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Antibacterial and Antifungal Activities of Some Medicinal Plants Used in Traditional Medicine

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Abstract: The extraction of some medicinal plants (*Plucheadioscorides* aerial part, *IPomoeacordofana* whole plant, *Zaleya pantendra* whole plant and *Heliotrpium supinum* aerial part), are commonly known to treat a variety of diseases in this study. Plants under study were investigated for their antibacterial activity against four standard bacterial strains *Bacillus subtilis* (NCTC8236), *Staphylococcus aureus* (ATCC25923), *Escherichia coli* (ATCC25922), *Pseudomonas aeruginosa* (ATCC27853), and two standard fungal strains *Aspergillius niger* (ATCC9763) and *Candida albicans* (ATCC7596) in vitro. The plants extracts with diversely solvents with increasing in the polarity, petroleum ether, ethyl acetate and methanol at a concentration of 100mg/ml were applied using the agar plate well-diffusion method. All the extracts obtained from *Zaleya pantendra* were showed high activity against all tested bacterial strains, and while have no activity against fungal strains. The methanol extract showed high significantly activity against of all bacterial strains activity in particular at Gram-positive bacteria *Staphylococcus aureus and* less activity to Gram-negative bacteria was *Escherichia coli*. The least anti bacterially active plants was *IPomoeacordofana*. The crude extract from ethyl acetate of *Heliotrpium supinum* showed high activity against all tested fugal strains of all extracts, and have broader spectrum towards *Aspergillius niger* (IZ=30mm). The methanol extract of *Zaleya pantendra* is appropriate candidates for the development of modern antimicrobial compounds.

Keywords: Medicinal Plants, Antibacterial, Antifungal, Antimicrobial Activity

1. Introduction

Medicinal plants consider as a rich resources of ingredients which can be used in drug development and synthesis. Besides that these plants play a critical role in the development of human cultures around the whole world [1].

Medicinal plants are a source of great economic value all over the world, and represent a rich source of antimicrobial agents; traditionally, crude plant extracts are used as herbal medicine for the treatment of human infectious diseases [2]. The interest in the study of medicinal plants as source of pharmacologically active compounds has increased worldwide. In Sudan, plants are the main medicinal source to treat infectious diseases [3]. Plant products have been part of phytomedicines since time immemorial. These can be derived from any part of the plant like bark, leaves, flowers, seeds [4]. i.e., any part of the plant may contain active components like, alkaloids, flavanoids, glucosides, tannins, gums, resins, essential oils, fatty oils, carbon compounds, hydrogen, oxygen, nitrogen salts of some chemicals and others few of these chemicals are toxic with residual effects. Hence, preparation and administration of plants drugs should be done by experts only. Preparation and administration of plants drugs should be done by experts only, Therefore, an extensive study is required to detect the medical properties of the plant. Several medicinal plants have been tried against pathogenic microorganisms [5, 6].

In Sudan, plants are the main medicinal source to treat infectious diseases. The present study were screened for their antimicrobial activity of different extracts from four plant species against four standard bacteria, two gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) and two gram negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) and against two fungi(*Candida albicans* and *Aspergillus niger*), which have been exploited

in traditional medicine for the treatment of various ailments.

The bacterial agents including Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Bacillus subtilis, and Proteus vulgaris cause several human infections [7, 8].The plant has been used as an anti-inflammatory agent in wound healing, anti-anxiety, anti-stress, anti-mutagenic, and spasmolytic agent and spasmolytic activities [9].

In Sudan, plants are the main medicinal source to treat infectious diseases. The present study were screened for their anti microbial activity of different extracts from four plant species against four standard bacteria, two gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) and two gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) and against two fungi (*Candida albicans* and *Aspergillus niger*), which have been exploited in traditional medicine for the treatment of various ailments. The bacterial agents including Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa, *Staphylococcus aureus* and Proteus vulgaris cause several individual infections.

2. Materials and Methods

2.1. Materials and Extraction Plant

The four different medicinal plants namely the aerial part of *Plucheadioscorides, IPomoeacordofana* whole plant*, Zaleya pantendra* whole plant and *Heliotrpium supinum* aerial part) were collected from West White Nile (Omdurman city), the same area (Table 1) and Chemical constituents (Table 2). The plants were identified in the Plant Botany Department. Each plant was spread and then air dried on sterile blotter under shade.

Table 1. *Plant Description.*

Name of plants	Family	Part used
Plucheadioscoridis	Asteraceae	Aerialparts
IPomoeacordofana	Convlulaceae	Wholeplant
Zaleya pantendra	Aizoaceae	Wholeplant
Heliotrpium supinum	Boragnaceae	Aerialparts

Table 2. *Botanical classification and active component of the plant.*

Name of plants	Family	Part used	Chemical constituents
Plucheadioscoridis	Asteraceae	Aerial parts	Essential oil, borneol, camphene, diterpenes, flavonoid [10].
IPomoeacordofana	Convlulaceae	Whole plant	Sesquiterpene alcohol, hydrocarbons in the oil .godotol A and B. Anthelmintic coumarin [11]
Zaleya pantendra	Aizoaceae	Whole plant	Antioxidant enzyme a activity, Amino acids [12].
Heliotrpiumsupinum	Boragnaceae	Aerial parts	Antibacterial, essential oils, flavonoids [13].

2.2. Solvent Extraction

The four different medicinal plants were shade dried and pulverized.50g of powdered material was packed in Soxhlet apparatus and subjected to continuous percolation for 6 hours using 500 cm^3 of petroleum ether, ethyl acetate and methanol (80%) as solvents .All extract were filtered through What man filter paper No.1, and concentrated under vacuum and dried in a desiccators .The extracts obtained and stored in refrigerator and were dissociated in Di methyl sulfa oxide for prior to use.

2.3. Antimicrobial Activity

All extracts of four different plants were tested by disc diffusion method [14]. A test stock concentration of10mg/ml form ethanol: H_2O (80:20) extracts were prepared by dissolving 0.1g of each extract in10mL of methanol in separate test tubes. The antimicrobial activities of each extract were tested against standard Gram positive bacteria (*Bacillus subtilus* National Culture Type Collection NCTC8236) *Staphylococcus aureus* American Type Culture Collection ATCC25923, Gram negative bacteria (*Escherichia coli* ATCC25922 and *Pseudomonas aeruginosa* (ATCC27853) and fungi (*Aspergillus niger* ATCC9763 and *Candida albicans* ATCC7596) using a gar well diffusion method and the result anti inhibition zones were measured and tabulated as means. The zones were measured with a transparent rule rand the result recorded in millimeters. The screening was done in triplicates. Negative controls involving the addition methanol instead of the extracts were included.

2.4. Antimicrobial Activity of the Standard Reference Drugs

Three antibiotics were used as standard reference drugs. They included two antibacterial drugs (Ciprofloxacin and Gentamicin) and Nystatin as anti fungal drug. Antibacterial drugs were tested at different concentrations obtained by taking 0.1g of each powdered drug and dissolved in 100mL sterile distilled water to give a concentration of 1000µg mL^{-1}followed by serial dilutions to give concentrations of 5, 10, 20 and 40µgmL^{-1}. There drugs were tested against standard bacteria i.e., *Staphylococcus aureus***,** *Basillus subtilus*, *Escherichia coli* and *Salmonella typhi*. The antifungal drug was also tested at different concentrations obtained by taking 0.1g of powdered drug and dissolved in 100 mL sterile is tilled water to give a concentration of 1000µgmL^{-1}followed by serial dilutions to give concentrations of 15, 30 and 60mg/ml of Nystat in against standard fungi *Aspergillus niger* and *Candida albicans.* Clotrimazole was also tested.

3. Results and Discussion

The antibacterial characteristics of the methanol, ethyl acetate and petroleum ether extracts of four Sudanese medicinal plants (the aerial part of *Plucheadioscorides, IPomoeacordofana* whole plant*, Zaleya pantendra* whole plant and *Heliotrpium supinum* aerial part) at concentration 100 mg/ml were tested against four standard bacterial strains (*Staphylococcus aureus* (ATCC25923), *Bacillus subtilis* (NCTC8236), *Escherichia coli* (ATCC25922) and *Pseudomonas aeruginosa* (ATCC27853), and against tow

standard fungal strains *Aspergillius nige r* (ATCC9763) and *Candida albicans* (ATCC7596). The results of the anti microbial activities are presented as per their measurement of zone of inhibition in millimeter (Table 3).

Table 3. *Antibacterial and Antifungal activity of investigated medicinal plants against different organisms.*

Family / Botanical and Vernacular Name	Part used	Yield%	Solvent used	Test organism used MDIZ (mm)					
				Bacteria				Fungi	
				B.s	S.a	P.s	E.c	Ca	A.s
		5.13	Pt	18	16	15	15	12	12
Plucheadioscoridis	Aerial part	1.61	Ea	16	17	14	18	-	12
		5.32	Me	18	19	19	16	-	-
		1.44	Pt	17	13	12	11	-	-
IPomoeacordofana	Whole plant	5.65	Ea	16	20	12	13	12	12
		3.42	Me	17	13	-	11	-	-
		2.60	Pt	18	-	-	12	-	-
Zaleya pantendra	Whole plant	2.66	Ea	25	17	-	19	-	-
		18.33	Me	23	25	18	16	-	-
		3.85	Pt	-	17	15	11	20	12
Heliotrpium supinum	Aerial part	4.73	Ea	16	18	17	12	17	30
		6.75	Me	19	-	-	17	12	14

S.a: *Staphylococcus aureus*, *B.s*: *Bacillus subtilus*, P.s= *Pseudomonas aeruginosa*, *E.c*: *Escherichia coli*, *Ca.:Candida Albicans* and *As.n:Aspergillus niger*, **M.D.I.Z: Mean Diameter of Inhibition Zones (mm) MD IZ >18 *Sensitive;14-18Intermediate;<14=Resistant(-)No activity.*

S.a: Staphylococcus aureus(ATCC25923),B.s: Bacillus subtilis (NCTC8236),

E.c: Escherichia coli (ATCC25922),P.a: Pseudomonas aeruginosa (ATCC27853).

Pt = petroleum ether, Ea= ethyl acetate, Me = methanol

The results showed that methanol was the best solvent for extracting antibacterial substances of *Zaleya pantendra* extract while ethyl acetate was the best solvent for extracting antifungal substances from *Heliotrpium supinum*. The results of the anti microbial activities are presented as per their measurement of zone of inhibition in millimeter. (Table 3). This resulting was depended on the number of pathogenic microorganisms inhibited and the diameter of inhibitory zones produced; it was also observed that the Gram positive bacteria *Bacillus subtilus* was the most sensitive microorganism inhibited by all extracts except toward petroleum ether of *Heliotrpium supinum extract*. All extracts have weak or no growth inhibition was observed against fungal strains, of all organisms *Aspergillus niger* (30mm-Figure 1) and *Candida albicans* (20mm) shows high inhibition zone 20mm) respectively which clear against *Heliotrpium supinum* of all plant extracts (Table 2).

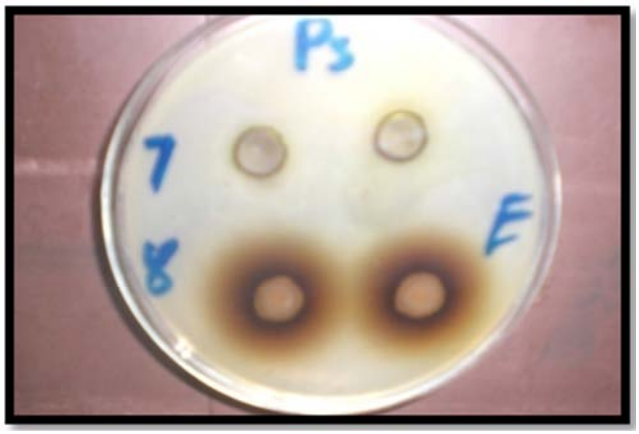

Fig. 1. *Inhibition zone of ethyl acetate of Heliotrpium supinum.*

Furthermore, all of the petroleum ether extracts exhibited inhibitory activity against the entire tested organism with zones of inhibition ranging from (11-18mm).The tested *Heliotrpium supinum* plant extract showed as positive activities against tested bacteria and fungi and *Zaleya pantendra* plant effective against fungi, in comparing with reference drugs. *IPomoeacordofana* extract has a less sensitive of all extracts, but *Plucheadioscoridis* had showed high antibacterial activity against *Bacillus subtilis* (IZ=18mm) by petroleum ether extract, *Pseudomonas aeruginosa* (IZ=19mm), *Staphylococcus aureus* (IZ=19mm) by methanol extract, while ethyl acetate extract was found effective against *Staphylococcus aureus* (IZ=17mm) and *Escherichia coli* (IZ=18mm). As can be seen from the finding, methanol extract of *Zaleya pantendra,* the most fastidious species against bacteria. All species of plants included in the present study were also found to be active on at least one of the selected microbial strains. The antibacterial activity profile of *Zaleya pantendra* extract against all the tested bacteria strains indicated that *Staphylococcus aureus*, *Bacillus subtilu*s were the most susceptible bacterium of all the bacterial test strains.

With justification, Gram-positive bacteria are frequently reported to have developed mulit-drug resistance to many of the antibiotics currently available in the market. Ethyl acetate extract of *Heliotrpium supinum* showed exceptionally stronger activity against *Aspergillius niger* (ATCC9763) and *Candida albicans* (ATCC7596), than other plant extracts. The reason for the difference in sensitivity between microbial strains might be ascribed to the differences in morphological constitutions between these microorganisms, Therefore, the

cell wall of Gram-negative organisms which are more complex than the Gram-positive ones act as a diffusion barrier and making them less susceptible to the antimicrobial agents than are Gram-positive [9, 10]. In spite of this permeability differences, however, some of the extracts have still exerted some degree of inhibition against Gram-negative organisms as well.

The estimate of obtained results shows that ethyl acetate extract of *Heliotrpium supinum* was highly effective against all tested bacterial and fungal strains, but methanol extract of *Zaleya pantendra* was highly effective against all tested bacteria only. The activity of the plant extracts against bacteria is an indication of the presence of large or slight spectrum antibiotic compounds or simply metabolic toxins in the plant [15]. Plants used in this study different extracts were different in their antimicrobial efficacy depending on the extractive solvent used. This result agrees favorably with the suggestion of [16]. Oloke and Kolawole that bio active components of any medicinal plant may differ in their solubility depending on the extractive solvents used.

4. Conclusion

It is concluded that this study would guide to the establishment of some valuable compounds that has to be used to formulate novel, varied and more potent antimicrobial drugs of normal source. The antibacterial screening insured the significance of these plants and the concentrated use by the healers as traditional medicines and pointed a good leading for further research studies in these plants.

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