Evaluation of the antifungal activity of various solvent extracts of *Feronia elephantum* correa (*Rutaceae*)

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ABSTRACT  
Medicinal plants play an important role for health care. Medicinal plants have ability to cure both infectious and non infectious diseases. According to an estimate about 25 % of medicines are derived from plants. The objective of the present study was to evaluate the antifungal activity of *Feronia elephantum* Correa by using Agar well diffusion assay. The fungal strains used in this research work were *Aspergillus niger*, *Penicillium expansum*, *Candida albicans* and *Fusarium oxysporum*. The length of inhibition zone was measured in millimetres. The results were referenced against Glucanazole antifungal agent. Methanolic fruit extract showed maximum antifungal activity against most of the strains where as moderate antifungal potential was shown by leaf extract in aqueous extract.

Keywords: Antifungal activity; plant extract; Agar well Diffusion Assay

1. INTRODUCTION

*Feronia elephantum* Correa belongs to the family *Rutaceae* commonly known as Elephant apple or Wood apple (English). It is found through out India and is known from pre-historic time immemorial in traditional systems of medicine for receiving constipation diarrhoea, dysentery, peptic ulcer and respiratory infections (Shoba., 2000).  
The pulp is applied externally as a remedy for bites of venomous insects and reptiles. Limited information is available regarding antifungal activity of *Feronia elephantum* therefore, present study is carried out to investigate antifungal activity of serial extracts from leaf, stem and fruit of *Feronia elephantum* against various fungal species (Photo 1 and 2). Leaves, stem and fruits of this tree at all stages of maturity are used as ethanomedicines against various human ailments. The fruits are used in gastric troubles, as heart tonic (Nadkarni., 2000).
Photo 1. *Feronia elephantum*.

Photo 2. *Feronia elephantum* (Wood Apple, Elephant Apple).
2. MATERIALS AND METHODS

Plant parts (leaf, bark and fruit) were thoroughly washed and air-dried, then ground into a powder form for preparation of the extract. The aqueous plant extract was prepared by macerating powdered plant sample with 50 ml sterile distilled water. The macerate was filtered and the filtrate was centrifuged at 8000 rpm for 15 minutes. The supernatant obtained after centrifugation was heat sterilized at 120 °C for 30 minutes. The extract obtained was preserved aseptically.

Solvent extracts of plant parts were prepared in 70% ethanol/methanol using Soxhlet extraction (Hoffman et al., 2004) for 72 hours and preserved at 4 °C in air tight containers. 1 mg of each solvent residue was redissolved in 1 ml of respective solvent and were used as test extract for antifungal activity.

2.1. Test fungal strains

The test fungal strains namely Aspergillus niger (MTCC 2723), Penicillium expansum (MTCC 2006), Candida albicans (MTCC 183) and Fusarium oxysporum (MTCC 1755) were produced from Microbial Type Culture Collection (MTCC), Chandigarh, India.

2.2. Antifungal activity

In vitro antimicrobial activity was screened by using Potato Dextrose Agar (PDA) using agar well diffusion method (Chung et al., 1990). Fungal strains were activated in Potato Dextrose Broth (PDB) and incubated for 24 h. 0.05 ml of inoculum was uniformly spread on agar plates. The ethanolic, methanolic and aqueous extracts were introduced in agar wells in concentration of 25 ppm, 50 ppm, 75 ppm and 100 ppm. Control experiment was carried out with Glucanazole. Antifungal potential was then determined on the basis of diameter of zone inhibition.

3. RESULTS AND DISCUSSION

All the concentration of plant extract had shown activity against test fungal organisms. The results showed that increase in concentration of extract increased zone of inhibition. Penicillium expansum and Candida albicans were most susceptible to methanolic fruit extract by forming inhibition zone of 17.33 to 26 mm and 21.33 to 27 mm respectively (Table - I, II, III & IV). Methanolic leaf extract was found to be less effective of Penicillium expansum and Fusarium oxysporum. Maximum activity against Aspergillus niger was shown by leaf extract in aqueous solution by forming the zonal inhibition of 14 mm, 21.66, 24.33 mm and 26 mm at 25 ppm, 50 ppm, 75 ppm and 100 ppm respectively.

Many researchers have suggested antifungal activity of medicinal plants against Aspergillus niger Penicillium expansum, Candida albicans and Fusarium oxysporum (Fawzia et al., 2004, Sivaraj et al., 2011) and (Satish et al., 2007). Unsaponifiable matter of wood apple and bael seeds has also shown in vitro activity against various fungi namely A. fumigatus, A. niger and A. flavous (Singh et al., 1983). The ethanolic bark extract showed notable antifungal potential for Fusarium oxysporum at 100 ppm (Zone inhibition 23.33 mm) and ethanolic fruit extract showed very less activity (Zone inhibition 11 mm) for the same strain at same concentration. Here the aim was to summarize the more recent common actions and therapeutic application of Feronia elephantum and its active constituent.
Table I. Results for *Feronia elephantum* Extracts showing measurement of Zone inhibition fungal cultures and control drug at 25 ppm.

| Fungal Strains     | Methanolic Extract | Ethanol Extract | Aqueous Extract | Control Glucanazole |
|--------------------|--------------------|-----------------|-----------------|---------------------|
|                    | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit |
| Aspergillus niger  |        |      |       |        |      |       |        |      |       |        |      |       |        |      |       |        |      |       |        |      |       |        |      |       |
|                    | 10     | 7.62 | 15    | 14.32  | 12    | 17    | 14     | 7.33  | 11    | 17     |
|                    | ± 0.00 | ± 0.47 | ± 1.41 | ± 0.47 | ± 1.42 | ± 0.80 | ± 0.00 | ± 0.94 | ± 0.81 | ± 0.81 |
| Penicillium expansum| 9.66   | 10   | 17.33 | 14    | 7.32  | 18    | 9.66   | 6     | 12    | 9.66   |
|                    | ± 0.47 | ± 0.00 | ± 0.42 | ± 1.63 | ± 0.47 | ± 1.63 | ± 0.94 | ± 1.63 | ± 1.41 | ± 0.47 |
| Candida albicans   | 10     | 12   | 21.33 | 8     | 2     | 15.66 | 16.66  | 3     | 14    | 10.66  |
|                    | ± 0.81 | ± 0.81 | ± 0.94 | ± 1.41 | ± 0.00 | ± 0.47 | ± 0.47 | ± 1.00 | ± 1.41 | ± 0.47 |
| Fusarium oxysporum | 12     | 10   | 13    | 13    | 15    | 3.66  | 14     | 13.66 | 10    | 7      |
|                    | ± 1.63 | ± 0.81 | ± 0.00 | ± 0.81 | ± 0.81 | ± 0.47 | ± 1.41 | ± 0.94 | ± 1.63 | ± 0.81 |

*Values are the mean of three replicates

Table II. Results for *Feronia elephantum* Extracts showing measurement of Zone inhibition fungal cultures and control drug at 50 ppm.

| Fungal Strains     | Methanolic Extract | Ethanol Extract | Aqueous Extract | Control Glucanazole |
|--------------------|--------------------|-----------------|-----------------|---------------------|
|                    | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit | Leaf   | Bark | Fruit |
| Aspergillus niger  | 13.35  | 11   | 18    | 18     | 16.20 | 20    | 21.62  | 10.66 | 13.66 | 20     |
|                    | ± 0.47 | ± 1.41 | ± 1.41 | ± 0.00 | ± 0.47 | ± 1.63 | ± 0.47 | ± 0.47 | ± 0.47 | ± 1.63 |
| Penicillium expansum| 13     | 14   | 20    | 16     | 11    | 20    | 14     | 8     | 14.66 | 13     |
|                    | ± 0.81 | ± 0.81 | ± 1.42 | ± 1.41 | ± 0.81 | ± 1.42 | ± 0.81 | ± 0.81 | ± 0.47 | ± 0.00 |
| Candida albicans   | 14     | 14   | 22.62 | 12     | 4.33  | 18    | 20.66  | 5     | 18    | 13     |
|                    | ± 0.00 | ± 0.81 | ± 0.47 | ± 1.41 | ± 0.47 | ± 0.81 | ± 0.47 | ± 1.61 | ± 2.15 | ± 0.00 |
| Fusarium oxysporum | 14     | 12   | 16.62 | 15     | 15    | 7     | 16.33  | 17    | 12    | 10.66  |
|                    | ± 0.81 | ± 0.94 | ± 0.94 | ± 0.81 | ± 0.81 | ± 1.41 | ± 0.94 | ± 1.63 | ± 0.81 | ± 0.47 |

*Values are the mean of three replicates
Table III. Results for *Feronia elephantum* Extracts showing measurement of Zone inhibition fungal cultures and control drug at 75 ppm.

| Fungal Strains       | Zone of inhibition (mm)* | Control Glucanazole |
|----------------------|--------------------------|---------------------|
|                      | Methanolic Extract | Ethanol Extract | Aqueous Extract |
|                      | Leaf | Bark | Fruit | Leaf | Bark | Fruit | Leaf | Bark | Fruit |
| **Aspergillus niger**|      |      |       |      |      |       |      |      |       |
| Leaf                 | 15   | 13   | 21    | 22   | 16   | 22.33 | 24.33 | 13   | 18    |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 0.81                 | 1.41 | 0.81 |       | 0.81 | 0.81 | 0.94  | 0.94  | 0.00 | 1.41  |
| **Penicillium expansum** |      |      |       |      |      |       |      |      |       |
| Leaf                 | 15   | 19   | 23    | 20.23| 13   | 22    | 18    | 10.66| 18    |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 1.41                 | 1.41 | 0.81 |       | 0.47 | 1.44 | 1.63  | 0.00  | 0.47 | 0.81  |
| **Candida albicans** |      |      |       |      |      |       |      |      |       |
| Leaf                 | 19.66| 16.33| 25    | 15.33| 8    | 21    | 23    | 7    | 22    |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 0.47                 | 0.47 | 0.00 |       | 0.47 | 1.41 | 1.41  | 0.00  | 1.41 | 1.41  |
| **Fusarium oxysporum** |      |      |       |      |      |       |      |      |       |
| Leaf                 | 16   | 15   | 21.33 | 17   | 19   | 8.66  | 18    | 19.33| 14    |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 0.81                 | 0.81 | 0.47 |       | 1.41 | 0.00 | 1.69  | 0.81  | 1.24 | 0.00  |

*Values are the mean of three replicates

Table IV. Results for *Feronia elephantum* Extracts showing measurement of Zone inhibition fungal cultures and control drug at 100 ppm.

| Fungal Strains       | Zone of inhibition (mm)* | Control Glucanazole |
|----------------------|--------------------------|---------------------|
|                      | Methanolic Extract | Ethanol Extract | Aqueous Extract |
|                      | Leaf | Bark | Fruit | Leaf | Bark | Fruit | Leaf | Bark | Fruit |
| **Aspergillus niger**|      |      |       |      |      |       |      |      |       |
| Leaf                 | 19   | 16   | 13.33 | 25   | 18   | 24    | 26    | 15   | 22    |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 0.81                 | 0.00 | 0.47 |       | 1.47 | 1.47 | 1.47  | 0.82  | 0.81 | 1.41  |
| **Penicillium expansum** |      |      |       |      |      |       |      |      |       |
| Leaf                 | 19   | 22.66| 26    | 23   | 14.66| 25    | 22    | 14   | 19.66 |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 1.41                 | 0.47 | 0.81 |       | 0.00 | 0.47 | 0.81  | 0.81  | 0.00 | 0.45  |
| **Candida albicans** |      |      |       |      |      |       |      |      |       |
| Leaf                 | 20   | 18   | 27    | 18.32| 12   | 24.33 | 26    | 9.66 | 25    |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 0.82                 | 0.00 | 2.13 |       | 0.47 | 1.41 | 0.94  | 0.81  | 0.94 | 1.41  |
| **Fusarium oxysporum** |      |      |       |      |      |       |      |      |       |
| Leaf                 | 18   | 19   | 24    | 20.65| 23.33| 11    | 21    | 21   | 17.33 |
| ±                    | ±    | ±    | ±     | ±    | ±    | ±     | ±     | ±    | ±     |
| 1.41                 | 1.41 | 0.00 |       | 0.47 | 0.47 | 1.41  | 1.41  | 0.81 | 0.47  |

*Values are the mean of three replicates
CONCLUSION

The present study exhibited the antifungal activity of various extracts of Feronia elephantum against Aspergillus niger, Penicillium expansum, Candida albicans and Fusarium oxysporum. As a result it is sure that these extracts can surely inhibit the growth of these microorganisms thereby preventing various diseases such as asthma, cough, dysentery etc. The inhibitory effect of the extracts justified the medicinal use of Feronia elephantum and further study is required to find out active component of medicinal value.

References

[1] Chung K. T., Thomasson W. R., Wu Yan C. D., J. App. Bacteriol, 69 (1990) 498-503.
[2] Fawzia Bibinarod, Ameenah Gurib- Fakim and Anwar Hussein Subratty, Journal of Cell and Molecular Biology 3 (2004) 15-21.
[3] Hoffman B. R., Delas Atlas H., Blanco K., Wiederhold N., Lewis and Williams L., J. Pharm. Bio. 1 (2004) 13-17.
[4] Nadkarni A. K., Indian Materia Medica, (2000), 3rd edn., p.. 45, Popular Prakashan Private Ltd., Mumbai.
[5] Satish S., Mohana D.C Ragavendra, M.P and Raveesha K. A., Journal of Agricultural Technology 3(1) (2007) 109-119.
[6] Shobha F. G., Thomas M.: Ethanopharmacol. (2001) 73-76.
[7] Singh K.V., Bhatt J. K., Fitoterapia 54 (1983) 261.
[8] Sivaraj R., Balakrishnan A., Thenmozhi M., Venckatesh R. Journal of Pharmacy Research 4(5) (2011) 1507-1508.

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