TABLE 1: ANTIBACTERIAL ACTIVITY OF THE FORMULATION

Test organism	Growth inhibition (Zone diameter mm)	
	CCl_4 (control)	Preparation (5:10 Guggul:Oil)
Staphylococcus aureus	-	16
Staphylococcus epidermidis	-	-
Pseudomonas aeruginosa	-	11
Proteus vulgaris	-	-
Alcaligenes faecalis	-	-
Serratia marcesens	-	-
Escherichia coli	-	11
Micrococcus glutamicus	-	14
Bacillus thermodenitrificans	-	12
Bacillus subtilis	-	11
Bacillus pumilus	-	12

diffusion of the test preparation followed by incubation at 37±0.5° for 18 h. The zone of inhibition of microbial growth was measured after incubation. Each experiment was carried out in triplicate and the mean diameter of inhibition zone recorded.

Results of screening of antimicrobial activity are summarized in Table 1. These preparations showed significant inhibition of the growth on *S. aureus, P. aeruginosa, E. coli, M. glutamicus, B. thermodenitrificans, B. subtilis,* and *B. pumilus.* Preparation containing 5:10 (w/v) proportion of guggul:coconut oil showed more antimicrobial activity than other preparation. The degree of inhibition ranged from 11 mm to 16 mm against test organisms.

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Antimicrobial Activity of the Essential Oil of *Feronia elephantum* Correa

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The essential oil from the leaves of *Feronia elephantum* correa (Syn. *Feronia limonea* (L.) Swingle, family Rutaceae), rich in methyl chavicol, has been studied for its antibacterial and antifungal activity against ten bacteria and ten fungi using filter paper disc agar diffusion technique. The oil exhibited strong to moderate activity against most of the test organisms. *Bacillus subtilis, Escherchia coli, Proteus vulgaris, Pseudomonas aeruginosa, Shigella sp., Aspergillus niger, Rhizopus nodosus, Trichophyton rubrum 5S* and *Trichoderma viride* had remarkable susceptibility to the oil.

Feronia elephantum (L.) Correa [syn. *Feronia limonia* (L.) Swingle, family - Rutaceae] is a moderate sized deciduous tree which is a native of India. The fruits, seeds and leaves of this tree have been reported to possess many medicinal properties[1] according to the Indian system of medicine. The leaves are astringent and carminative and are prescribed for vomiting, hiccough, dysentery, indigestion and slight bowel affections of children[1]. The pulp of the fruit is used as a condiment. The leaves are aromatic with a smell of anis seed. The fruits are considered tonic, antiscorbutic and alexipharmic and taken as such or in the form of a sauce[2]. The essential

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oil from *F. marthex* has exhibited spasmolytic action, pronounced vasodilation and a marked depressant effect in experimental animals[3]. The essential oil from the leaves of *F. elephantum* has been found rich in methyl chavicol[4]. The present communication reports the *in vitro* antimirobial activity of the essential oil from the leaves of *F. elephantum* against ten bacterial and ten fungal microorganisms.

The leaves of *F. elephantum* were collected from the cantonment area of Sagar. The shade dried leaves were subjected to hydrodistillation in a galvanised tin still when a pale yellow essential oil was obtained in an yield of 0.2% (v/w). Filter paper disc agar diffusion method[5] was followed for the evaluation of antimicrobial activity.

The test bacterial and fungal cultures were procured from the Microbiology department of Gandhi Medical College, Bhopal, M.P. and Dr. Hari Singh Gour University, Sagar, M.P. Amongs these, *Bacillus subtilis* causes septicaemia and food poisoning. *Escherchia coli, Proteus vulgaris* and *Pseudomonas aeruginosa* frequently cause urogenital tract infections and diarrhoea. *Shigella* sps. are the commonest pathogens that cause dysenteries. *Rhizopus nodosus* is a food contaminating fungus. *Aspergillus niger* is the causal organism of seborrheic dermatitis of scalp and otomycosis. *Trichoderma viride* also causes dermatitis. *Trichophyton rubrum* is a well known fungal pathogen that causes superficial infection of keratinized tissues and skin. The bacterial and fungal organisms were subcultured on oxoid nutrient agar and Sabouraud's broth respectively. Homogenous suspensions were prepared by transferring aseptically a few loopfuls of either spores or organisms in growth phase into the nutrient medium, followed by vigorous shaking. Twenty millilitres of medium was poured in each Petridish under standard operating conditions and allowed to gel. Sterile Whatman No. 1 filter paper discs (6 mm diameter) were thoroughly moistened with neat oil and its dilutions of 20,000 ppm, 10,000 ppm and 1,000 ppm using Tween 80 and placed on seeded agar plates. Potassium penicillin G (2000 ppm) and streptomycin sulphate (2000 ppm discs were used as standard for antibacterial and the discs moistened with aqueous solution of resorcinol (20,000 ppm) were used as standard for antifungal

TABLE 1: ANTIBACTERIAL ACTIVITY OF THE ESSENTIAL OIL OF FERONIA ELEPHANTUM CORREA

S. No.	Microorganism	Zone of Inhibition mm*				Control 2000 ppm
		Neat oil	20,000 ppm	10,000 ppm	1000 ppm	
	Gram +ve bacteria					Potassium penicillin G
1.	*Bacillus mycoides*	15	14	11	7	17
2.	*S. subtilis*	24	21	18	16	20
	Gram-ve bacteria					Strptomycin sulphate
3.	*Escherchia coli*	26	24	21	18	18
4.	*Proteus vulgaris*	22	20	17	14	16
5.	*Pseudomonas aeruginosa*	32	26	21	18	28
6.	*Ps. mangiferae*	12	10	7	-	26
7.	*Shigella shiga*	23	21	19	16	8
8.	*Sh. Sonnei*	18	15	13	10	16
9.	*Vibrio cholerae*	16	13	10	7	18
10.	*Xanthomonas campestris*	10	8	-	-	29

*Zone of inhibition values in mm include the diameter of the filter paper disc (6 mm). Each value is a mean of three determination. - indicates no inhibition

TABLE 2: ANTIFUNGAL ACTIVITY OF THE ESSENTIAL OIL OF *FERONIA ELEPHANTUM* CORREA

S. No.	Microorganism	Zone of Inhibition mm*				Control Resorcinol (20,000 ppm)
		Neat oil	20,000 ppm	10,000 ppm	1000 ppm	
1.	*Aspergillus flavous*	15	12	10	7	20
2.	*A. fumigatus*	14	12	11	8	14
3.	*A. niger*	20	18	14	11	12
4.	*A. terreus*	16	13	10	8	20
5.	*Candida albicans*	10	8	-	-	14
6.	*Curvularia prasadii*	1	7	-	-	13
7.	*Rhizopus nodosus*	21	18	15	13	12
8.	*Trichoderma viride*	24	20	18	14	11
9.	*Trichophyton rubrum* 5 S	18	13	11	10	10
10.	*T. rubrum* 12 S	20	16	14	10	27

*Zone of inhibition values in mm include the diameter of the filter paper disc (6 mm). Each value is a mean of three determination. - indicates no inhibition.

activity. The Petriplates were incubated at 37° in an incubator for 36 h in case of bacteria and at 27° for 72 h in case of fungi. The antimicrobial activity was measured in terms of zone of inhibition which included the diameter of the disc (6 mm) on a Techno Antibiotic Zone Reader. An average of three independent determinations was recorded for each treatment. The results for antibacterial and antifungal activity are given in Table 1 and Table 2 respectively.

A perusal of Table 1 indicates that the neat essential oil from the leaves of *F. elephantum* has strong to moderate activity against the ten test organisms. The activity of the neat oil against *B. subtilis, E. coli, P. vulgaris, Pseudomonas aeruginosa* and *Shigella shiga* is better than the standards potassium penicillin G (2000 ppm) and streptomycin sulphate (2000 ppm). The oil has retained comparable to fairly good activity at 1000 ppm dilution against these organisms.

A study of Table 2 reveals that the oil could check the growth of many test fungi effectively. It has exhibited strong inhibitory action against *Trichoderma viride, Trichophton rubrum 5S, A. niger* and *R. nodosus*. At 1000 ppm dilution the activity of the oil against these organisms is weak. The rest of the test fungi have moderate to weak susceptibility to the neat oil which significantly diminished on serial dilutions of the oil.

The *in vitro* antimicrobial studies have revealed strong inhibitory effect of the oil of *F. elephantum* against a wide range of microorganisms and may be exploited in gel or ointment form for controlling infections caused by the test microorganisms after these results are substantiated by *in vivo* studies.

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