

# Ethnomedicinal review of Usnakantaka (*Echinops echinatus* Roxb.)

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## ABSTRACT

*Echinops echinatus* Roxb. (*E. echinatus*), commonly known as “Usnakantaka,” is a xerophytic herbaceous plant traditionally used as a stimulant to treat use the term Sexual debility in Indian traditional systems of medicine. The roots, leaves, fruit, and bark are extensively used in folk medicine as well as in Ayurveda. Also, the plant shows a wide range of pharmacological activities such as antifungal, analgesic, diuretic, reproductive, hepatoprotective, antioxidant, anti-inflammatory, wound-healing, antipyretic, and antibacterial properties. Among the several active constituents, apigenin, apigenin-7-O-glucoside, echinacin, 5,7-dihydroxy-8,4'-dimethoxy-flavanone-5-O- $\alpha$ -L-rhamnopyranosyl-7-O- $\beta$ -D-arabinopyranosyl-(1 $\rightarrow$ 4)-O- $\beta$ -D-glucopyranoside are the most important in terms of reported pharmacological activities. The current review focuses on the updated information from various scientific studies and reports available in the context of the phytoconstituents and pharmacology of this plant. This review also provides adequate information about the use of this plant in an Indian system of medicine, Ayurveda.

**Key words:** Apigenin, Ayurveda, echinacin, *Echinops echinatus*, sexual disability

## INTRODUCTION

Brahmadandi is a well-known drug in the Ayurvedic system of medicine for the treatment of sexual disability. It is used as a sexual stimulant both internally and externally.<sup>[1]</sup> At present, a number of plants are known by the trade name Brahmadandi viz., *Echinops echinatus* Roxb. (*E. echinatus*), *Tricholepis glaberrima* DC, and *Argemone mexicana*.<sup>[2]</sup> In the present article, the details of phytochemical and pharmacological reports on *Echinops echinatus* Roxb. were included.

Asteraceae is one of the largest flowering plant families, with about 30,000 species<sup>[3]</sup> and a little over 1,100 genera<sup>[4]</sup> distributed more or less throughout the globe. Of this family, there are

around 900 species under 167 genera that are grown in India.<sup>[5]</sup> The genus *Echinops* encompasses about 120 species of flowering plants.<sup>[6]</sup> *E. echinatus* is a xerophytic herbaceous plant that is commonly known as “Brahmadandi” or “Utakatira.” It is widely distributed in the desert regions of Africa, the Mediterranean, India, and the Southeast Asian countries. Its root, leaves, fruit, and bark are the most commonly used parts.<sup>[7]</sup> Within India, it grows at an altitude of 1,500 m throughout the country. It is ordinarily present on and along roadsides, grasslands, and open forest areas.<sup>[8]</sup>

### Vernacular names

- English: Indian globe thistle, Camel's thistle
- Gujarati: *Shuliyō, Utkanto, Utkato*
- Hindi: *Gokbru, Uthkanta, Utakatira*
- Sanskrit: *Kantalu, Kantaphala, Utati, Utkantaka, Karabbadana, Sringsbunkashana*
- Urdu: *Barham dandi, Labh, Untkatara, Jachir*
- Marathi: *Utkatar, Kate-chendu*
- Telugu: *Brahmadandi*
- Kannada: *Brahmadande*
- Gujarati: *Utkanto, Shuliyō*.<sup>[9]</sup>

## BOTANICAL DESCRIPTION

It is an erect, rigid, pubescent, annual herb about 1 m in height. It has short, stout stems with branches widely spreading from the base. The leaves are alternately arranged, sessile, oblong, deeply

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pinnatifid, 7-12 cm long, and covered with cottony wool beneath; the lobes are triangular, sinuate, and prickly, and the spines are often 2.5 cm long. Flowerheads occur in solitary white spherical balls (globose), 3-5 cm across, clustered at the ends of branches. The flowers are surrounded by strong white bristles resembling pappus hairs; the pappus is short, yellowish, and forms a short cylindrical brush above the achene. Petals of the tiny white flowers are 5 mm long. Flowering occurs between December and January.

## PHYTOCHEMISTRY

Phytochemical screening of the plant has revealed the presence of triterpenoids, isoflavones, glycosides, phenolic compounds, and alkaloids. Various parts of the plant such as roots, leaves, flowers, and other aerial parts were used for the extraction of a variety of phytoconstituents. [Table 1 and Figure 1].<sup>[2,10-17]</sup>

## REVIEW IN AYURVEDA

A few references to this plant are available in Ayurvedic texts. It is cited to possess *katu* (pungent) and *tikta* (bitter) *rasa* (taste), *katu vipaka* (pungent postdigestive effect) and *usna virya* (hot potency). It pacifies *vata* (The Air or Nervous System Humor) and *kapha* (The water humor or protective humors). Decoction of the root is given to pregnant women for facilitating delivery. Use of the plant is indicated in cases of *mutrakrichha* (dysurea), *madhumeha* (diabetes), *trishna* (thirst), *bridroga* (cardiac diseases), *ashmari* (urolithiasis), and *jvara* (fever). The seeds are recommended in cases of *nishphota* (blisters on the skin) and *klaihyata* (sexual disability).<sup>[18-21]</sup>

## ETHNOBOTANICAL USES

The roots of the plant as well as the seeds have aphrodisiac properties.<sup>[22,23]</sup> In cases of sexual disability and spermatorrhea, root powder of *E. echinatus* is taken either with equal quantities of turmeric and mustard,<sup>[24]</sup> or with misri (sugar),<sup>[25]</sup> or with milk.<sup>[7]</sup> It is also used by the traditional healers of Chhattisgarh to treat people with poor sexual vitality. A paste of the root bark is applied superficially on the male genitals 1 h prior to intercourse.<sup>[26-28]</sup> In addition, aqueous paste of the root is applied on the lower abdomen of a pregnant female to facilitate the delivery process. It is also recommended for internal use for the same purpose.<sup>[9,26,29]</sup> Indigenous tribal peoples of southern Rajasthan place the roots of the plant among the hairs of the pregnant woman's head to facilitate the delivery process, but it is believed that if it is not removed immediately after delivery, the uterus may come out.<sup>[30]</sup> The root is an aphrodisiac as well as an abortifacient.<sup>[23]</sup> A mixture of leaf powder or root extract and honey is taken in the morning to expel round worms.<sup>[24]</sup> Ash of the whole plant is used with ghee or butter to treat leukorrhea.<sup>[24]</sup> In Gujarat, people prepare a suspension of the root bark of *E. echinatus* with milk and use it to treat diabetes.<sup>[1]</sup> The ash from the spines of the inflorescence is mixed with cow ghee and applied locally to cure eczema.<sup>[31]</sup> In addition, leaf paste is used externally for skin papules.<sup>[32]</sup> People in Orissa use this plant to cure diarrhea,<sup>[33]</sup> while in Maharashtra, a decoction of the whole plant is used as febrifuge.<sup>[34]</sup> For respiratory problems, fumigation is done by burning its leaves and roots; asthma patients get symptomatic relief by inhaling the fumes.<sup>[28]</sup> The root extract is effective in treating whooping cough.<sup>[22]</sup> It is also used in malarial fever and renal colic.<sup>[5]</sup> In Rajasthan again, *E. echinatus* paste is smeared on the soles and palms to treat heatstroke.<sup>[35]</sup> The indigenous people of the Cholistan

**Table 1: Phytoconstituents of *E. echinatus***

Plant part	Nature	Extract	Compound
Whole plant	Triterpenoid	Alcoholic extract	Taraxasterol acetate ( <b>1</b> ) <sup>[10]</sup>
	Isoflavone glycoside	Methanolic extract	Echinaside, 7-hydroxy-isoflavone, kaempferol-4'-o-methyl ether, kaempferol-7-methyl ether ( <b>2</b> ), Myrecetin-3-O-alpha-l-rhamnoside, Kaempferol ( <b>3</b> ) and kaempferol-3-O-alpha-l-rhamnoside echinaside ( <b>4</b> ), aglycone ( <b>5</b> ) <sup>[11]</sup>
Aerial parts	Phenolic compounds		Apigenin ( <b>6</b> ), apigenin-7-O-glucoside ( <b>7</b> ), echinacin and echinaticin <sup>[12]</sup>
	Alkaloids		Echinopsine ( <b>8</b> ), echinopsidine ( <b>9</b> ) and echinozolinone ( <b>10</b> ) (3 (2-hydroxyethyl)-4 (3H)-quinazolinone) <sup>[13]</sup>
	Triterpenoid	Alcoholic extract	Taraxasterol acetate ( <b>1</b> ) <sup>[14]</sup>
	Flavone	Alcoholic extract	Apigenin ( <b>6</b> ), apigenin 7-O-glucoside ( <b>7</b> ) <sup>[14]</sup>
	Glycosyl flavones	Alcoholic extract	Echinacin and echinaticin <sup>[14]</sup>
	Glycosyl flavones	Chloroform fractionation of alcoholic extract	Apigenin 7-O-glucoside ( <b>7</b> ) <sup>[14]</sup>
Leaves	Glycosyl flavones	N-Butanol fractionation of alcoholic extract	Apigenin 7-O- beta -d-(4"-cis-p-coumaroyl) glucoside <sup>[14]</sup>
	Flavanone glycoside	Methanolic extract	5, 7-dihydroxy-8,4'-dimethoxy- flavanone-5-O-α-L-r hamnopyranosyl-7-O-β-D-arabinopyranosyl-(1→4)-O-β-D-glucopyranoside,dihydroquercetin-4'-methyl ether ( <b>11</b> ) <sup>[15]</sup>
Roots			Lupeol ( <b>12</b> ) <sup>[2]</sup>
Flowers	Glycosyl flavones	Methanolic extract	Apigenin ( <b>6</b> ), apigenin 7-O-glucoside ( <b>7</b> ) <sup>[16,17]</sup>
	Acylflavone glucoside	Methanolic extract	Echitin ( <b>13</b> ) <sup>[16,17]</sup>
	Alkaloid	Methanolic extract	7-hydroxy-echinozolinone ( <b>14</b> ) <sup>[16,17]</sup>
	Alkaloid	Methanolic extract	7-hydroxy-3-(2-hydroxyethyl)-(3H)-quinozolin-4-one <sup>[16,17]</sup>

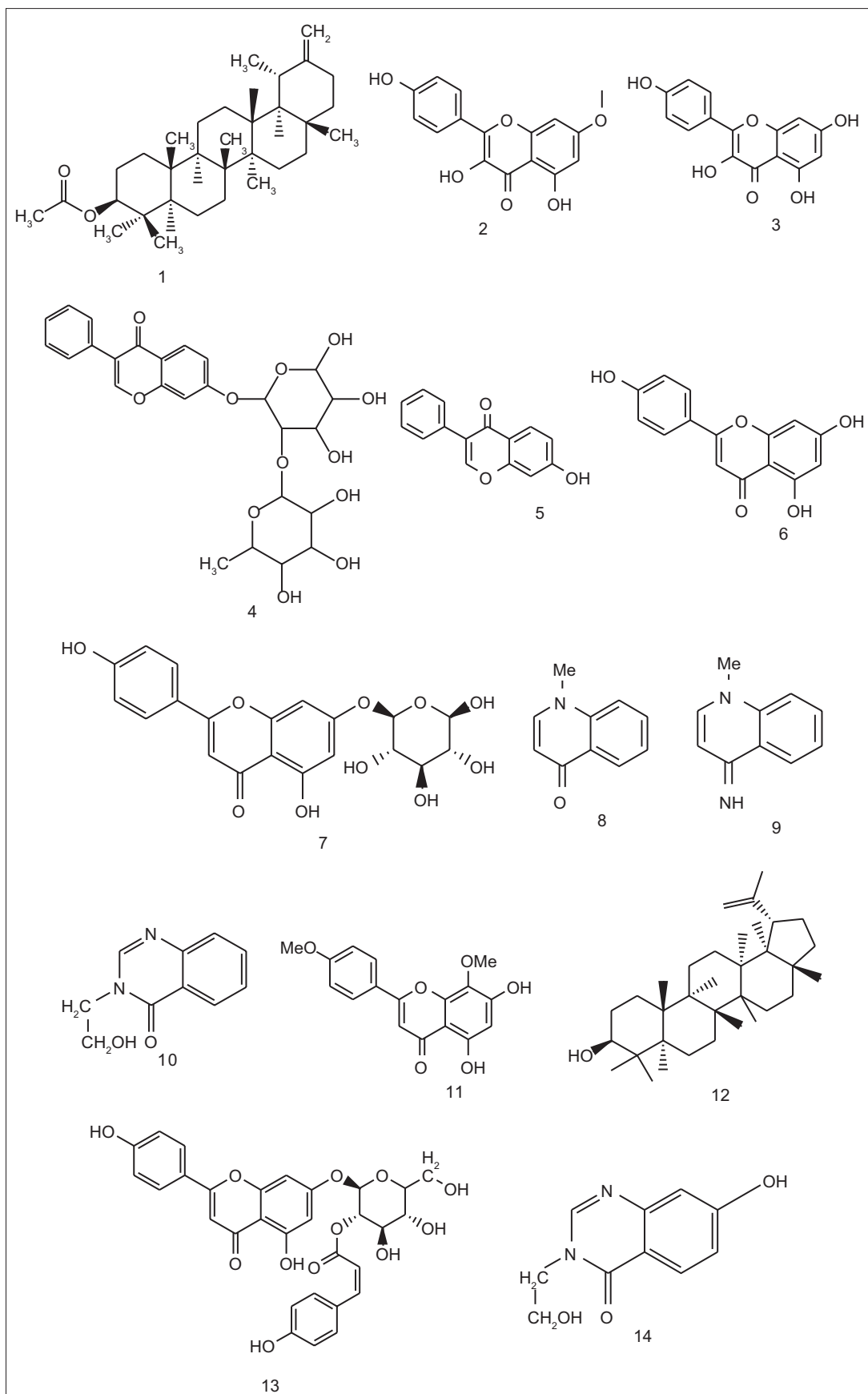


Figure 1: Structures of phytoconstituents of *E. echinatus*

desert (Pakistan)<sup>[36]</sup> and Gond tribe of Bhandara, Maharashtra<sup>[37]</sup> use this plant to treat liver disorders. In case of scorpion stings, the root is eaten raw directly in order to relieve pain.<sup>[38]</sup> In Kerala, decoction of the whole plant, leaf paste, and leaf powder are used to treat diabetes.<sup>[39]</sup> The Pashto tribe of Malakand District, Pakistan use it for gastrointestinal disorders, respiratory illness, nerve disorders (hysteria and epilepsy), cardiovascular complaints, and circulatory diseases. The plant is recommended for jaundice, hysteria, dyspepsia, hoarseness of throat, and cough. The powdered root is used as an antilice treatment and also applied to the wounds of cattle for killing maggots.<sup>[40]</sup> Local application of the root powder mixed with acacia gum on the hair kills lice.<sup>[22]</sup> Decoction of the root is used as a remedy for polyurea.<sup>[7]</sup> It is also given to horses as special fodder, which alleviates their digestive problems.<sup>[41]</sup> The plant is a diuretic, liver tonic, aphrodisiac, general tonic, and nervine tonic. It is also recommended in hysteria, dyspepsia, jaundice, and scrofula.<sup>[7,9,22]</sup> Its roots have been claimed to be useful in treating colds, whooping cough in children, fever, and wounds.<sup>[42,43]</sup> It increases the appetite, stimulates the liver, and is useful against brain disease, chronic fever, migraine, heart diseases, joint pains, urinary disorder, urinary infection, as well as worm and hemorrhoids in Ethiopia.<sup>[44]</sup>

## PHARMACOLOGICAL REVIEW

### Antifungal activity

Several phenolic compounds like apigenin (6), apigenin-7-O-glucoside (7), echinacin, and echinaticin have been isolated from *E. echinatus*. Also, two methylated derivatives, echinacin permethyl ether and apigenin-5,4'-dimethyl ether, have been reported, which were synthesized from echinacin and apigenin-7-O-glucoside (7). These compounds have been reported for their activity against the germination of conidia of *Alternaria tenuissima* (Kunz. ex Pers.) Wiltshire, which causes leaf blight disease in the pigeon pea (*Cajanus cajan*) at concentrations ranging 25-150 µg/mL. Echinacin at 150 µg/mL is considered to be the most potent of these compounds.<sup>[12]</sup>

### Analgesic activity

In one study, the analgesic property of the methanolic extract of the aerial parts and roots has been reported. The analgesic potential has been measured using hot plate, tail immersion, and tail flick models; it was reported that the methanolic extract at 250 mg/kg and at 500 mg/kg body weight exhibits significant analgesic activity.<sup>[23]</sup>

### Diuretic activity

The methanolic extract of the aerial parts and roots of *E. echinatus* has also been evaluated for diuretic activity in an *in vivo* Lipschitz test model. The results show a significant increase in urine volume and electrolyte excretion at 250 mg/kg and 500 mg/kg body weight.<sup>[45]</sup>

### Reproductive activity

The terpenoid fraction prepared from the petroleum ether extract of the roots of *E. echinatus* at the doses of 30 mg/kg

and 60 mg/kg body weight has been evaluated, and it shows a significant decrease in the weight of the reproductive organs. In addition, there was a significant decrease in the levels of serum testosterone and cauda epididymal sperm concentration.<sup>[46]</sup>

### Hepatoprotective activity

The ethanolic extract of *E. echinatus* at 500 mg/kg/day and 750 mg/kg/day has been tested in CCl<sub>4</sub>-intoxicated rabbits for 7 days, and the serum biochemical parameters and histopathological observations of the liver have been reported. The extract shows significant reinstatement in serum glutamine pyruvate transaminase (SGPT), serum glutamine oxaloacetate transaminase (SGOT), alkaline phosphatase (ALP) levels as compared to CCl<sub>4</sub> and silymarin control groups. Histopathological findings also confirm the hepatoprotective potential of the plant.<sup>[47]</sup>

### Antioxidant activity

The free radical-scavenging property of *E. echinatus* has also been reported in various *in vitro* models, such as the scavenging of 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical, nitric oxide radical, and superoxide anion.<sup>[48]</sup>

### Anti-inflammatory activity

The ethanol extract of the whole plant of *E. echinatus* was studied in carrageenan-, formaldehyde- and adjuvant-induced inflammation in rats. The extract showed significant inhibition of acute inflammation.<sup>[49]</sup> A triterpenoid "taraxasterol acetate (1)" from *E. echinatus* has been reported for anti-inflammatory potential in albino rats (19 mg/kg and 100 mg/kg) for carrageenan-, formaldehyde- and adjuvant-induced inflammation.<sup>[10]</sup> In addition, the isolation and structural elucidation of a new anti-inflammatory agent (5,7-dihydroxy-8,4'-dimethoxy-flavanone-5-O- $\alpha$ -L-rhamnopyranosyl-7-O -  $\beta$ -D-arabinopyranosyl-(1 $\rightarrow$ 4)-O- $\beta$ -D-glucopyranoside) from *E. echinatus* has been reported. The compound has been evaluated for anti-inflammatory activity in carrageenan-induced hind paw edema, in which 32.21% inhibition of edema has been reported.<sup>[15]</sup>

### Protective effect on prostate

The butanolic fraction of the ethanolic extract of *E. echinatus* has been reported for its protective effect on the prostate. The extract was found to prevent the increases in prostate weight induced by testosterone and to reduce prostate-specific antigen (PSA) levels significantly. It was further evaluated for *in vitro* 5 $\alpha$ -reductase inhibitory activity. Butanolic and water-insoluble fractions of the ethanolic extract were found to be significant inhibitors of 5 $\alpha$ -reductase compared to finasteride.<sup>[50]</sup> But the petroleum ether and aqueous extracts did not show significant activity.<sup>[51]</sup>

### Anti-irritant activity

The anti-irritant activity of *E. echinatus* was investigated in several fractions of the chloroform extract of powdered plant. The fractions were tested on abraded and irritated rabbit skin. Out of five fractions, two were reported to have significant effect.<sup>[52]</sup>

### Antibacterial activity

A mother tincture of *E. echinatus* has been evaluated for antibacterial activity against several microorganisms. It was found to be highly effective against *Salmonella typhi*, moderately effective against *Escherichia coli*, and not very effective against *Pseudomonas aeruginosa* at 200 µg/mL and 400 µg/mL strength of mother tincture.<sup>[53]</sup>

### Antipyretic activity

The antipyretic activity of the ethanolic extract of *E. echinatus* has been evaluated in rabbits. At 500 mg/kg and 750 mg/kg, it shows antipyretic activity but less than positive control.<sup>[54]</sup>

### Wound-healing activity

Extracts of *E. echinatus* in petroleum ether, chloroform, ethanol, and distilled water have been evaluated for wound-healing activity in incision, incision, and dead space models.<sup>[55,56]</sup>

## CONCLUSION

The documentation of medicinal plants along with their potential uses in the health care system is very important, especially for those plants that have been documented earlier in traditional systems of medicine and have been prescribed for a long time by traditional practitioners. In this review, various phytochemical and pharmacological investigations of one plant have been reported, which account for its hepatoprotective, diuretic, analgesic, antifungal, antioxidant, anti-inflammatory, antibacterial, antipyretic, wound-healing, and other properties. This review provides detailed and systematic information about the concerned plant, which may prove to be useful for researchers, and for the promotion of the traditional knowledge of medicinal plants.

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