British Biotechnology Journal
14(3): 1-6, 2016, Article no.BBJ.24290
ISSN: 2231–2927, NLM ID: 101616695

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Antimicrobial Activities of Essential Oils from Some Medicinal and Aromatic Plants

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Authors' contributions

This work was carried out in collaboration between all authors. Author DK designed the study and wrote the protocol. Author MIK managed the literature searches, managed the analyses of the study and performed the statistical analysis. Author MHS wrote the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BBJ/2016/24290
Editor(s):
(1) Mahalingam Govindaraj, ICRISAT, Patancheru, India.
(2) Kuo-Kau Lee, Department of Aquaculture, National Taiwan Ocean University, Taiwan.
Reviewers:
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(4) Anonymous, Coventry University, UK.
(5) Anonymous, University of Lisbon, Portugal.
Complete Peer review History: http://sciencedomain.org/review-history/15192

Original Research Article

Received 12th January 2016
Accepted 13th June 2016
Published 28th June 2016

ABSTRACT

This research work was designed to examine the antimicrobial activities of some medicinal and aromatic plants. The essential oils of *Adansonia digitata, Arachis hypodaea, Capsicum frutecens, Gossypium hirsutum, Hisbiscus esculentus, Nicotiana tabacum L., Piliostigma reticulatum Hochst, Sesamum alatum thoning, Solamum incanum L., Vernonia amygdalin and Vigna unguiculata* were extracted by hydro-distillation and the oils were evaluated against some microorganisms. Among the plants tested, essential oils from *Vigna unguiculata* showed activity against all the tested microorganisms except *Bacillius subtilis* with minimum inhibition of 75 mm each. *Piliostigma reticulatum* Hochst showed activity against *Staphylococcus aureus, Escherichia Coli, Pseudomonas aeruginosa, Candida albicans* with minimum inhibition of 100 mm each. *Sesamum alatum Thoning* showed activity against *Staphylococcus aureus, Pseudomonas aeruginosa* and *Proteus mirabilis* with minimum inhibition of 100 mm each. The activities of the essential oils

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against the tested organisms may be responsible for the assumed therapeutic uses of the plants by the traditional healers.

Keywords: Adansonia digitata; antimicrobial activity; essential oils; hydro-distillation; Candida albicans.

1. INTRODUCTION

Medicinal plant is any plant in which one or more of its organs contain substances that can be used for therapeutic purpose or which are precursors for the synthesis of useful drugs [1]. This description makes it possible to distinguish medicinal plant whose therapeutic properties constituent have been established scientifically and plant that are regarded as medicinal, but which have not yet been subjected to a thorough scientific study.On the other hand it was also suggested that the term indicates merely specie known to beneficially modulate the physiology of sick mammals and that has been used by mankind. Medicinal plants may be defined as those plants that are commonly used in treating and preventing specific ailments and diseases, and that are generally considered to play a beneficial role in health care and in traditional medicine [1]. Medicinally active substances tend to be concentrated in one or all parts of the plant as follows: - roots, stems, leaves, flowers, fruits and seeds, rhizomes, bulbs and tubers [2,3].

The extraction of bioactive agents from plants is one of the most intensive areas of natural products research today [4,5]. This is due to the fact that in recent years,pathogens resistant to human drugs have been reported, because of the indiscriminate use of the antimicrobial drugs [6,7]. Therefore there is need to develop alternative antimicrobial drugs for the treatment of infectious diseases that are resistant to the conventional antibiotics. Traditionally used medicinal plants have variety of compounds that have therapeutic properties. These substances can either inhibit the growth of pathogen or kill them and are thus considered for developing new antimicrobial drugs [8-10]. Consequently, antimicrobial properties of medicinal plants are being increasingly reported all over the world [11-14].

Antimicrobial screening is useful for determination of plant species that are of immense biological importance, because it can eventually lead to the isolation of novel compounds with antimicrobial prpperties [15]. Therefore the aim of this study is to investigate the antimicrobial activities of essential oils from some medicinal and aromatic plants.

2. MATERIALS AMD METHODS

2.1 Collection of Plant Materials

Eleven plants used for this study were collected at different locations in Lala Development Area in Adamawa State. All the plants collected were identified by Forestry department Modibbo Adama University of Technology, Yola, Nigeria, where their voucher specimens were deposited and voucher number obtained namely: FMU10012, FMU10013, FMU10014, FMU10015, FMU10016, FMU10017, FMU10018, FMU10019, FMU10020, FMU10021, FMU10022. The plants leaves were dried at room temperature for three weeks. The dried materials were ground with a coffee grinder.

2.2 Extraction of Essential Oils

500 g each of the ground leaves of *Adansonia digitata, Arachis hypodaea, Capsicum frutecens, Gossypium hirsutum, Hisbiscus esculentus, Nicotiana tabacum L., Piliostigma reticulatum Hochst, Sesamum alatum thoning, Solamum incanum L., Vernonia amygdalin, Vigna unguiculata* were subjected to hydrodistillation in a glass Clevenger apparatus, according to the British Pharmacopeia (BP) method [16]. At the end of the hydrodistillation, the essential oil from the plants materials were collected in hexane which were then concentrated until the hexane was removed to obtain only the essential oil. The concentrate was re-dissoved in DMSO [17].

2.3 Test Organisms

The bacterial and fungal strains used for the investigation are:- *Baccillus subtilis, Escherichia coli, Staphylococcus aureus, Proteus mirabilis, Pseudomonas aerugunosa* and *Candida albicans.*

The microorganisms were collected from the Microbiology Department, Modibbo Adama University of Technology, Yola. Adamawa State.

2.4 Determination of Antimicrobial Activity

The antimicrobial activity of the essential oil extract was determined using disc diffusion method [18]. Petri dish containing 10 ml of Mueller Hinton agar medium was seeded with 24 hours old culture of a selected bacterial and fungal strains. Sterile filter paper discs (9 mm in diameter) containing 1000-5000 ppm of a essential oil dissolved in DMSO, was placed on the surface of the medium. DMSO and water alone served as negative controls. A standard disc containing chloramphenicol antibiotic drug (30 µg/disc) was used as a positive control. Incubation was carried out for 24 hours at 37℃. The assessment of antimicrobial activity was based on the measurement of diameter of inhibition zone formed around the disc. (Diameter of inhibition zone minus diameter of the disc). An average zone of inhibition was calculated for three replicates. An inhibition zone of 8 mm or greater was considered as a good antimicrobial activity [14]. According to Ogunwande [19], a cleared zone bigger than 10 mm will be interpreted as sensitive while smaller than 9 mm will be interpreted as resistance.

Extracts that showed positive activity in the preliminary screening were serially diluted in DMSO (two-fold) and loaded on the filter paper discs. These serially diluted concentrations of the extracts was assayed in triplicate as described above to determine the minimum inhibitory concentrations (MIC) i.e. the minimum concentration per disc to inhibit growth of' the test microorganisms [20].

3. RESULTS AND DISCUSSION

Result of antimicrobial susceptibility screening of the essential oils from different plants revealed degrees of activities against test organisms (Table 1). Among the plants tested, essential oils from *Vigna unguiculata* showed activity against all the tested microorganisms except *B. subtilis* with minimum inhibition concentrationof 75 mm each. The activity of the *V. unguiculata* extracts against all the tested organisms suggest the leaves of *V. unguiculata* is a potential source of alternative medicine, this agreed with the works of [21-23] which reported that the leaves and seeds of *V. unguiculata* are used to treat swelling and tooth ailments.

Table 1. Antimicrobial activities of essential oils extracted from some medicinal and aromatic plants against some selected microorganism (zone of inhibition in mm)

Conc %	*Staphylococcus aureus*		*Escherichia coli*	*Pseudomonas aeruginosa*	*Proteus mirabilis*	*Bacillus subtilis*	*Candida albicans*
Adansonia digitata	100	-	-	-	-	-	24
	75	-	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Arachis hypodaea	100	-	-	-	-	-	23
	75	-	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Capsicum frutecens	100	-	-	-	15	-	-
	75	-	-	-	17	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Gossypium hirsutum	100	-	-	-	-	-	-
	75	-	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Hisbiscus esculentus	100	22	-	-	-	-	-
	75	14	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-

Conc %	*Staphylococcus aureus*		*Escherichia coli*	*Pseudomonas aeruginosa*	*Proteus mirabilis*	*Bacillus subtilis*	*Candida albicans*
Nicotiana tabacum L.	100	-	-	-	24	-	-
	75	-	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Piliostigma reticulatum Hochst	100	12	14	20	-	-	23
	75	-	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Sesamum alatum thoning	100	16	-	20	17	-	-
	75	-	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Solamum incanum L.	100	27	12	25	-	-	24
	75	22	-	20	-	-	20
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Vernonia amygdalina	100	-	-	-	-	-	-
	75	-	-	-	-	-	-
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-
Vigna unguiculata	100	20	16	12	24	-	14
	75	12	10	14	18	-	19
	50	-	-	-	-	-	-
	25	-	-	-	-	-	-

Key: - = Negative

Essential oils from *Adansonia digitata, Arachias hypogeae* showed activity on candida albicans only with minimum inhibition of 100 mm each.

The leaves, bark and fruits of *A*. *digitata* are traditionally employed in several African regions as foodstuff and for medicinal purposes [24].

Nicotiana tabacum L and *Capsicum frutescens* L only showed activity against *P. mirabilis with* minimum inhibition of 75 mm. The claim that the leaves of *N. tabacum L*. are chewed for the treatment of tooth ache may be associated to the phytochemical constituents of the leaves.

Hibiscus esculentus showed activity only to *S. aureus* minimum inhibition of 75 mm.

Piliostigma reticulatum Hochst showed activity against *S. aureus, E. coli*, *P. aeruginosa, C. albicans,* with minimum inhibition of 100 mm each. This agreed with the work of [24], in which the leaf extract from the plant *P. reticulatum* was found to exhibit antimicrobial activity against some bacteria and fungi such as *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Proteus vulgari* and *Candida albicans*. The antimicrobial activity of these oils indicates that they can serve as potential source of drugs development.

Sesamum alatum Thoning showed activity against *S. aureus, P. aeruginosa, and P. mirabilis* with minimum inhibition of 100 mm each. This is in line with the work of [25,26] which state that the methanolic and ethanolic extracts exhibited broad spectrum antimicrobial effect against *Baccillus subtilis, Escherichia coli, Proteus mirabilis, Pseudomonas aerugunosa* and *Candida albicans* except *Staphylococcus aureus*, while the aqueous extract exhibited inhibitory activity on *Staphylococcus* aureus and *Candida albicans.* This justifies the assertion that all parts of *S. alatum Thoning* are useful.

4. CONCLUSION

The antimicrobial activities of the essential oils against the tested microorganisms signify the potential of these plants as sources of

therapeutic agents. This supports the traditional use of these plants in curing various ailments whose causative agents are some of the organisms used in this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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