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# *Elephantopus Species:* Traditional Uses, Pharmacological Actions and Chemical Composition.

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**Abstract**
This review paper is a comprehensive summary of the traditional uses, phytochemical composition, pharmacological activity and compounds isolated from different specie of *Elephantopus*, family (asteraceae). The plant is a genus of about twelve plants out of which majority are natives of south east USA. It is used in traditional folk medicine for the treatment of nephritis, oedema, dampness, pain in the chest, fever, scabies, arthralgia due to wound and cough of Pneumonia. It is also used as a tonic, febrifuge, and diaphoretic against cough, bronchitis, and asthma.
Phytochemicals identified in this plant, includes flavonoids, terpenoids, saponins, tannins, carbohydrates and proteins. Previous studies on the plant revealed various pharmacological activities, which are attributed to its phytochemical content.These activities include analgesic, anti-inflammatory, antidiabetic, antiasthmatic, antimicrobial and wound healing properties. Compounds isolated from different solvent fractions of the plant includes elephantopin, triterpenes, stigmasterol epifriedelinol and lupeol.Other compounds are copaene isopropyl dimethyl hexahydronaphthalene, cyclosativene and Zingiberene from the essential oils of *Elephantopus scaber*
In conclusion, *Elephantopus sp* has wide traditional and pharmacological uses in various disease conditions. Therefore, further research is advocated on this plant.
**Key words**: *Elephantopus specie*, traditional medicine, pharmacological actions, phytochemical constituents and compounds isolated.

## INTRODUCTION

The traditional uses of medicinal plants and their scientific evaluation by researchers to provide basis for their safety and efficacy is a trend that has gained much popularity and is still on the increase. Plant based medicines are easily accepted by majority of people in the developed and developing countries. The renewed drift towards the use of herbs for curative, palliative and preventive purposes by both rural and urban dwellers owes to the fact that the rural community have strong belief in their traditional medicine men whom have been tested and trusted within the communities, while the urban dwellers or elites class accepts this herbs based on the facts presented by scientist using scientifically validated procedures to test. Analyse and establish the safety and efficacy of the traditional claims. This procedure is usually followed by some pre-clinical and clinical trials before the finished product is offered for sale.
About 160,000 plants have been reported to have been used for treatment of different kinds of diseases; researches have been carried out on almost 100,000 of these plants. The researches includes, investigation of the type of secondary metabolites present in the plant (Photochemistry/Phytochemistry) .Investigation of the traditional claims of efficacy of the plant in treating a disease condition by the use of in-vitro and/or in-vivo models of the disease condition (Pharmacology). Isolation and characterization are also carried out on the plant with the intent to find out the compounds present in the plant material and its physicochemical properties.
Knowledge of the structure of the compound will help the chemist in synthesizing mega quantities of the compound on a large scale in industries and this will help in standardization of the synthesized compound which will now be packaged as a finished product. Synthesis also helps to reduce deforestation and the greenhouse effect. Ethno pharmacological studies of a plants helps in providing a summary of previous research work done on the plant and serve as a source of basic and concise information on the plant.
*Elephantopus* family asteraceae is a genus of at least twelve species of perennials in the daisy family. Several species are native to the south eastern United States USDA and at least one is native to India and the Himalaya (Shandesh *et al.*, 2010). Plants in this family includes *Elephantopus mollis* and *Elephantopus carolinianus*, *Elephantopus scaber and Elephantopus tomentosus* among others .The plant derives its name from the Greek

 

word ‘elephas’, elephant and ‘pous’, foot. It is known as devils grandmother in New England, woolly elephant-foot (USA), *lengua de vaca* (cows tongue) in Puerto Rico.

Research on the medicinal properties of *Elephantopus* species and isolation of various compounds from the plant has been carried out (Ho *et al.,* 2009;, Inta *et al.,* 2008;, Yam *et al.,* 2009). Such studies have been carried out based on the knowledge of the solubility of specific compounds in specific solvents also known as solvent fractionation. Among the plants of this genera, *Elephantopus scaber* and *Elephantopus tomentosus* are the most widely studied. The traditional uses, Pharmacologic properties, phytochemical composition and the various compounds isolated from the plants have been variously reported. This review intends to provide a summary of investigations and findings from the different specie of *Elephantopus* plants. The review intends to look at the traditional uses, phytochemical compositions, pharmacological properties and compounds isolated from *Elephantopus specie*.

**Traditional uses of *Elephantopus specie***

***Elephantopus scaber***

*Elephantopus scaber* L**.** is a species of flowering plant in the asteraceae family. It is found in Tropical Africa, Eastern Asia, Indian Subcontinent, Southeast Asia, and Australia Its natural habitat is subtropical or tropical moist montane forests. *Elephantosus scaber* is popularly known as *Elephant's foot (English), Gojivha (Sanskrit), Eddumalikechettu (Telugu), and Nayi nalige (Kannada.* It is used in Colombia and Brazil as a tonic, febrifuge, and diaphoretic against cough, bronchitis, and asthma .In south of China, the whole plant is used for the treatment of hepatitis, bronchitis, fever, cough associated with pneumonia, and arthralgia (Chen, 1985).

In Malaysia, decoction of *E. scaber* root has been used to accelerate contraction of abdominal area and prevent inflammation after childbirth. Besides, whole *E. scaber* was also boiled with red bean to remove flatulence (Hammer and Johns,1993; Ong and Nordiana, 1999a; Ong and Nordiana,1999b).

People in Thailand have used *E. scaber* to treat cough, as a tonic (root decoction) (Inta *et al*., 2008), chapped lips and galactogogue (whole plant decoction) (Hammer and Johns, 1993)

It has also been used in Madagascar as an antipyretic agent (decoction of aerial part)

(Rasoanaivo *et al*., 1992); in Taiwan (whole plant decoction) to treat hepatitis; in Nigeria (hot water extract of leaves) to cure arthritis (Hammer and Johns, 1993) and in Mauritius to treat diarrhoea, urinary problems and pimples (root paste) (Gurib-Fakim *et al*., 1993).

In India whole plant of *E. scaber* are used for the treatment of toothache as a toothbrush (Achuta *et al*., 2010). Also, the whole plant has been reported to be useful for curing insomnia, diabetes, bronchitis, viral or bacterial infection, leukaemia, rheumatism, snake bite, diuresis, antipyresis, to eliminate bladder stones and for filariasis. The leaves crushed and mixed with salt is used to treat dysentery (Achuta *et al.*, 2010), while the water extract of the leaves is applied externally to treat eczema and ulcers (Daniel, 2006; Jasmine and Daisy, 2008)

In Southern China, Hong Kong and Taiwan, the whole plant of *E. scaber*, is widely used in the treatment of nephritis, edema, dampness, pain in the chest, fever, scabies, arthralgia due to wound and cough of Pneumonia. (Peer and Metzger, 1980; Hsu, 1986; Tsai and Lin, 1999). The Murut people of Sabah Malaysia used the roots of the Elephantopus specie to treat bloody stool (Julius, 2003).

***Elephantopus mollis***

In Chota Nagpur the root of *E. mollis* is given for fever. The plant is much used as a diuretic and febrifuge in Madagascar and as a vulnerary in Jamaica (Mohan *et al*., 2012).

The whole plant is taken as a remedy against diarrhoea, a preparation from the root is used for the treatment of colic and the plant is applied topically for the treatment of skin infections and measles. It is also used as antipyretic in erysipelas (Mohan *et al.,* 2012).

The whole plant is used as a Cardiotonic, astringent, febrifuge, diuretic, and as antidote for snakebite. The Root is used as antiodotalgic and antiemetic,while the leaves are used in ulcers and eczema. The Root and leaf emollient, anti-diarrhoeal, in dysuria and other urethral complaints, swelling or pain in stomach (Muthiumani *et al*., 2010). Alcoholic tincture of *E. scabber* was reported to be used as a sex stimulant by some rural people residing in the villages of upper north eastern Thailand (Seewapong and Sam-ang, 2005).

***Elephantopus tomentosus***

Elephantopus tomentosus plant is a native of North America (Miller and Miller, 1999). In Malaysia, *E. tomentosus* is taken internally as a diuretic, febrifuge, analgesic, anti-helminthic and anti-inflammatory agent. *E. tomentosus* is also applied externally as a poultice for abdominal pains (Jaganath, 2000). Yam *et al*. (2009) reported the use of the plant for the treatment of pain and inflammation.

A major difference between *E. scaber* and *E. tomentosus* is that the latter is taller and contains whitish flowers (Ridley, 1922).

 

## PHARMACOLOGICAL EFFECTS

**Antimicrobial activity:** The antimicrobial activity of *E. scaber* was reported by (Avani and Neeta 2005; Ganga Rao *et al.,* 2012). Further research into the antimicrobial activity was done by Sridhar *et al.* (2012) by the use of different strains of pathogenic bacteria and fungi. The result was analysed using well diffusion method. Antitumor effect of the isolated sesquiterpene lactones was reported by (Lee *et al.,* 1975, Fuchino *et al.*, 2001). Antioxidant activity of *E. scaber* was performed using the DPPH free-radical scavenging assay and the methanol fraction was observed to have a higher hydroxyl and superoxide scavenging activity, while the ethyl acetate fractions contain highest phenol content than other fractions (Ganga Rao *et al.,* 2012).
Similarly, the antimicrobial activity of *E. mollis* was investigated by, Ragasa *et al.*( 2009) triterpenoids isolated from this plant revealed antimicrobial activity against *E. coli*, *P.aeruginosa*, *C. albicans* and *T. mentagrophytes*. The acetone fraction of *E. scabber* demonstrated remarkable antibacterial effect against Methicillin resistant *Staphylococcus aureus* and Methicillin sensitive *Staphylococcus. aureus* as reported by (Jasmine *et al.,* 2007).

**Antidiarrheal activity:** The antidiarrheal and cardiotonic activity of *E. scaber* was investigated (Muthiumani *et al.,* 2010).The petroleum ether, benzene, chloroform and ethyl acetate extracts were investigated for their anti-diarrhoeal activity using Gastrointestinal motility test method. The ethyl acetate fraction showed the highest activity while the petroleum ether extract showed significant cardio tonic activity on the hypodyanamic frog heart (Muthiumani *et al.,* 2010).
**Antidiabetic activity:** Antihyperglycaemic effect of *E. scaber* fractions were investigated in streptozotocine induced diabetic rat, the methanol extract, acetone extract and aqueous fractions showed excellent hypoglycaemic effect in rats. The extracts were also observed to have anticholesterolemic activity. Triglyceride levels were also lowered by these extracts. These activities caused a reduction in blood glucose levels and increase the concentration of insulin (Daisy *et al*., 2007;,2009, Daisy and Jasmine 2008).
**Antitumor activity:** Molephantinin and Phantomolin isolated from *E. mollis* demonstrated potent antitumor activity against Leukaemia, Ehrlich ascites carcinoma and Walker 256.Molephantin also showed potent cytotoxic activities (Ragasa *et al.,* 2009). Deoxyelephantopin from Elephantopus scaber L. induces cell-cycle arrest and apoptosis in the human nasopharyngeal cancer CNE cells (Miaoxian *et al.*, 2011).Tumour suppression effect of Deoxyelephantopin was investigated on mammary adenocarcinoma, the results provides an evidence of the anti tumour activity of the compound (Chi- Chan *et al.*,2010;, Lee and Shyur 2012). Deoxyelephantopin was also found to inhibit cancer cell proliferation, and functions as a selective partial agonist against PPARgamma (Zou G. *et al.*, 2008).The apoptopic potentiation ability, inhibition of invasion and abolishing osteoclastogenesis were reported by Ichikawa *et al* . (2006). They found that the activity was through suppression of nuclear factor-kappaB (nf-kappaB) activation and nf-kappaB-regulated gene expression. A new elemanoklid

**Analgesic and antinflamatory activity**
Yam *et al.* (2009) investigated the analgesic effect of *Elephantopus tomentosus*, the ethanolic extract was assayed using the carrageenan induced paw oedema model, while the analgesic activity was analysed using the tail flick, hot plate and acetic acid induced writhing. The plant was observed to have significant analgesic and anti-inflammatory activity.
**Hepatoprotective and Antioxidant Effect**
The hepatoprotective effect of *E. scaber* was determined in mice; the plant extract was able to reverse the liver damage induced by ethanol administration. This action buttressed the traditional use of the plant as a liver tonic (Wan Yong Ho *et al., 2012*) .The hepatoprotective effect of *E. scaber* was further proven by the works of Hsiao-Fang Hung *et al*.( 2011).The water extract of E. *scaber* was observed to have a protective effect on SD rats induced liver damage. The mechanism of *E. scaber* protection involves an antioxidant effect and inhibition of p38 MAP kinase and COX-2 expressions in LPS-stressed acute hepatic injury in SD rats (Wan Yong Ho *et al., 2012*).The hepatoprotective and antioxidant activity of *E. scaber* was evaluated using the methanolic extract. Administration of the extract to rats in which liver damage was previously induced by carbon tetrachloride was found to reverse the damage. Also, this effect was thought to be as a result of the free radical scavenging effect of the extract (Kannakuzhiyil, 2012).
**Wound Healing Properties**
The ability of *E. scaber* to promote healing of wound was studied in rats by using the excision, incision and dead space wound models in rats. The ethanol extract and deoxyelephantopin isolated from the plant were observed to promote healing of wounds in rat, (Singh S D *et al.,* 2005).

 

**Diuretic effect**

Diuretic effect of *E. scaber* was studied in healthy volunteers, the plant was found to have a diuretic effect though, not very significant Laranja *et al.* 1991.

**Antiasthmatic activity**

Antiasthmatic activity of *E. scaber* was investigated using histamine and acetylcholine-induced bronchospasm, mast cell degranulation and histamine induced constriction on isolated guinea pig tracheal chain at different dose levels. The ethanolic extract of the plant was found to significantly decrease the bronchospasm induced by histamine, acetylcholine and protected mast cell degranulation.

**Effect on bone regeneration**

Ethanolic extract of *E. mollis* was investigated for its ability to regenerate an injured bone in experimental rats .The Ethanolic extracts of *E. mollis* was observed to accelerate fracture repair in *the rats* (Ngueguim *et al.*, 2012)

**Other activities:** Leishmanicidal activity of some compounds isolated from *E. mollis* were reported. The compounds include Elephantopin, Melantophin, Isoelephantopin and 2-deethoxy-2β-methoxyphantomolin (Fuchino *et al*., 2001). In Taiwan, it has been reported that water extract of *E.scaber* and *E. mollis* plants possess a liver protective effect on carbon tetrachloride ($CCl_4$)-induced acute liver damage (Lin *et al.*, 2001).

## PHYTOCHEMISTRY

Phytochemicals refers to chemicals produced by plants which may have an impact on health, or on flavour, texture, smell, or colour of the plants, but are not required by humans as essential nutrients. Phytochemical screening of different species of *Elephantopus* revealed the presence of different secondary metabolites in different fractions of the same species of the plant. According to a research carried out by Sridhar *et al.* (2012), the aqueous extract of *E. scaber* contains carbohydrates, tannins, saponins, proteins and flavonoids while the methanol fraction contains alkaloids in addition to the phytochemicals present in the aqueous fraction. *E.species* has been reported to contain flavonoid esters triterpenoids and sesquiterpene lactones (Lee *et al.*, 1975; Fuchino *et al*., 2001). Ganga Rao *et al.* (2012), reported that *E. species* also contains glycosides and oils

**Compounds isolated**

In a study by Anees *et al.* (2009), six compounds were isolated from *E. scaber* using two solvents n-hexane (polar) and methanol (non polar) solvent and three different parts of the plant (roots, leaves and stem). The isolated compounds were stigmasterol, lupeol, stearic acid deoxyelephantopin isomers, analogue 1 and analogue 2 of deoxyelephantopin. The major phytochemical constitutes of the plant are elephantopin, triterpenes, stigmasterol epifriedelinol and lupeol (Consolacion, 2009). The dichloromethane soluble portion of the dried leaves of *E. mollis* was subjected to 1D and 2D NMR spectroscopy and following compounds were found, 2-deethoxy-2-hydroxyphantomolin,stigmasterol, α amyrin fatty acid ester and Lupeol fatty acid ester. Their structures were confirmed by comparing their $^{13}C$ NMR with those found in the literature (Consolacion, 2009).

The chemical compositions of the essential oils of *E. scaber* was reported by Wang *et al.* (2009), Cyclosativene,Copaene,Isopropyl dimethyl hexahydronaphthalene, Zingiberene ,
Trimethyldimethylenedecahydronaphthalene,Caryophyllene,Dimethyl-6-(4-methyl-3-pentenyl), norpinene -β-Sesquiphellandrene, β Caryophyllene,Isocaryophyllene, α-Santalol
Ledol, α-Bisabolol,Caryophyllene oxide,Cadinol, Bisabolol,Isopropyl dimethyl- tetrahydronaphthalenol, Hexahydrofarnesyl acetone,Hexadecanoic acid, Phytol and
Octadecadienoic acid.

## CONCLUSION

The use of plants as a source of medicine is as old as the existence of man, renewed interest into the use of herbal medicines is not unrelated to the emergence of new diseases, ineffectiveness of existing drugs and adverse effects of synthetic drugs. It is interesting to note that a large number of plants have been extensively studied and some remarkable discoveries have emerged from such studies. One of the major shortcomings of most studies is that they are carried out by academicians who are only interested in obtaining a degree or a publication. Therefore the researches are usually left half way in as much as the target objective of the researcher is achieved.

The present review tried to look at *Elephantopus* family on a broad perspective, with a knowledge that a lot of research has already been done on the plant. The principal findings of these researches were collated through different search engines and websites and the principal investigators dully acknowledged. Such findings were summarized in this article, even though the article cannot be said to be all-encompassing. This paper tried to

 

expose the different traditional uses of *Elephantopus specie* such as its use for pain relief, wound healing, skin infections, sex stimulant and as a liver tonic. The plant was also found to possess different phytochemicals such as saponins, tannins, and terpenoids. Flavonoids and phenols seem to be the most important phytochemicals, as they were reported to be involved in most of the investigated activities. The major compounds isolated from the plants were the sesquiterpene lactones such as elephantopin, triterpenes, stigmasterol, epifriedelinol and lupeol. Different biological activities of the plant have been investigated, such activities includes antimicrobial, anti tumour, hepatoprotective and anti-inflammatory activities. Other reported activities included anti hyperglycaemic, anti cholesterolemic and analgesic activity.

As evidenced from the barrage of reports regarding the biological activity and chemical composition of *Elephantopus specie* the plant could be a potential source of income generation for the regions where it is found. Also, further synthesis is required to produce drugs from the isolated compound in large scale; this will reduce dependence on the natural source and as such reduce deforestation.

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**CONFLICT OF INTEREST**

The authors declares that there is no conflict of interest with regards this paper.

Table 1: compounds isolated from different fractions of *E. species*

| **Specie** | **Extract** | **Compound Isolated** | **Reference** |
|---|---|---|---|
| *E. scabber* | Ethanol | Deoxyelephantopin | Miaoxian *et al*. 2011,Chi-Chan *et al.* 2010,Lee and Shyur 2012,Singh *et al.* 2000, Zou G *et al.* 2008, Liang *et al*. 2008, Than *et al*. 2005, Xu *et al*. 2006. Ichikawa *et al.* 2006. Liang et al., 2008; Xu *et al.* 2006. |
| | | Isodeoxyelephantopin | Liang *et al*. 2008 |
| | | Elescaberin | Xu *et al*. 2006 |
| | | Isoscabertopin | Xu *et al*. 2006 |
| | | Scabertopin | Xu *et al*. 2006 |
| | | 17,19-dihydrodeoxyelephan-topin | Xu *et al*. 2006 |
| | Methanol | lupeol, stigmasterol and 11,13dihydro-deoxyelephantopin | Silva *et al.* 1982 |
| | Acetone | 6-[l-(10,13-dimethyl-4,5,8,9,10,ll,12,13,14,15,16,17-dodecahydro-lHcyclopenta[a] phenanthren -17-yl)-ethyl]-3-methyl-3,6-dihydro-2H-2-pyranone. | Jasmine *et al.* 2007. |
| | | Deoxyelephantopin and Iso-17,19 dihydroxyelephantopin | Than *et al.* 2005. |
| | Chloroform | Deoxyelephantopin and Isodeoxyelephantopin | Ichikawa *et al.* 2006 |
| | Light petroleum extract | epifriedelinol, lupeol, stigmasterol and a mixture of triacontan-l-01and dotriacontan-l-01 | Sim and Lee, 1969 |