Global Scientific JOURNALS

GSJ: Volume 8, Issue 9, September 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

Antimicrobial Activity of *Mahonia aquifolium* Leaves Extract on Human pathogenic organisms

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Abstract

The persistent resistance of micro-organisms necessitates the need to intensify studies on the use of possible strategies for proper control of pathogens using extracts from natural products. The organic extract of *Mahonia aquifolium* was evaluated for antimicrobial activity against some commonly known pathogenic forms of bacteria viz., *Epidermophyton floccosum, Staphylococcus pyogenes, Baccilus subtilis, Staphylococccus aureus, Candida albicans, Staphylococcus epidermilis, Corynebacterium parvum.* The research was investigated using standard microbiological procedures. The antimicrobial activity was performed by agar disc diffusion method. The methanolic extract of the plant proved to be considerably more active when compared to other solvents' extract. *Bacillus subtilis,* was the most resistant bacterial strain against the methanolic extract followed by *Streptococcus pyogenes* and *Epidermophyton floccosum.*

Key words: Antimicrobial activity, disc diffusion, pathogen, Resistance, Organic Extract.

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Introduction

Antimicrobial agents provide valuable adjunctive therapy for the prevention and the control of diseases. Limitations in their prolonged use have stimulated the search for new, naturally occurring agents with more specific activity and fewer adverse effects so a significant revival of interest in natural products as a potential source for new medicines has been observed (Jagadish *et al.,* 2019). Natural products have received significant recognition as source for new antimicrobial products in biomedical research. Nature has been a source of medicinal agents for years and a massive number of modern drugs have been produced from natural sources, many based their use in traditional medicine (Nair *et al.,* 2005). The modern pharmaceutical industry is highly dependent on plant-based medicines, with more than 50% of drug substances derived from natural resources (Krief *et al*., 2004).

The pace of development of new antimicrobial drugs has slowed down while the prevalence of resistant bacteria is no longer matched by expansion in the arsenal of agents (Akinpelu D.A and Onakoya T.M., 2006). Several research works have been done to discover new antimicrobial compounds from various kinds of sources such as microorganisms, animals and plants. One of such resources is folk medicine and systematic screening of them may result in the discovery of novel effective compounds ((Janovska *et al.,* 2003). There are several reports on the antimicrobial activity of many plants extracts in different regions of the world (Chung *et al*., 2004; Nair, R. and Chanda, 2004; De Boer *et al.,* 2005; Nair *et al.,* 2005).

The side effects and the resistance that pathogenic microorganisms built against antibiotics has made scientists to shift attention to extracts from plant species used in herbal medicine (Essawi and Srour, 2000). Plant-based antimicrobials

represent a vast untapped source of medicines and further exploration of plant antimicrobials needs to occur. The aim of this study was to screen the organic solvent leaves extract of *Mahonia aquifolium* for phytochemicals that could be useful for the development of new tools as antimicrobial agents.

Materials and methods

Plant material:

Fresh tree leaves of *Mahonia aquifolium* was collected from Forestry Research Institute of Nigeria Ibadan. The fresh tree leaves sample was taken for authentication to determine its taxonomic identity at the department of botany in university of Ibadan.

The fresh tree plant leaves material were washed under running tap water, air dried and then homogenized to fine powder and kept in air tight bottles.

Preparation of extracts:

For solvent extraction, 50g of air-dried powder was poured in to 250 ml of organic solvent (Petroleum ether, chloroform, ethyl acetate, methanol and water) in conical flask, plugged with cotton wool and then kept on a rotary shaker at 190-220 rpm for 24hours. After 24 hours the supernatant was collected and the solvent was evaporated at room temperature. The repeated procedure was followed in all the other solvents and water. The extracts were kept at 4^0C in airtight bottles inside refrigerator.

Microorganisms:

Antimicrobial activity was examined for all the organic extracts from the tree leaves material.

*Epidermophyton floccosum, Staphylococcus pyogenes, Baccilus subtilis, Staphylococccus aureus, Candida albicans, Staphylococcus epidermilis, Corynebacterium parvum.*were all collected and sub-cultured using nutrient agar from Post Graduate research laboratory, Department of Microbiology, University of Ibadan, Oyo state, Nigeria.

Phytochemical Screening Test

Phytochemical screening was done for analyzing secondary metabolites, which are responsible for antimicrobial activity. The phytochemical screening of the plant extract was carried out to detect the presence or absence of certain bioactive compounds (phytochemicals).

Antibacterial Assay

Tree leaves extracts of *Mahonia aquifolium* which were prepared with different solvents (Petroleum ether, Chloroform, Ethyl acetate, Methanol and Water) were used to test their antibacterial activity.

Antibacterial activity was demonstrated using a modification of the method originally described by Bauer *et al.*, (1966) which is widely used for the antibacterial susceptibility testing. Liquid nutrient agar media and the Petri plates were sterilized by autoclaving at 120^{o}C for 30 minutes. Under aseptic conditions in the laminar airflow chamber, 20ml of the agar medium was dispensed into each Petri dish (plate) to yield a uniform depth of 4mm. After solidification of the media, the bacterial strains were swabbed on the surface of the agar plates. Whatmann No.1 filter paper was cut into small discs of diameter 0.4cm and autoclaved. These discs were dipped into the plant extract of three concentrations namely (20mg/ml, 10mg/ml and 5mg/ml). The dipped discs were placed on the appropriate swabbed Petri plates such that the Petri plates

have three concentration of the plant extract. It was then incubated at 37^{o}C for 24 hours the antibacterial drug which was used here was chloramphenicol for control. After incubation the zone of inhibition was measured in mm.

Results

Table 1: Phytochemical Screening of *Mahonia aquifolium* leaves Extracts

Phytochemicals	Petroleum Ether	Chloroform	Ethyl Acetate	Methanol	Water
Alkaloids	-	-	-	+	-
Saponins	-	-	-	+	+
Tannin & phenolic compound	-	-	+	+	+
Flavonoids	-	-	-	+	-
Steroids	-	+	+	+	-
Terpenoid	-	-	-	+	-
Amino acids	-	-	-	-	-
Carbohydrates	-	+	-	-	+
Glycosides	-	-	-	+	-
Cardioglycosides	-	-	-	+	-

'+' – Present '-' – Absent

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Table 2: Antimicrobial activity of *M. aquifolium* Leaves Extracts

Extracts	Concentrations (mg/ml)	*E.f*	*S.p*	*B.s*	*S.a*	*C.a*	*S.e*	*C.p*
Petroleum	10	9	-	7	8	7	6	9
Ether	5	-	-	-	6	-	6	5
	2.5	-	-	-	6	-	-	6
Chloroform	10	7	6	7	-	-	7	7
	5	6	6	6	-	-	6	5
	2.5	-	-	-	-	-	-	5
Ethyl	10	8	9	8	11	7	7	7
Acetate	5	6	7	7	6	-	5	4
	2.5	6	-	5	-	-	-	-
Methanol	10	6	7	6	14	14	13	9
	5	5	5	5	10	8	8	6
	2.5	-	5	-	8	6	7	5
Water	10	6	-	-	-	-	9	7
	5	5	-	-	-	-	6	5
	2.5	-	-	-	-	-	-	-

"-" Indicates that there is no Zone of inhibition (mm).

E.f - Epidermophyton floccosum, S.p - Staphylococcus pyogenes, B.s - Baccilus subtilis, S.a - Staphylococccus aureus, C.a - Candida albicans, S.e - Staphylococcus epidermilis, C.p - Corynebacterium parvum

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Discussion

The data presented in Table 1 indicates the presence of phytochemicals present in the organic extracts of *Mahonia aquifolium.* The phytochemical analysis of *Mahonia aquifolium* leaves extract revealed the presence of alkaloids, flavonoids, tannins, saponins, flavonoids and several other aromatic compounds which were also reported by Jigna *et al., 2005*. The result in table 2 shows that the extracts from the plant leaves studied inhibited growth of the tested micro-organisms with to various degrees. The presence of detected phytochemical constituents in leaves of *Mahonia aquifolium* might be responsible for the observed antimicrobial activity. The methanolic extract of the tree leaves showed considerably more activity when compared to the other solvents' extracts which is in accordance with the findings of Shiamala *et al.*, 2014, who concluded that methanol was established to be the most effective among the tested solvents at recovering the phenolic and certain constituents with significant antibacterial properties. Strong antibacterial activity was recorded against *Staphylococcus aureus* followed by *Corynebacterium parvum* and *Staphylococcus epidermilis* while a weak antimicrobial activity of the extract was recorded against *Bacillus subtilis* and *Epidermophyton floccosum*. Similar conclusion was drawn

by Aernan *et al*., (2016), who proved that extract of leaf and stem of *Passiflora edulis* had antibacterial activity against gram negative and gram positive bacteria.

Conclusion

From the above results it can be deduced that *Mahonia aquifolium* leaves extract has great potential as antimicrobial compound against humam pathogenic microorganisms. The results suggest that the antimicrobial activity of the crude extract is considerably active. This antimicrobial compound can be used in the treatment of human diseases or infections caused by these microbes. This economic tree plant material will serve a lot in the discovery of bioactive natural products for the development of new antimicrobial drugs that will accurately and successfully address the unmet therapeutic needs.

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