

Antimicrobial activity of selected medicinal plants' extracts against streptococcus pneumoniae

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Abstract

The objective of this research was to determine the antibacterial and antifungal activities of the five medicinal plants against *Streptococcus pneumoniae*. *Aloe secundiflora* was more effective followed by *Vernonia brachycalyx*, *Terminalia brownii*, *Carissa edulis* and *Tithonia diversifolia*. In the case of solvents, ethanol was the best then water, ethyl acetate and lastly hexane. The work envisaged by this research includes determination of the efficacies of the solvent extracts used in the treatment of bacterial and fungal diseases. Further separation of solvent extracts was done using column chromatography. Bioassay guided chromatography revealed the activity trends. Hence in this study, the antibacterial and antifungal activity of selected medicinal plants were tested against bacterial and fungal isolates.

Keywords: Antibacterial, Antifungal, Activity, Medicinal, Antimicrobial.

1. Introduction

Herbal medicines, also known as herbal remedies, herbal medicinal products, phytopharmaceuticals, Phytotherapeutic agents or phytomedicines [1] have been used by billions of people around the World for thousands of years to treat various diseases [2]. Herbal medicines have shown proven benefits for the prevention and cure of different ailments and thus have become a popular form of healthcare. The increase in the popularity is due to increase in the cost of treatment with modern medicine, fear of side effects of modern drugs and appreciation of natural remedies, which represent the alternative healthcare movement. This renders the herbal and alternative medicines very strategic in use for disease prevention and health promotion as has been advocated for by WHO since 1970s in recognition of this fact [3]. There are many herbal medicinal products in Kenyan markets today which are used in treating various ailments [4]. Some of the diseases treated include pneumonia, typhoid and candidiasis [5].

The antimicrobial activity of herbal medicinal products may be attributed to the presence of alkaloids [6] and flavonoids [7]. Flavonoids have been shown to have anti-bacterial, anti-inflammatory, anti-allergic, anti-mutagenic, anti-viral, anti-neoplastic, anti-thrombotic and vasodilatory activity. Flavonoids are of immense medicinal values since they possess antioxidant and anti-inflammatory activity. It has the ability to scavenge hydroxyl radicals, super oxide anions and lipid peroxy radicals [8, 9].

2. Materials and Methods

2.1 Collection of Ethno-Botanical Information and Treatment Methods

The ethno-botanical information of these medicinal plants was given once the herbalists revealed the particular medicinal plants employed in the preparation of each formulation to cure pneumonia, typhoid and candidiasis [10]. This information was obtained using questionnaires and also oral interviews.

2.2 Collection of plant material

Plant materials from five different plants namely *Terminalia brownii*, *Vernonia brachycalyx*, *Carissa edulis*, *Aloe*

secundiflora and *Tithonia diversifolia* were collected from their sources in Eastern Kenya with the help of the herbalists and studied on various parameters. The samples were collected in sterile polyethylene bags.

Table 1: Specific parts of the Medicinal plants used

S. No.	Plant species	Part used
1	<i>Terminalia brownii</i>	Bark
2	<i>Vernonia brachycalyx</i>	Stem and leaves
3	<i>Carissa edulis</i> ,	Stem and leaves
4	<i>Aloe secundiflora</i>	Leaves
5	<i>Tithonia diversifolia</i> .	Leaves

2.3 Preparation of plant extracts

Plant sample specimens were air-dried on the laboratory benches away from direct sunlight. Once dry, the plant parts were grounded into powdered form, stored in plastic bags and sealed to avoid contact with moisture for further use. The specific plant parts were extracted using solvents of increasing polarity (Hexane, Ethyl acetate, Ethanol and aqua) using soxhlet apparatus method. All the extracts were concentrated and spray dried to obtain the powder form of the extracts.

2.4 Test organisms

The bacterial isolate *Streptococcus pneumoniae* and fungal isolate *Candida albicans*, all clinical isolates, were obtained from KEMRI Nairobi. The anti-biotic agents (powder); gentamycin and erythromycin were purchased from Kobian Kenya Limited.

2.5 Sensitivity Testing Using Disk Diffusion Method

The antimicrobial screening was carried out using the disk diffusion method. Antibacterial activity was done on Nutrient Agar using *Streptococcus pneumoniae* as bacterial isolate. Antifungal activity was determined on Potato Dextrose Agar (PDA) using *Candida albicans* as fungal isolate. 28 g/L of Nutrient agar was dissolved and sterilized at 121 °C in an autoclave. The test microorganism were inoculated into tubes of nutrient broth separately and incubated at 37 °C and 28 °C

for 24 h for bacterial and fungal isolates respectively. The media were left to cool to around 40 °C and dispensed in sterile petridishes and left to solidify. Each of the cultures was then adjusted to 0.5 McFarland turbidity standards and inoculated (0.1 ml each) onto respective agar plates. It was allowed to dry for 10 minutes. Paper disks were diffused in each of the samples and dried at 40 °C. The disks were pressed gently onto the seeded agar plates with the tips of sterile forceps.

Antimicrobials gentamycin and erythromycin with yeast as an anti-fungal served as negative controls. The plates were incubated at 37 °C for 24 hours after which antimicrobial activity was determined by measurement of diameter zones of inhibition (Mm) (against the test organisms) around each of the extracts and the antibiotics ^[11].

3. Results/ Discussion

Table 1: Antibacterial activity of different plant extracts against *Streptococcus pneumoniae*

Plant name	Solvent used/ Zone of inhibition						
	Hexane	Ethanol	Ethyl acetate	Water	Control		
					ERY	GEN	YEA
<i>Terminalia brownii</i>	6.8 ± 0.5	9.2 ± 0.3	7.8 ± 0.5	6.8±0.1	6.6±0.2	6.8±0.4	6.0±0.0
<i>Vernonia brachycalyx</i>	9.5 ± 0.8	9.5± 1.2	7.0±0.8	7.8±0.6	8.2±0.6	7.2±0.5	4.0±0.2
<i>Carissa edulis</i>	7.5 ± 0.7	8.0±0.9	8.3±1.2	10.0±1.2	7.8±0.3	7.2±0.1	5.6±0.6
<i>Aloe secundiflora</i>	7.3±0.4	17.0±0.8	7.5±0.2	0.0±0.0	8.4±0.7	8.0±0.8	4.2±0.1
<i>Tithonia diversifolia</i>	0.0±0.0	0.0±0.0	8.0±0.5	0.0±0.0	2.2±0.4	2.4±0.6	0.8±0.0

*Analysis done in triplicates; NI- No Inhibition

ERY- (Erythromycin 15µg); GEN-(Gentamicin 15 µg); YEA-(Yeast 10 µg)

The anti-bacterial and anti-fungal activities of the extracts were shown in Table 2. All the solvent extracts of all the plants were effective. *Streptococcus pneumoniae* was inhibited to a greater extent by *Vernonia brachycalyx* extracts. *Terminalia brownii* showed excellent antibacterial activity towards all organisms tested. The zone diameter for plant extracts were greater than the standard antibiotics gentamicin, erythromycin and yeast. Towards fungi also, the *Carissa edulis* extracts were highly effective.

Aloe secundiflora is widely reported to possess several activities ^[11]. Various authors had reported the presence of a wide range of phytochemicals from *Aloe secundiflora* ^[11, 5]. They suggest these extracts as eco-friendly fungicides. The minimum bactericidal concentration of *Aloe secundiflora* ranged from 4.2 mg to 17.0 mg/ml. The Minimum bactericidal concentration is low, thus showing good antibacterial activity against the tested organisms.

It has been used as a folk remedy for candidiasis, cold, diarrhea, typhoid, pneumonia, dysentery, flu, inflammation, measles, sore throat and in healing of wounds ^[5]. Several alkaloids have been isolated from leaf extracts having pharmacological properties ^[5, 11]. Apart from alkaloids, other important compounds isolated from *Aloe secundiflora* include flavones, steroids, flavonoids, tannins and saponins ^[13].

Aloe secundiflora and *Vernonia brachycalyx* very high antibacterial and antifungal activities that prove their use in traditional medicine. Extensive research is required to find out the mechanisms of action as well as bioactivity of the various phytochemicals present in them.

4. Conclusion

There are many herbal medicinal products in Kenyan markets today which are used in treating various ailments. Herbalists prescribe and administer herbal drugs which are polyherbal in the treatment of pneumonia, typhoid and candidiasis. Pneumonia drug consists of a combination of five different plants while typhoid and candidiasis drugs consist of four plants each. Characterization and evaluation of the herbal drugs is necessary so as to establish the dosage of the medicine for proper treatment. This can be done by determining the efficacy of these herbal medicines through biological *in-vitro* assay

screening and their LD₅₀ and the therapeutic doses can be obtained and compared to those of conventional drugs

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5.2 Author's Contribution and Competing Interests

There were no competing interests.

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