Review

ANTI-MICROBIAL POTENTIAL OF *ELEPHANTOPUS SCABER:* AN UPDATE REVIEW

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ABSTRACT:

Elephantopus scaber commonly known as Prickly-leaved Elephant's foot is one of an important medicinal herb in traditional medicine.Although traditional practitioner's use this medicinal herb as whole plant in the form of decoction, but leaves are most important part of *Elephantopus scaber*. Soxhlet extraction is the common method for extraction due to nature of plant capability to withstand at high temperature. Petroleum ether, n-hexane, acetone, benzene, chloroform, ethylacetate, ethanol, methanol, aqueous alcoholic, water are commonly tested solvent. Ethylacetate, aqueous alcoholic and chloroform extract found highest activity as anti-bacterial activity. Solid to solvent ratio around 1:2 to 1:5 whereas maximum extraction time was found to be 72 hours regardless which method of extraction has employed. Disc diffusion method found to be most common method to check anti-bacterial activity.17,19-dihydrodeoxyelephantopin, iso-17,19- dihydro-deoxy elephantopin and 8-hydroxyl Naringenin are most important bioactive compounds responsible for anti-bacterial activity.

KEYWORDS: Medicinal herbs; Anti-microbial; Elephant's foot; Sesquiterpene lactones

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INTRODUCTION:

Medicinal plants are important source of new antimicrobial agents. The increasing rates of antibiotic-resistant microbial infections requires continuous development of new bioactive compounds[1]. *Elephantopus scaber L,*known as Prickly-leaved elephant's foot is a tropical plant native to Tropical Africa, Eastern Asia, Indian sub-continent, Southeast Asia and Northern Australia[2].

It has been used for treatment of number of illnesses such as anti-bacterial, anti-inflammatory, antipyretic, diuretic, anti-cough agent, antibiotics, emollient, bronchitis, wound healing and tonic[3][4][5][6][7][8].Different herbal combinations were used for an effective sexual, gynecological and cancer treatment [9][10].

Figure 1: Aerial view of *Elephantopus scaber*

EXTRACTION METHOD

Most of the extractions were performed by soxhlet extraction but some people used simple maceration. Leaf is most common part of the plant for extraction. Whole plant, aerial part, roots, flowers have also been used. Time for extraction is usually an important parameter to extract everything. Scientist use simple maceration for 72 hours whereas an average of 18 hours of extraction for soxhlet. The range of solid to solvent extraction is about 1:2 to 1:5. Here table 1.1 present list of extraction method for anti-microbial activity.

Table 1. List of extraction method for anti-microbial activity

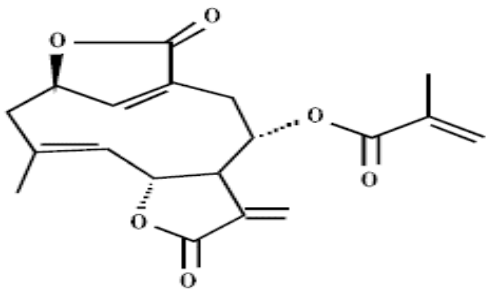
Part use	Extraction Method	Time	Solid to solvent ratio(g/ml)	Reference
Root and Leaves	Soxhlet Extraction	8hrs	1:4	[11]
Whole plant	Soxhlet Extraction	18hrs	1:2	[12]
Leaves	Soxhlet extraction	--	--	[13]
Leaves	Maceration	24hrs	1:2	[14]
Whole plant	Maceration	72hrs	--	[15]
Leaves	Soxhlet extraction	48hrs	--	[16]
Leaves	Soxhlet extraction	--	--	[17]
Leaves	Soxhlet extraction	--	--	[18]
Whole plant	Maceration		1:5	[19]
Aerial part	Soxhlet extraction	--	--	[20]

Anti-bacterial activity:

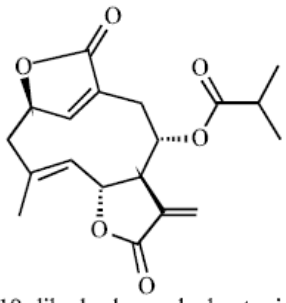
From the literature review, it was found that disc diffusion method is commonly used for anti-bacterial activity. *Staphylococcus aureus, Salmonella paratyphi* A, *Klebsiella pneumonia, Pseudomonas aeruginosa, Shigellasonnei, Escherichia coli* and *Salmonella typhimurium,Bacillus subtilis, Proteus vulgaris,Streptococcus pyogenes, Leuconosto clactis, Proteus mirabilis, Enterococcus faecalis, Entrobactoraerogenes, Bacillus cereus, Bacillus pumilus, Bacillus subtilis, Bordetella bronchiseptica, Micrococcus luteus, Staphylococcus epidermis, Klebsiella pneumonia, Streptococcus faecalis. Vibrio cholera, Aspergillus niger, Aspergillus flavus, Rhizopus indicus, Mucorindicus* are common use microbial agent to test activity of extract. Petroleum ether, n-hexane, acetone, benzene, chloroform, ethylacetate, ethanol, methanol, aqueous alcoholic, water are commonly tested solvent. Ethylacetate, aqueous alcoholic and chloroform extract found highest activity as anti-bacterial activity. Chloramphenicol is most common standard drug to compare the activity of extract. Other standard drugs are Gentamicin, Ciprofloxacin, Ampicillin, Norfloxacin. Minimum and maximum dose for test of anti-microbial activity range from 5µg to 200mg respectively. List of detail for anti-microbial activity performed by different scientist was mentioned in table 1.2

Isolation of Bioactive compound for Anti-bacterial activity:

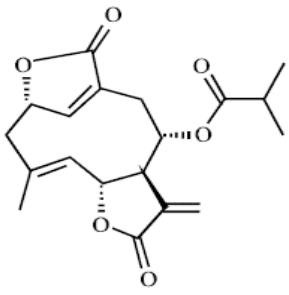
17, 19-dihydrodeoxyelephantopin, iso-17, 19-dihydrodeoxyelephantopin and 8-hydroxyl Naringenin are most important bioactive compounds responsible for anti-bacterial activity that have been reported till now.



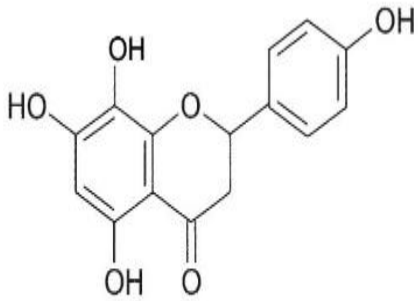
Deoxyelephantopin



17, 19-dihydrodeoxyelephantopin



iso-17, 19-dihydrodeoxyelephantopin



8-hydroxyl Naringenin

Table 1. List of anti-microbial activity on *Elephantopus scaber*

Part use	Extract	Microorganism used	Method used	Dose tested	Standard used	Result	Reference
Aerial plant	Petroleum ether, chloroform, methanol	*Staphylococcus aureus, Salmonella paratyphi A, Klebsiella pneumonia, Pseudomonas aeruginosa, Shigellasonnei, Escherichia coli* and *Salmonella typhimurium*	disk diffusion method	0.1-1.5mg/ml	Chloramphenicol	A	[20]
Leaves	Methanolic	*Staphylococcus aureus, Escherichia coli, Bacillus subtilis, Pseudomonas aeruginosa, Proteus vulgaris*	disk diffusion method	100µg	Chloramphenicol	B	[18]
Leaves	Aqueous and Methanol	*Escherichia coli, Staphylococcus aureus, Streptococcus pyogenes, Pseudomonas aeruginosa, Leuconostoclactis and Salmonella typhiand four fungal strains Aspergillus niger, Aspergillus flavus, Rhizopus indicus* and *Mucor indicus*	well diffusion technique	50mg-200mg	-	C	[13]
Leaves, root and flower	Ethanol, aqueous, chloroform, benzene, acetone and petroleum ether	*E. coli, K. pneumonia, P. aeruginosa, S. aureus, B. cereus, S. typhi, S. marcescens, Acinetobacter sp., Enterobacter sp., P. mirabilis, E. faecalis* and *S. pyogenes*	disk diffusion method	-	-	D	[11]
Whole plant	Methanol, hexane, acetone	β-lactamase Producing Methicillin Resistant *Staphylococcus aureus*	disk diffusion method	-	-	E	[12]
Whole plant	Ethanolic and	*Staphylococcus*	-	-	-	F	[21]

	acetone extracts	*aureus,Bacillussubtilis,Candida albicans*					
Whole plant	Acetone	β-lactamase Producing Methicillin Resistant *Staphylococcus aureus*	disk diffusion method	-	-	G	[22]
Leaves	Ethyl acetate	Gram-positive bacteria (Staphylococcus aureus) and Gram-negative bacteria (*Escherichia coli, Proteus mirabilis* and *Vibrio cholera*)	disk diffusion method	5,10,15 and 20µg/ml	-	H	[14]
Whole Plant	Methanol	Two gram positive bacteria (*Bacillus subtilis* and *Staphylococcus aeureus*) and one gram negative bacteria (*Escherichia coli*)	Agar diffusion method	-	-	I	[15]
Leaves	Ethanol	urinary tract infection (UTI) causing pathogens viz. *Staphylococcus aureus, Pseudomonas aeruginosa, Proteus mirabilis, Enterococcus faecalis* and *Escherichia coli*	disk diffusion method	250 and 500 µg/ml	Gentamicin, Ciprofloxacin	J	[16]
Leaves	Hexane, chloroform, acetone, methanol and water successively.	*Bacillus cereus, Staphylococcus aureus, Streptococcus heamolyticus, Salmonella typhi, Entrobactoraerogenes, Vibrio cholera, Escherichia coli, Proteus vulgaris, Klebsiella pneumonia, Serratiamarcesens, Proteus rettigiri* and *Pseudomonas aeruginosa.*	disk diffusion method	--	--	K	[17]

Whole plant	Ethyl acetate and petroleum ether	*Bacillus cereus, Bacillus pumilus, Bacillus subtilis, Bordetella bronchiseptica, Micrococcus luteus, Staphylococcus aureus, Staphylococcus epidermis, Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Streptococcus faecalis*	Agar dilution method	1,2,4mg/ml	Ciprofloxacin	L	[19]
Root and Aerial part	Petroleum ether, diethyl ether, methanol and water	*Bacillus subtilis, Staphylococcus aureus, Micrococcus luteus and Bacillus cereus,Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris* and *Salmonella typhi*	disk diffusion method, broth dilution method	--	Ampicillin Chloramphenicol Ciprofloxacin Norfloxacin	M	[23]

A= Methanolic extract was found to be the most effective against the tested organisms; **B=** The plants showing significant therapeutic activity may be due to the presence of sesquiterpenedialactone; **C=** Methanolic extract more active against anti-fungal stain compare to anti-bacterial activity; **D=** The chlorofrom extracts of E. scaber showed the highest zone of inhibition against Bacillus cereus whereas The leaves ethanolic extracts of E. scaber demonstrated the highest zone of inhibition against three pathogens viz., Enterococcus faecalis, Proteus mirabilis, Salmonella Typhi and Enterobacter sp; **E=** MIC of plant extract range from 3.12 to 50mg/mL against MRSA strain; **F=**17,19-dihydrodeoxyelephantopin and iso-17,19- dihydrodeoxyelephantopin isolated from *E. scaber* was effective against Staphylococcus aureus; **G=** 6-[1-(10,13-dimethyl-4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17- dodecahydro-1H- cyclopenta[α] phenan thren-17-yl)ethyl]-3-methyl-3,6-dihydro-2H-2 pyranone A novel terpenoid from *Elephantopus scaber* possess anti-bacterial activity againstExtended Spectrum β-Lactamases (ESβL)Staphylococcus aureus; **H=** Ethylacetate leaf extract possess significant antibacterial activity at 20µg/ml against the tested bacteria; **I=**Methanolic extract of *Elephantopus scaber* was less susceptible to kill gram negative and gram positive bacteria.; **J=** *Elephantopus scaber*exhibited highest activity against all the tested strains as compared to *Litsea glutinosa L* and *Vitex peduncularis W.*; **K=** Crude acetone extract of *E. scaber* showed no significant antibacterial activity against the tested bacteria. But the isolated compound (8-hydroxyl Naringenin) from the acetone extract showed significant activity against 12 tested bacteria.; **L=**Results of the study confirm the antimicrobial potential of the ethyl acetate extract of *E. scaber*; **M=** Various extracts of the roots and aerial parts of E. scaber has shown significant antibacterial and antifungal activity against the gram positive, gram negative strain in concentration dependent manner.

DISCUSSION:

Optimization of already established extraction method such as soxhlet extraction need to perform to find out ideal conditions. Application of new extraction technique for isolating essential oil and phenolic compounds needs to be done such as microwave and ultrasonic-assistedextraction.There are lot medicinal uses of *Elephantopus scaber*as polyherbal formulation but no one able to understand the mechanism.

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