from *E. kebericho* for its protective effect against diarrhea and spasmodic. This research confirms the use of extract of *Echinops kebericho* possesses antidiarrheal and spasmolytic activities.

According to [76] flavonoid is collection of polyphenolic compound and has been confirmed to exhibit a different of biological activities for example antioxidant, anti-inflammatory, antispasmodic, and antidiarrheal effects. Study by [77] reported that the antidiarrheal activity of flavonoids to inhibit intestinal motility and hydro-electrolytic secretions.

3.3.4. Oral Acute Toxicity Activities

Many plants produce biologically active substance which can poison, kill and repel other species. [71] demonstrated that the graded doses of 70% methanol extract of *E. Kebericho* Mesfin did not exhibit any signs of toxicity in mice. Experiments by [15] confirmed that *E. kebericho* extract in hydro-alcoholic did not produce significant changes in behaviors, such as alertness, motor activity, breathing, restlessness, diarrhoea, convulsions, coma, and appearance of the animals. Research by [78] showed that the people in the central and south-western parts of Ethiopia use the smoke of *E. kebericho* to repel snakes from their vicinity. These results confirm that natural products from *Echinops* species are potential sources of new and selective agents for the treatment of important diseases.

3.3.5. Antileishmanial Activity

Leishmaniasis is a disease caused by obligate intracellular parasitic protozoa of the genus Leishmania [79]. According to [80], leishmaniasis is transmitted to humans and other mammals by the bite of infected females and flies vector. For the past decade, there have been a few studies conducted concerning the antileishmanial activity of phytochemicals of *Echinops kebericho*. In one pharmacological study, essential oils extract of *Echinops kebericho* was found to be highly active as antileishmanial activities [17].

3.4. Major Threats to Echinops Kebericho

Currently, many medicinal plants are being seriously depleted in Ethiopia due to anthropogenic factors [45, 81], agricultural expansion, deforestation, fuel wood harvesting, overgrazing and urbanization [82, 83]. *Echinops kebericho* has been registered under national red list as vulnerable since it is facing a high risk of extinction in the wild, mainly associated with its traditional medicinal use [84]. Study conducted in Tembaro Zone, Southern Ethiopia [85] showed that *Echinops kebericho*, was marketed mainly for therapeutic purpose to generate income. The first report made by [86] revealed the popularity of *E. kebericho* trade in all 19 markets of central parts Ethiopia. The numerous tuberous roots are sold as small pieces or in entire in many markets in Gojjam, Shewa and Wellega [29]. According to [87], the use and practices related with traditional fumigation of *E.kebericho* isa vital after birth in many parts of Ethiopia. For instance, a study in Borana, southern Ethiopia showed that *E.kebericho* has been reported to have abortifacation effect, and also used to care forepilepsy, epistaxis, atrophy, sudden, evil spirit sickness by people of Kembatta, Southern Ethiopia [85]. Thus, due to its over use in the wild the species is facing a high risk of extinction in the wild.

Echinops kebericho Mesfin is known as seriously endangered endemic shrubs of Ethiopia [88]. Study conducted in Mecha Wereda, West Gojjam Zone of Amhara region [14], indicated that *E. kebericho* is insufficient medicinal plant due to overexploitation. Moreover, the natural regeneration status of *E. kebericho* is restricted to a particular microclimate; the domestication of this species is very difficult. *E. kebericho* reproduce by seed which is incompetent due to inadequate and in viability of seeds. Propagation by seeds is time consuming to achieve large scale production for preservation and farming of the species. Despite these problems, the local people destruct the whole plant before seed set as they use the root part for medicinal use. Generally, a problem related with natural propagation and overexploitation for medicinal use has put *E. kebericho* in the list of critically endangered plant species of Ethiopia [89]. It is among few prioritized medicinal plants of Ethiopia that needs urgent conservation. The micropropagation of *E. kebericho* is very useful to preserve germplasm of this endangered species, to promote scientific activities, commercial cultivation and sustainable usage of the species. Study by [90], reported the *in vitro* and *ex vitro* seed based propagation of *E. kebericho*. Other study has also showed that micropropagation of *Echinops kebericho* has a considerable practical significance for large scale production of plants for their rehabilitation in natural habitat, *ex vitro* cultivation and sustainable utilization of this medicinal plant [65].

4. Conclusion and Recommendations

The extensive literatures survey revealed that *Echinops kebericho* Mesfin is important medicinal plant with diverse pharmacological spectrum. The plant shows the presence of many chemical constituents which are responsible for varied pharmacological and medicinal properties. The pharmacological analysis will also highlight how the limited population numbers of the plant can be utilized as source of

medicine. Although Ethiopian *Echinops kebericho* is widely used by traditional practitioners for curing various diseases, it is threatened due to over exploitation of root part; hence urgent conservation attention is needed to conserve this species for sustainable usage in the future. Moreover, the present researchers believe that the therapeutic use of the *E. kebericho* will provide basic data for further researches focus on pharmacological studies and the conservation of this most endangered and endemic medicinal plant in Ethiopia.

Authors' Contributions

Gadisa Demie is a lecturer at Department of Forestry College of Agriculture and Veterinary Science, Ambo University, Ethiopia. He planned the Review, searched data, analyzed the data and wrote the manuscript.

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