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ANTIBACTERIAL AND ANTIOXIDANT ACTIVITIES OF THE LEAF EXTRACTS OF *Solanecio biafrae* AGAINST SELECTED CLINICAL ISOLATES

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Abstract

An average Nigerian household consumes vegetables of various kinds but are ignorant of their antibacterial properties and other benefits. There is also an increase in the prevalence of multidrug resistant strains of bacteria which has raised the spectra of untreatable bacterial infections. This challenge has requested for urgency to search for new infection-fighting strategies. This study therefore investigated the antibacterial activities of the ethanolic and acetonic leaf extracts of *Solanecio biafrae* against some selected clinical isolates. Agar well diffusion technique was used for the antibacterial susceptibility testing of the microbial isolates and the minimum inhibitory concentration was tested using tube broth dilution method. The zones of inhibition of the ethanolic leaf extract of *Solanecio biafrae* for *Staphylococcus aureus*, *Enterococcus faecalis*, *Acinetobacter baumanii*, *Acinetobacter haemolyticus*, *Pseudomonas aeruginosa*, *Enterobacter agglomerans*, *Escherichia coli*, *Citrobacter youngae*, *Yersinia pestis* and *Klebsiella oxytoca* were considerably high. *Acinetobacter baumanii* was the most susceptible organism to the extract (35.0 mm at 200 mg/ml). *A. baumanii*, *A. haemolyticus*, *P. aeruginosa* and *E. agglomerans* were the most susceptible organisms to the acetonic leaf extract of *S. biafrae* (20.0 mm at 200 mg/ml). Saponins, tannins, flavonoids, alkaloids, terpenoids, steroids and cardiac glycosides were all present in the ethanolic extract of *S. biafrae*. Alkaloids however were absent for the acetonic extract of *S. biafrae*. Carbohydrate, crude ash, crude fat, crude protein, crude fibre and moisture contents were all present in different quantities in the two extracts. The susceptibility of *A. baumanii*, *E. coli* and *Y. pestis* was dependent on the permeability of their cell walls to the plant extracts. The polarity of the extracting solvents and the concentration of the extracts contributed greatly to the antibacterial activities exerted by the plant extracts. The plant used for this study is a potential antibacterial agent and more research should be carried out to evaluate its *in vivo* efficacy and possible toxicity.

KEYWORDS: *Solanecio biafrae,* Phytochemical, Antibacterial susceptibility, Proximate, Medicinal plant

Introduction

One of the major causes of primary infections of humans is a group of microorganisms known as bacteria. Despite exceptional medical advances in the development of antibiotics, bacterial infections remain an important healthcare concern due to the emergence of increasing bacterial resistance which correspondingly increases healthcare costs and mortality rates. In recent years, considerable efforts have been made to control the spread of pathogens with various strategies, including the use of alternative antibacterial and other antimicrobial compounds (Papadopoulos *et al.*, 2008 and Harrewijn *et al.*, 2001).

African indigenous leafy vegetables are herbaceous species that are either cultivated or randomly hunted and collected from the wild for human consumption of their leaves. They have medicinal properties reserved for the sick

and for recuperation (Mensah *et al.*, 2008). Vegetables and several other plants may possess many different phytochemicals which make them potential sources of therapeutic agents since ancient times (Abalaka *et al.*, 2011 and Oyewole *et al.*, 2012). There is an increasing interest in the use of natural products because of several lethal diseases that are now very common in modern times and scientific evidences abound that majority of these chronic conditions are related to diet and life style. There is a wide-spread belief now that natural foods and medicines are healthier than processed and synthetic products. This is why food-based approach and developments of new drugs from natural products are considered important interventions in the action plan against chronic diseases. World Health Organization (WHO) therefore encourages countries to identify and exploit traditional medicine and phytotherapy (Kumar *et al.*, 1983).

The presence of phytochemicals in vegetables explains the reason for their use in ethnomedicine for the treatment and management of various ailments (Aja *et al.*, 2010). Investigations for functional food ingredients and nutraceutical products are important nowadays to promote health and reduce risk of disease. *Solanecio biafrae* is among the numerous underutilized indigenous vegetables in Nigeria. Fresh succulent leaves of *Solanecio biafrae* is used as food, usually cooked as leafy vegetables for their unique taste and flavour especially among the rural and local populations in Nigeria. Studies have established their substantial nutritional and medicinal values (Zheng *et al.*, 2001, Ajiboye *et al.*, 2013 and Okoro *et al.*, 2014).

Materials and Methods

Collection of plant samples

Fresh leaves of *S. biafrae* were collected in sterile polythene bags on the 11thof June 2018 at Okusa market, Akungba-Akoko, Ondo State, Nigeria at exactly 10:16am and were authenticated at the herbarium of Plant Science and Biotechnology Department, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria.

Collection of test organisms

Bacterial pathogens were collected in agar slants from Adekunle Ajasin University's health centre on the 5th August 2018 at exactly 12:40 pm and were identified using microbat test kit and API test kit for Gram-negative and Gram-positive bacteria respectively.

Preparation of Plant Extracts

The fresh leaves of *Solanecio biafrae* were sun-dried for 14 days and were ground into fine powder using an electric blender. The powder was then stored in air-tight glass bottle prior to use. Ethanolic extraction and acetonic extraction were carried out by soaking 250 g of the powder in 750 ml of ethanol and by soaking 250 g of the powder in 750 ml of acetone in separate glass jars for 9 days. At the end of the 9 days, the extract was filtered through Whatman No.1 filter paper and the filtrate was concentrated using vacuum rotary evaporator in order to reduce its volume. The filtrate was then freeze-dried to powdered form. The powdered extract was then stored in pre-weighed screw-capped glass bottles and the yield of the extract was weighed. The powdered extract was then kept in a refrigerator at 4^{o}C prior to use.

Antibacterial susceptibility testing of plant extracts

The extracts of *Solanecio biafrae* were tested for their antibacterial properties using the agar well diffusion technique. Twenty five milliliters of Mueller-Hinton agar was poured into sterile Petri dishes where standardized microorganisms had already been seeded by pour plate technique and the inoculated plates were then allowed to set. A sterile cork-borer of 6 mm diameter was used to punch wells on the agar in each of the Petri dishes. Different holes representing four different concentrations (200mg/ml, 100mg/ml, 50mg/ml and 25mg/ml) were made on the

surface of the inoculated plates with one hole in the centre of each plate to serve as positive control. The extracts were then appropriately filled into the wells with three drops each of the respective extract. The central hole was filled with tetracycline (10mg/ml) as positive control while distilled water was used as negative control. This process was carried out for the two extracts and the inoculated plates were then left for few minutes for the extracts to diffuse into the agar. The plates were then incubated at 37°C for 18 hours after which the zones of inhibition were measured.

Determination of minimum inhibitory and minimum bactericidal concentration

The Minimum Inhibitory Concentration (MIC) of the leaf extracts was determined by incorporating between 200 mg/ml and 6.25 mg/ml of the two extracts into different sets of test tubes containing the culture medium (Mueller Hinton broth). The test organisms were then introduced into each of these test tubes. The sets of test tubes which contained a mixture of the test organism, the plant extract and the culture medium were then incubated at 37°C for 24 hours. The MIC was regarded as the lowest concentration of the extract that did not permit any visible growth of the test organisms. Tubes used for the MIC assay that did not show any visible growth of organisms after the period of incubation were sub-cultured onto freshly prepared Mueller Hinton agar plates. The Minimum Bactericidal Concentration was regarded as the lowest concentration of the extract that did not yield a single bacterial colony on the Mueller Hinton agar plates after 24 hours of incubation at 37°C.

Statistical analysis

Data obtained from this study were expressed as mean values of triplicates ± standard deviation using one-way ANOVA with the commercial software application SPSS 16.0. Differences were considered significant at $P<0.05$.

Results

The antibacterial activity of the ethanolic leaf extract of *S. biafrae* showed noteworthy inhibitory effect against *Staphylococcus aureus*, *Enterococcus faecalis*, *Acinetobacter baumanii*, *Acinetobacter haemolyticus*, *Pseudomonas aeruginosa*, *Enterobacter agglomerans*, *Escherichia coli*, *Citrobacter youngae*, *Yersinia pestis* and *Klebsiella oxytoca* with different zones of inhibition at varying concentrations of 25 mg/ml, 50 mg/ml, 100 mg/ml and 200 mg/ml of the plant extract. At 200 mg/ml, the extract was mostly active against *A. baumanii* (35.0 mm) but *S. aureus* had the least susceptibility to the extract (19.0 mm). *A. baumanii* and *Y. pestis* were the most susceptible organisms to the extact at 100 mg/ml (30.0 mm) while *S. aureus* (17.0 mm) was the least susceptible organism. The extract was mostly active against *A. baumanii* (26.0 mm) at 50 mg/ml but less active against *E. coli* (11.0 mm). The least susceptible organism to the extract at 25 mg/ml was *E. coli* (10.0 mm) while the most susceptible organism was *A. baumanii* (20.0 mm). The positive control had its highest activity against *A. baumanii* (37.0 mm) and its lowest activity against *S. aureus* (20.0 mm). The negative control was not active against any of the tested organisms (Table 1). At 200 mg/ml, *P. aeruginosa*, *E. agglomerans*, *E. haemolyticus* and *A. baumanii* were the most susceptible organisms to the acetonic extract of *S. biafrae* (20.0 mm) but *S. aureus* had the least susceptibility to the extract (14.0 mm). The extract was mostly active against *A. haemolyticus* (18.0 mm) at 100 mg/ml but less active against *K. oxytoca* (11.0 mm). *A. haemolyticus* was the most susceptible organism to the extract at 50 mg/ml (16.0 mm) while *P. aeruginosa*, *E. agglomerans*, *Y. pestis*, *K. oxytoca* and *C. youngae* were the least susceptible organisms (10.0 mm). The least susceptible organisms to the extract at 25 mg/ml were *Y. pestis* and *C. youngae* (6.0 mm) while the most susceptible organism was *A. haemolyticus* (12.0 mm). The

positive control had its highest activity against *A. haemolyticus* and *C. youngae* (19.0 mm) and its lowest activity against *A. baumanii*, *E. faecalis* and *P. aeruginosa* (14.0 mm). The negative control was not active against any of the tested organisms (Table 2). The ethanolic extract of *S. biafrae* had its least MIC against *E. faecalis*, *A. baumanii*, *P. aeruginosa*, *C. youngae* and *Y. pestis* (6.25 mg/ml). Its lowest MBC was against *A. baumanii*, *P. aeruginosa*, and *C. youngae* (12.5 mg/ml). The least MIC for the acetonic extract of *S. biafrae* was against *A. baumanii*, *P. aeruginosa*, *C. youngae* and *K. oxytoca* (6.25 mg/ml). Its lowest MBC was against *A. baumanii*, *C. youngae* and *K. oxytoca* (12.5 mg/ml) (Table 3). The ferric-reducing antioxidant potential of the ethanolic and acetonic leaf extracts of *S. biafrae* increased with increase in concentration (Figure 1). The DPPH scavenging effect of both ethanolic and acetonic extracts of the plant (*S. biafrae*) increased with increase in concentration (Figure 2). The ABTS scavenging effect of both ethanolic and acetonic extracts of *S. biafrae* also increased with increase in concentration (Figure 3). The ethanolic and acetonic *S. biafrae* extract brought about an increase in the percentage inhibition of lipid peroxidation in egg homogenate with increase in concentration (Figure 4).

Table 1: Result of the Effect of the Antibacterial Activity of the ethanolic leaf extract of *Solanecio biafrae* by Agar Well Diffusion Method

Microorganism	Concentration of extract				+ve Control
	Zone of Inhibition				
	200mg/ml	100mg/ml	50mg/ml	25mg/ml	Tetracycline (10mg/ml)
Staphylococcus aureus	19.0±2.0 ^{a}	17.0±1.0 ^{a}	12.5±2.0 ^{a}	11.0±1.0 ^{ab}	20.0±2.0 ^{a}
Enterococcus faecalis	32.0±3.0 ^{cd}	25.0±1.0 ^{c}	21.0±3.0 ^{c}	18.0±2.0 ^{cd}	35.0±4.0 ^{de}
Acinetobacter baumanii	35.0±2.0 ^{d}	30.0±1.0 ^{d}	26.0±3.0 ^{d}	20.0±4.0 ^{d}	37.0±2.0 ^{e}
Acinetobacter haemolyticus	23.0±2.0 ^{ab}	20.0±1.0 ^{ab}	12.0±2.0 ^{a}	10.0±3.0 ^{a}	30.0±2.0 ^{c}
Pseudomonas aeruginosa	34.0±1.0 ^{cd}	22.0±2.0 ^{b}	15.0±3.0 ^{a}	13.0±2.0 ^{ab}	35.0±3.0 ^{de}
Enterobacter agglomerans	30.0±1.0 ^{c}	26.0±2.0 ^{c}	20.0±4.0 ^{bc}	13.0±1.0 ^{ab}	31.0±3.0 ^{cd}
Escherichia coli	20.0±4.0 ^{ab}	18.0±1.0 ^{a}	11.0±2.0 ^{a}	10.0±3.0 ^{a}	21.0±1.0 ^{ab}
Citrobacter youngaae	22.0±1.0 ^{ab}	20.0±2.0 ^{ab}	15.0±1.0 ^{a}	10.0±1.0 ^{a}	23.0±2.0 ^{ab}
Yersinia pestis	33.0±3.0 ^{cd}	30.0±1.0 ^{d}	24.0±3.0 ^{cd}	15.0±2.0 ^{bc}	37.0±1.0 ^{e}
Klebsiella oxytoca	24.0±1.0 ^{b}	20.0±3.0 ^{ab}	16.0±2.0 ^{ab}	12.0±1.0 ^{ab}	25.0±2.0 ^{b}

Values are means of triplicates ± SD. Zones of inhibition are in mm. Values with the same superscript down the column are not significantly different, significant difference exists at P<.05

Table 2: Result of the Effect of the Antibacterial Activity of the acetonic leaf extract of *Solanecio biafrae* by Agar Well Diffusion Method

Microorganism	Concentration of extract				+ve Control
	Zone of Inhibition				
	200mg/ml	100mg/ml	50mg/ml	25mg/ml	Tetracycline (10mg/ml)
Staphylococcus aureus	14.0±3.0 a	13.0±1.0 abc	11.0±1.0 a	9.0±2.0 a	16.0±2.0 b
Enterococcus faecalis	19.0±1.0 bc	16.0±3.0 cd	12.0±2.0 a	8.0±2.0 a	14.0±1.0 a
Acinetobacter baumanii	20.0±1.0 c	15.0±2.0 bcd	12.0±2.0 a	8.0±2.0 a	14.0±2.0 a
Acinetobacter haemolyticus	20.0±3.0 c	18.0±2.0 d	16.0±1.0 b	12.0±2.0 b	19.0±1.0 b
Pseudomonas aeruginosa	20.0±2.0 c	12.0±1.0 bc	10.0±2.0 a	7.0±2.0 a	14.0±2.0 a
Enterobacter agglomerans	20.0±1.0 c	14.0±2.0 abc	10.0±2.0 a	8.0±1.0 a	15.0±2.0 a
Escherichia coli	15.0±2.0 a	12.0±1.0 bc	11.0±1.0 a	7.0±2.0 a	16.0±1.0 b
Citrobacter youngaae	16.0±2.0 ab	14.0±3.0 abc	10.0±2.0 a	6.0±1.0 a	19.0±2.0 b
Yersinia pestis	19.0±1.0 bc	13.0±1.0 abc	10.0±2.0 a	6.0±1.0 a	15.0±2.0 a
Klebsiella oxytoca	15.0±2.0 a	11.0±1.0 a	10.0±1.0 a	7.0±2.0 a	16.0±3.0 b

Values are means of triplicates ± SD. Zones of inhibition are in mm. Values with the same superscript down the column are not significantly different, significant difference exists at P<.05

Table 3: Minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of the ethanolic and acetonic leaf extracts of *Solanecio biafrae*

Clinical isolate	MIC (mg/ml)		MBC (mg/ml)	
	Ethanolic extract	Acetonic extract	Ethanolic extract	Acetonic extract
Staphylococcus aureus	25.0	12.5	50.0	25.0
Enterococcus faecalis	6.25	25.0	25.0	50.0
Acinetobacter baumanii	6.25	6.25	12.5	12.5
Acinetobacter haemolyticus	12.5	12.5	25.0	50.0
Pseudomonas aeruginosa	6.25	6.25	12.5	25.0
Enterobacter agglomerans	25.0	25.0	50.0	50.0
Escherichia coli	12.5	12.5	25.0	25.0
Citrobacter youngae	6.25	6.25	12.5	12.5
Yersinia pestis	6.25	25.0	25.0	50.0
Klebsiella oxytoca	25.0	6.25	50.0	12.5

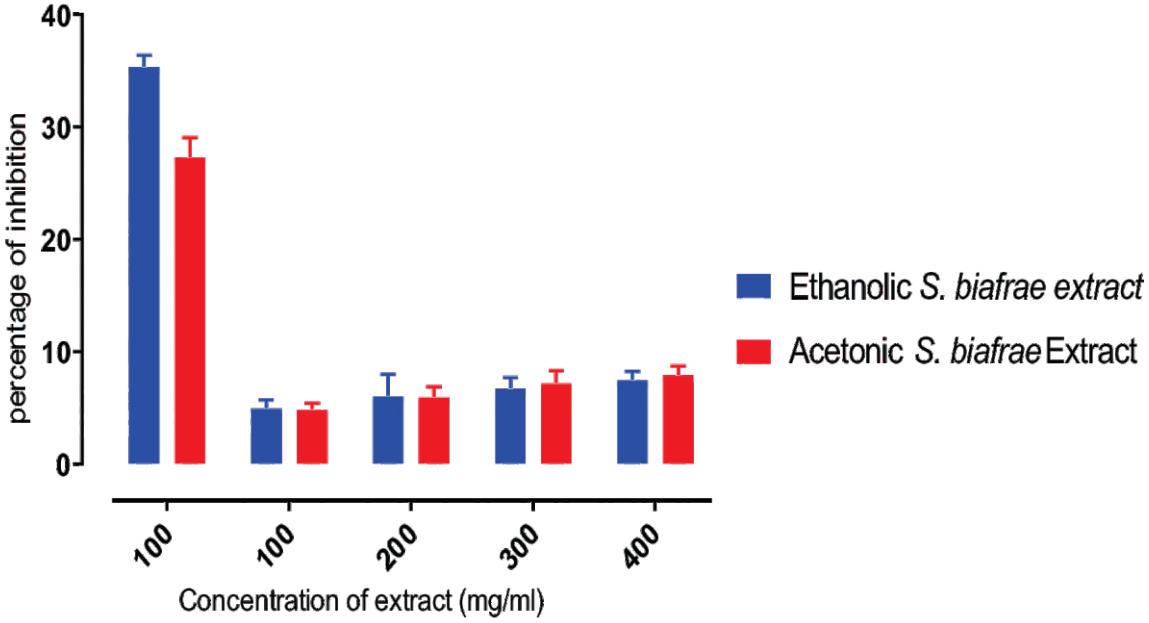

Figure 1: FRAP results for acetonic and ethanolic extracts of *Solanecio biafrae.*

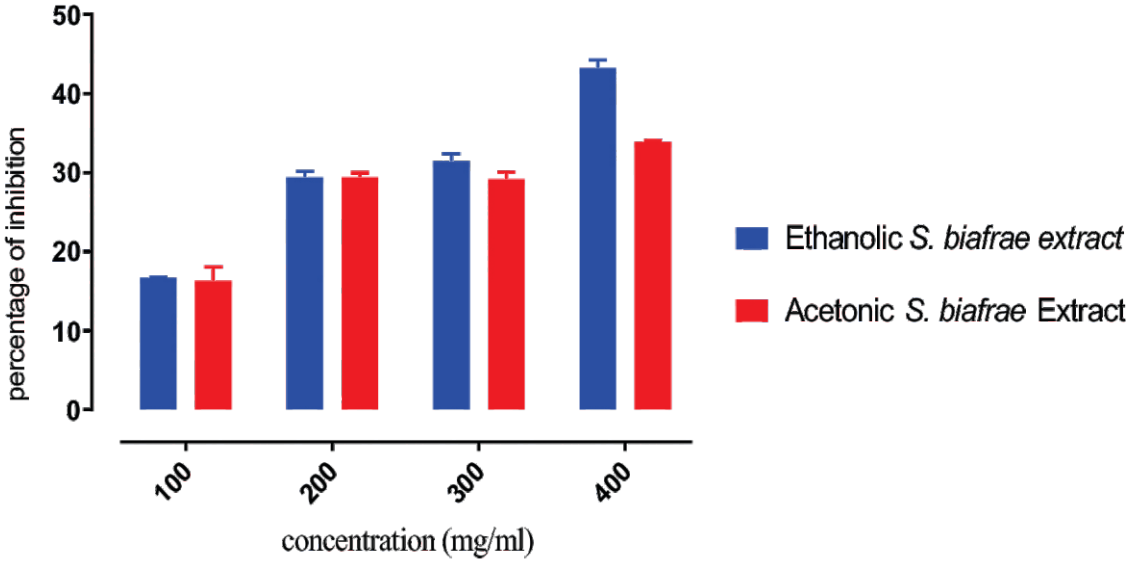

Figure 2: DPPH results for acetonic and ethanolic extracts of *Solanecio biafrae.*

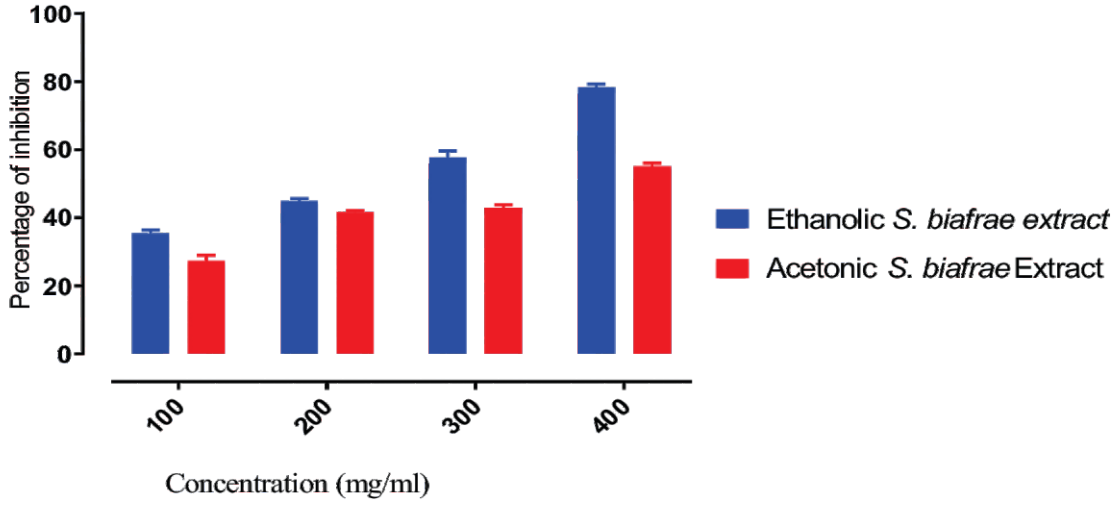

Figure 3: ABTS results for acetonic and ethanolic extracts of *Solanecio biafrae.*

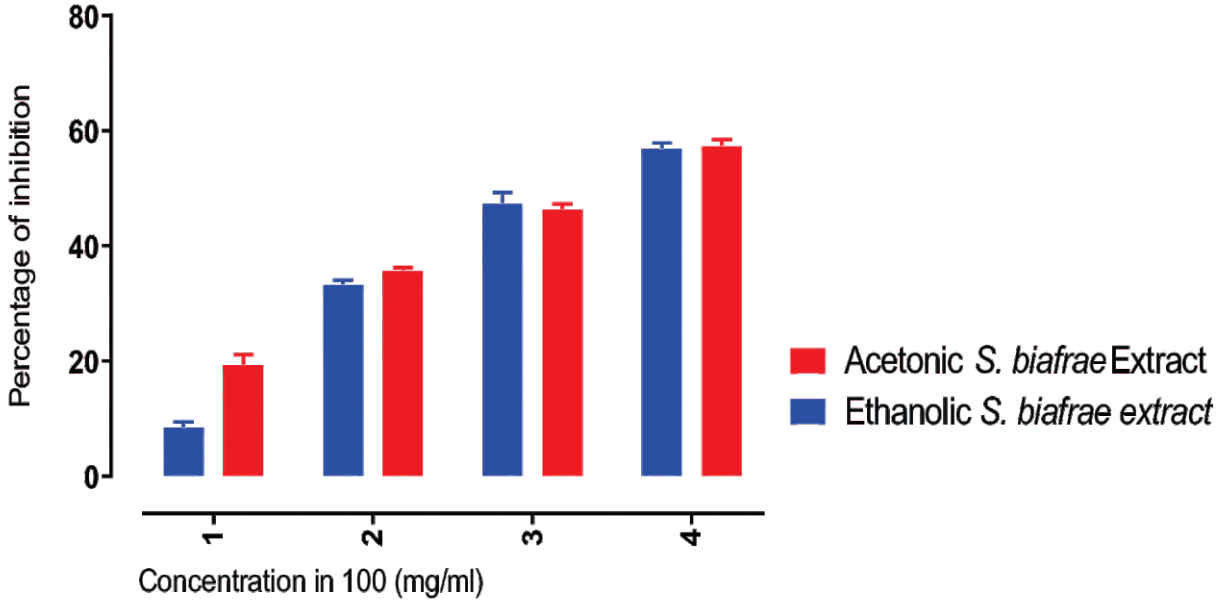

Figure 4: Lipid Peroxidation results for acetonic and ethanolic extracts of *Solanecio biafrae*.

Discussion

Pathogenic bacteria have long been known to cause several diseases in humans. Among these organisms are the ones used for this study which include *Staphylococcus aureus*, *Enterococcus faecalis*, *Acinetobacter baumanii*, *Acinetobacter haemolyticus*, *Pseudomonas aeruginosa*, *Enterobacter agglomerans*, *Escherichia coli*, *Citrobacter youngae*, *Yersinia pestis* and *Klebsiella oxytoca*. This study evaluated the antibacterial activity of the ethanolic and acetonic leaf extracts of *Solanecio biafrae* against the aforementioned microorganisms and also determined the antioxidant activity of the vegetable.

The antibacterial activity of the ethanolic leaf extract of *S. biafrae* showed that all of the clinical isolates were susceptible to the extract. The antibacterial activity shown by the plant used for this study may be attributed to the phytochemical components of the plants which have been implicated in antimicrobial activity. These components are bioactive compounds provided by plants to cure microbial diseases as substantiated by Orhue, *et al.*, (2014). All of the plant extracts showed increasing antibacterial activity with gradual increase in concentration of the plant extracts. This research revealed that the ethanolic extract of *S. biafrae* had more pronounced antibacterial activity against *A. baumanii*, *P. aeruginosa*, *Y. pestis* and *E. faecalis*.

Gram-negative organisms have a cell membrane surrounding their cell wall, this membrane is made up of lipopolysaccharide which gives them extra resistance against antibiotics, detergents and lysozyme. However, the plant extracts used for this study were more active against the Gram-negative organisms than the Gram-positive organisms in contrast to the works of Sudjana *et al* (2009) and Sheldon (2002) that stated otherwise.

The susceptibility of *A. baumanii*, *P. aeruginosa*, *Y. pestis* and *E. coli* was dependent on the permeability of their cell walls to the plant extracts as previously stated by Muroi and Kubo (1996). The plant-derived chemicals e.g. alkaloids and flavonoids were slightly more active against the Gram-negative bacteria than the Gram-positive bacteria in contrast to the work of Delaquis *et al* (2002) that stated otherwise.

The polarity of the extracting solvents and the concentration of the extracts contributed greatly to the antibacterial activities exerted by the plant extracts

against the tested organisms as previously reported by Ghasemzadeh *et al* (2011) and Hapaz *et al* (2003) respectively. The results of the antibacterial susceptibility tests indicate that the leaves used for this study had some measurable inhibitory activity against Gram-negative bacteria including *K. oxytoca* that was resistant to the extract used by Somayeh *et al* (2014). In comparison to this study, Ashraf *et al* (2018) reported that all the plant extracts used for their study were potentially effective in suppressing the growth of *E. coli* and *P. aeruginosa* amongst other organisms with variable potency.

Several researchers have investigated the efficiency of plant extracts and their effective compounds as antimicrobial agents to control the growth of pathogenic bacteria and some have suggested that the antimicrobial components of the plant extracts (terpenoid, alkaloid and phenolic compounds) interact with enzymes and proteins of the microbial cell membrane causing its disruption to disperse a flux of protons towards cell exterior which induces cell death or may inhibit enzymes necessary for amino acid biosynthesis (Burt, 2004, Gill and Holley, 2006). Alkaloids and flavonoids have also been reported by Rahman *et al* (2009) and Ghasemzadeh *et al* (2011) respectively to have antibacterial properties. This explains the reason for the antibacterial activities exerted by the plant extracts against the tested organsisms. Alkaloid which has been reported to be an antimalarial, analgesic and stimulant was absent in the acetonic extracts of the plants in contrast to the work of Duke and Ayensu (1985). Flavonoid which is known to protect against intestinal tract infections was present in the ethanolic extracts of the plants in comparison to the work of Cathrine and Nagarajan (2010).

Other researchers attributed the inhibitory effects of these extracts to their hydrophobicity which enable them to react with the proteins of the microbial cell membrane and mitochondria thus, disturbing their structures an changing their permeability (Friedman *et al.*, 2004 and *Tiwari et al.*, 2009). Maher *et al* (2012) reported that the ethanolic extract of the plant used for their study (*Urtica pilulifera*) had antibacterial effect against all the Gram-negative bacteria used for their study. Their findings however support the results of this study as all the Gram-negative organisms used for this study were also susceptible to the ethanolic extracts of *S. biafrae*.

Furthermore, they reported little or no activity against Gram-positive *Streptococcus pneumoniae* in contrast to the results of this study which showed that Gram-positive *Enterococcus faecalis* and Gram-positive *Staphylococcus aureus* were both very susceptible to the plant extracts used for this study. The findings of Ismet *et al* (2012) substantiates the results of this study as the acetonic extract of the plants used for their study showed considerably high activity against Gram-negative *E. coli*.

Gupta *et al* (2010) investigated the antibacterial activity of five ethanolic and aqueous extracts of the plants used for their study against *S. aureus* and *P. aeruginosa* and reported that the ethanolic extracts of four of the plants were effective against the tested organisms. Their findings also compare with the results of this study as the ethanolic extracts of the plants used for this study were also active against *S. aureus* and *P. aeruginosa* amongst other organisms. Shan *et al* (2007) and Chaudry and Tariq (2008) reported the antibacterial activity of *Cuminum cyminum* extract against Gram-negative *E. coli*, Gram-negative *P.* aeruginosa and Gram-positive *S. aureus*. Their findings compare greatly with the results of this study as the plant extracts used for this study were also very effective against both Gram-negative and Gram-positive bacteria.

All of the plant extracts were subjected to different antioxidant assays such as ferric-reducing antioxidant assay, DPPH

antiradical assay, ABTS radical scavenging assay, lipid peroxidation assay and iron (II) chelation assay. Reducing power has been used to measure the potential antioxidant activity of bioactive compounds in different products, including peptides and these bioactive compounds may serve as a significant indicator of such products' potential antioxidant activity (Amadou *et al.*, 2010). It was observed that the reducing power of ethanolic and acetonic extracts of *S. biafrae* increased as the concentrations increased. Different studies have indicated that the reducing power of bioactive compounds is associated with their antioxidant activity. Therefore, the antioxidant activity of the tested samples might partially be as a result of their reducing power. Furthermore, reducing compounds can react directly with peroxides and also with certain precursors and thereby, prevent peroxide formation. The reducing capacity of the *S. biafrae* extract might be due to their hydrogen-donating ability. Therefore, the extracts may contain reducing compounds which can react with free radicals to stabilize and terminate radical chain reactions. With regards to the absorbance reading taken at 700 nm wavelength, *S. biafrae* extracts exhibited a higher ferric-reducing antioxidant.

The DPPH scavenging effect of both ethanolic and acetonic extracts of *S. biafrae* increased with increase in concentrations. With regards to percentage inhibition of the DPPH antiradical assay of the plant extracts, ethanolic *Solanecio biafrae* extract had a higher scavenging ability. The ABTS scavenging effect of both ethanolic and acetonic extracts of *Solanecio biafrae* also increased with increase in concentrations. The ethanolic and acetonic extracts of *S. biafrae* brought about an increase in the percentage inhibition of lipid peroxidation in egg homogenate with increase in concentration. However, phenolic compounds have been reported to prevent the decomposition of hydrogen peroxide into free radicals (Maisuthisakul *et al.* 2007).

Hence, the observed inhibition of lipid peroxidation by the extracts of *S. biafrae* may be due to the concentration of phenolic compounds in the extracts. The ability of the extracts to inhibit lipid peroxidation was tested using the method of (Ruberto *et al.,* 2000).

Conclusion

As many studies have proven the use of medicinal plants for the treatment of various infections, the plant under study (*Solanecio biafrae*) also showed various degrees of antibacterial activity. Plant extracts have great potential as antibacterial agents against microorganisms. Thus, they can be used in the treatment of infectious diseases caused by various microorganisms. This research has helped to know that the vegetable used for this study is a potential agent for the treatment of some clinical infections caused by bacteria. Moreover, more research should be carried out to evaluate its *in vivo* efficacy and possible toxicity. The synergistic effect of antibiotics with plant extracts against pathogenic bacteria may lead to new choices for the treatment of infectious diseases.

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