Journal of Advances in Microbiology

5(4): 1-5, 2017; Article no.JAMB.34488
ISSN: 2456-7116

The Antibacterial Potency of Alkaloid and Saponin Extracts from *Solanum macrocapon* (Garden Egg)

V. A. Ajibade[1*] and M. F. Ibiyemi[1]

[1]Department of Science Technology (Microbiology), Federal Polytechnic, Ado-Ekiti, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author VAA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MFI managed the analyses and the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMB/2017/34488
Editor(s):
(1) Graciela Castro Escarpulli, Laboratorio de Bacteriologia Medica, Instituto Politécnico Nacional, Mexico.
Reviewers:
(1) Wan Mohdh Nuzul Hakimi Wan Salleh, Universiti Pendidikan Sultan Idris (Upsi), Malaysia.
(2) S. Murugesan, Periyar University, India.
Complete Peer review History: http://www.sciencedomain.org/review-history/21284

Original Research Article

Received 29th May 2017
Accepted 18th June 2017
Published 7th October 2017

ABSTRACT

The antibacterial potency and efficacy of alkaloid and saponin extracts from *Solanum macrocapon* (Garden egg) were investigated. The susceptibility of bacteria strains viz were *Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa* against the two extracts was determined using disk diffusion methods with different concentration (10 – 0.625 mg/mL). All the bacteria were susceptible to both alkaloid and saponin with different ranges of zone of inhibition at concentration of 10 mg/mL. The susceptibility of the bacteria to alkaloid with zone of inhibition for *Escherichia coli* (14.00 mm), *Staphylococcus aureus* (12.00 mm)*, Pseudomonas aeruginosa* (10.00 mm) and susceptibility of the organisms to saponins with zone of inhibition for *Pseudomonas aeruginosa* (21.00 mm), *Staphylococcus aureus* (12.00 mm) and *Escherichia coli* (10.00 mm). The minimum inhibitory concentration (MIC) of the alkaloid and saponins crude extracts were observed at 1.25 mg/mL respectively. The most susceptible bacteria to saponin and alkaloid were *Pseudomonas aeruginosa* and *Escherichia coli* respectively.

**Corresponding author: E-mail: ajibvijay@yahoo.com;*

Keywords: Alkaloids; antibacterial; potency; saponin.

1. INTRODUCTION

Medicinal plants are rich in a wide variety of secondary metabolite such as tannins, terpenoids, alkaloids, saponin and flavoids which have found to act on potential pathogens [1]. These bioactive substances or active principle of medicinal plants which are used for therapeutic purposes can be found in almost all parts of the plants but the concentrations are often high in some parts such as leaves, fruits, stem, bark and root [2]. Almost all plants are medicinal hence they serve as raw material for synthetic drugs.

Solanum macrocapon belongs to family of Solanaceae which is also known as African eggplant is a perennial plant that is closely related to the eggplant [3]. It contains alkaloids which are usually bitter in taste and characterized by powerful physiologic activity [4]. *S. macrocarpon* originated from West Africa but is now widely distributed in Central Africa; it is widely cultivated for it's used as food, medicinal purposes and as an ornamental plant [5].

Alkaloids are plant metabolites that have an enormous number of bitter nitrogenous compounds containing ring structures, alkali-like reactivity and pharmacological activity [6], the alkaloids represent a very diverse group of medically significant compounds that include well known drugs like the opiates, most common alkaloids include morphin, quinine, ephedrine, nicotin, caffeine and artropine. The amazing effects of these alkaloids on humans has led to the development of powerful pain killer medications and serious addiction by people who are ignorant of the properties of this chemical [7].

Before the advent of modern day medicine of which many drugs are synthetically produced; extracts of many plants were known to elicit certain reactions from human body. Among such plants that have been used for medical purpose are *S. nigrum*, *S. macrocarpon* [8]. The roots, leaves and fruits of *S. macrocarpon* in Nigeria either in the process or unprocessed form contain medicinal qualities [5]. The uses of *S. macrocarpon* in indigenous medicine range from weight reduction to treatment of several ailments including allergic rhinitis, nasal catarrh, skin infections, rheumatic, swollen joint pain, gastro-oesophageal reflux disease, constipation and dyspepsia [9].

Saponins are class of chemical compounds which are found in various plant species, saponins are steroids and triterpene glycosides due to their soap-like properties, the presence of both lipid soluble (the triterpene) and water soluble (the sugar) elements in one molecules gives saponins detergent properties and they form lather when shaken with water. Saponin has been known to posses antibacterial properties which make it to be useful for prevention and control of some bacterial infection that affect human being and other animals of interest [10]. This work aims at evaluating the antibacterial potency of alkaloids and saponins extracts from *S. macrocapon*

2. MATERIALS AND METHODS

2.1 Collection of Sample

The seeds of *Solanum macrocapon* (Garden egg) were obtained from grocery in Ado-Ekiti, Nigeria. It was identified and authenticated in Agricultural Technology Department, Federal Polytechnic, Ado- Ekiti, South-Western Nigeria where voucher specimen No FPA/AG.RES/0124 was preserved.

2.2 Extraction of Crude Saponin

Fresh seeds of *Solanum macrocapon* were sliced into pieces to facilitate even drying which was done for four days and it was milled with the aid of milling machine to powdery form. 100g of the powdered seeds were weighed and subjected to successive Soxhlet extraction in di-ethyl ether for 72 hours and the residue was collected and air–dried for 24 hours. The dried residue was extracted using methanol and it was re-distilled to eliminate methanol solvents and collection of the powdered residue was done at the bottom of the conical flask. Reconstitution of the extract was carried out using distilled water and n-butanol in ratio 1:3, the solution formed was filtered overnight using Whatman filter paper No. 4 to form a band layers. The upper layer was re-distilled to recover the n-butanol while lower layer solution was the required crude saponin.

2.3 Extraction of Crude Alkaloid

5 g of the milled sample was weighed and macerated in 100 mls of 95% ethanol twice a day, it was allowed to stand for 3 days for complete extraction. The solution was filtered using Whatman filter paper No 4 the filtrates, were collected and evaporated to dryness by placing it in low intensity sunlight while the residue was then mixed with distilled water and filtered with chloroform. The filtrates was evaporated in vacuum to dryness, the solid materials which settles at the bottom of the conical flask is the alkaloids (AQAC, 2014).

2.4 Re-activation of Stock Culture and Antibacterial Assay

The isolates from stock collected in Microbiology laboratory of the Department of Science Technology, Federal Polytechnic, Ado- Ekiti were sub-cultured in 5 mL of nutrient broth and incubated for 18 – 24 hours, this was subculture on nutrient agar plates to re-activate.

The re–activated culture was serially diluted to 10-3, a loopful of the suspension was spread evenly on a dried nutrient agar. The extract at different concentration was impregnated on to paper disk punched from Whatman No. 4 filter paper and placed equidistant on the agar. The plates were incubated at 37 C for 24 hours and the diameter of zone of inhibitions was measured. Diameter of inhibition greater or equal to 10.00 mm was interpreted as susceptible, while less than 10.00 mm was resistant.

3. RESULTS AND DISCUSSION

Table 1 shows the degree of potency of different concentration of saponin extracted from *S. macrocapon* and Table 2 shows the degree of potency of different concentration of alkaloids extracted from *Solanum macrocapon.* In Table 1, the bacteria were susceptible at varying concentration of the extracts. At 10 mg/ml, *S aureus, E. coli, S. typhi* and *P. aeruginosa* showed zone of inhibition of 12.0, 14.0, 0.2 and 10.0 mm respectively. However, the least zone of inhibition was evident with *Salmonella typhi* at 0.2 mm.

The test bacteria were susceptible at varying concentration of the extracts in Table 2, at 10mg/ml, *Staph aureus, E. coli, S. typhi* and *P. aeruginosa* showed zone of inhibition of 12.0, 10.0, 0.1, and 21.0 mm respectively. However, the least zone of inhibition was evident with *S. typhi* at 0.1 mm and highest zone of inhibition was evident with *P. aeruginosa* at 21.0 mm.

Table 3 shows the minimum inhibitory concentration (MIC) of crude saponin and alkaloids exracts from Solanum macrocarpon seed. In Table 3 it was observed that at different concentration of alkaloids. *Staphylococcus aureus, E. coli, S. typhi* and *P. aeruginosa* were susceptible at a minimum inhibitory concentration (MIC) of 2.5 mg/ml and while *S. typhi* was susceptible at 5.0 mg/ml. Also, the MIC of *E. coli* and *P. aeruginosa* was 1.25 mg/ml concentration of alkaloids while *Staphylococcus aureus* and *S. typhi* were 2.5 mg/ml and 10 mg/ml respectively.

The therapeutic significant of saponin cannot be underestimated. This active component has been extracted from different parts of plants viz: fruits, seed, bark and leaves [11]. However, the concentration of saponin in these parts differs, saponin which is often detected by its foaming activity has been researched to be potent on several pathogenic bacteria especially Salmonella typhi [12]. Saponin extracted from *Solanum macrocarpon* seed showed high potency on *S. typhi* and *Staph aureus* with minimum inhibitory concentration (MIC) of 10.0 mg/ml and 2.5 mg/ml. The antibacterial potency of crude alkaloid and saponin extracted from *Solanum macrocarpon* seed was examined. In this study, this result correlate with the findings of Nattakara et al. (2015) where he reported the antibacterial activity of the extract of *Solanum macrocarpon* tested against five pathogenic bacteria (*Staphylococcus aureus, Staph. Intermedius, Staph. epidermidis, B. cereus and P. aeruginosa*).

It is however important to note that in all published works over the last twenty years, there has not been any report of toxicity or side effects made in any human or animal and research has shown that saponin could be toxic especially at high concentration; it has been proved that saponin at a low concentration that gives adequate potency is not toxic to cells [13]. The concentration of saponin that gave the desired therapeutic activity in this research is minimal and does not pose any threat.

Table 1. The degree of potency of different concentration of Alkaloids extracted from *Solanum macrocapon* seed

Test organism	Diameter of zone of inhibition (mm) Concentration (mg/mL)				
	10	**5**	**2.5**	**1.25**	**0.625**
Staphylococcus aureus	12.0	8.6	5.4	3.1	0
Escherichia coli	14.0	11.8	9.3	7.1	0
Salmonella typhi	0.2	0	0	0	0
Pseudomonas aeruginosa	10.0	9.2	7.1	5.0	0

Table 2. The degree of potency of different concentration of Saponin extracted from *Solanum macrocapon* seed

Test organism	Diameter of zone of inhibition (mm) Concentration (mg/mL)				
	10	**5**	**2.5**	**1.25**	**0.625**
Staphylococcus aureus	12.0	10.5	9.2	6.0	0
Escherichia coli	10.0	8.5	7.3	5.1	0
Salmonella typhi	0.1	0	0	0	0
Pseudomonas aeruginosa	21.0	15.1	12.6	9.2	0

Table 3. The minimum inhibitory concentration (MIC) of the crude Saponin and Alkaloid extracted from *Solanum macrocapon* seed

Test organisms	Minimum inhibitory concentration (MIC) (mg/ml)	
	Alkaloids	**Saponins**
Staphylococcus aureus	3.1	6.0
Escherichia coli	7.1	5.1
Salmonella typhi	0	0
Pseudomonas aeruginosa	5.0	9.2

4. CONCLUSION

Medicinal significant of alkaloid extract cannot be overemphasized. This nitrogenous base phytochemical has been shown to be potent to clinically isolated pathogens at low concentration [14]. In this research, its therapeutic effect is evident on *Salmonella typhi*; the etiologic agent of typhoid fever, *E. coli*; the etiologic agent of infant diarrhea, *Staph aureus* and *P. aeruginosa* which are clinical isolates from furuncles and wounds respectively. The use of *S. macrocarpon* seed as folklore medicine is therefore appropriate.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/21284